KUMPULAN JURNAL

SHYNESS **DAN** *BIG FIVE PERSONALITY*

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DAFTAR ISI

NO.	JUDUL ARTIKEL	PENULIS	PENERBIT	TAHUN
1.	Big-Five personality and aspects of the self-concept: Variable- and personcentered approaches.	Aleksandra, P.	*Personality and Individual Differences, 127, 107–113*	2018
2.	.An Investigation of the Relationship between Shyness and Loneliness Levels of Elementary Students in a Turkish Sample	BAS, G.	*International Online Journal of Educational Sciences, , 2(2), 419-440*	2010
3.	Act-frequency signature of the big five	Benjamin, P., Chapman., & Lewis, L., Golberg	*Personality and Individuals Differences, 116, 201-205*	2017
4.	Exploring beyond simple demography variables: Differences between traditional laboratory samples and crowdsourced online samples and the big five personality traits	Douglas, E., C., Jared, V., & Tera, D., L.	*Personality and Individuals Differences, xxx, xxx-xxx*	2017
5.	Linking shyness to loneliness in Chinese adolescents: The mediating role of core self-evaluation and social support	Jingjing, Z., Fangxing, S., Qi Chen., Min., L., Yonghui, W., Feng, L..	*Personality and Individual Differences, 125, 140-144.*	2018
6.	Linking child temperament, physiology, and adult personality: Relations among retrospective behavioural inhibition, salivary cortisol, and shyness.	Kristiee, L., P., Michelle, K., J., & Louis, A.,S.	*Personality and Individual Differences, 113, 68-73*	2017
7.	Relationsip between	Lei, H., Jingyu, G.,	*Computers in*	2017

	shyness and mobile phone addiction in Chinese young adults: Mediating roles of self-control and attachment anxiety.	Min, J., Fengqiang, G., Huayong, Y.	*Human Behavior, 76, 363-371.*	
8.	Associations between personality, sports participation and athletic success. A comparison of Big Five in sporting and non-sporting adults	Patrizia, S., Dario, B., Andrea, G., Marco, D., Dario., M	*Personality and Individual Differences, 121, 176-183*	2018
9.	Shyness in Early Infancy: Approach-Avoidance Conflicts in Temperament and Hypersensitivity to Eyes during Initial Gazes to Faces	Yoshi, ., M., Kazuo., O., & Masako., M., Y	*Shyness in Early Infancy, 8, (6), 1-7.*	2013
10.	Big Five Personality and adolescent Internet Addiction: The mediating role of coping style.	Yueyue, Z., Dongping, L., Xian., L., Yanhui, W., Lian, Y.	*Addictive Behaviors, 64, 42-48*	2017

Big-Five personality and aspects of the self-concept: Variable- and person-centered approaches

Aleksandra Pilarska

Department of Personality Psychology, Institute of Psychology, Adam Mickiewicz University, Szamarzewskiego 89AB, 60-568 Poznań, Poland

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ABSTRACT

This study used variable- and person-oriented approaches to examine the importance of Big-Five personality in predicting aspects of the self-concept (i.e., self-control, self-esteem, and self-feelings). The Mini-IPIP scales (IPIP-BFM-20), Self-Control Scale (SCS), Rosenberg's Self Esteem Scale (SES), and Test of Self-Conscious Affect (TOSCA-3) were administered to 357 Polish students (59% female). The variable-centered approach, based on multiple regression analysis, revealed that the personality traits explained 5 to 45% of the variance in the self-variables, with the largest effect found on self-control. Two-step cluster analysis yielded three personality types, which corresponded to the previously described Resilient, Overcontrolled, and Undercontrolled types, and were meaningfully distinguished on self-variables of interest. However, this type approach showed weaker predictions than continuous and even dichotomized Big-Five traits.

1. Introduction

According to McCrae and Costa's (2008) personality model, basic, biologically-based tendencies, such as the Big-Five traits, are expressed as characteristic adaptations, which represent all acquired psychological attributes that are, to some extent, shaped by contingencies in psychosocial contexts. In this model, basic tendencies and characteristic adaptations represent, respectively, the distal (indirect) and proximal (direct) determinants of behaviors and experiences. A particularly important subset of characteristic adaptations is the self-concept. It consists of knowledge, views, and evaluations of the self, through which people understand themselves. The self-concept occupies a central position in many personality theories and has been associated with a wide range of human actions and modes of response. The prominence of the self-concept is amply demonstrated in psychotherapy, which is often explained in terms of reconstruction of the self (e.g., Rogers, 1951). However, to the extent the self-concept is shaped by stable personality traits, it cannot be expected to be affected by therapeutic interventions. This investigation was designed to study the associations between these two layers of personality. More specifically, it focused on how core personality traits, i.e., extraversion, agreeableness, conscientiousness, emotional stability (reversed neuroticism), and openness, explain differences in self-esteem, self-conscious emotions (or self-feelings), and self-control.

Self-esteem and self-feelings both refer to the evaluative aspect of the self. Self-esteem is typically defined as one's attitude of personal worth (Rosenberg, 1965). It serves such vital functions as buffering existential anxiety, monitoring the degree of social inclusion-exclusion, and promoting goal achievement (see review by Kernis, 2006). Low self-esteem is associated with various emotional/behavioral problems, including depression, aggression, and loneliness (e.g., Donnellan, Trzesniewski, Robins, Moffitt, & Caspi, 2005; Leary, Schreindorfer, & Haupt, 1995).

Self-conscious emotions constitute an important class of emotions that are theorized to be critically involved in social behavior regulation (Tangney & Dearing, 2002; Tracy & Robins, 2004). Prototypical self-conscious emotions include guilt, shame, and pride. Both shame and guilt arise from a perceived wrongdoing; guilt, however, is concerned with a negative evaluation of a specific act, while shame pertains to a negative evaluation of the whole self. Guilt-proneness has been linked with reparative and prosocial behaviors such as empathy, altruism, and caregiving. Shame-proneness, in contrast, has been found to be related to social-psychological maladjustment (e.g., social withdrawal; Tangney & Dearing, 2002). Pride is a positive emotion that promotes sense of achievement and self-satisfaction. Some researchers distinguish between pride in self (alpha/hubristic) and pride in behavior (beta/authentic), with the latter being shown to lead to more positive outcomes than the former (Tangney & Dearing, 2002; Tracy & Robins, 2007).

Self-control refers to the executive aspect of the self. Defined as the capacity to override one's responses (thoughts, feelings, impulses, and behaviors), self-control is posited as crucial for achieving personally valued goals (Baumeister, Vohs, & Tice, 2007). Consistent with this view, research has linked self-control to many positive outcomes,

including personal adjustment, academic performance, and social relationships (De Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012). Poor self-control results in deteriorated performance, and has immense personal and societal repercussions as diverse as procrastination, depression, obesity, violent crime, and drug abuse (Tangney, Baumeister, & Boone, 2004).

To date, most research has taken the variable-centered approach (e.g., regression; structural equation modeling) to address the relation between the Big-Five personality and self-variables. Several studies have reported the Big-Five correlates of self-esteem (e.g., Donnellan, Oswald, Baird, & Lucas, 2006; Robins, Hendin, & Trzesniewski, 2001), generally showing that self-esteem had positive associations with all five personality dimensions, especially the two having a clear affective component, namely emotional stability and extraversion. Self-control has previously been found to correlate strongly and positively with conscientiousness, and, to lesser degrees, with emotional stability and agreeableness (Marcus, 2003; Tangney et al., 2004). The scarce available research has linked authentic pride to socially desirable and generally adaptive Big-Five traits (especially extraversion and emotional stability), whereas hubristic pride has been negatively related to the two prosocial traits of agreeableness and conscientiousness (Tracy & Robins, 2007). The only consistent finding concerning guilt and shame has been that both correlate negatively with emotional stability (Abe, 2004; Einstein & Lanning, 1998; Harder & Greenwald, 1999).

This study aimed to extend previous research by using both variable- and person-centered approaches. It not only focused on separate traits in a nomothetic way, but also considered how individuals' standings on each of the Big-Five traits might shape their self-concepts. The person-centered approach has recently attracted considerable interest in Big-Five personality research. Using Q-factor or cluster analyses, three personality types (known as RUO types) have most consistently been identified: Resilient (i.e., well-adjusted), Undercontrolled (i.e., dysregulated), and Overcontrolled (i.e., constricted; Asendorpf, Borkenau, Ostendorf, & van Aken, 2001; Robins, John, Caspi, Moffitt, & Stouthamer-Loeber, 1996). However, only two studies have reported on the effect of personality type on self-variables of interest (to be exact, self-esteem). Both have found Undercontrollers and Overcontrollers to have lower self-esteem than Resilients (Asendorpf et al., 2001; Pulkkinen, Männikkö, & Nurmi, 2000). Considering that the RUO typology refers back to Block and Block's (1980) proposal, which focused on ego-resiliency and ego-control, it seems reasonable to expect that the personality types would be distinguished by their self-regulation tendencies and capabilities, as reflected by self-control and self-feelings. This study, thereby, could provide evidence on the suitability of Block and Block's model as a reference framework for interpreting the Big-Five types.

The point is also worth noting that despite the advantage of preserving information on individuals' personality structure, the type approach suffers from the disadvantage of losing information on interindividual within-type variation, which makes its predictive power questionable. Several studies have evaluated the extent to which this approach can compete with the variable-centered approach, and most of them found the dimension prediction outperforming the type prediction (e.g., Asendorpf, 2003; Costa, Herbst, McCrae, Samuels, & Ozer, 2002; Roth & von Collani, 2007). However, because the outcome of such head-to-head comparisons may depend on different factors, like number and intercorrelations of the predictors, type of the criterion variable (dimensional or type), study design (cross-sectional or longitudinal), a definite conclusion about the relative predictive power of types versus traits awaits further investigation.

Based on the literature review and research objectives, the following hypotheses were proposed (1) self-variables would be predictable from the Big-Five traits, with self-control being predicted mainly by conscientiousness, self-esteem, pride, and shame-proneness being related most strongly to emotional stability, and guilt-proneness being predicted mainly by agreeableness; (2) the clusters for Resilient,

Overcontrolled, and Undercontrolled would emerge; (3) the clusters would differ with respect to self-variables, with Undercontrollers reporting lowest self-control, Resilients scoring highest on self-esteem, guilt-proneness, and beta-pride, and Overcontrollers reporting highest shame-proneness, and (4) the Big-Five traits would show a higher predictive power than the Big-Five types.

2. Method

2.1. Participants and procedure

Participants were a convenient sample of 357 Poznan (Poland) university students (59% female), majoring in different academic disciplines (29% in professions and applied sciences, 27% in social sciences, 14% in humanities, 10% in natural and formal sciences, and 20% in interdisciplinary academic areas). Participants' mean age was 21.19 years ($SD = 1.88$, range = 18–31). Questionnaires were administered, in a counterbalanced order, in classrooms during academic class hours by trained research staff. Participation was voluntary, and anonymity and confidentiality were guaranteed. No financial incentives were offered.

Based on the most complex analysis planned, the sample size was determined sufficient to detect a small effect size of $f^2 = 0.05$, with 80% power and alpha set at 0.05.

2.2. Measures

The Big-Five traits (i.e., extraversion, agreeableness, conscientiousness, emotional stability, intellect) were measured by Donnellan et al.'s (2006) Mini-IPIP scales (IPIP-BFM-20; adapted by Topolewska, Skimina, Strus, Cieciuch, & Rowiński, 2014).[1] The instrument consists of 20 items rated on a 5-point scale (1 = very inaccurate, 5 = very accurate), with higher scores indicating that the trait describes the individual better.[2]

To assess self-control, the Self-Control Scale (SCS) developed by Tangney et al. (2004; adapted by Pilarska & Baumeister, in press) was employed. It consists of 36 5-point scale items ranging from 1 = not at all to 5 = very much. These items pertain to control over thoughts, emotions, impulses, performance, and habit-breaking, and yield a single total score, with higher values indicating higher self-control.

Self-esteem was evaluated using the Rosenberg's Self Esteem Scale (SES; Rosenberg, 1965; adapted by Łaguna, Lachowicz-Tabaczek, & Dzwonkowska, 2007). The SES is a 10-item scale in a 4-point format (1 = strongly agree, 4 = strongly disagree), with higher scores indicating greater self-esteem.

Self-conscious emotions were assessed with Tangney, Dearing, Wagner, and Gramzow's (2000) Test of Self-Conscious Affect (TOSCA-3; adapted by Adamczyk & Sobolewski, 2014). The measure uses 16 scenarios followed by responses indicating shame-proneness, guilt-proneness, alpha-pride, beta-pride, and defenses such as externalization (i.e., blaming others) and detachment (i.e., minimizing problems or emotionally distancing oneself). Responses are rated on a 5-point scale, ranging from 1 (not likely) to 5 (very likely), with higher scores indicating a greater proneness to that reaction.

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[1] The IPIP-BFM-20 measures the five basic traits as identified in the lexical approach. There is sufficient overlap between the lexically- and psychometrically-derived models to assume intellect and Costa and McCrae's openness refer to the same personality domain. Moreover, the items on the IPIP Intellect and the NEO-PI Openness scales possess similar content.

[2] A person-mean substitution was used to replace missing values for participants missing up to 20% of a (sub)scale's items. The (sub)scale was unscored for those missing more items.

Table 1
Internal consistencies, descriptive statistics, and intercorrelations among study variables.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	*M (SD)*
1. Extraversion	**0.84**													3.32 (0.99)
2. Agreeableness	0.11*	**0.71**												3.87 (0.69)
3. Conscientiousness	−0.02	0.13*	**0.75**											3.19 (0.91)
4. Emotional stability	0.21***	−0.15**	0.19***	**0.70**										2.73 (0.84)
5. Intellect	0.33***	0.16**	0.05	0.25***	**0.73**									3.76 (0.75)
6. Self-control	0.00	0.07	0.62***	0.28***	0.24***	**0.89**								3.07 (0.52)
7. Self-esteem	0.36***	−0.01	0.22***	0.49***	0.39***	0.37***	**0.88**							2.89 (0.51)
8. Guilt	−0.09	0.43***	0.03	−0.23***	−0.01	−0.01	−0.13*	**0.77**						3.84 (0.50)
9. Shame	−0.29***	0.16**	−0.07	−0.33***	−0.24***	−0.24***	−0.33***	0.47***	**0.78**					2.85 (0.59)
10. Alpha-pride	0.24***	0.08	0.01	0.04	0.14*	0.00	0.18***	0.15*	0.06	**0.53**				3.78 (0.62)
11. Beta-pride	0.19***	0.08	−0.06	0.01	0.14*	−0.07	0.16*	0.13*	0.00	0.75***	**0.54**			3.85 (0.64)
12. Externalization	−0.03	−0.22***	−0.15**	0.03	−0.19***	−0.27***	−0.04	−0.13*	0.28***	0.23***	0.35***	**0.70**		2.48 (0.52)
13. Detachment	0.09	−0.19***	−0.15**	0.20***	0.02	−0.16**	0.15**	−0.25***	−0.20***	0.33***	0.36***	0.47***	**0.64**	2.95 (0.57)

Note. Cronbach's α are reported in the diagonal.
 *** $p \leq .001$.
 ** $p \leq .01$.
 * $p \leq .05$.

3. Results

[Table 1](#) presents the basic statistical description of study variables.[3] Possible gender differences were assessed by Mann-Whitney tests. With respect to the Big-Five traits, men reported higher emotional stability ($Z = 4.81$, $p < .001$) and intellect ($Z = 1.96$, $p = .050$), but lower agreeableness ($Z = 2.94$, $p = .003$) than women. As for the self-variables, men, as compared to women, scored higher on self-esteem ($Z = 2.16$, $p = .031$), externalization ($Z = 2.42$, $p = .015$), and detachment ($Z = 5.34$, $p < .001$), while lower on guilt ($Z = 4.12$, $p < .001$) and shame ($Z = 4.60$, $p = .001$). These results were broadly consistent with past findings (e.g., Benetti-McQuoid & Bursik, 2005; Chapman, Duberstein, Sörensen, & Lyness, 2007).

3.1. The variable-centered approach

Following the variable-centered approach, associations between self-aspects and the Big-Five traits were explored using regression analyses. Gender was controlled for, due to gender differences observed on several study variables.

As presented in Table 2, self-control was strongly positively related to conscientiousness and weakly to emotional stability and intellect. Self-esteem was positively predicted by emotional stability and, to lesser extents, intellect, extraversion, and conscientiousness. Guilt and shame were both associated with higher agreeableness (although the association was stronger for guilt) and lower extraversion and emotional stability. Shame-proneness was also weakly negatively predicted by intellect. Intellect, agreeableness, and conscientiousness were negative, rather weak predictors of externalization. Detachment was modestly positively predicted by emotional stability, and negatively by conscientiousness and agreeableness. Finally, small positive associations were noted between extraversion and pride in self (alpha) and behavior (beta). The overall predictive power of the Big-Five traits (i.e., the variance explained above and beyond gender) was moderate for self-control and self-esteem, relatively low for guilt and shame, and even less pronounced for externalization, detachment, alpha-pride, and beta-pride.

Additional analyses also examined possible interactions between personality traits and gender in predicting self-variables. One interaction effect was observed ($pr^2 = 0.01$, 95% CI: {0.00–0.04}, $t = 2.01$, $p < .05$): intellect was more strongly associated with self-esteem for

men compared with women.

3.2. The person-centered approach

In the person-centered approach, a cluster analysis was carried out to identify different profiles of the Big-Five traits, and then relate them to self-aspects. A two-step procedure, i.e., Ward's hierarchical clustering method followed by k-means method (using the initial centroids as input), was used. The stability of the cluster solutions was checked by a double-split cross-validation procedure. The two-step procedure was performed on split-half samples (saving three-, four-, and five-cluster solutions), and the two solutions were compared for agreement as follows. Participants within each half-sample were reclassified based on the cluster centers derived from the other half-sample. For each half-sample, these new cluster assignments were then compared with the original cluster assignments using Cohen's kappa. An average kappa around 0.60 was considered acceptable (Asendorpf et al., 2001).

The replicability estimates (average κ values) for the three-, four-, and five-cluster solutions were 0.60, 0.53, and 0.56, respectively. Thus, only the three-cluster solution met the criterion, and is presented in Fig. 1 using z-scores based on the total sample.[4] The three clusters differed on all clustering variables (η^2 ranged from 0.49 to 0.02; Willks's $\lambda = 1.12$, $F(10, 698) = 88.00$, $p < .001$, $\eta^2 = 0.56$) and corresponded to the previously described personality prototypes. Cluster 1 (45%) fit the profile for the Overcontrolled type and was characterized by low scores in emotional stability, extraversion, and intellect combined with average scores in agreeableness and conscientiousness. Cluster 2 (29%) showed a well-adjusted profile with high or above average scores in all dimensions, and was consistent with the Resilient type. Cluster 3 (26%) had low scores in agreeableness, high scores in emotional stability, and average scores on the remaining dimensions. It showed similarity to the Undercontrolled type, but was marked by higher stress tolerance, calmness, and confidence (i.e., emotional stability) than typically found (for analogous results, see Meeus, Van de Schoot, Klimstra, & Branje, 2011).

Gender differences were found in the distribution across clusters ($\chi^2 = 14.59$, $p < .01$). Men were almost equally distributed throughout the profiles (36%, 28%, and 36%, respectively), whereas women were overrepresented among Overcontrollers (51%), but underrepresented among Undercontrollers (19%). These results accord with Scholte, van Lieshout, de Wit, and van Aken's (2005) findings and fail to support the types as being gender-indifferent.

The three personality types were then compared on self-variables

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[3] Data were screened for outliers using the boxplot rule. Three identified outliers were noted as missing values (however, the results did not differ from when they were retained).

[4] Raw IPIP-BFM-20 scores are available as supplemental information.

Table 2
Regressions of self-variables on the Big-Five traits.

BFM trait	Self-control	Self-esteem	Guilt	Shame	Alpha-pride	Beta-pride	Externalization	Detachment
Extraversion β	−0.07	0.22***	−0.12*	−0.23***	0.22***	0.17**	0.04	0.08
Agreeableness β	−0.01	−0.04	0.41***	0.17***	0.04	0.06	−0.16**	−0.11*
Conscientiousness β	0.58***	0.14***	−0.01	−0.06	0.01	−0.07	−0.13*	−0.15**
Emotional stability β	0.15***	0.37***	−0.12*	−0.17***	−0.01	−0.02	0.05	0.16**
Intellect β	0.21***	0.24***	−0.00	−0.14**	0.05	0.08	−0.19***	−0.03
Gender β	−0.05	−0.04	−0.13**	−0.16**	−0.03	0.00	0.08	0.22***
ΔR² (95% CI)	0.45*** (0.37–0.51)	0.38*** (0.30–0.44)	0.19*** (0.13–0.27)	0.17*** (0.11–0.24)	0.06*** (0.01–0.10)	0.05** (0.01–0.09)	0.09*** (0.03–0.14)	0.07*** (0.02–0.12)
R² (95% CI)	0.45*** (0.37–0.51)	0.38*** (0.30–0.44)	0.25*** (0.16–0.31)	0.24*** (0.15–0.30)	0.06*** (0.01–0.10)	0.05** (0.01–0.09)	0.10*** (0.03–0.15)	0.15*** (0.07–0.20)

Note. ΔR^2 = incremental R^2 for the Big-Five traits, R^2 = explained variance.
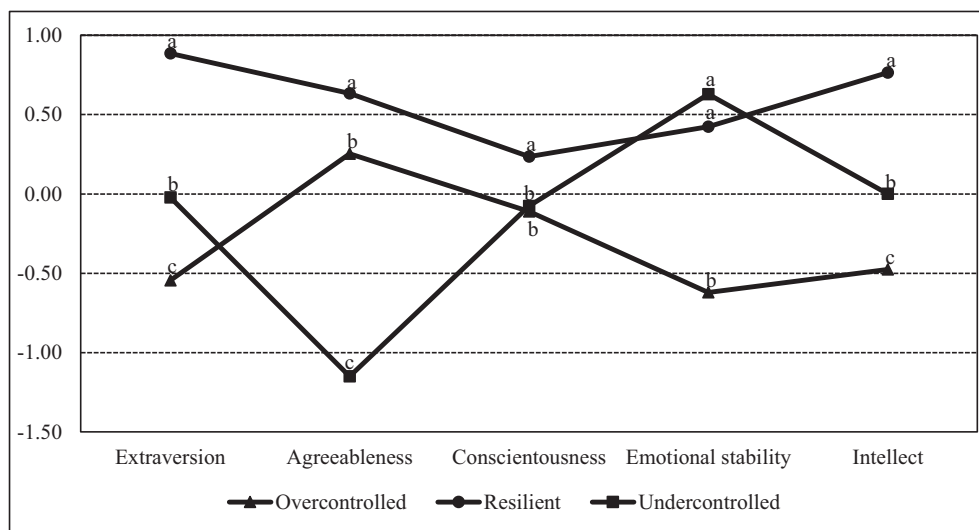*** $p \le .001$.
** $p \le 0.01$.
* $p \le .05$.

Fig. 1. Personality types characterized by their Big-Five z-score patterns. Means with different subscripts differ at $p < .05$ or less.

Table 3
Effects of cluster membership and gender on self-variables.

Variable	Cluster effect		Gender effect		Interaction	
	F	η² (95% CI)	F	η² (95% CI)	F	η² (95% CI)
Self-control	11.52***	0.06 (0.02–0.11)	0.72	0.00 (0.00–0.02)	0.13	0.00 (0.00–0.01)
Self-esteem	48.53***	0.22 (0.14–0.29)	0.40	0.00 (0.00–0.02)	0.28	0.00 (0.00–0.01)
Guilt	18.55***	0.10 (0.04–0.16)	9.79**	0.03 (0.00–0.07)	1.32	0.01 (0.00–0.03)
Shame	19.58***	0.10 (0.05–0.16)	16.07***	0.04 (0.01–0.09)	0.11	0.00 (0.00–0.01)
Alpha-pride	8.74***	0.05 (0.01–0.10)	0.26	0.00 (0.00–0.02)	2.68	0.02 (0.00–0.05)
Beta-pride	7.43***	0.04 (0.01–0.09)	0.00	0.00 (0.00–0.00)	3.41*	0.02 (0.00–0.05)
Externalization	3.62*	0.02 (0.00–0.06)	3.18	0.01 (0.00–0.04)	0.44	0.00 (0.00–0.02)
Detachment	4.71**	0.03 (0.00–0.07)	22.93***	0.06 (0.02–0.12)	0.02	0.00 (0.00–0.00)

*** $p \le .001$.
** $p \le .01$.
* $p \le .05$.

using analysis of variance. To exclude the possibility that cluster effects were due to gender differences, gender main and interaction effects were also investigated. As shown in Table 3, for all self-variables, the main effect of cluster was significant, with η^2 ranging from 0.22 to 0.02. More specifically, Resilients reported higher self-control than both Overcontrollers and Undercontrollers, and they manifested greater alpha- and beta-pride than Overcontrollers. Overcontrollers reported lower self-esteem and higher shame-proneness than the remaining prototype members. Finally, Undercontrollers reported lower guilt-

proneness than both Overcontrollers and Resilients, and also scored higher on externalization than Resilients and higher on detachment than Overcontrollers (see Fig. 2). One interaction effect proved significant – the Resilient men reported higher beta-pride than men in the remaining groups; among women, no such differences were observed.

To perform head-to-head comparisons between variable- and person-centered approaches, in line with Costa et al. (2002), multiple regression analyses were conducted according to two models: (1) entering the personality types (dummy coded) first, followed by the Big-
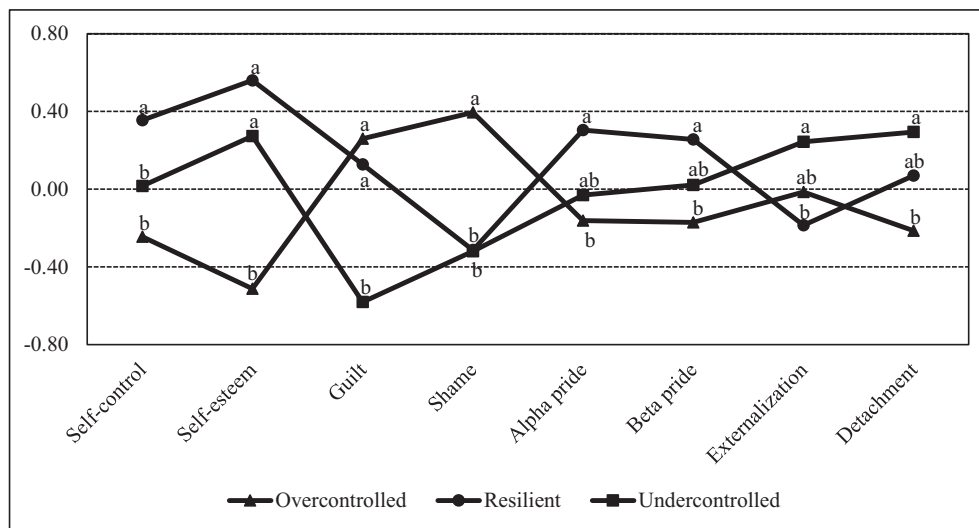
Fig. 2. Personality types characterized by their self-variables z-score patterns. Means with different subscripts differ at $p < .05$ or less.

Table 4
Regression summaries of the Big-Five traits and types predicting self-variables.

	Model 1 & 3		Model 1		Model 2				Model 3		Model 4			
	Step 2 (types)		Step 3 (traits)		Step 2 (traits)		Step 3 (types)		Step 3 (traits)		Step 2 (traits)		Step 3 (types)	
	ΔR^2	95% CI	ΔR^2	95% CI	ΔR^2	95% CI	ΔR^2	95% CI	ΔR^2	95% CI	ΔR^2	95% CI	ΔR^2	95% CI
Self-control	0.06***	0.02–0.12	0.39***	0.34–0.48	0.45***	0.37–0.51	0.00	0.00–0.03	0.25***	0.18–0.33	0.30***	0.22–0.37	0.01	0.00–0.04
Self-esteem	0.22***	0.15–0.29	0.15***	0.12–0.26	0.38***	0.30–0.44	0.00	0.00–0.02	0.07***	0.03–0.14	0.26***	0.17–0.32	0.03***	0.01–0.09
Guilt	0.10***	0.05–0.16	0.10***	0.05–0.17	0.19***	0.13–0.27	0.00	0.00–0.01	0.05**	0.01–0.10	0.11***	0.05–0.17	0.03***	0.01–0.09
Shame	0.10***	0.05–0.17	0.07***	0.03–0.13	0.17***	0.11–0.24	0.00	0.00–0.01	0.04*	0.00–0.08	0.13***	0.06–0.19	0.01	0.00–0.05
Alpha-pride	0.04***	0.01–0.08	0.02	0.00–0.05	0.06***	0.01–0.10	0.00	0.00–0.03	0.01	0.00–0.03	0.04*	0.00–0.07	0.01	0.00–0.04
Beta-pride	0.03**	0.00–0.07	0.03*	0.00–0.06	0.05**	0.01–0.09	0.01	0.00–0.04	0.01	0.00–0.02	0.03	0.00–0.05	0.02	0.00–0.05
Externalization	0.02*	0.00–0.06	0.07***	0.02–0.11	0.09***	0.03–0.14	0.00	0.00–0.01	0.04*	0.00–0.08	0.06***	0.01–0.10	0.00	0.00–0.02
Detachment	0.03**	0.00–0.07	0.04**	0.01–0.09	0.07***	0.02–0.12	0.00	0.00–0.03	0.04*	0.00–0.08	0.05**	0.01–0.09	0.01	0.00–0.05
Average ΔR^2	0.08		0.11		0.18		0.00		0.06		0.12		0.02	

Note. In all analyses, gender was entered in a first step (not reported). In Models 1 and 3, the dummy-coded type indicators were entered as a second step, followed by the dimensional predictors as a third step. In Models 2 and 4, the order of the last two steps was reversed. For Models 3 and 4, the Big-Five scores were dichotomized using median split. ΔR^2 = incremental R^2 for the particular step.
 *** $p \le .001$.
 ** $p \le .01$.
 * $p \le .05$.

Five traits, and (2) entering the traits first, followed by the personality types (dummy coded). The effect of gender was partialled out on Step 1. As shown in Table 4 (Models 1 and 2), for all self-variables, except alpha-pride, the Big-Five traits evidenced incremental validity over the personality types, but not vice versa. These comparisons, however, could be considered unfair to the type approach, since the type indicators were dichotomous variables, whereas personality dimensions were continuous ones. To free the comparisons from this handicap, predictions from the types were contrasted with predictions from dichotomized personality dimensions (Table 4, Models 3 and 4). The types fared better in these analyses, and exhibited incremental validity over the dichotomized Big-Five scores in predicting self-esteem and guilt-proneness. Nevertheless, the type approach was still less predictive than the dimensional approach.

4. Discussion

The current study examined the Big-Five variable- and person-centered approaches regarding their relative utility in the prediction of various aspects of the self.

The variable-centered approach, using regression analyses, yielded several significant relationships that were partially consistent with

predictions. Three Big-Five traits showed positive associations with self-control: conscientiousness, emotional stability, and intellect, with consciousness being the strongest predictor. This replicated previous findings (e.g., Marcus, 2003; Tangney et al., 2004) and made sense conceptually. All personality traits, except agreeableness, positively predicted self-esteem, with emotional stability being the primary predictor, corroborating the findings of others (e.g., Robins et al., 2001). The patterns of predictors were somewhat similar between guilt- and shame-proneness. The positive effect of agreeableness, however, was considerably stronger for guilt, supporting its prosocial nature (Tangney & Dearing, 2002), whereas the negative effect of intellect emerged only for shame. The latter was consistent with Einstein and Lanning's (1998) findings, and suggested that shame was related to low introspection. Contrary to expectations, extraversion, but not emotional stability, was positively associated with pride. Also, there was no evidence that the Big-Five traits differentially predicted the two pride facets.

Overall, the Big-Five traits had varying predictive power in regard to self-variables. The relationships of personality with self-control and self-esteem were substantial, and could be genetically influenced (e.g., Neiss, Stevenson, Legrand, Iacono, & Sedikides, 2009). Personality traits, however, were rather weak determinants of self-conscious

emotions and defenses. This could partly be due to the situational variance inherent in scenario-based measures, such as the TOSCA. The resulting relatively low reliabilities, especially of the pride subscales, might have reduced the associations of interest. However, it could also be attributable to self-conscious emotions being more socially- and less biologically-based (Tracy & Robins, 2004).

Applying the person-centered approach, three personality types were identified, which appeared to represent the Resilient, Overcontrolled, and Undercontrolled types (e.g., Asendorpf et al., 2001; Meeus et al., 2011; Robins et al., 1996). The Big-Five profiles of Overcontrollers and Undercontrollers were mutually complementary, as suggested by Scholte et al. (2005). Note, however, that the Under-controlled type was mainly antagonistic, but not neurotic. The combi-nation of low agreeableness and low neuroticism has been previously associated with callousness-unemotional traits and narcissistic person-ality characteristics (Costa & Widiger, 2002). This is consistent with the ANOVA results showing Undercontrollers having high self-esteem, being less prone to guilt, and more likely to externalize blame and detach themselves. As in earlier studies (e.g. Robins et al., 1996), Re-silients were the most well-adjusted group; they had strong self-control and positive self-concepts, and were prone to guilt, but not shame. Overcontrollers showed the least favorable affect and self-evaluations, being distinguished by their low self-esteem and shame-proneness, as expected. These results converge with past research linking the Un-dercontrolled type to externalizing problems (i.e., outer-directed and generating discomfort in others) and the Overcontrolled type to inter-nalizing problems (i.e., inner-directed and generating distress in the individual; Robins et al., 1996). Surprising as it may seem, Over-controllers had low self-control, not different from Undercontrollers. This may have been due to methodological reasons, i.e., the SCS failing to measure the range between appropriate control and over-control (Letzring, Block, & Funder, 2005). It also aligns with recent reports that Overcontrollers may score low in some aspects of effortful control (Alessandri et al., 2014). Another point worth noting is that the Big-Five types did not differ substantially in conscientiousness, which was the strongest predictor of self-control in the variable-centered approach. In general, the three groups were quite clearly differentiated by the self-variables, with effect sizes varying between small and medium.

Finally, performing head-to-head comparisons to evaluate the pre-dictive utility of personality types and traits, this study showed that the Big-Five traits, in both continuous and dichotomized forms, fared better than the types. This was in concordance with Asendorpf (2003), but contrary to Roth and von Collani (2007, who examined the five-cluster solution) and Asendorpf and Denissen (2006, who examined long-itudinal data). More research is certainly needed before the Big-Five types could be considered well-established and provide a serious al-ternative to dimensions, especially in cross-sectional predictions. Nevertheless, they serve the purpose of summarizing configurations that seem generalizable across diverse samples. This study found some deviations from the general pattern (as in the Undercontrolled type), but the pattern was there and yielded reasonable predictions with re-spect to self-variables.

The present results should be interpreted in conjunction with sev-eral limitations. There may be concerns about the representativeness of the university student sample and the generalizability of findings.[5] Sample composition has been shown to affect the clustering results, e.g., a nationally representative German sample suggested a five-cluster solution (Herzberg & Roth, 2006). Future research should seek to fur-ther substantiate the associations between core traits and self-aspects with more demographically diverse samples. Another shortcoming concerns the low internal consistencies of some of the TOSCA-3 sub-scales. These suboptimal reliabilities, although fairly common for

scenario-based instruments and quite similar to those reported by Tangney and Dearing (2002), call for caution of interpretation and further evaluation of the measure's usefulness. Also, the results would be strengthened by validation with measures not relying on self-report (e.g., other-ratings). Notably, additional studies should help determine whether the observed gender effects reflect measurement bias or im-portant substantive differences.

Collectively, the results support the importance of Big-Five per-sonality characteristics as predictors of self-control and self-esteem, at least when approached from the variable-oriented perspective. Self-conscious emotions, especially pride, seemed to reflect aspects of self-evaluation less well captured by the Big-Five. Of note, although the person-centered approach had modest predictive power, the findings add to the evidence that the RUO types are robust across cultures, samples, and instruments.

Acknowledgements

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2018.01.049.

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An Investigation of the Relationship between Shyness and Loneliness Levels of Elementary Students in a Turkish Sample

Gökhan BAŞ[1]

Abstract

The aim of this research is to analyse the shyness and loneliness levels of elementary students. This research has been conducted in accordance with general screening model. The sample of the research is constituted of 470 elementary students. "Revised Cheek and Buss Shyness Scale" and "University of California Los Angeles Loneliness Scale" were used in the study in order to collect data from the students. Pearson moments correlation coefficient technique, independent samples t-test and regression test have been employed for analysing the data. The significance level was taken as .05 in the research. As a result of the research, it has been found out that the shyness levels of male students were found to be higher than the female students. It has also been found out that female students feel more loneliness than male students. It was also found out that there is a positive relationship between students' shyness and loneliness levels. In order to find out the prediction level of shyness on loneliness, the regression analysis was made. According to the result of the study, shyness predicts loneliness by 2%. At the end of the research, the findings were commented under other research findings in the literature and some recommendations were put forward.

Key Words: shyness, loneliness, Turkish students, elementary level of education

Introduction

Numerous terms have been used to refer to the experience of apprehension and anxiety in social situations, including dating anxiety, speech anxiety, social anxiety, shyness, embarrassment, social phobia, shame, social inhibition, reticence, communication apprehension, introversion, stage-fright, and audience anxiety (Crozier, 2000; Leary & Kowalski, 1993; Van Dam-Baggen & Kraaimaat, 1999). Although these terms are not synonymous with one another, feeling of discomfort in social occasions and the accompanying anxiety resulting from the presence of interpersonal evaluation is the common experience of all (Buss, 1980; Schlenker & Leary, 1982). This study focused on shyness and loneliness levels of elementary students.

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[1] Selcuk Univeristy Educational Sciences Department, Konya gokhan51bas@gmail.com

Shyness

Shyness has been conceptualized and defined in a number of ways, mostly being regarded as belonging to a particular category. One such category views shyness as a subjective experience which is exhibited as nervousness and apprehension in interpersonal encounters (Buss, 1980; Leary & Schlenker, 1981; Zimbardo, 1977). Buss (1980), for instance, defined shyness as an inhibition of expected social behaviour, together with feelings of tension and awkwardness. This line of definitions can be said to regard shyness as a social phenomenon, and a form of social anxiety.

Shyness has long been described as a character trait, an attitude, or a state of inhibition (Durmuş, 2007). Researchers investigating shyness have attempted to develop objective definitions of this human experience. For example, shyness has been defined as discomfort, inhibition, and awkwardness in social situations, particularly in situations with unfamiliar people (Buss, 1985) or as a tendency to avoid social interaction and to fail to participate appropriately in social situations (Durmuş, 2007; Pilkonis, 1977; Schölmerich, Broberg & Lamb, 2000).

Leary (1986) proposed that shyness is totally a social phenomenon, and that it should be defined in terms of both social anxiety and inhibition. Leary (1986) thus, defined shyness as an affective-behavioural syndrome characterised by social anxiety and interpersonal inhibition which results from the prospect or presence of others of interpersonal evaluation.

Shyness is a form of excessive self-focus, a preoccupation with one's thoughts, feelings and physical reactions. Shyness may vary from mild social awkwardness to totally inhibiting social phobia. It may be chronic and dispositional, serving as a personality trait that is central in one's self-definition. Situational shyness involves experiencing the symptoms of shyness in specific social performance situations but not incorporating it into one's self-concept. The reactions for shyness can occur at any or all of the following levels: cognitive, affective, physiological and behavioural, and may be triggered by a wide variety of arousal cues (Henderson & Zimbardo, 1998).

Shyness is virtually an unavoidable emotion, given that it is directly related to many aspects of human nature (Izard, 1972; Pilkonis, 1977). Like many other emotions, shyness is learned in social relationships, and experienced mostly in connection to others (Asendorpf, 1990). Undoubtedly, shyness is a familiar concept and experience for many of us. In fact, it is so inherent part of human life that almost everyone reported experiencing a period of shyness at certain times in his/her life, though the level of experience shows variations from one person to the other (Carducci, 1999; Bozgeyikli, 2002; Henderson & Zimbardo, 1998; Zimbardo, 1989; Zimbardo & Radl, 1981).

Various domains of difficulty have also been identified to further define the condition of shyness. Buss (1985), for example, classified two domains, fearful shy individuals versus self-conscious shy individuals. In the former group, fear of novelty and autonomic reactivity was hypothesised to be the major component. Pilkonis (1977) distinguished the privately shy from the publicly shy, wherein the privately shy were socially skilled but self doubting and uncomfortable and the publicly shy were more visibly uncomfortable and less skilled. Another sub-classification of shyness defined by Zimbardo (1977) consisted of three groups. The first group was composed of individuals who did not seek social interaction and preferred to be alone. The second group included individuals who were reluctant to approach others, was socially unskilled, and had low self-confidence. The last group comprised individuals who were confined by societal expectations and were concerned about violating these expectations.

The studies of shyness within theoretical frameworks after 1970s have contributed a lot to the understanding of the concept in a more systematic fashion, mainly after the findings pointing out its high prevalence were obtained. Several empirical investigations by researchers (Arkin, Appelman & Burger, 1980; Asendorpf, 1987, 1989; Buss, 1980; Cheek & Buss, 1981; Crozier, 1979; Jones & Russell, 1982; Leary, 1983a, 1983b) have focused on the aetiology, measurement, behavioural characteristics, social impact, and treatment alternatives for shyness. In addition, with those research attempts, great advances were achieved toward understanding how and why experience of shyness has made such a large impact on many individuals' lives.

Loneliness

Human beings are social by nature. They desire to form and maintain positive and significant interpersonal relationships. Loneliness may affect mood, social skills and sociability (Johns, Freeman & Goswick, 1981; Karaoğlu, Avşaroğlu & Deniz, 2009). All human beings feel loneliness at some point in their lives (Demir & Fışıloğlu, 1999). Although research on loneliness has increased in the past two decades, no consensus has been reached concerning a definition of the construct (Medora & Woodward, 1986), but various definitions have arisen. Seligman (1983) described loneliness as one of the most poorly understood of all psychological phenomena. DeJong-Gierveld (1988) considered loneliness multidimensional and defined it as a lack of opportunity to have a relationship with others on an intimate level. According to Peplau & Perlman (1982), loneliness is the unpleasant experience that occurs when a person's network of social relations is significantly deficient in either quality or quantity.

Loneliness is a universal emotional and psychological experience. Loneliness is also seen as a normal experience that leads the individual to achieve deeper self-awareness, a time to be creative, and an opportunity to attain self-fulfilment and to explore meaning of life (Bozgeyikli, 2002; Crozier, 2000; Hamarta, 2000; Henderson & Zimbardo, 1998; Yalom, 2001). Loneliness is also a condition of human life, an experience of humanizing which enables the person to sustain, extend, and deepen his/her humanity (Moustakas, 1961). According to Weiss (1973), loneliness is caused not by being alone but being without some definite needed relationship or set of relationships. Loneliness appears always to be a response to the absence of some particular relational provision, such as deficits in the relational provisions involved in social support (DiTomasso, et al. 2003; Özdemir & Tuncay, 2008).

However, the experience of loneliness is likewise unpleasant and distressing. Loneliness may also lead to people to submerge themselves into dependency relations, following direction, imitation, being like others, and striving for power and status (Peplaue, 1982). Reading, watching TV, using the internet, doing social activities, attending parties, drinking, and also using drugs do not only signal loneliness, but these also may be some

adaptive or maladaptive coping strategies university students use to overcome this unpleasant and distressing experience – loneliness (Özdemir & Tuncay, 2008). Even with advances in technology designed to facilitate communication between people, loneliness may be on the rise. In a recent longitudinal study, Kraut, et al. (1998) observed that higher levels of use of the Internet were associated with declines in communication with family members, decreases in the size of one's social circle, and increased loneliness. Loneliness is related also to a number of negative mood states and destructive behaviour patterns. Reviews of the literature (Hansson, Jones, Carpenter & Remondet, 1986; Jones, Rose & Russell, 1990; McWhirter, 1990) have documented links between loneliness and depression, anxiety, and interpersonal hostility as well as with substance abuse, suicide, and vulnerability to health problems. Given the prevalence and the magnitude of suffering associated with loneliness, researchers and clinicians may be called upon increasingly to identify personal and interpersonal factors that increase risk for its onset and exacerbation (Jackson, Soderlind & Weiss, 2000).

Although no agreement on the definition of loneliness is available, it can be defined as an emotion which is evoked when the social relationships of an individual are extremely deficient both qualitatively and quantitatively (Deniz, Hamarta & Arı, 2005; Peplau & Perlman, 1982). Loneliness is composed of negative emotions such as trouble and distress (Jones, Freemon & Goswick, 1981; Russell, Peplau & Cutrona, 1980). Weiss (1973) pointed out the existence of a link between attachment theory and loneliness. He defined loneliness as an anxiety situation which arises when the individual is separated from his/her attachment figure.

Relationship between Shyness and Loneliness

Numerous studies have observed a robust correlation between shyness and loneliness but few have attempted to explain why this relationship exists. This study assessed the extent to which variables associated with self-presentation approaches to shyness and social support mediated the association between shyness and loneliness. Two hundred and fifty-five American college students completed self-report measures of shyness, loneliness, and expectations of rejection, interpersonal competence and close social support. A path

analysis indicated that high levels of shyness were related to features of a protective style of self-presentation (perceived deficits in interpersonal competence, heightened expectations of rejection). In turn, low levels of interpersonal competence predicted reductions in social support. Together, measures indicative of a protective self-presentation style and reductions in social support predicted increases in loneliness. However, shyness and loneliness had a significant association, even after controlling for the influence of self-presentation and social support. Findings suggest that although features of protective self-presentation and social support may partially explain the association between shyness and loneliness, shyness and loneliness are also directly related (Jackson, et al. 2002).

Although shyness and loneliness are distinct constructs, they tend to overlap, inasmuch as measures of each typically correlate (Jones, Rose & Russell, 1990). Both are linked to unsatisfactory social interaction (Jones, Rose & Russell, 1990). Loneliness has been defined as "a sense of isolation that persists over time" (Perse & Rubin, 1990, p. 37). Lonely persons tend to be deficient in communication skills (Spitzberg & Canary, 1985). In turn, these deficiencies isolate people from the very social activities that might reduce loneliness (Perse & Rubin, 1990). According to media uses and gratification theory, when needs cannot be met in more "natural" ways, people often turn to media (Katz, Gurevitch & Haas 1973; Rosengran & Windahl, 1972; Rubin & Rubin, 1985).

Measures of shyness and loneliness typically show a correlation ranging from .40 to .50 (Ashe & McCutcheon, 2001; Jones, Rose & Russell, 1990). Shyness and loneliness are reliably correlated (Ashe & McCutcheon, 2001; Jones, Rose & Russell, 1990; Sherri, Rickard & Zlokovich, 2009) but the degree to which intervening variables mediate their relationship is not clear. In one recent conceptualization, Dill & Anderson (1999) posit that shyness is typically an antecedent of loneliness and that several variables contribute to the loneliness often endured among the shy. First of all, fear and anxiety can interfere with the shy person's attempts to interact with others. Furthermore, the embarrassment and sense of failure that accompanies social interactions of the shy can lead to further avoidance.

When this pattern leads a shy person to have fewer social contacts than desired, loneliness has emerged (Jackson, et al. 2002).

Most of the researches about shyness and loneliness were conducted on university and high school students (Arı & Hamarta, 2000; Demir, 1990; Deniz, Hamarta & Arı, 2005; D'Souza, et al. 2008; Karaoğlu, Avşaroğlu & Deniz, 2009; Erözkan, 2009; Moraldo, 1981; Todd, Soderlind & Weiss, 2000). It is needed further studies to be carried out at elementary level of education since the shyness and loneliness are highly affected at earlier ages at primary and elementary level of education. In this regard, if students are educated by being social individuals from earlier ages (primary and elementary levels), they can be more social and feel less shyness and loneliness in social activities so that they can demonstrate themselves easily. According to Pancar (2009) and Yüksel (2002), academic achievement is affected by these two factors, there are studies needed to be carried out on students' shyness and loneliness levels at elementary level of education so that students can be educated in order to be more social individuals in daily life. In this regard, as Shin (2007) states, academic success is affected by students' social behaviours. On the other hand, unfortunately, cross-cultural data about shyness and loneliness are scarce. The degree, frequency, and quality of a person's shyness and loneliness will be a function, among other things, of the society in which he or she lives. In light of the growing awareness that research conducted in Western cultures does not necessarily represent the psychology of non-Western populations (Triandis, 1996). In this study the authors examined the levels of shyness and loneliness in a Eurasian country, Turkey.

The study aimed to investigate the effects of attachment styles and gender on loneliness and social skills. In this respect, the following questions were to be answered in this study:

1. Do average shyness levels of students differentiate with respect to gender?

2. Do average loneliness levels of students differentiate with respect to gender?

3. Is there a significant relationship between shyness levels and loneliness levels of students?

4. Do shyness levels of students significantly affect the average loneliness levels?

Method

Participants

In this study, the sample set of the research was taken from five elementary schools of Nigde, Turkey by the random set sampling method. Using random sampling is the best way of ensuring that the observations are independent (Karasar, 2005) and in this model, a researcher develops an accurate sampling frame according to a mathematically random procedure, and then locates the exact element that was selected for inclusion in the sample (Neuman, 2000). All data were collected by the researcher himself between December 2009 and February 2010.

The participants were 470 students (204 female and 266 male students) recruited from five different elementary schools of Nigde. Elementary school students studying in classes VI, VII and VIII were selected for the present study. None of the participants knew in advance that they would be asked questions both about shyness and loneliness. The demographic information for the sample is given in Table 1 below.

Table 1. Demographics of the sample

Class Type	Gender		Total	
	Female	Male		
	n	n	n	%
6. Class	58	61	119	20.95
7. Class	56	58	114	20.07
8. Class	61	56	117	20.60
Total	204	266	470	100.00

As one looks at the Table 1 given above, it can be seen that there are 204 female and 266 male students. Of all, 43 % of the students are females and 57 % of the students are males. The distribution of classes was: (1) sixth class 31.48 %, (2) seventh class 31.91 %, (3) eighth class 36.59 %.

Instrumentation

Revised cheek and buss shyness scale (RCBS). *Revised Cheek and Buss Shyness Scale* (RCBS) is one of the most commonly employed measures of dispositional shyness (Cheek & Briggs, 1990). The original Cheek and Buss Shyness Scale (Cheek & Buss, 1981) contained 9 items. The development of the revised form aimed at improving the psychometric properties of the original scale. The revision resulted in a 13-item revised version of the original scale. There are also two other revised versions of the scale, one with 14 and the other with 20 items; however 13-item RCBS was of interest for the present study, given that it has been accepted as the most prominent measure in shyness research (Leary, 1991). The RCBS was found to be internally consistent (coefficient alpha = .90), and 45-day test-retest reliability coefficient was r = .88 (Cheek & Briggs, 1990). Considerable support was also reported for the validity of the scale. The convergent validity was supported via strong correlations with Social Avoidance and Distress Scale (Watson & Friend, 1969, r = .77), and Social Reticence Scale (Jones et al., 1986, r = .79). The scale also correlated with the original 9-item version (r = .96). Leary (1986) recommended the use of RCBS as an appropriate measure of shyness due to its inclusion of both behavioural and physiological factors. 13 items of the RCBS has been translated into Turkish by Güngör (2001). She selected seven items from the obtained response list and added them to the translated 13-item scale. As a result, she created a 20-item Shyness Scale. Güngör (2001) reported evidence for the validity of the 20-item scale after correlating it with Turkish version of *Liebowitz Social Anxiety Scale* (Eren-Gümüş, 1997). The correlation between scores on Shyness Scale and avoidance of SKDE was found to be .78. In addition, Shyness Scale and the total scores obtained from SKDE correlated highly (r = .71). The reliability study included a test-retest, and internal consistency methods. The test-retest reliability coefficient was reported as .83, and Cronbach alpha coefficient for internal consistency was found to be .91.

University of California Los Angeles loneliness scale (UCLA). *University of California Los Angeles Loneliness Scale* (UCLA) The UCLA developed by Russell, Peplau & Ferguson (1978), revised by Russell, Peplau & Cutrona (1980), and adapted to Turkish

participants by Demir (1990) was used to measure the loneliness levels of students. The UCLA is a 20-item Likert-type scale to measure general loneliness levels of participants. The reliability coefficient of the UCLA was calculated as .94 by the re-test method and the Cronbach's Alpha reliability coefficient of the UCLA was found as .96. The parallel form validity of the UCLA was tested with the Beck Depression Inventory and the correlation coefficient was found as .77 (Demir, 1990).

Procedure

Participants were tested in small groups, ranging in size from 15 to 25. All participants received the same description of the study. Participants were told that all responses provided were both confidential and anonymous, and that they could choose to terminate participation at any point. Participants then completed the demographics section of the questionnaire followed by *the UCLA Loneliness Scale* and *the Revised Cheek and Buss Shyness Scale*. Participants were allowed as much time as needed to complete the questionnaire, with typical completion time being 15 minutes. Upon completion, participants were given a debriefing form regarding the general purpose of the study along with the researcher's contact information should they have further questions.

Statistical Analyses

The analyses of the study included descriptive statistics, regression analysis, independent samples t-test, and Pearson correlation coefficients were employed to analyse the data obtained by inventories used in the research. The SPSS 15.0 package was used in the analyses of the data. The significance level was taken as .05 in the study.

Findings

Sub problems of the research and results of the statistical analysis performed for these sub problems are given below:

I. Comparison of shyness levels of students with respect to gender

Do average shyness levels of students differentiate with respect to gender? The shyness levels of elementary students were compared with respect to gender by t-test. A summary of statistics and their significances are given in Table 1.

Table 1. Elementary students' shyness levels in terms of gender

Gender	n	$\overline{X}$	Std. Dev.	t	p
Male	266	52.41	13.74	1.115	.233
Female	204	51.15	10.22		

p>.05

When the table above is analysed, it can be said that the shyness level of male students is $\overline{X}$ = 52.41±13.74 and shyness level of female students is $\overline{X}$ = 51.15±10.22 so that male students feel more shyness than female students. In order to find out the difference between these two groups, the independent samples t-test was used. The t-value was found as t(38)= 1.115 (p= .233, p>.05) so that a statistical significant difference was not found between these two group of students in terms of gender variable.

II. Comparison of loneliness levels of students with respect to gender

Do average loneliness levels of students differentiate with respect to gender? The loneliness levels of elementary students were compared with respect to gender by t-test. A summary of statistics and their significance are given in Table 2.

Table 2. Elementary students' loneliness levels in terms of gender

Gender	n	$\overline{X}$	Std. Dev.	t	p
Male	266	39.72	9.56	.564	.586
Female	204	41.66	10.48		

p>.05

When the Table 2 is analysed, it can be said that the loneliness level of male students is $\overline{X}$ = 39.72±9.56 and loneliness level of female students is $\overline{X}$ = 41.66±10.48 so that female students feel more loneliness than male students. In order to find out the difference between these two groups, the independent samples t-test was used. The t-value was

found as t(38)= .564 (p= .586, p>.05) so that a statistical significant difference was not found between these two group of students in terms of gender variable.

III. Relationship between shyness and loneliness levels of elementary students

Is there a significant relationship between shyness levels and loneliness levels of students? The relationships amongst shyness levels and loneliness levels of students are given in Table 3 below.

Table 3. Relationship between shyness and loneliness levels

		Shyness
Loneliness	*r*	.342

n= 470 *p*<.001

In order to define the relationship between elementary students' shyness and loneliness levels, the Pearson moments coefficient test was used. When the relationship between the shyness and loneliness levels of elementary students are analysed, it can be said that there is a positive statistical significant correlation (*r*= .342, *p*<.001) between students' shyness and loneliness levels.

IV. Regression analysis for the prediction of shyness for loneliness

Do shyness levels of students significantly affect the average loneliness levels? The regression analysis was performed to determine the effects of shyness on loneliness. Results given in Table 4 show the effect of shyness levels of students on their loneliness levels below.

Table 4. Regression analysis for the prediction of shyness for loneliness

Model	R	R²	F	β	t
Loneliness	.352	.023	4.852	**.342**	3.066

p<.05

The effects of shyness on loneliness were examined by the regression analysis and the results are given in Table 4 above. The regression coefficient levels was found as *R*= .352.

Shyness level of the elementary students explain 2 % (R^2= .23) of loneliness level of the students. When one looks at β (.342) and t-values (t= 3.066) in the analysis, it can be seen that shyness predicts loneliness in a statistical significant level (p<.05).

Discussion and Conclusions

According to the findings of the research, shyness levels of male students were observed to be higher than shyness levels of female students, but the difference between these two groups is not found out to be statistically significant at .05 level. The shyness levels of male students were found out to be higher than female students in studies carried out by Ashe & McCutcheson (2001), Yıldırım (2006) and Durmuş (2007). These findings in these studies correlate with the result of the current study.

According to the results obtained in the study in terms of loneliness, loneliness levels of male students were found out to be higher than loneliness levels of female students, but the difference between these two groups is not found out to be statistically significant at .05 level. This finding is similar to the findings of Arı & Hamarta (2000), Deniz, Hamarta & Arı (2005), Wittnberg & Reis (1986) and Yıldırım (2006).

It was found out that there was a statistical positive relationship between shyness levels and loneliness levels of elementary students. In studies carried out by Ashe & McCutcheson (2001), Booth & Bohnsack (1992), Booth, Bartlett & Bohnsack (1992), Sherri, Richard & Zlokovich (2009), Moraldo (1981), Jones, Rose & Russel (1990), D'Souza, et al. (2008), Dill & Anderson (1999), Yüksel (2002) and Jackson, et al. (2002), it was found a statistical relationship between shyness levels and loneliness levels of students. These findings correlate with the results of the current research. Shyness levels of students had a statistical significant effect on their loneliness levels. While a low level of shyness affects loneliness negatively, high level of shyness affects loneliness positively. Research findings showed that loneliness levels of students are affected by their shyness levels. The results of the studies carried out by Duggan & Brennan (1994), Jackson, Towson & Narduzzi (1997) and Deniz, Hamarta & Arı (2005) correlate with the results of the current study.

It is reasonable to speculate that some specific genetic factors increase vulnerability to both shyness and loneliness (Deniz, Hamarta & Arı, 2005). Furthermore, it can be said that if students are unsocial in their daily activities, they feel lonelier and face with loneliness. If students are to be social individuals, they should be educated so as to be social so that they do not feel lonely themselves because they participate actively in social organisations and activities (Deniz, Hamarta & Arı, 2005; Jones & Carver, 1991). In this regard, it can be said that according to Deniz, Hamarta & Arı (2005), Booth, Bartlett & Bohnsack (1992) and Moraldo (1981), shy students tend to be more lonely then their peers.

In this study, the relationship between shyness levels and loneliness levels of elementary students was held. More research is needed in order to generalise the findings of this research to other settings. This research cannot be generalised to other level of educational organisations. Since shyness and loneliness are universal concepts, cross-cultural studies may also be considered as future work. Further studies can be made in order to find out the relationship amongst shyness, loneliness, locus of control, self-esteem and social anxiety since the terms self-esteem and social anxiety are highly related with the terms shyness and loneliness. Furthermore, research on samples less homogeneous in age, educational level, and ethnicity would be useful for assessing the generasibility of the findings in the research.

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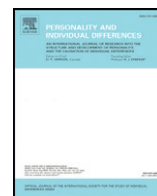
Act-frequency signatures of the Big Five

Benjamin P. Chapman [a,*], Lewis R. Goldberg [b]

[a] University of Rochester School of Medicine and Dentistry, United States
[b] Oregon Research Institute, United States

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ABSTRACT

The traditional focus of work on personality and behavior has tended toward "major outcomes" such as health or antisocial behavior, or small sets of behaviors observable over short periods in laboratories or in convenience samples. In a community sample, we examined a wide set (400) of mundane, incidental or "every day" behavioral acts, the frequencies of which were reported over the past year. Using an exploratory methodology similar to genomic approaches (relying on the False Discovery Rate) revealed 26 prototypical acts for Intellect, 24 acts for Extraversion, 13 for Emotional Stability, nine for Conscientiousness, and six for Agreeableness. Many links were consistent with general intuition—for instance, low Conscientiousness with work and procrastination. Some of the most robust associations, however, were for acts too specific for a priori hypothesis. For instance, Extraversion was strongly associated with telling dirty jokes, Intellect with "loung[ing] around [the] house without clothes on", and Agreeableness with singing in the shower. Frequency categories for these acts changed with markedly non-linearity across Big Five Z-scores. Findings may help ground trait scores in emblematic acts, and enrich understanding of mundane or common behavioral signatures of the Big Five.

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1. Behavioral markers of the Big Five

The Big Five were derived from lexically encoded person descriptors, and then labeled for general understanding. Phrases such as "high in Neuroticism," "low in Conscientiousness," and so forth may have some intuitive meaning to personality researchers, non-personality oriented psychologists, and the lay public alike. But what exactly is meant by the statement that person X is "highly Agreeable"? Such questions demand some sort of reference phenomenon with intuitive meaning, in which a measurement of "high" (or low, medium, etc.) levels of a trait can be cast (Blanton & Jaccard, 2006a, 2006b). Because they are the top of a hierarchy of more specific traits, broad-band constructs such as the Big Five can poses challenges for concrete reference phenomena since they may correspond to numerous concrete metrics.

1.1. The act frequency approach

One line of work aimed more explicitly at behavioral characterization of the Big Five focuses on mundane or incidental behaviors that make up everyday life, and originates in the Act Frequency Approach (AFA) (Buss & Craik, 1981). The original intent of the AFA was to obtain numerical frequency ratings of a behavior across a given time period (i.e., an hour, a month, a year). Actual methodology substituted the number of distinct behaviors performed at least once for the number of times any given behavior was performed. The AFA was criticized as too positivistic, in that it would delimit personality to observable behavior (Block, 1989). Since most accept the existence of internal states and see them as integral to personality, this argument seems compelling. However the "observable" critique could be dropped in approaches employing self-reports of behavior.

The early AFA work provided valuable inroads by having college students generate several dozen behaviors and assign them to personality dimensions similar to the Big Five (Buss & Craik, 1981). More recent work has proposed a list of behavioral indicators of Conscientiousness, validating them with the correlations with Conscientiousness measures in undergraduates (Jackson et al., 2010). Frequency measurement of behaviors at differing levels of traits has not been an objective in this work. Counts of behaviors performed at least once in the last year were used in classic AFA work and Likert-type response scales in more recent studies (Jackson et al., 2010). Other studies have addressed behavioral metric issues using speech times in different content categories (Mehl et al., 2006), a temporal intensity metric, or categories of "extremely uncharacteristic" to "extremely characteristic" (Sherman, Nave, & Funder, 2012). True frequency or count metrics seem rare, perhaps because of the analytic challenges they impose: behavioral counts are not likely to change in a linear fashion across trait levels, and thus require generalized linear (i.e. non-linear) models of trait-behavior association (Blanton & Jaccard, 2006a, 2006b).

* Corresponding author at: Departments of Psychiatry and Public Health Sciences, University of Rochester Medical Center, 300 Crittenden Blvd., Rochester, NY 14642, United States.
E-mail address: Ben_Chapman@URMC.Rochester.edu (B.P. Chapman).

1.2. Focus of the Present Study

Our goal was to build on this literature in four ways. First, rather than examining a smaller number of behaviors, we sought to identify "signature" behavioral acts for each of the Big Five from a much larger set (400). Although this by no means represents all conceivable behaviors, it is the largest group of which we are aware, spanning wide content, public and private, and common and uncommon actions. This approach trades tight laboratory control and observer ratings of immediate or induced behaviors for a much wider sampling domain and time frame (i.e., past year). Second, we utilized a set of behavioral acts with actual frequency categories. This approach weds the goal of an intuitively meaningful metric—the simple number of times an act is performed—with a "closed frequency category" response scale designed to reduce the recall bias inherent in reporting a specific number. Third, we employed a lexical measure of the Big Five. Previous work has focused on questionnaire-based measures, which sometimes ask about actual behaviors themselves. For instance, an item on the Conscientiousness scale of the popular NEO-Five Factor Inventory is "I always keep my belongings well organized". Naturally, such a scale correlates with reported organizational behaviors. However, this may be at least partly due to how the trait is defined, which introduces a circularity or "criterion contamination" that might inflate correlations between reported act frequencies with questionnaire trait measures. Lexical measures, by measuring the Big Five based strictly on trait descriptive adjectives, provide a trait measurement that does not directly incorporate questions about behavioral acts. Fourth, we examined trait-behavior linkages in a community sample. While college samples have provided valuable data thus far, our goal was to identify the most robust act-trait associations in a sample representing a broader swath of society.

2. Methods

2.1. Participants and procedure

Participants were members of the Eugene-Springfield Community Sample (ESCS), a sample of non-institutionalized adults in the Eugene-Springfield, Oregon metropolitan community recruited from lists of home-owners (Goldberg & Saucier, 2016). The personality questionnaire was administered in the summer of 1993 and the behavioral act survey in the fall of 1997. Of 1065 persons with complete personality and demographic data in 1993, 765 completed the behavioral act survey in 1997. The sample had a mean age of 51.4 (SD = 12.7), and a modal education level of some college (i.e., 28%, with 20% having a college degree, 17% having levels less than college, and 35% having levels beyond college); 98% were white, and 58% female.

2.2. Measures

2.2.1. Big Five 100 trait-descriptive adjectives (TDA-100)

This inventory consists of 100 adjectives measuring the Big Five (Goldberg, 1992). Each Big Five factor is assessed by 20 adjectives, to which persons report their resemblance on a 1–5 Likert scale. Both positive and negative adjectives are included, and factorial and convergent validity evidence is extensive (Goldberg, 1992). We used varimax-rotated principal component scores for each Big Five dimension. Although some argue for the use of principal factor scores, principal component scores can be directly computed and in this case the two sets of scores are nearly perfectly correlated. Thus, we refer use the term "factor" in a general sense throughout this manuscript.

2.2.2. Behavioral acts inventory (BAI)

The BAI consists of a set of 400 behavioral acts spanning a widely varying range of behaviors (Goldberg, 2010). Examples include "checked out a library book," "painted my toenails," "yelled at a stranger," and "ate spicy food." The BAI was developed from previous behavioral act lists, revised with the input of community focus groups (see Goldberg, 2010 for details). Acts span a wide range of categories from physical activity, to leisure pursuits and hobbies, personal habits, interpersonal behaviors, health practices, work behaviors, and many other domains. The complete list can be found in the online supplement Table 10. Participants were asked to report the frequency with which they performed each act using the following rating scale: (1) "never in my life," (2) "not in the past year," (3) "once or twice in the past year," (4) "three to 15 times in the past year," (5) "15 or more times in the past year." The frequencies in these rating categories were designed to minimize recall error, since people are not likely to know the exact number of times they performed a behavior, but tend to be able to recall their behavioral frequency within these broad categories.

2.3. Analyses

Our primary question involved culling through 400 different acts to identify a relatively small number of reported behaviors highly associated with each Big Five domain. As with studies examining a large number of genetic variants for associations with a phenotypic trait, this problem demands rigorous attention to multiple testing. We thus imposed a low critical alpha level of $p < 0.001$, deeming a Type 1 error rate of 1 in 1000 acceptable for an exploratory study. From the acts significant by this criterion, we selected an additional set of "signature" behaviors significant according to the more stringent False Discovery Rate (FDR; Benjamini & Hochberg, 1995). In this analysis the critical threshold emerging for FDR control at 0.05 was $ps < 0.000147$.

Our secondary goal involved quantifying trait-behavior associations so that different levels of a trait could be benchmarked with the frequencies at which its signature behaviors occur. Therefore, we used ordinal logistic regression, a type of model equipped to deal directly with ordered categories, and controlled for age, gender, education. We estimated average marginal effects, which are covariate-adjusted probabilities for each behavioral frequency category at Z-scores of −1, 0, and 1 of a given trait. Gender specific acts (i.e., "Got a breast exam," "Got a testicular exam") were examined only in relevant genders. Partial correlations controlling for the same set of demographics revealed essentially similar results. Finally, secondary analyses examined all associations using simple Pearson correlation coefficients.

3. Results

3.1. Specific behavioral signatures of the Big Five

Table 1 reports the behavioral acts associated with each Big Five dimension. The top portion of the table includes acts significant by the FDR rejection threshold, while the bottom includes additional acts achieving a high level of significance (ps < 0.001). At least eight "signature" acts were identified for all Big Five dimensions except Agreeableness, for which a relatively smaller number appeared. A few behavioral acts were associated with more than one dimension, but in opposite directions. For instance, buying or reading more books increased in frequency with increasing levels of Openness, but decreased in frequency with higher levels of Conscientiousness. This was not due to correlations among Big Five scores, which were orthogonal. In general, Extraversion was associated with behaviors reflecting social and physical stimulation, Agreeableness with some domestic tasks, Conscientiousness with the avoidance of irresponsible behaviors, low Emotional Stability with various types of self-medication, and Intellect with a range of bohemian, cognitively stimulating, and non-conformist acts.

3.2. Frequencies of signature behavioral acts across levels of the Big Five

Supplement Tables 1–5 show the marginal probability of performing each "signature" act at given frequencies for low, average, and high

Table 1
Behavioral acts associated with each Big Five factor.

Factor I Extraversion	Factor II Agreeableness	Factor III Conscientiousness	Factor IV Emotional stability	Factor V Intellect
Associations with p < 0.000147				
Participated in an exercise program	Sang in a car or shower	(Did not) spend an hour at a time day dreaming	(Did not) take tranquilizing pills	Spent an hour at a time day dreaming
Drank whiskey, vodka, gin, or other hard liquor	(Did not) become intoxicated	(Did not) swear around other people	(Did not) make fun of someone	Meditated
Went running or jogging		(Did not) buy a book	(Did not) swear around other people	Swore around other people
Drove while talking on the phone		(Did not) eat something spicy for breakfast	(Did not) take a sleeping pill	Bought a book
Drank in a bar		(Did not) let work pile up until just before a deadline	(Did not) drink alcohol or use other drugs to make myself feel better	Lounged around my house without clothes on
Talked on a cellular phone		(Did not) have an overdue fine for a movie rental or library book	(Did not) take medication for depression	(Did not) Follow a sports team closely
Told a dirty joke		(Did not) read a book	(Did not) have a nightmare	Read poetry
Tried to get a tan		(Did not) chew on a pencil	(Did not) take three or more different medications in the same day	Tried something completely new
Played golf				Bought organic food
Discussed ways to make money				Produced a work of art
Cheered loudly at a sports event				Ate something spicy for breakfast
Decorated a room				Discussed ways to make money
Used a sauna or hot tub				Smoked marijuana
				Attended an art exhibition
				Attended an opera or orchestra concert
				Repaired or did maintenance on a car myself
				Composted food scraps or yard waste
Additional associations with p < 0.001				
Swore around other people	Ironed clothes	(Did not) sleep past noon	(Did not) drink four or more soft drinks a day	Shot a gun
Asked questions in a meeting or lecture	(Did not) make fun of someone		(Did not) spend an hour at a time daydreaming	Played piano or another instrument
Planned a party	Played with a child		(Did not) read personal ads	Made an entry in a diary or journal
Drove a car over 75 miles per hour	Washed dishes		(Did not) lose my temper	Finished a large project
Gave a prepared talk or public recital			(Did not) diet to lose weight	Talked in a language other than English
Volunteered for a club or organization			(Did not) drive faster than normal because I was angry	Painted a picture
Discussed sexual matters with a female friend				Cooked a complete meal
Discussed sexual matters with a male friend				Read a book
Did an imitation or impersonation of another person				
Gambled with cards or dice				
Flew in an airplane				

Notes: The top section presents acts with rejected null hypotheses according to False Discovery Rate q-value (ps < 0.000147). The bottom section reports additional acts using a cut-off of p < 0.001 Acts with "did not" preceding them indicate inverse associations with original positively stated items.

levels of the associated trait. Because different behaviors have different base rates, it is helpful to identify the steepest frequency gradients by considering the ratio of probability at high vs. low levels the trait. Dangerous or unconventional behaviors had somewhat lower base rates, but reasonably steep frequency gradients along their associated Big Five dimensions. For instance, driving while talking on the phone more than 15 times a year was (probability ratio of 0.12/0.05 =) 2.4 times more likely at high (+1 SD), relative to low (−1 SD) Extraversion. Drinking to intoxication more than 15 times a year was (0.05/0.02 =) 2.1 times more likely at low relative to high Agreeableness. Lounging around one's house without clothes on more than 15 times the prior year was (0.04/0.02 =) 2 times more likely at high, relative to low Openness. One behavioral frequency category—*never* buying or reading a book *in one's life*—was not endorsed by anyone in the sample.

At the other extreme, swearing around other people was relatively prevalent. Thus, even though this behavior decreased with increasing Conscientiousness, there was still a 25% chance that persons +1 SD in Conscientiousness had cursed around others more than 15 times in the past year.

Secondary analyses of correlations revealed highly similar results (Supplement Tables 6–7, and Figs. 1–5). Most correlations ranged between 0.2 and 0.3 in absolute magnitude. Criterion-keyed scales formed by summing the top 10 acts for each Big Five domain tended to correlate 0.3 to 0.4 with their respective Big Five domain (Supplement Table 9). Regression of each act on all Big Five domains simultaneously produced maximal multiple Rs around 0.4 (Supplement Table 10). Finally, sensitivity analysis examining interactions between traits and demographic factors did not reveal any moderation effects significant by FDR.

4. Discussion

4.1. Big Five descriptive interpretations and measurement implications

Signature acts may inform the development of complementary, behaviorally based measures of the Big Five. Secondary correlational analysis suggested that the top 10 behaviors formed ad-hoc criterion-keyed scales having moderate, but not high convergence with a traditional trait-descriptive adjective measure. Thus more work appears necessary to construct such scales, perhaps beginning with the present results and adding new behaviors, and/or considering different weighting schemes. One measure already exists for Conscientiousness (the Behavioral Indicators of Conscientiousness, or BIC), using (a) behaviors generated by content experts rather than empirically selected, (b) response categories ranging from "never performed the behavior" to "performed the behavior quite often" rather than frequency categories, and (c) college rather than community sample respondents (Jackson et al., 2010). Despite these differences, our analysis revealed several similar Conscientiousness behaviors.

In evaluating the specific Big Five signature acts identified here, it may be useful to consider three classes. The first class consists of behaviors that might be naturally attached to particular Big Five dimensions, a priori. These behaviors are analogous to content-based, face-valid indicators that later emerge as marker items on a factor. The second kind of behaviors is those one might associate with a Big Five domain only after seeing the results. Such behaviors have an "of course, that makes sense" quality to them after the fact. Some of these acts may be particularly useful in mildly "disguising" a Big Five scale by including less face-valid content. And, finally, there is a small set of signature acts that appear flatly counter-intuitive. This is analogous to a "surprise" marker item on a factor that was supposed to load on an entirely different one. This type of behavioral indicator, if replicated in other investigations, might be of use when there is a need to completely conceal the Big Five domain being measured.

4.2. Theoretical characterization of the Big Five

4.2.1. Extraversion

Analyses of trait-descriptive terms in English and other languages suggest that the core aspects of the Extraversion factor include Activity Level/Energy Level, Assertiveness, and Gregariousness (e.g., Goldberg, 1990). In the present analyses, these components were reflected in the identification of behaviors indicative of social activity (talked on a cellular phone, planned a party) as well as social confidence and dominance (asked questions in a meeting or lecture, gave a public talk or planned presentation). However, our results also indicted that one of the most prominent behaviors of extraverted people is the discussion of ways to make money. This is, at first glance, not something one immediately associates with Extraversion, at least not as a prototypic behavioral marker. However, this is consistent with reward reactivity, and some evidence suggests generally higher earnings and occupational success for extraverts, and these achievements may be attributed to their charismatic interpersonal qualities (Judge, Bono, Ilies, & Gerhardt, 2002).

Positive affect also appears to be a core facet of Extraverion (Lucas, Diener, Grob, Suh, & Shao, 2000). Behaviors inducing positive affect (told a dirty joke, cheered loudly at a sporting event), sometimes in a hedonic way (drank in a bar, sat in a sauna or hot tub) were also singular markers of Extraversion. Individuals higher in Extraversion claimed to discuss sex more often, consistent with the finding that they tend to have more sexual partners (Nettle, 2006). As well, the "dark side" of Extraversion was apparent in behaviors related to sensation seeking (drove more than 75 miles an hour, talked on a cellular phone while driving, drank whiskey, gin, vodka, or hard liquor). Extraversion has previously been linked to dangerous driving (Lajunen, 2001), and drinking behaviors may reflect the desire for social stimulation as well as

intoxication (Malouff, Thorsteinsson, Rooke, & Schutte, 2007). Some forms of physical activity, which also stimulate pleasure circuitry (i.e., the "runner's high"), were also found for Extraversion (went running or jogging, participated in an exercise program, played golf). The activity component of Extraversion entails a sense of vitality and vigor known to be facilitated by regular exercise (Rhodes, Courneya, & Jones, 2005).

4.2.2. Agreeableness

Few specific behavioral markers were identified for Agreeableness using the relatively stringent statistical criterion we employed. Agreeableness may be weakly associated with a larger number of acts, with relatively few highly distinguishing behaviors. Another possibility is that the sampling domain spanned by our 400 behavioral acts simply undersampled behavioral signatures of Agreeableness. However, Agreeable persons did show trends toward behaviors that either directly or indirectly benefited others, controlling for gender (ironed clothes, washed dishes, played with a child), consistent with the desire for interpersonal harmony that characterizes Agreeableness. Interestingly, singing in the shower was one of the most robust markers of this Big Five dimension. Persons lower in Agreeableness also admitted they "became intoxicated" more often over the prior year than those higher in Agreeableness.

4.2.3. Conscientiousness

Persons high in Conscientiousness rarely did things like "sleep till noon," "let work pile up until just before a deadline," accrue late fees for books or videos, or daydream. These all reflect the facets of responsibility and organization found in examinations of the component structure of Conscientiousness (Roberts, Chernyshenko, Stark, & Goldberg, 2005). Social propriety and self-control were reflected in less frequent cursing. Chewing on pencils was singularly (and inversely) linked to Conscientiousness as well. This apparently unremarkable act may reflect the neglect of hygiene and cleanliness denoting low Conscientiousness (Jackson et al., 2010), but may serve as an indicator of procrastination in written activity. One rather curious behavior was the tendency for Conscientious persons to buy and read books less often. This seems counter-intuitive because Conscientiousness, on the whole, is characterized by desirable behaviors. However, to the extent that Conscientious persons work long hours to achieve goals, time for reading may be perceived as a rare luxury.

4.2.4. Emotional stability

Most of the behaviors describing low levels of Emotional Stability reflected efforts to cope with stress either legally (took "tranquilizing pills," "a sleeping pill," "medication for depression," "three or more medications in the same day," "drank alcohol") or feloniously ("used other drugs to make myself feel better"). Since Neuroticism is defined by mood dysregulation and is a risk factor for many types of psychiatric distress, it leads to greater mental health service utilization (Goodwin, Hoven, Lyons, & Stein, 2002) and thus access to prescription medication. Poor nutrition ("drank four or more soft drinks a day"), possibly also a self-medication strategy, and accompanying dissatisfaction with one's body ("went on a diet"), were also consistent with neurotic persons' generally worse eating habits (Goldberg & Stycker, 2002) and weight gain (Sutin, Ferrucci, Zonderman, & Terracciano, 2011).

Behaviors denoting anger or hostility were also highly characteristic of low Emotional Stability ("swore around other people," "made fun of someone," "drove too fast because I was angry"). Such activities are often considered indicative of low Agreeableness, whereas low Emotional Stability is often conceptualized as negative affect not specifically related to anger (anxiety and depression, principally). The Five Factor Model, however, includes a facet of "angry hostility" for Neuroticism (Costa & McCrae, 1992). In the Big Five or lexical tradition, "vindictiveness," "temper," and "antagonism" adjective clusters load on the low end of Agreeableness. Finally, persons lower in Emotional Stability had more nightmares—an oft-forgotten correlate of Neuroticism that, in

fact, was a major marker of the trait in the early Eysenck Personality Inventory (Eysenck & Eysenck, 1964).

4.2.5. Intellect

An abundance of behaviors distinguished between high and low levels of Intellect. Obvious among these were contemplative ("spent an hour at a time daydreaming," "meditated"), aesthetic ("played piano or another instrument," "painted a picture," "produced a work of art," attending art exhibitions and orchestras), and literary acts (bought or read books, "talked in a language other than English," "made an entry in a diary or journal"). However, Intellect has also been described as a tendency to defy convention or orthodoxy, possibly as a result of novelty seeking. This non-conformist tendency was also clear in several behavioral acts ("tried something completely new," "lounged around my house without clothes on," "smoked marijuana"). To a small extent, the behavioral signatures indicative of high Intellect were opposite those of high Conscientiousness: four different behaviors were linked to both domains, but in opposite directions ("cursed or swore around others," "bought a book," "read a book," "ate something spicy for breakfast"). An underlying dialectic of convention and task focus (Conscientiousness) vs. rebellion and intellectual focus (Intellect) may be a useful conceptual frame for the behavioral tendencies differentiating these two factors.

4.3. Limitations and future directions

These findings must be interpreted with a balanced understanding of our study's qualifications and strengths. First, the behavioral acts we identified should not be interpreted as a complete catalogue of all behaviors associated with each Big Five dimension. We selected only the most robustly characteristic acts for each dimension, from a set of 400 behavioral acts. Tens of thousands of such acts might be investigated. We also studied a community sample, and it would be particularly interesting to examine Big-Five related behavioral signatures across different cultural groups. Indeed, any generalizations must be made with careful regard to the characteristics of this sample. Some behavioral acts have secular context, meaning their frequencies may change with societal change. In other cases, acts of the same nature may be performed through different modalities, such as reading a newspaper online rather than in print. Finally, the behavioral acts we studied were self-reported. Observer ratings of behaviors will certainly be important as a converging line of evidence. Tradeoffs exist between the two methods: while observer reports provide an inter-subjective perspective, it would be virtually impossible to record hundreds of behaviors across all situations, particularly private ones (Goldberg, 2010). A literature also exists on contextual manifestation of personality (for instance, the messiness of one's room; Gosling, Ko, Mannarelli, & Morris, 2002). The acts studied here may in some cases proxy these contextual cues, or dovetail with them in everyday life and future work might bridge these literatures. Our study's strengths included a rigorous search strategy across the largest behavioral set of which we are aware, combined with a statistical approach rigorous enough for exploratory work but balanced in Type I and Type II error tradeoffs. To our knowledge, probabilistic behavioral frequency estimates across varying levels of the Big Five also have yet to be reported. In sum, our findings point toward the possibility of eventually supplementing traditional trait measurement approaches with signature behavioral acts.

Supplementary data

Supplementary data to this article can be found online at http://dx.doi.org/10.1016/j.paid.2017.04.049.

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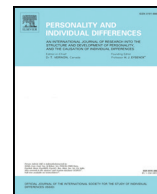
Exploring beyond simple demographic variables: Differences between traditional laboratory samples and crowdsourced online samples on the Big Five personality traits☆,☆☆

Douglas E. Colman [a,*], Jared Vineyard [b], Tera D. Letzring [a]

[a] Department of Psychology, Idaho State University, United States
[b] Idaho Center for Health Research, Idaho State University, United States

ABSTRACT

Amazon's Mechanical Turk (MTurk), a popular crowdsourcing website, is increasingly being utilized by researchers to obtain psychological data. This transition has prompted evaluation of sourcing costs, psychometric properties, and motivations of participants. However, research is limited comparing traditional and crowdsourced participants on personality measures. Therefore, in the current study laboratory participants (drawn from three universities) and MTurk workers completed the Big Five inventory and provided demographic information using web-based surveys. Controlling for age and gender, laboratory participants were significantly lower in Openness ($\hat{d} = 0.26$), and higher in Extraversion ($\hat{d} = 0.37$), Agreeableness ($\hat{d} = 0.15$), and Neuroticism ($\hat{d} = 0.05$) than MTurk participants. However, pairwise comparisons among individual sites revealed there were means above and below that for MTurk participants for Openness and Conscientiousness. Given these differences, researchers are encouraged to consider how such personality characteristics may influence the outcomes of their research when designing and conducting psychological studies that use crowdsourcing techniques to recruit participants.

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It has been said that what is done alone is sometimes better accomplished in a crowd. Modern behavioral researchers are now turning more frequently to cost-effective online solutions to sample and collect data from human participants (Howe, 2006). What is collectively known as crowdsourcing has become a popular avenue for data collection, with Amazon's Mechanical Turk (MTurk) becoming one of the most commonly used services. Crowdsourcing offers a significant advancement in the study of large populations (Paolacci & Chandler, 2014), but questions remain concerning the importance of individual differences between the more traditional laboratory samples in which data are collected in-person in a laboratory and MTurk samples in which data are collected online without participants coming to a laboratory. In addition, recent research has demonstrated that relatively wide variation exists in personality characteristics when participants are assessed with traditional in-person data collection across 30 colleges

and universities (Corker, Donnellan, Kim, Schwartz, & Zamboanga, 2015). The current study explored differences across settings by comparing a large sample of MTurk participants to several college student samples that used in-person data collection.

Crowdsourcing refers to using the internet to distribute tasks or work among a large group of individuals for compensation (Behrend, Sharek, Meade, & Wiebe, 2011; Chandler & Shapiro, 2016; Howe, 2006). MTurk provides a platform for researchers to post tasks for "workers" to complete for relatively little compensation. Compensation ranges from a few cents for short studies up to several dollars, although the majority of tasks posted by researchers fall below $1.00. Recently, psychologists have increasingly used the internet, and crowdsourcing in particular, to recruit samples for studies and experiments traditionally gathered from community or university samples (Chandler & Shapiro, 2016; Skitka & Sargis, 2006).

The use of crowdsourcing websites provides a significant advantage to researchers in that large samples can be collected in a relatively short amount of time (Buhrmester, Kwang, & Gosling, 2011), compared to months (and sometimes years!) for data collection occurring in-person. In short, crowdsourcing is more efficient because it does not require physical lab space, eliminates the need for data entry, and allows for data collection at any time of the day or week. However, there has been concern over the equivalence of data quality among the various

participant recruitment and data collection methods (Buhrmester et al., 2011; Gosling, Vazire, Srivastava, & John, 2004; Ward, 1993).

It has been argued that platform (paper-and-pencil, lab computer, and crowdsourced) differences could significantly alter the results of a study. Yet, evidence from several studies has demonstrated that differences between traditional in-person and crowdsourced participants are minimal. At the assessment level, there is already strong evidence of measurement equivalence/invariance for personality measures taken by MTurk workers and traditional in-person participants. Specifically, the 100 item IPIP version (Goldberg et al., 2006) of the NEO-PI-R was found to have equivalent psychometric properties across samples (Behrend et al., 2011). Likewise, the Big Five inventory (John, Naumann, & Soto, 2008) showed measurement invariance when MTurk participants were restricted to being from countries in which English is the primary language (Feitosa, Joseph, & Newman, 2015). In addition to efficiency and data equivalency, MTurk participants tend to be more diverse on important demographic variables such as age, education, and ethnicity than traditional in-person college/university participants (Behrend et al., 2011; Paolacci & Chandler, 2014). This greater demographic variability directly addresses one of the common limitations of studies conducted in-person at a single location.

Although there are benefits to crowdsourcing psychological data, such samples may not always produce conclusions that can be generalized to a non-MTurk population. One characteristic of crowdsourced participants that has the potential to inhibit generalizability is personality. Previous research has found that crowdsourced samples, in comparison to in-person samples, were lower on Extraversion, Neuroticism, Openness to experience, and Conscientiousness[1] when the Big Five traits were assessed with a 10-item inventory, as well as lower on trait level self-esteem when assessed with a single item (Goodman, Cryder, & Cheema, 2013; Kosara & Ziemkiewicz, 2010). A second study found that a crowdsourced sample again revealed lower levels of Extraversion and Neuroticism, but found higher levels of Openness and lower levels of Agreeableness (Kosara & Ziemkiewicz, 2010). Additionally, personality traits have also been found to be quite variable across traditional samples collected from different regions of the US (Corker et al., 2015), and therefore it is not yet clear whether the magnitude of the differences found between MTurk and traditional samples is within the range that would be expected based on regional differences.

Furthermore, it is well-known that differences in personality are related to behavioral differences that can result in variation in important life outcomes (Ozer & Benet-Martinez, 2006; Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007), and therefore meaningful differences in personality between crowdsourced and traditional samples could be muddying the conclusions that can be drawn about basic psychological processes. Therefore, if consistent differences in personality exist between crowdsourced and traditional participants, it would behoove researchers to uncover and consider such differences when using crowdsourced samples.

Measuring and reporting variance in personality patterns across settings is a key aspect of understanding the impact of these differences for research efforts. Samples using crowdsourcing methods, university students, or community members differ on important variables. Therefore, replication of previous work and comparing multiple samples should be employed to strengthen the understanding of these differences. Using multiple samples allows for improved comparison within traditional settings and improves reliability of estimates of personality and related individual differences. Previous work has shown variability between crowdsourced and traditional samples (Goodman et al., 2013; Kosara & Ziemkiewicz, 2010), however a multiple-sample strategy is needed from both crowdsourced and traditional milieu to better examine the pattern of differences.

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[1] Differences for Extraversion, Neuroticism, and self-esteem were found in two studies, while differences for Conscientiousness and Openness were only found in one study.

Table 1
Demographic characteristics by sample.

	Sample					
	A	B	C	D1	D2	D3
Gender						
Male	389	145	137	31	39	36
Female	880	355	279	135	88	79
Age						
M	37.15	21.77	19.43	21.00	19.50	20.41
SD	12.55	5.32	2.32	4.09	2.02	3.43
Range	18–78	18–53	18–39	17–50	17–35	17–44

1. Summary

Recent research has noted significant variability in participant personality across the United States and concluded that studies comparing a limited number of participant sources run the risk of over-generalizing research findings (Corker et al., 2015). On the other hand, data from crowdsourced participants are thought to provide high quality data (Buhrmester et al., 2011) and incorporate a wider range of individuals with regard to age and ethnic background (Behrend et al., 2011). Less clear, however, is the personality profile of crowdsourced participants compared to traditional in-person participants. Thus, the current analyses expand upon the framework of Corker et al. (2015) by examining the individual differences among participants from several in-person samples and a larger sample of crowdsourced participants (Table 1).

2. Method

2.1. Participants

2.1.1. Sample A

These data (*N* = 1279) were collected between Fall 2014 and the end of 2015 via an online survey platform. Data were collected as part of several projects for which all participants were recruited from MTurk, but restricted to individuals with an approval rating of 95% or greater who reside in the United States.[2] Participants were financially compensated between $0.50 and $2.00, depending upon the project.

2.1.2. Sample B

These data (*N* = 500) were collected between Fall 2014 and Spring 2016 in person at Idaho State University located in the West region of the United States. Data were collected as part of two separate projects for which all participants were recruited from a department subject pool. Announcements about each project were also made in some courses where research was a required element. As such, all participants were undergraduate students and were remunerated with research credits.

2.1.3. Sample C

These data (*N* = 418) were collected between Fall 2012 and the end of 2013 in person at Washington University in St. Louis, a private university in the Midwest region of the United States (Vazire et al., 2016). These participants were taking part in a longitudinal study for which they receive financial compensation. Recruitment occurred through various methods, including a department subject pool, flyers, and announcements in classes. Most of the participants were undergraduate students but a few (about 7%) were graduate students.

2.1.4. Sample D

These data (*N* = 408) were collected in or after 2007 and prior to 2014 in person at University of British Columbia located in British Columbia, Canada. Data were collected as part of several projects in

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[2] All participants met inclusion criteria, which consisted of successfully answering ≥80% of embedded attention checks and completing ≥80% of the procedure in the given study.

which participants received financial compensation or were remunerated with course credit. This dataset was compiled for a previously published study (Rogers & Biesanz, 2014), but the results presented herein are not previously published. Because of the ethnic diversity of undergraduate students in this sample, we utilized the same three ethnic sub-groupings outlined in Rogers and Biesanz (2014). These subgroups are Euro-Canadian (Sample D1; $n = 166$), Acculturated East Asian (Sample D2; $n = 127$), and Semi-Acculturated East Asian (Sample D3; $n = 115$).

2.2. Measures

2.2.1. Big Five inventory

The self-report version of the 44-item Big Five inventory (BFI; John et al., 2008) was used to assess participants' personality trait dimensions of Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism. Respondents rated the applicability of short phrases (e.g., *does a thorough job* for Conscientiousness and *is original, comes up with new ideas* for Openness) on a Likert Scale. This measure has been demonstrated to have adequate reliability with Cronbach's alpha coefficients from 0.79 to 0.88 for the five subscales and 0.83 for the overall measure (Benet-Martínez & John, 1998). The minimum Cronbach's alpha for self-reports across samples were 0.74, 0.65, 0.87, 0.77, and 0.82 for Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism, respectively. Noteworthy is that the width of the Likert Scales varied across the samples; some samples used a 5-point width, while one implemented a 7-point width, and another a 15-point width. Thus, to make the scaling comparable across samples, subscale scores were converted using the *Percentage of Maximum Possible* (POMP) method (Cohen, Cohen, Aiken, & West, 1999). This conversion was completed using the following equation: $\left[\frac{Observed\ scale\ score-\ Min.\ possible\ scale\ score)}{Max.\ possible\ scale\ score-\ Min.\ possible\ scale\ score)}\right] \times 100$. As such, values reported herein have a real range from 0 to 100.

3. Results

The goal of this study was to discover how the Big Five personality characteristics vary across samples, with special consideration toward crowdsourcing. First, however, we compared estimates of the Big Five traits in our study to those estimated in recent research. Specifically, collapsed across in-person samples, the observed trait levels are similar to those observed by Corker et al. (2015) across 30 college/university samples for Conscientiousness and Extraversion, lower for Openness and Agreeableness, and higher for Neuroticism.[3] The point estimates and their 95% confidence intervals are listed in Table 2.

3.1. Are crowdsourced participants similar across geographic location?

In a similar vein to the study by Corker et al. (2015), we explored geographic differences in the personality trait levels of crowdsourced participants. For a large proportion (81.1%; 1037 of 1279) of MTurk participants (those from Sample A), state of residence was reported. This subsample contained individuals from every U.S. state as well as Washington D.C. However, this subsample was too small (e.g., two states were only reported once) to compare personality trait levels across all states. As such, a larger, generally accepted grouping criterion was used. Specifically, location was grouped into the four regions (Northeast, Midwest, South, and West) and nine divisions (New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific) outlined by the United States Census Bureau (n.d.).

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[3] Corker et al. (2015) used the Mini IPIP (Donnellan, Oswald, Baird, & Lucas, 2006) to assess the Big Five personality domains.

Table 2
Mean values and 95% confidence intervals for in-person participants in Corker et al., 2015 and current sample.

Personality trait	Corker et al., 2015			Current sample		
	M	95% CI		M	95% CI	
		Lower	Upper		Lower	Upper
Openness	68.75	67.75	69.50	64.45	63.68	65.21
Conscientiousness	64.25	63.50	65.75	64.31	63.46	65.17
Extraversion	57.75	56.25	59.00	58.20	57.15	59.25
Agreeableness	73.25	72.50	75.00	70.08	69.28	70.89
Neuroticism	45.00	44.00	46.00	48.07	47.04	49.10

Note. The values listed from the Corker et al. (2015) paper are the meta-analytic estimates across sites (e.g., grand means) presented in Fig. 1 of the published paper. To make the scales directly comparable, we transformed the values using the POMP method (Cohen et al., 1999).

We first examined whether participants were similar demographically across the geographic locations. Across the four regions and nine divisions, there were no differences in the frequencies of reported gender ($\chi^2(3) = 0.96, p = 0.81; \chi^2(8) = 3.52, p = 0.90$, respectively) or age ($F(3, 1025) = 1.12, p = 0.34, \eta_p^2 = 0.003; F(8, 1020) = 1.54, p = 0.14, \eta_p^2 = 0.012$, respectively).

Next, we examined regional differences on the Big Five personality traits across geographic locations. The Big Five traits are theoretically orthogonal (e.g., Costa & McCrae, 1995; Goldberg, 1993), and therefore differences across locations were explored using univariate analyses. In the current subsample, there were no significant differences across the four regions for Conscientiousness, Extraversion, and Neuroticism (all $F < 0.60, p > 0.61, \eta_p^2 < 0.002$). There were, however, significant differences for Openness ($F(3, 1033) = 2.64, p = 0.05, \eta_p^2 = 0.008$) and Agreeableness ($F(3, 1032) = 2.73, p = 0.04, \eta_p^2 = 0.009$). Tukey post hoc analyses for Openness revealed that none of the differences reached statistical significance, with the largest difference observed between the West and Midwest regions ($M_{\text{diff}} = 0.15$, 95% CI [$-0.01, 0.32$],[4] $p = 0.09, \hat{d} = 0.22$).[5] Alternatively, the Tukey post hoc analyses for Agreeableness revealed that only the South and Northeast regions were significantly different ($M_{\text{diff}} = 0.17$ [0.003, 0.34], $p = 0.04, \hat{d} = 0.24$).

Lastly, differences across the nine divisions were also explored using univariate analyses. These analyses indicated there were no significant differences across the nine divisions for Conscientiousness, Extraversion, Agreeableness, and Neuroticism (all $F < 1.49, p > 0.15, \eta_p^2 < 0.011$). However, there were significant differences in Openness ($F(8, 1028) = 2.50, p = 0.01, \eta_p^2 = 0.02$). Examination of the Tukey post hoc analyses revealed that only two regions had a statistically significant difference – the Pacific and Middle Atlantic divisions ($M_{\text{diff}} = 0.25$ [0.004, 0.50], $p = 0.04, \hat{d} = 0.37$).[6]

3.2. Are crowdsourced participants different than traditionally sourced participants?

We first explored age and gender differences. Using an independent-samples *t*-test, it was found that, in line with previous research (Behrend et al., 2011; Paolacci & Chandler, 2014), participants who were recruited to participate in person were significantly younger ($M = 20.61, SD = 4.12$) than the crowdsourced sample ($M = 37.15, SD = 12.55; t(1520) = 44.53, p < 0.001$, 95% CI of the difference

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[4] Values in brackets denote 95% confidence intervals for the remainder of the results.
[5] Cohen's d effect sizes were estimated using the following formula for all pairwise post-hoc comparisons: $\hat{d} = \frac{\overline{X_i'} - \overline{X_k'}}{\sqrt{MS_{error}}}$.
[6] Our MTurk sample was composed of data collected as part of two different projects which took place approximately one year apart (Fall 2014 vs. Fall 2015). As such, we conducted a series of *t*-tests on the Big Five personality traits between these two time points. Of these analyses, we only found a significant difference in Conscientiousness ($t(356.02) = 2.81, p = 0.005, M_{\text{diff}} = 3.59$ [1.08, 6.09], $d = 0.19$).
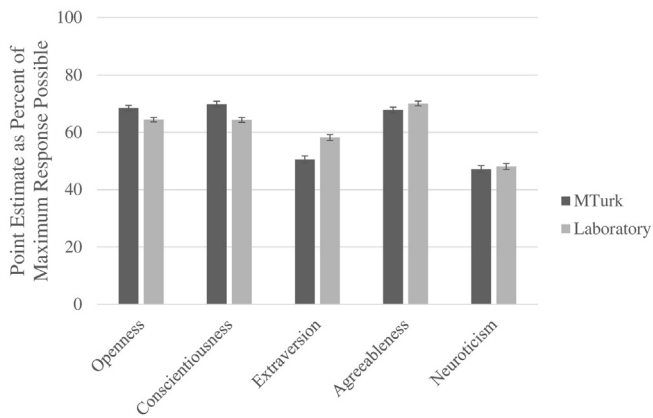
Fig. 1. Unadjusted mean values on the Big Five personality traits for in-person Laboratory participants (combined across samples) and Amazon's Mechanical Turk (MTurk) participants. Displayed means and 95% confidence interval are shown in the Percentage of Maximum Possible (Cohen et al., 1999) metric, which has a real range from 0 to 100.

[15.81, 17.27], $d = 1.78$).[7] Additionally, chi-square tests were used to examine the distribution of gender within and between samples. There were disproportionally more females than males overall ($\chi^2(1) = 416.32$, $p < 0.001$). Additionally, based on a 2 (gender) × 2 (sample) chi-square test of association, this difference in the number of female and male participants was consistent for both samples; $\chi^2(1) = 0.50$, $p = 0.48$. Given these findings, some researchers may advocate for using these variables as covariates when examining differences across samples. However, heeding the recommendations by Simmons, Nelson, and Simonsohn (2011), we have opted to report analyses with and without the covariates of age and gender.

Independent-samples t-tests were used to compare MTurk and traditional in-person participants on each of the Big Five traits. Compared to MTurk participants, in-person participants had lower levels of Openness ($t(2482.3) = 6.52$, $p < 0.001$, $M_{diff} = 4.00$, [2.80, 5.21], $d = 0.26$) and Conscientiousness ($t(2511.4) = 8.14$, $p < 0.001$, $M_{diff} = 5.51$, [4.18, 6.84], $d = 0.32$), higher levels of Extraversion ($t(2525.4) = 9.26$, $p < 0.001$, $M_{diff} = 7.62$, [6.01, 9.23], $d = 0.36$) and Agreeableness ($t(2471.5) = 3.54$, $p < 0.001$, $M_{diff} = 2.31$, [1.03, 3.59], $d = 0.14$), and similar levels of Neuroticism ($t(2540.4) = 1.11$, $p = 0.27$, $M_{diff} = -0.88$, [-2.44, 0.68], $d = 0.04$). Inclusion of age and gender as covariates in a series of ANCOVAs produced similar, but not fully parallel, results. These models also indicated that in-person participants possessed lower levels of Openness x($F(1, 2551) = 19.59$, $p < 0.001$, $\hat{d} = 0.26$) and higher levels of Extraversion ($F(1, 2551) = 66.29$, $p < 0.001$, $\hat{d} = 0.37$) and Agreeableness ($F(1, 2550) = 41.23$, $p < 0.001$, $d = 0.15$). However, Neuroticism ($F(1, 2548) = 21.36$, $p < 0.001$, $\hat{d} = 0.05$) was higher for in-person participants while Conscientiousness had similar levels to MTurk participants ($F(1, 2551) = 0.07$, $p = 0.80$, $\hat{d} = 0.32$). See Fig. 1 for the unadjusted means and 95% confidence interval for each personality trait by recruitment method.

3.3. Assessment of the Big Five personality traits across all samples

With only a single pairwise difference between regions and a single pairwise difference between divisions in trait levels, we conducted the following analyses under the assumption that MTurk participants constitute a single recruitment and data collection sample. Therefore, trait levels were compared across six groups: MTurk and each of the five traditional in-person samples. We again conducted the analyses both without age and gender as covariates (using ANOVAs) and with age

and gender as covariates (using ANCOVAs). Without controlling for age and gender, the analyses revealed that sample means were significantly different for the traits of Openness ($F(5, 2593) = 17.32$, $p < 0.001$, $\eta_p^2 = 0.03$), Conscientiousness ($F(5, 2593) = 43.08$, $p < 0.001$, $\eta_p^2 = 0.08$), Extraversion ($F(5, 2593) = 18.10$, $p < 0.001$, $\eta_p^2 = 0.03$), and Agreeableness ($F(5, 2592) = 9.67$, $p < 0.001$, $\eta_p^2 = 0.02$), although the effect sizes were small. However, there were no significant differences across samples for the trait of Neuroticism ($F(5, 2590) = 1.92$, $p = 0.09$, $\eta_p^2 = 0.004$).

When controlling for age and gender, the results were again similar to the analyses that did not control for age and gender, but not a full parallel. Specifically, there were significant differences across samples for each Big Five trait: Openness, $F(5, 2547) = 12.21$, $p < 0.001$, $\eta_p^2 = 0.02$; Conscientiousness, $F(5, 2547) = 26.92$, $p < 0.001$, $\eta_p^2 = 0.05$; Extraversion, $F(5, 2547) = 14.08$, $p < 0.001$, $\eta_p^2 = 0.03$; Agreeableness, $F(5, 2546) = 14.17$, $p < 0.001$, $\eta_p^2 = 0.03$; and Neuroticism, $F(5, 2544) = 5.94$, $p < 0.001$, $\eta_p^2 = 0.01$. The unadjusted means and 95% confidence interval for each sample are displayed by personality trait in Fig. 2. Further, the adjusted effect sizes for the pairwise comparisons are listed in Table 3 for each type of model (no covariates vs. covariates) for each trait.

As seen in Table 3, there were many significant differences among the samples with regards to personality traits. For Openness and Conscientiousness, there is a large amount of variability among all the samples, although MTurk participants tended to be somewhat higher on these two traits. On the contrary, there was little difference across in-person samples for Extraversion and Agreeableness. However, MTurk participants were consistently lower than all other samples on these two traits. Lastly, and interestingly, there was little difference across all samples on Neuroticism.

4. Discussion

Sampling is a critical element to the external validity of studies (Landers & Behrend, 2015). Specifically, sampling strategy can limit generalizability through two means – range restriction and omitted variable bias. Traditional in-person participant data sourcing often consists of college students with a limited range of age, life experience, and ethnic diversity. Thus, one advantage to crowdsourcing psychological data is the diversity of the participants (Behrend et al., 2011; Mason & Suri, 2012; Paolacci & Chandler, 2014). For example, in the current MTurk sample an increased range and variability for age was found compared to the traditionally sourced participants (range = 18 to 78 for MTurk vs. 17 to 53 for in-person samples; $SD = 12.52$ for MTurk vs. 5.32 for the most variable in-person sample).
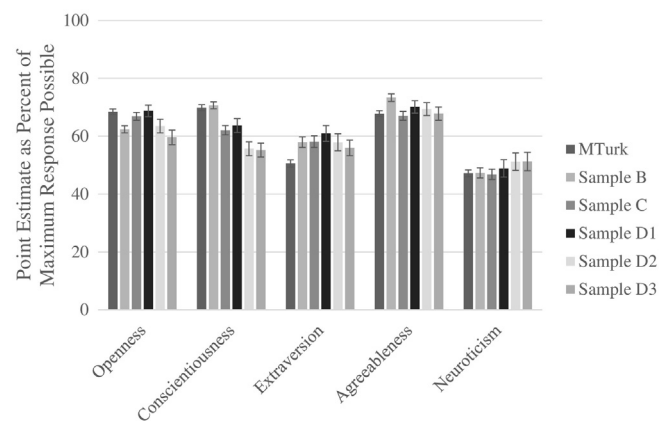

Fig. 2. Unadjusted mean values on the Big Five personality traits for each data collection sample. Displayed means and 95% confidence interval are shown in the Percentage of Maximum Possible (Cohen et al., 1999) metric, which has a real range from 0 to 100.

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[7] Following the recommendations of Delacre, Lakens, and Leys (2017) we defaulted to Welch two sample t-tests for analyses. Therefore, the reported degrees of freedom are adjusted.

Table 3
Estimated Cohen's *d* effect sizes for the pairwise comparisons across samples by trait.

Sample vs. sample	Openness		Conscientiousness		Extraversion		Agreeableness		Neuroticism	
A vs. __										
B	0.39***	0.38***	−0.05	−0.05	−0.35***	−0.35***	−0.34***	−0.34***	−0.01	−0.01
C	0.10	0.11	0.46***	0.45***	−0.36***	−0.36***	0.04	0.04	0.02	0.01
D1	−0.02	−0.02	0.37***	0.38***	−0.50***	−0.50***	−0.14	−0.14	−0.08	−0.09
D2	0.32**	0.31*	0.84***	0.86***	−0.35**	−0.35**	−0.09	−0.10	−0.20	−0.20
D3	0.57***	0.57***	0.87***	0.89***	−0.26	−0.26	0.00	0.00	−0.20	−0.21
B vs. __										
C	−0.29***	−0.27***	0.51***	0.50***	−0.01	−0.01	0.38***	0.38***	0.03	0.03
D1	−0.41***	−0.41***	0.41***	0.43***	−0.15	−0.15	0.19	0.20	−0.08	−0.07
D2	−0.07	−0.07	0.89***	0.91***	0.00	0.00	0.24	0.25	−0.19	−0.19
D3	0.18	0.18	0.92***	0.94***	0.09	0.09	0.33*	0.34*	−0.19	−0.19
C vs. __										
D1	−0.12	−0.13	−0.10	−0.08	−0.14	−0.14	−0.18	−0.18	−0.10	−0.10
D2	0.21	0.20	0.38**	0.41***	0.01	0.01	−0.14	−0.14	−0.22	−0.22
D3	0.47***	0.45***	0.41**	0.44***	0.10	0.10	−0.04	−0.04	−0.22	−0.22
D1 vs. __										
D2	0.34	0.34	0.48***	0.49***	0.15	0.15	0.05	0.05	−0.12	−0.12
D3	0.59***	0.59***	0.50***	0.51***	0.24	0.24	0.14	0.14	−0.12	−0.12
D2 vs. __										
D3	0.25	0.25	0.03	0.03	0.09	0.09	0.09	0.10	0.00	0.00

Note. The left column for each trait contains the values derived from the model without covariates, while the right column for each trait contains the values derived from the model with the covariates of age and gender included. Cohen's *d* effect sizes were estimated using the following formula: $\hat{d} = \dfrac{\overline{X'_i} - \overline{X'_k}}{\sqrt{MS_{error}}}$.

* *p* < 0.05.
** *p* < 0.01.
*** *p* < 0.001.

In regards to the focus of the present article, some research suggests that personality varies significantly between crowdsourced samples and traditional community and college student samples (Goodman et al., 2013; Kosara & Ziemkiewicz, 2010). In the current study in which traditional samples from multiple locations were used, a similar pattern of results was found. Additionally, these findings generally held even after controlling for the covariates of age and gender, a step not taken in previous work. Specifically, the MTurk workers were more Open to Experience, but less Extraverted, Agreeable, and Neurotic compared to traditionally recruited participants.

Issues might arise, however, when trying to make inferences about the MTurk population by comparing a large sample of workers to traditionally sourced participants (e.g., students, community members). For instance, research has recently shown that traditional samples vary significantly in the Big Five personality characteristics across locations (Corker et al., 2015). Thus, we first examined differences in the personality characteristics of MTurk workers across regions and divisions of the U.S. Interestingly, unlike traditional samples, there was only one significant pairwise difference based on geographic region across the five personality traits. Similarly, there was only a single significant pairwise difference across the nine U.S. divisions. Given these findings, we felt it justified to treat the MTurk workers stemming from the various geographic locations within the U.S. as a single sample as we explored differences between MTurk workers and the traditional, in-person research participants.

In a similar vein, generalizability could be inhibited if only a single sample of in-person participants was compared to the MTurk sample. Thus, in addition to the large MTurk sample, three different traditional samples in which data collection location varied widely were used to explore differences in personality. From this, it was found that MTurk workers tended to have higher levels of Openness and Conscientiousness, but lower levels of Extraversion and Agreeableness. This is a similar pattern of results to the previous research (Goodman et al., 2013; Kosara & Ziemkiewicz, 2010) and the comparison between all in-person participants (combined across samples) and MTurk workers. However, we see from Table 2 that these are general patterns and *not absolute trends*. Thus, researchers should remain cognizant of differences among recruitment and data collection sites when sourcing psychological data – whether crowdsourcing techniques are being implemented or not.

While Landers and Behrend (2015) discuss the personality characteristics of convenience samples in the context of range restriction, our findings herein should fall under the purview of both range restriction and variable omission problems. Range would be more restricted in student samples, as they will be younger and thus have less life experience. For example, researchers interested in job, career, or management related constructs would likely find different results across sampling locations and methods for this reason. Indeed, significant differences between students and working adult samples have been found (Ward, 1993), which significantly limits the generalizability of traditional samples in such research domains.

On the other hand, omitting personality variables when considering relations is the cause for concern. Research on the relation between income and life satisfaction exemplifies this issue. Specifically, it has been reported that income is an important factor in one's life satisfaction (Frijters, Haisken-DeNew, & Shields, 2004). However, it also has been shown that higher Conscientiousness, Extraversion, and Agreeableness, and lower Neuroticism, predicted greater life satisfaction even when accounting for income (Soto & Luhmann, 2013). Furthermore, Neuroticism moderated this relationship in that life satisfaction was more strongly related to income for highly neurotic vs. emotionally stable individuals. These findings exemplify the fact that failing to account for differences in these types of characteristics among samples can, and often do, lead to over-generalized, and sometimes inappropriate, conclusions.

In light of the current findings and those in prior research, we strongly recommend future research studies to take individual differences, especially the Big Five personality traits, into account during design, collection, and analysis of crowdsourced data. Ultimately, if researchers do consider, and go as far as statistically controlling for, characteristics of participants that likely affect the constructs of interest, MTurk is a great way to obtain a more diverse sample that contains participants that hold a greater amount of life experiences. Such considerations represent an extremely important process in the generalization of results gleaned from convenience samples (Landers & Behrend, 2015), such as crowdsourced workers. Not only will these

considerations allow researchers to appropriately generalize results, but it may lead to theory revision and even new discoveries, through the exploration of individual differences as potential mediators and/or moderators of the relationship being explored.

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Linking shyness to loneliness in Chinese adolescents: The mediating role of core self-evaluation and social support

Jingjing Zhao, Fangxing Song, Qi Chen, Min Li, Yonghui Wang, Feng Kong*

School of Psychology, Shaanxi Normal University, Xi'an, China
Shaanxi Provincial Key Laboratory of Behavior & Cognitive Neuroscience, Xi'an, China

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ABSTRACT

This study examined the validity of two models predicting the relationship between shyness and loneliness: the cognitive bias and social network mediation models. Four hundred and eighty adolescents, with their age range between 14 and 18 years, were administered the Cheek and Buss Shyness Scale, Core Self-Evaluation Scale, Multi-dimensional Scale of Perceived Social Support and Emotional and Social Loneliness Scale. Structural equation modeling showed that core self-evaluation and social support partially mediated the association between shyness and loneliness, and the mediating effect of social support was larger than that of core self-evaluation. In addition, a multiple-group analysis found that the paths for the mediation model did not differ between males and females, providing preparatory support to its robustness. The results are discussed in terms of the conceptional context.

Loneliness has been considered to be a crucial area of research in psychological health and is defined as "a subjective unpleasant or even uncomfortable state as a result of the contradiction between one's social expectation and her/his actual social network" (Peplau & Perlman, 1982). In the last ten years, a lot of research has explored the potential causes of loneliness. Some research has indicated that loneliness is due to a lack of integration into social networks, whereas the other has demonstrated the important role of personality (e.g., Chen, Hicks, & While, 2014; Mahon, Yarcheski, Yarcheski, Cannella, & Hanks, 2006; Vanhalst et al., 2012a).

Shyness is considered as one of the crucial characterological factors of loneliness. Although shyness and loneliness are different concepts, both of them have strong associations with more negative emotions and unsatisfactory social relationships (Jones, Rose, & Russell, 1990). A lot of research has observed a stable and strong correlation between shyness and loneliness, and shyness is an effective predictor of loneliness in different populations such as adolescents and adults (e.g., Jackson, Fritch, Nagasaka, & Gunderson, 2002; Mahon et al., 2006; Zhao, Kong, & Wang, 2012, 2013). Although the literature has demonstrated that shyness is related to loneliness, the specific mechanisms involved in the relationship remain unclear. For example, loneliness may be influenced by shyness through social network variables. In addition, the relation between them may reflect a negative cognitive process. Consistent with this, two potential models (the cognitive bias and social network mediation models) have been proposed by Levin and Stokes (1986) to explain the relationship of shyness with loneliness.

The cognitive bias model suggests that the relationship of individual difference variables (e.g., shyness) with loneliness reflects a negative cognitive process, and it is important to consider the theoretical and clinical significance of the transformation from social toward individual therapeutic models (Levin & Stokes, 1986). Specifically, some people view themselves and the world negatively, which make them more inclined to evaluate themselves as neurotic, shy, and lonely. According to the model, a likely mediator of the shyness–loneliness relationship is core self-evaluation which reflects one's fundamental appraisals toward their self-worth and abilities. Core self-evaluation is "a broad dispositional trait that is indicated by four more specific traits—self-esteem, generalized self-efficacy, locus of control, and emotional stability (low neuroticism)" (Judge, Locke, & Durham, 1997). Some researchers have proposed that one's evaluations about themselves can play an important role in the development of psychological distress (Kong, Wang, & Zhao, 2014; Orth, Robins, & Roberts, 2008; Smith, Haynes, Lazarus, & Pope, 1993). Moreover, as specific traits in core self-evaluation, self-esteem and self-efficacy have been shown to mediate the relationship between shyness and loneliness (e.g., Li, Dang, He, & Li, 2013; Zhao et al., 2012, 2013). In addition, some researchers also provided evidence that shyness and loneliness are negatively related to neuroticism and an external locus of control (e.g., Afshan, Askari, & Manickam, 2015; Anderson & Arnoult, 1985; Briggs, 1988; Bruch & Belkin, 2001; Stokes, 1985; Vanhalst et al., 2012b). Therefore, we speculated that core self-

* Corresponding author at: School of Psychology, Shaanxi Normal University, Xi'an 710062, China.
E-mail addresses: kongfeng87@126.com, kongfeng@snnu.edu.cn (F. Kong).

evaluation may mediate the shyness–loneliness relationship.

The social network mediation model posits that personal dispositions (e.g., shyness) exhibit an impact on loneliness through social network variables (Levin & Stokes, 1986). That is, personal dispositions can lower one's motivation and/or ability to build and maintain social relationships, thus resulting in loneliness (Levin & Stokes, 1986). According to the model, because shy people have deficient social networks, they tend to experience high levels of loneliness in a new social context (Levin & Stokes, 1986). In line with the model, social support has been shown to be associated with feelings of loneliness (Chen et al., 2014; Kong & You, 2013; Liu, Gou, & Zuo, 2016; Löfvenmark, Mattiasson, Billing, & Edner, 2009; Yildirim & Kocabiyik, 2010; Zhao, Tan, Gao, & Wang, 2017). More importantly, social support has been demonstrated to act as a mediator of the relationship between shyness and loneliness. For instance, Zhao et al. (2013) found that social support acted as a mediator of the shyness-loneliness relationship among Chinese college students. Furthermore, Tan, Ai, Wen, Wu, and Wang (2016) extended the finding to Chinese adolescents.

1. Strengths of the present research

The first strength of the study was to examine the validity of the two models in the context of adolescence. Developmental changes during the transition period lead to special vulnerabilities to perceived social isolation (Laursen & Hartl, 2013). During this period, adolescents spend less time with family members and more time with peers (Laursen & Hartl, 2013). They may lose connection with their family members and are expected to build new networks, and thus tend to experience higher levels of loneliness (Mahon et al., 2006). Therefore, testing the mechanisms involved in the shyness–loneliness relationship seems particularly important, which can advance knowledge development and provide the basis for loneliness interventions.

The second strength of the study was to test the mediation models in Asian culture, especially in Chinese culture. As a collectivistic country, China with its strong Confucian traditions might place much more stress on interpersonal relationships. Compared to Western countries, satisfactory interpersonal relationships is more important in predicting loneliness in China.

The third strength of the study was to consider the independent contribution of both social support and core self-evaluation on explaining the shyness–loneliness relationship, which has been never analyzed together in one and the same study before. Testing the concurrent mediation model in which social support and core self-evaluation mediated the effect of shyness on lonliness would expand our consolidated understanding of the mechanism underlying the relationship.

Taken together, the present study compared the validity of the cognitive bias and social network mediation models between shyness and loneliness in Chinese adolescents. First, we conducted mediation analyses to test the concurrent mediating effects of core self-evaluation and social support on the shyness–loneliness relationship. We hypothesized that both core self-evaluation and social support would be significant mediators. Second, we conducted an effect size contrast analysis to compare the mediating effect of core self-evaluation and social support. We hypothesized that the mediating effect social support would be stronger than that of core self-evaluation.

2. Method

2.1. Participants

The participants were 480 adolescents (163 males and 317 females) from two local high schools in Xi'an and Guilin. The age range was 14–18 ($M = 16.12$, $SD = 0.84$). Of the participants, 30.0% in ten grade, 69.4% in eleventh grade, 0.6% in twelfth grade; 48.8% of the students came from rural areas and 51.3% came from urban areas;

57.5% of the students came from Han majority and 42.5% came from national minority such as Zhuang nationality. The study was approved by the institutional review board of local university.

2.2. Measures

2.2.1. Cheek and Buss Shyness Scale (CBSS)

The CBSS consists of 13 items (Cheek & Buss, 1981). Each item is answered on a 5-point scale (1 = strongly disagree, 5 = strongly agree). The Chinese version of the CBSS has satisfactory reliability and validity (Huang & Leung, 2009; Ma, 1999). In this study, the Cronbach alpha coefficient for the CBSS was 0.90.

2.2.2. Core Self-Evaluation Scale (CSES)

The CSES, developed by Judge, Erez, Bono, and Thoresen (2003) consists of 12 items. Each item is answered on a 5-point scale ranging from 1 = strongly disagree to 5 = strongly agree. The Chinese version of the CSES has satisfactory reliability and validity (Gu, Wen, & Fan, 2015; Kong et al., 2014). In this study, the scale had a Cronbach alpha coefficient of 0.75.

2.2.3. Multi-Dimensional Scale of Perceived Social Support (MSPSS)

The MSPSS, developed by Zimet, Dahlem, Zimet, and Farley (1988) consists of 12 items to assess three sources of support: significant other ($\alpha = 0.87$), family ($\alpha = 0.88$), friends ($\alpha = 0.89$). The participants rated the items on a 7-point scale (1 = very strongly disagree; 7 = very strongly agree). The Chinese version of the MSPSS has satisfactory reliability and validity (Chou, 2000; Kong, Ding, & Zhao, 2015; Kong, Zhao, & You, 2012). In this study, the scale had a Cronbach alpha coefficient of 0.92.

2.2.4. Emotional and Social Loneliness Scale (ESLS)

The ESLS (Wittenberg, 1986, cited in Shaver & Brennan, 1991) consists of 10 items to assess emotional loneliness (5 items; $\alpha = 0.60$) and social loneliness (5 items; $\alpha = 0.68$). The participants rated the items on a 5-point scale (1 = strongly disagree, 5 = strongly agree). The Chinese version of the ESLS has satisfactory reliability and validity (Kong & You, 2013; Liu, 1999). In this study, Cronbach alpha coefficient for the ESLS was 0.66.

2.3. Procedure

We contacted the head teachers of two high schools in Xi'an and Guilin and described the objectives of the study to them. They approved the research and allowed the administration of questionnaires to the students. Four hundred and eighty students voluntarily participated in the survey and no compensation was given for their involvement. After collecting informing consent, all the questionnaires were completed in a classroom.

2.4. Analytical strategy

We used SPSS 22.0 and Amos 22.0 to analyze the data. Firstly, we conducted correlation analysis to establish the correlation between the main variables. Then the two-step procedure was used to analyze the mediation effects (Anderson & Gerbing, 1988). The measurement model was first tested to assess if each of the four latent variables was represented by its indicators. Three item parcels were created for the shyness and core self-evaluation factors to exclude the possibility of inflated measurement errors that may be caused by multiple items for each factor. If skewness and kurtosis values for all variables were satisfactory, then use the maximum likelihood estimation to test the structural model.

The model fit was evaluated in terms of chi-square statistics; root-mean-square error of approximation (RMSEA), standardized root-mean-square residual (SRMR): best if below 0.08; comparative fit index (CFI),

Table 1
Descriptive statistics and zero-order correlations for all measures.

Measure	M (SD)	1	2	3	4
1. CBSS	36.30 (9.64)	1			
2. CSES	38.98 (6.30)	−.55***	1		
3. MSPSS	60.83 (13.04)	−.41***	.48***	1	
4. ESLS	26.30 (5.72)	.51***	−.43***	−.58***	1

Note. CBSS, Cheek and Buss Shyness Scale; CSES, Core Self-Evaluations Scale; MSPSS, Multi-Dimensional Scale of Perceived Social Support; ESLS, Emotional and Social Loneliness Scale.
*** $p < .001$.

normative fit index (NFI), goodness-of-fit index (GFI): best if above 0.90. In addition, 5000 bootstrap samples were drawn from the full data set and a 95% confidence interval was used to determine whether the mediation effect was significant.

3. Results

Descriptive statistics and intercorrelations for all variables (shyness, core self-evaluation, social support and loneliness) are presented in Table 1. All variables were significantly correlated to each other.

3.1. Measurement model

The measurement model was composed of four latent constructs (shyness, core self-evaluation, social support and loneliness) and 11 observed variables. An initial test of the measurement model generated a very good fit to the data: χ^2 (38, $N = 480$) = 97.10, $p < .001$; RMSEA = 0.057; SRMR = 0.039; CFI = 0.98; NFI = 0.96; GFI = 0.97. All the factor loadings for the indicators were reliable ($p < .001$), suggesting that the indicators well represented all their latent constructs. In addition, shyness, core self-evaluation, social support and loneliness were significantly correlated to each other ($p < .001$). These constructs had satisfactory skewness and kurtosis values (all < 1).

3.2. Structural model

The total effect of shyness on loneliness was significant, $r = 0.50$, $p < .001$. A partially-mediated model (Fig. 1) with two mediators (core self-evaluation and social support) revealed a good fit to the data:

χ^2 (39, $N = 480$) = 128.42, $p < .001$; RMSEA = 0.069; SRMR = 0.068; CFI = 0.97; NFI = 0.95; GFI = 0.96. It was particularly important that the relationship between shyness and loneliness was mediated both by core self-evaluation (95% CI = [0.02, 0.21]) and social support (95% CI = [0.22, 0.35]). Thus, our hypothesis was supported. In addition, we performed a multiple mediator analysis to determine which variable had a greater mediation effect, and found social support was a stronger mediator than core self-evaluation (95% CI = [0.05, 0.34]).

Finally, a multi-group analysis was carried out to test if there are significant sex differences in the final model. We compared the first model allowing the structural paths to vary across sexes, with the second model allowing these paths to be equal across sexes. All other parameters were constrained to be equal. There were non-significant differences between the two models, $\Delta\chi^2$ (5, $N = 480$) = 3.48, $p > .05$, indicating that there was no sex differences in these models.

In addition, we also examined the influence of univariate and multivariate outliers on our findings. Fifty one cases were identified as univariate (9 cases) and multivariate outliers (42 cases) and removed from the data set. First, the measurement model showed a very satisfactory fit: χ^2 (38, $N = 429$) = 97.46, $p < .001$; RMSEA = 0.060; SRMR = 0.040; CFI = 0.98; NFI = 0.96; GFI = 0.98. Second, the partially-mediated model with two mediators showed a good fit: χ^2 (39, $N = 480$) = 120.23, $p < .001$; RMSEA = 0.070; SRMR = 0.063; CFI = 0.97; NFI = 0.95; GFI = 0.95. Finally, the multi-group analysis revealed that there were no significant differences for the path coefficients between females and males, $\Delta\chi^2$ (5, N = 429) = 2.94, $p > .05$, suggesting that there was no sex differences in these models. Compared to the data with outliers, there was no difference seen between them. There, our results were not affected by univariate and multivariate outliers.

4. Discussion

The main aim of the current study was to compare the validity of *the cognitive bias and social network mediation models*. The structural equation modeling results seems to provide support for both models. More importantly, social support was a stronger mediator in the shyness-loneliness relationship than core self-evaluation.

These findings extend those reported in a number of other studies examining the potential causes of loneliness (Larose, Guay, & Boivin, 2002; Levin & Stokes, 1986; Vaux, 1988) and cast new light on the
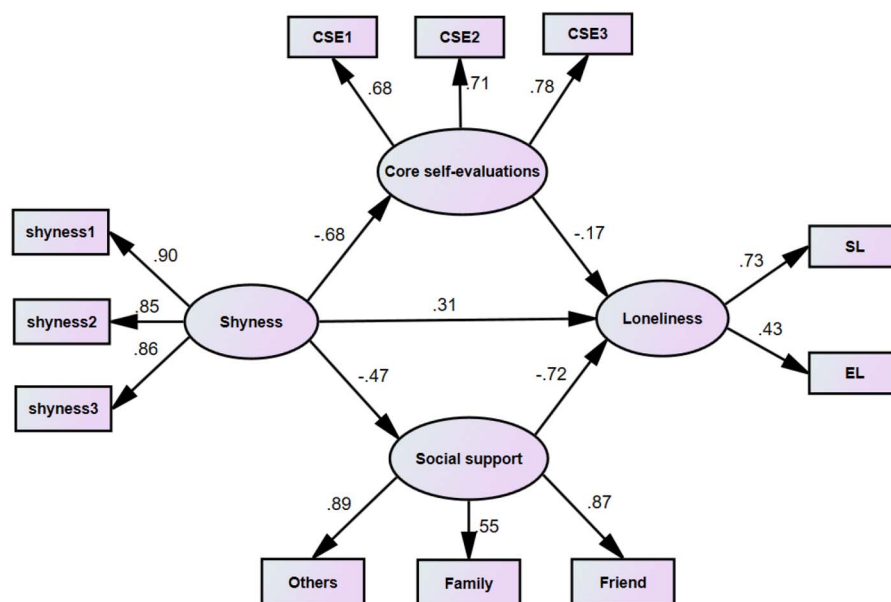

Fig. 1. The finalized structural model (N = 480). Note. Factor loadings are standardized. Shyness1–shyness3 = three parcels of shyness; CSE1–CSE3 = three parcels of core self-evaluations; SL = social loneliness; EL = emotional loneliness.

determinants and mechanisms between individual differences and loneliness in adolescents. On one hand, our findings indicated that core self-evaluation accounted for the shyness-loneliness relationship during adolescence. This is in line with the cognitive bias model (Levin & Stokes, 1986), according to which, the shyness–loneliness relationship may reflect a negative cognitive process. Specifically, shy people have a negative view of self and the world, which may predispose them to invoke negative appraisals toward their self-worth and abilities that lead them to experience states of loneliness.

More importantly, the findings emphasize the important role of social support in the shyness-loneliness relationship above and beyond core self-evaluation during a transition period. This is in accordance with the social network mediation model (Levin & Stokes, 1986) that posits that personal factors (e.g., shyness) affect loneliness through social network variables. High levels of shyness may lower shy individuals' motivation and/or ability to build and maintain social relationships, and thus lead to their deficient social networks, so shy people are more apt to experience high levels of loneliness in a new social context. In addition, we also found that social support played a more crucial role in accounting for the shyness–loneliness relationship. This seems to support our culture hypothesis model in which satisfactory social relationships is more important in predicting loneliness in Chinese culture. Further investigation is still needed to test the culture hypothesis model in cross-cultural studies.

The present study is certainly not without limitations. First, because our study design was cross-sectional, causal inferences cannot be made. Future longitudinal or experimental studies will facilitate more causal evaluations. Second, the data in this study were gathered only through self-report measures. Multiple methods for evaluation may be employed to reduce the impact of such bias. Third, the results of the current study should be generalized only to Chinese adolescents. Finally, the two models were respectively examined in the present study, so we did not address the relationship (e.g., interaction) between these two models, which should be investigated in further studies.

Despite its limitations, the present study represents the first attempt to investigate both core self-evaluation (cognitive bias model) and social support (social network mediation model) in one and the same study to explore the potential mechanisms between shyness and loneliness in Chinese adolescents. These findings suggest that shyness influences loneliness by two different pathways, with the influence of shyness on loneliness mediated by social support and the influence of shyness on loneliness mediated by core self-evaluation. It may provide valuable information for intervention design aimed at reducing the distress accompanying both shyness and loneliness. On one hand, self-monitoring interventions that encourage adolescents to maintain a positive self-evaluation can be developed to affect the shyness-loneliness relationship. On the other hand, developing programs that provide opportunities for social support or network development may benefit shy and lonely people. In addition, these interventions might be also helpful to decrease the clinical risk of loneliness (e.g., depression; Joiner, 1997).

Acknowledgements

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Linking child temperament, physiology, and adult personality: Relations among retrospective behavioral inhibition, salivary cortisol, and shyness

Kristie L. Poole [a,*], Michelle K. Jetha [b], Louis A. Schmidt [c]

[a] MiNDS Neuroscience Graduate Program, McMaster University, 1280 Main Street West, Hamilton, Ontario L8S 4K1, Canada
[b] Department of Psychology, Cape Breton University, 1250 Grand Lake Road, Sydney, Nova Scotia B1P 6L2, Canada
[c] Department of Psychology, Neuroscience & Behaviour, McMaster University, 1280 Main Street West, Hamilton, Ontario L8S 4K1, Canada

ABSTRACT

Shyness has been linked to several distinct behavioral antecedents and biological correlates across development, including early behavioral inhibition and neuroendocrine dysregulation. In the present study, we examined whether self-reported history of childhood behavioral inhibition, concurrent cortisol output, and sex affected shyness levels in adults. Results revealed that a history of childhood *social* behavioral inhibition predicted higher shyness among female adults with high levels of cortisol output. Among women with low cortisol levels, there was no relation between childhood social behavioral inhibition and shyness levels. These associations were not consistent when examining a history of *non*social behavioral inhibition, or among adult males. These findings highlight the importance of differentiating social versus nonsocial behavioral inhibition when examining relations between childhood temperament and adult shyness. Further, these findings raise the possibility that neuroendocrine dysregulation may have a unique role in predicting and maintaining social behaviors such as shyness depending on sex and individual differences in temperament.

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1. Introduction

Behavioral inhibition is an early emerging temperament that is characterized by fearfulness and wariness in response to novelty, including unfamiliar environments, objects, and/or people (Garcia-Coll, Kagan, & Reznick, 1984). There is a well-established link between this temperament and the emergence of distinct behavioral, psychological, and physiological correlates across development (Fox, Henderson, Rubin, Calkins, & Schmidt, 2001). Most noteworthy, behaviorally inhibited children experience more socioemotional maladjustment, including social withdrawal and shyness in later childhood, as well as an increased risk for anxiety related disorders, particularly social anxiety, in adolescence and adulthood (e.g., Chronis-Tuscano et al., 2009; Hayward, Killen, Kraemer, & Taylor, 1998; Hirshfield-Becker et al., 2007; Kagan, Reznick, & Snidman, 1987; Pérez-Edgar & Fox, 2005).

Although a behaviorally inhibited temperament is a strong predictor for the development of social tendencies such as shyness, not all fearful children experience and maintain these social inhibitions across time (Fox et al., 2001). Inconsistent relations may indicate the presence of moderators linking childhood temperamental inhibition and later shyness. Therefore, it is important to examine multiple aspects of an individual that may interact with childhood temperament to predict shyness.

First, behavioral inhibition is a construct that is comprised of both social and nonsocial components, both of which are unique from each other (Dyson, Klein, Olino, Dougherty, & Durbin, 2011; Kochanska, 1991; Neal, Edelmann, & Glachan, 2002; Schofield, Coles, & Gibb, 2009). However, much research examining the association between behavioral inhibition and later social behavioral tendencies (e.g., shyness, social anxiety, sociability) has failed to differentiate the specificity of social versus nonsocial childhood behavioral inhibition in these relations. There is evidence to suggest that *social* fearfulness and inhibition in early life may have particularly strong links with the development of shyness and social anxiety given its strong social basis (Brooker, Kiel, & Buss, 2016; Chronis-Tuscano et al., 2009; Hayward et al., 1998; Kochanska & Radke-Yarrow, 1992; Mick & Telch, 1998; Schofield et al., 2009). This highlights the importance of considering different types of childhood behavioral inhibition (i.e., social versus nonsocial) when examining the association with later shyness.

Second, beyond temperamental vulnerabilities, there are several physiological systems, such as the hypothalamic pituitary adrenal (HPA) axis, that have been implicated in fear responses, including those with a social basis (e.g., shyness). The end product of the HPA axis is cortisol, which has been noted as playing an important role in the maintenance of fear responses (Schulkin, Morgan, & Rosen, 2005). For example, behaviorally inhibited children have been shown to

* Corresponding author.
E-mail addresses: poolekl@mcmaster.ca (K.L. Poole), michelle_jetha@cbu.ca (M.K. Jetha), schmidtl@mcmaster.ca (L.A. Schmidt).

display high cortisol levels under both stressed (e.g. Kagan et al., 1987) and non-stressed (e.g. Schmidt et al., 1997) conditions, which may be reflective of a hyperactive HPA axis. Increased HPA axis activity may be an underlying biobehavioral process predisposing individuals to avoid and withdraw from normative social contexts in everyday life, whereas lower activation of the HPA axis may reflect the tendency to approach social encounters. However, the majority of previous research has examined cortisol as an *outcome* or *correlate* of a fearful and shy temperament (e.g., Beaton et al., 2006; Kagan et al., 1987; Schmidt, Santesso, Schulkin, & Segalowitz, 2007; Schmidt et al., 1999), and surprisingly less literature has examined whether individual differences in HPA activity may act a moderating factor on the relation between temperament and personality development across time. As a result, the role of cortisol in moderating human anxiety and related phenomena such as shyness, particularly beyond childhood, is not clearly understood. By treating cortisol as a moderator, we may be able to better understand its role in shyness as a potential mechanism underlying links between early temperament and later shyness, as well as under what conditions temperamental biases are most likely to affect levels of shyness. Importantly, examination of the interaction of childhood temperament and current biological influences may provide a more complete picture of the developmental processes underlying adult shyness.

Finally, there is evidence to suggest that the relation between temperament and socioemotional functioning in later life may be different in males and females. As a direct association, behavioral inhibition in toddlers and social anxiety in adolescence has been shown to be stronger in females than males (Schwartz, Snidman, & Kagan, 1999), and shyness has been more strongly linked to social anxiety in females than males in both childhood and adolescence (Hayward et al., 2008; Tsui, Lahat, & Schmidt, 2017). Although limited, some research has examined how individual differences in physiological regulation may influence these associations in males and females in samples of children. For example, high cortisol in preschool-aged children predicted withdrawal behaviors in those who had a negative reactive temperament in infancy, but was stronger in boys than girls (Pérez-Edgar, Schmidt, Henderson, Schulkin, & Fox, 2008). Beyond the influence of cortisol output, other biological markers associated with shyness have differentially affected the association between temperament and social behavior across sexes, with right frontal EEG asymmetry having a stronger influence in preschool aged boys than girls (Henderson, Fox, & Rubin, 2001), and respiratory sinus arrhythmia (RSA) having a stronger influence in preschool-aged girls than boys (Morales, Beekman, Blandon, Stifter, & Buss, 2015). Importantly, this demonstrates that individual differences in the physiological systems involved in social behavior such as shyness may exert different effects in male and female children and the extent to which sex differences emerge is not consistent. As well, these sex differences have also not been extensively examined into later development (e.g., adulthood).

1.1. Research aims and hypotheses

We addressed at least four gaps in the current literature by examining behavioral and biological factors hypothesized to be implicated in adult shyness: We examined 1) the specificity of social versus nonsocial self-reported childhood behavioral inhibition, 2) if hyperactivity of the adult HPA axis interacted with temperamental vulnerabilities, 3) if sex differences existed in these relations, and 4) the association of these factors on shyness in a later developmental period that has been previously unaddressed. In doing so, this study helped delineate the specificity of social and nonsocial components of early fear, as well as the interactive effects of this temperament with individual differences in biological functioning and sex. Notwithstanding the cross-sectional nature of the study, this investigation is an important first step in understanding multiple factors of an individual's past and current development that may influence shyness in adulthood.

We hypothesized that cortisol output would moderate the association between retrospective childhood *social* behavioral inhibition and adult shyness. Specifically, we predicted that high cortisol levels combined with a history of high social behavioral inhibition would be linked to the highest levels of adult shyness. Given that previous literature has found inconsistent relations in examining how physiological processes may interact with temperament to predict social behavior in males and females, no specific predictions were made with respect to the effect of sex.

2. Method

2.1. Participants

A convenience sample of healthy adults was recruited from Central-west Ontario as part of a larger study examining behavioral and physiological correlates of socioemotional functioning in adulthood. A total of 81 adults (44 females), primarily Caucasian (81%), participated in this study ($M_{age} = 30.21$, S.D. = 11.23). Participants were recruited from McMaster University, as well as through advertisements in the community and online.

2.2. Procedures

After a complete description of the study was provided, written informed consent was obtained from the participants. Upon acclimation to the laboratory, participants provided their first saliva sample. Participants then completed a series of self-report questionnaires pertaining to personality dimensions and mental health, and then provided their second saliva sample. The participants then completed computer tasks that comprised a face processing task and ERP measures. These measures were collected as part of the larger study and are presented elsewhere (Jetha, Zheng, Schmidt, & Segalowitz, 2012). Finally, participants provided their third saliva sample prior to leaving the laboratory. All procedures were completed at McMaster University and approved by the University's Research Ethics Board.

2.3. Measures

2.3.1. Retrospective childhood behavioral inhibition

History of childhood behavioral inhibition was assessed using the *Retrospective Self Report of Inhibition* (RSRI; Reznick, Hegeman, Kaufman, Woods, & Jacobs, 1992). The RSRI is a 30-item self-report questionnaire assessing a broad range of childhood behaviors associated with behavioral inhibition. The items ask respondents to think about how they felt when they were in early elementary school and to rate items using a five-point Likert-scale. From the total scale, fearfulness related to social (12 items; $\alpha = 0.82$) and non-social contexts (12 items; $\alpha = 0.77$) can be derived to create subscales related to these two dimensions of behavioral inhibition. An example item from the social behavioral inhibition subscale includes "Did you enjoy meeting new children your age?" and an example of an item from the non-social behavioral inhibition subscale includes "Were you scared of the dark?". The RSRI has demonstrated good postdictive validity when self-reports are corroborated with objective accounts of inhibition in childhood, indicating that it is a useful and valid instrument to assess behavioral inhibition in childhood, particularly when prospective data are not available (Reznick et al., 1992). The RSRI (including the social and non-social subscales) has been employed extensively beyond the original validation study (Reznick et al., 1992; e.g., Coles, Schofield, & Pietrefesa, 2006; Hayward et al., 1998; Mick & Telch, 1998; Neal et al., 2002; Schmidt & Fox, 1995; Van Ameringen, Mancini, & Oakman, 1998; Schofield et al., 2009). In support of the separability of the two components of BI, the social and non-social subscales demonstrate low correlation in previous studies (Neal et al., 2002; Schofield et al., 2009).

2.3.2. Adult shyness

Shyness was self-reported and measured using the five highest loaded items (Bruch, Gorsky, Collins, & Berger, 1989) from the original *Cheek and Buss Shyness Scale* (Cheek & Buss, 1981). The following five items comprised the shyness subscale: "I feel inhibited in social situations"; "I find it hard to talk to strangers"; "When I'm in a group of people, I have trouble thinking of the right thing to say"; "I feel nervous when speaking to someone in authority" and "It takes me a long time to overcome my shyness in new situation". Items were scored on a 5-point scale ranging from 0 ("not at all characteristic") to 4 ("extremely characteristic"), thus total shyness scores can range from 0 to 20, with higher scores reflecting more shyness. The shyness scale demonstrated good internal consistency in our sample ($\alpha = 0.87$).

This brief measure has been shown to be highly correlated with the Harm Avoidance (HA3) Shyness subscale on the longer Temperament and Character Inventory (Cloninger, Przybeck, Svrakic, & Wetzel, 1994; Jetha, Goldberg, & Schmidt, 2013), as well correlated with other related constructs such as social anxiety (e.g., Poole, Van Lieshout, & Schmidt, 2017; Rai, 2011). This 5-item measure of shyness has been used in several previously published studies (e.g., Jetha et al., 2013; Poole et al., 2017; Schmidt & Fox, 1995; Schmidt, Miskovic, Boyle, & Saigal, 2008), allowing for less participant burden without compromising predictive validity.

2.3.3. Salivary cortisol

2.3.3.1. Collection. Participants were asked to expectorate 50 μL of saliva into a cryogenic tube. Participants were also asked to refrain from smoking, eating and drinking dairy products, drinking caffeine and alcohol prior to their visit to the laboratory, as these factors can alter cortisol values (Gunnar & Talge, 2008).

2.3.3.2. Assaying and measures. All saliva samples were transported on ice and stored at −20 °C prior to assays. Saliva was centrifuged at 3000 ×g for 15 min and only the supernatant was assayed. All enzyme immunoassays were carried out on NUNC Maxisorb plates. Cortisol antibodies (R4866) and corresponding horseradish peroxidase conjugate were obtained from C. Munro of the Clinical Endocrinology Laboratory, University of California, Davis. Steroid standards were obtained from Steraloids, Inc. Newport, Rhode Island. Plates were first coated with 50 μL of antibody stock diluted at 1:8500 in a coating buffer (50 mmol/L bicarbonate buffer pH 9.6). Plates were sealed and stored for 12–14 h at 4 °C. 50 μL wash solution (0.15 mol/L NaCl solution containing 0.5 ml of Tween 20/L) was added to each well to rinse away any unbound antibody, then 50 μL phosphate buffer per well was added. The plates were incubated at room temperature for 2 h before adding standards, samples, or controls. For each hormone, two quality control salivary samples at 30% and 70% binding (the low and high ends of the sensitive range of the standard curve) were prepared. 50 μL cortisol horseradish peroxidase conjugate were added to each well, with 50 μL of standard, sample, or control. After plate loading, plates remained incubated for 1 h. Next, the plates were washed with 50 μL wash solution and 100 μL of a substrate solution of citrate buffer, H2O2 and 2,2′-azino-bis [3-ethylbenzthiazoline-6-sulfonic acid) was added to each well and the plates were covered and incubated while shaking at room temperature for 30–60 min. The plates were then read with a single filter at 405 nm on the microplate reader (Titertek multiskan MCC/340). Blank absorbances were obtained, standard curves generated, a regression line was fit to the sensitive range of the standard curve (typically 40–60% binding) and samples were interpolated into the equation to get a value in pg per well. Each sample was assayed in duplicate and averages were used. Interplate variation (CV) was 6.45% while intraplate variation was 6.51%.

A single composite measure of total cortisol output across the three samples was computed by summing all useable samples. The average collection time was 1:44 p.m. Cortisol data were missing for a total of 9 participants, owing to not enough saliva donated for reliable assaying. Accordingly, the final sample of participants with useable cortisol data was 72. Analyses were performed and revealed that participants with missing cortisol data were not significantly different on measures of retrospective behavioral inhibition, shyness, age, or sex relative to those with complete cortisol data.

2.4. Statistical analyses

For our main analyses, we performed two separate hierarchical linear regressions. For our first regression, the dependent measure was continuous adult shyness score, and the predictors were entered in the following order: (1) covariates (i.e., sample collection time and oral contraceptive use), (2) childhood social behavioral inhibition, (3) cortisol output, (4) sex, (5) childhood social behavioral inhibition × cortisol output, (6) childhood social behavioral inhibition × sex, (7) cortisol output × sex, and (8) childhood social behavioral inhibition × cortisol output × sex. For our second regression, we performed identical analyses as the first, with the exception that we replaced childhood social behavioral inhibition with nonsocial behavioral inhibition. All analyses were controlled for oral contraceptive use in females, which are known to influence cortisol levels (Kirschbaum, Pirke, & Hellhammer, 1995), as well as controlled for mean time of sample collection given cortisol levels are known to have a diurnal rhythm with levels tending to decline throughout the day (Posener, Schildkraut, Samson, & Schatzberg, 1996). Time of day was not systematically related to participant age, total salivary cortisol output, retrospective behavioral inhibition, or shyness.

All statistical analyses were performed using SPSS Version 21.0, with significance levels set at $\alpha = 0.05$.

3. Results

3.1. Preliminary data analysis

Table 1 displays descriptive statistics and Pearson's correlations for the main measures used in the present study. Retrospective report of childhood social behavioral inhibition and nonsocial behavioral inhibition were correlated ($r = 0.34$; $p = 0.002$). Childhood *social* behavioral inhibition was weakly correlated with adult shyness ($r = 0.19$; $p = 0.08$). Cortisol output was not correlated with either component of retrospective behavioral inhibition or adult shyness (all $ps > 0.05$). All variables fell within the normal distribution range (West, Finch, & Curran, 1995). Analyses indicated no sex differences on age, childhood social behavioral inhibition, childhood nonsocial behavioral inhibition, adult shyness, cortisol output, or time of cortisol collection.

3.2. Main analyses

3.2.1. Retrospective social behavioral inhibition, cortisol output, and sex predicting adult shyness

The results of the hierarchical regression analyses are presented in Table 2. When predicting adult shyness, the full model accounted for 24% of the total variance, $F(9, 62) = 2.17$, $p = 0.04$. Results revealed a

Table 1
Bivariate correlations and descriptive statistics for variables.

	1	2	3	4	Mean (S.D.)	Skew statistic
Social BI	–	0.34[**]	− 0.11	0.19[*]	28.11 (0.84)	0.57
Nonsocial BI		–	− 0.06	0.01	22.72 (0.84)	0.74
Cortisol output			–	− 0.04	6.79 (0.64)	0.90
Adult shyness				–	6.54 (0.47)	0.52

BI – behavioral inhibition; S.D. – standard deviation.
[**] $p < 0.01$.
[*] $p < 0.10$.

Table 2
Hierarchical linear regression of retrospective childhood social behavioral inhibition, sex, and concurrent cortisol levels predicting adult shyness.

	Predictor	Dependent measure: adult shyness		
		Beta	ΔR^2	ΔF
Step 1	Cortisol collection time	−0.19		
	Oral contraceptive use	−0.08	0.033	1.15
Step 2	Social BI	0.213	0.043	3.13[*]
Step 3	Cortisol	−0.32	0.001	0.07
Step 4	Sex	−0.04	0.002	0.11
Step 5	Social BI × cortisol	0.62	0.019	1.36
Step 6	Social BI × sex	−0.23	0.002	0.12
Step 7	Cortisol × sex	−0.42	0.036	2.61
Step 8	Social BI × cortisol × sex	−3.39	0.103	8.29[**]

Standardized Betas are presented. BI – behavioral inhibition, $N = 72$.

[**] $p < 0.01$.
[*] $p < 0.10$.

significant three-way interaction between childhood social behavioral inhibition, cortisol, and sex, $\Delta F (1, 62) = 8.10$; $p = 0.006$.

In order to further explore the sex differences, two separate regressions were completed for female and male subgroups. The predictors entered for females included: (1) mean collection time and oral contraceptive use, (2) social behavioral inhibition, (3) cortisol output, and (4) social behavioral inhibition × cortisol output. The predictors entered for males included: (1) mean sample collection time, (2) social behavioral inhibition, (3) cortisol output, and (4) social behavioral inhibition × cortisol output.

When predicting shyness in adult females, the full model accounted for 35.7% of the total variance, $F (5, 34) = 3.78$, $p = 0.008$. Results revealed a significant interaction between childhood social behavioral inhibition and cortisol, $\Delta F (1, 34) = 6.08$; $p = 0.019$. In order to interpret this interaction, females were divided into two groups based on their cortisol output. For the individuals with high cortisol levels (i.e., scoring above median), there was a significant positive relation between childhood social behavioral inhibition and adult shyness, $B = 0.47$, $p = 0.02$. In contrast, for females with low cortisol levels (i.e., scoring below median), there was no relation between childhood social behavioral inhibition and adult shyness, $B = 0.02$, $p = 0.83$. Fig. 1 illustrates the nature of this interaction.

The equivalent analysis with males found a non-significant model, accounting for 16.8% of the total variance, $F (4, 27) = 1.25$, $p > 0.05$. There were no significant interactions between social behavioral inhibition and cortisol output, and no main effects of social behavioral inhibition or cortisol output.
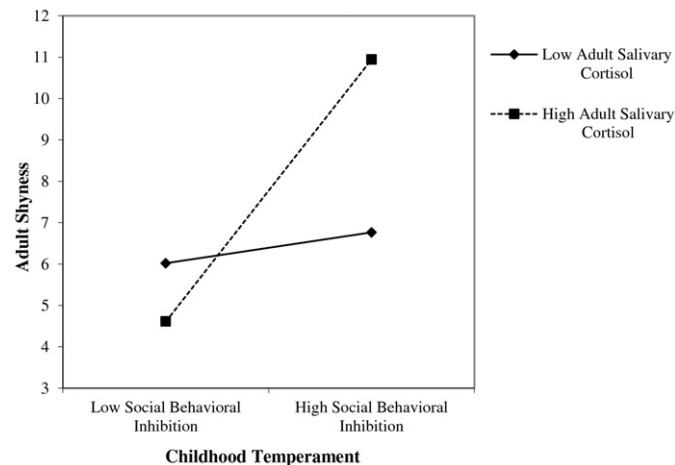

Fig. 1. Moderating role of cortisol levels on the relation between childhood social behavioral inhibition and adult shyness in females.

3.2.2. Retrospective nonsocial behavioral inhibition, cortisol output, and sex predicting adult shyness

The full model was non-significant, accounting for only 9% of the total variance, $F (9, 62) = 0.70$; $p > 0.05$. There was no significant three-way interaction between nonsocial behavioral inhibition, cortisol output and sex, no two-way interactions between any predictors, and no main effects of nonsocial behavioral inhibition, cortisol output or sex.

4. Discussion

The present study examined whether a self-reported history of childhood behavioral inhibition, concurrent cortisol output, and sex predicted shyness levels in adults. Results revealed that a history of childhood *social* behavioral inhibition predicted higher shyness in female adults who had high levels of cortisol output. Among women with low cortisol levels, there was no relation between childhood social behavioral inhibition and shyness levels. Furthermore, these results were not consistent with a history of *nonsocial* behavioral inhibition, or among adult males.

These findings highlight the specificity of social behavioral inhibition in predicting shyness in adults, which is consistent with previous studies findings examining these temperamental components in relation to socioemotional adjustment, shyness, and social anxiety (Brooker et al., 2016; Hayward et al., 1998; Kochanska & Radke-Yarrow, 1992; Mick & Telch, 1998; Schofield et al., 2009). The present study extends this literature by finding that individual differences in HPA axis activity further explain these relations, particularly among females in adulthood.

The findings among the female participants can be explained within a differential susceptibility model. Differential susceptibility to contextual influences is one approach that is gaining considerable traction in the field of developmental psychopathology. This model is used to understand individual differences in outcomes and is based on the idea that biological vulnerability factors at the level of an individual do not always predict the same outcome. In fact, in certain contexts, these biological factors may lead to *opposite* outcomes (see for example, Belsky & Pleuss, 2009). In the present study, cortisol can be conceptualized as the differential susceptibility factor, and temperament can be considered the developmental context. Females with high levels of cortisol (i.e., differential susceptibility factor) exhibited the highest and lowest levels of shyness (i.e., opposite outcomes), depending on whether they also had higher or lower levels of childhood social behavioral inhibition (i.e., developmental context), respectively. This interaction suggests that high cortisol was differentially sensitive to childhood temperament vulnerabilities. Females with low cortisol output had midlevels of shyness regardless of whether they reported a history of low or high social behavioral inhibition in childhood, suggesting that temperamental biases did not play a role in shyness for these individuals. It is important to note that independently, neither childhood social inhibition nor concurrent cortisol levels significantly predicted shyness in adults; instead, it was the interaction of these two factors.

Increased HPA axis activity (i.e., higher cortisol) has been shown to exert different effects depending on an individual's history and development (McEwen, Gray, & Nasca, 2014). Although cortisol is oftentimes perceived as a 'stress' hormone, it may actually be better conceptualized as a marker of energy and metabolism as opposed to a marker of stress *per se* (Sapolsky, 1992; Schulkin, 2011). The idea that cortisol is a marker of energy and metabolism has a long history in both nonhuman animals and humans (Creel, 2001; Sapolsky, Alberts, & Altmann, 1997). Specifically, cortisol has been related to both high *and* low social rank across species (Ray & Sapolsky, 1992; Virgin & Sapolsky, 1997). These findings have led to two hypotheses. The first is called the "stress of domination" which posits higher cortisol in socially *dominant* individuals because these individuals must fight more than subordinates to maintain their position (i.e., require more energy). In contrast, the "subordination stress" hypothesis (Blanchard, Sakai, McEwen, Weiss, & Blanchard, 1993) may also be observed and explained by the fact that

social *subordinates* are prone to greater harassment, and thus experience elevated cortisol secretion in response to this social stress.

Although the present study did not examine social rank *per se*, when conceptualizing individuals low in shyness as more socially dominant, and high shy individuals as less socially dominant, our findings parallel hypotheses from an evolutionary perspective. That is, in viewing cortisol as an 'energy' hormone, it makes sense that some shy individuals may experience high energy expenditure (as indexed by high cortisol) from a relatively chronic state of social stress. However, individuals who are low in shyness and presumably more outgoing and bold may also require a lot of energy resources in everyday life in participating in social approach-related behaviors. By developing a more clear understanding of how heightened glucocorticoid functioning is affected by different developmental contexts (e.g., temperamental biases), researchers may be better equipped to understand the developmental origins of adult personality in general, and shyness in particular.

Although self-reported retrospective temperament and concurrent cortisol output interacted to predict shyness in females, the same associations did not exist in male adults, highlighting possible sex differences in the association of childhood temperament and adult shyness. Previous research has found that the link between behavioral inhibition in toddlers and social anxiety in adolescence was stronger in females than males (Schwartz et al., 1999) and that shyness was more closely linked to social anxiety in females than males in both childhood and adolescence (Hayward et al., 2008; Tsui et al., 2016). However, research has been less exhaustive in examining how individual differences in cortisol output may influence the strength of these relations in males and females.

It is possible that the observed sex differences in the relations between retrospective childhood temperament, cortisol and shyness may result from differences in hormone production (beyond cortisol) among males and females. For the female with higher cortisol levels and a temperamental bias towards shyness, the presumably low testosterone production (relative to males) may differentially impact the effects of high cortisol production in predicting shyness. Specifically, testosterone is involved with approach-related behaviors such as drive, dominance, and sociability (Dabbs, Hargrove, & Heusel, 1996; Dabbs & Ruback, 1988; Mazur, 1985). For the male with a history of inhibition and thus the same temperamental bias, the higher levels of testosterone may act to buffer the cumulative risk that high cortisol may play in predicting the development of shyness. That being said, the physiological mechanisms that underlie shyness in males and females may differ to some degree. Given that these hypotheses are speculative, it will be important for future studies to examine whether females may be more vulnerable to the presence of cumulative biological sensitivity factors implicated in the development of shyness relative to males. This is particularly relevant given the inconsistent results have been found with respect to sex differences in the moderating influence of physiological regulation in previous studies (e.g., Henderson et al., 2001; Hinnant & El-Sheikh, 2013; Morales et al., 2015; Pérez-Edgar et al., 2008).

4.1. Limitations

The present study has several limitations that warrant acknowledgment. First, the most noteworthy design limitation is the use of a self-report, retrospective measure of childhood temperament, which may limit the validity of the findings. Although the RSRI has been used extensively in previous studies and exhibits good postdictive validity (Reznick et al., 1992), the results should be interpreted with this limitation in mind. It would be particularly useful for future research to utilize an objective measure of both social and nonsocial fear in early childhood and prospectively examine shyness in later life. Second, both the predictor (i.e., temperament) and dependent measure (i.e., shyness) were self-reported cross-sectionally, and thus it is possible that perceptions

in current personality could influence self-perceptions in retrospective temperament. However, given the relatively low direct correlation between these measures, this does not seem apparent in the current study. Third, the collection times of the saliva samples were not identical across all participants. Given the diurnal rhythm in cortisol levels, this may have affected our findings. However, we did control for time of sample collection in order to aid with this shortcoming. Further, the small sample size in the present study was relatively homogenous in terms of ethnicity, and so future studies should employ larger sample sizes with greater variability in order to determine the generalizability of the findings.

Finally, although the present study sheds light on the specificity of social versus nonsocial behavioral inhibition, as well as the moderating roles of sex and cortisol in predicting shyness in adults, there are undoubtedly additional factors that may interact with early life temperament to predict adult shyness. The absence of a longitudinal study design restricts us from examining these influences. For example, important contextual factors in childhood and adolescence (e.g., parenting styles, peer relations, social experiences) as well as adulthood (e.g., social support, relationship quality) likely exert significant influence on the relation between behavioral inhibition and adult shyness, which were not examined in the present study. Furthermore, additional biological vulnerability factors beyond cortisol levels (e.g., respiratory sinus arrhythmia, genetics, and brain activity) in both childhood and adulthood are likely interacting with temperamental predispositions and may be underlying shyness in adulthood. Since the present study used concurrent (i.e., adult) cortisol output, it will also be important for future studies to examine lifetime patterns of cortisol output, including across earlier development. Accordingly, given the interactions among early adverse experiences, individual differences in temperament, and biological factors reported by others in predicting adolescent (Lahat et al., 2017) and adult (Aron, Aron, & Davies, 2005; Schmidt et al., 2008) shyness, future studies should aim to not only replicate findings of the present study using a longitudinal, prospective study designs (e.g., Schmidt et al., 2017; Tang et al., 2017), but to also examine the role of additional factors internal and external to the individual to see if they are influencing the relation between social inhibition in childhood and adult shyness. This will allow for a more complete picture of the complex developmental pathways of shyness across time.

5. Implications and conclusions

The present study highlights the importance of considering both social and nonsocial components of childhood behavioral inhibition when examining socioemotional outcomes associated with this temperament, as a history of self-reported social fear may have a unique contribution to shyness. Further, findings underscore the importance of considering moderating physiological factors on the relation between childhood temperament and adult shyness. It appears that differences among physiological systems underlying stress regulation may exert interactive effects with temperamental biases when predicting shyness. High cortisol levels may have different roles in the development and maintenance of social behaviors such as shyness, depending on individual differences in childhood temperament. However, it was also revealed that these processes might act in different ways among females and males, which emphasizes the importance of exploring sex differences when examining links among temperament, physiology, and personality across development.

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Full length article

Relationship between shyness and mobile phone addiction in Chinese young adults: Mediating roles of self-control and attachment anxiety

Lei Han [a], Jingyu Geng [a], Min Jou [b, *], Fengqiang Gao [a], Huayong Yang [a]

[a] School of Psychology, Shandong Normal University, Ji'nan, Shandong, China
[b] Department of Industrial Education, National Taiwan Normal University, Taipei, Taiwan

ARTICLE INFO

ABSTRACT

Mobile phones are indispensable for many young adults, but such devices may negatively affect their mental health and well-being. Previous studies revealed a significant association between shyness and mobile phone addiction. This study further explored this association, its underlying mechanisms, and the mediating effects of self-control and attachment anxiety of mobile phone addiction. Investigational methods included a cross-sectional design and multiple questionnaires, namely the College Students' Shyness Scale, Experiences in Close Relationships Inventory, College Students' Self-Control Scale, and Mobile Phone Addiction Index. Correlation analysis indicated that shyness, attachment anxiety, and mobile phone addiction have significant, positive correlations with each other, as well as significant, negative correlations with self-control. Hayes's PROCESS macro revealed that self-control and attachment anxiety played multiple mediation roles in the relationship between shyness and mobile phone addiction. In other words, (1) shyness was negatively associated with mobile phone addiction, (2) both attachment anxiety and self-control played partial and parallel mediating roles between shyness and mobile phone addiction, and (3) attachment anxiety and self-control mediated the link between shyness and mobile phone addiction sequentially. The results of this study indicate that mobile phone addiction among shy young adults can be eliminated through the development of self-control and alleviation of attachment anxiety.

1. Introduction

Rapid development of mobile phone technologies provided a rich selection of functions and improved portability that increased the prevalence of mobile phone use, especially among young people. The number of mobile phone users in China reached 1.27 billion by the end of 2014, with young adults (aged 18–22 years) being the one of the largest and fastest-growing demographics of mobile phone owner and users (Chen et al., 2016). Despite offering great convenience, mobile phones can exert negative influences, induce extreme emotional changes and even cause serious physiological reactions, giving rise to the phenomenon popularly known as "mobile phone addiction" (Pedrero Pérez, Rodríguez Monje, & Ruiz, 2012). An epidemiological investigation determined that mobile phone call times exceeding 1 h per day cause heating behind, around, or on the ear, as well as headaches, dysphoria,

fatigue, lack of concentration, and memory loss (Sandström, Wilen, & Mild, 2001), while another investigation found that adolescents using mobile phones for more than 7 h per day reported more headaches, anxiety, tiredness, stress, sleep disturbances, and concentration difficulties (Fredrik, Michael, & Lennart, 2008). Furthermore, a prospective cohort study found that frequent mobile phone use is associated with stress, sleep disturbances, and symptoms of depression (Thomée, Harenstam, & Hagberg, 2011). Previous studies also revealed that compulsive use of mobile phones might lead to psychological disorders (Beranuy, Oberst, Carbonell, & Chamarro, 2009; Lee, Chang, Lin, & Cheng, 2014), and that overuse of mobile phones was associated with depression, social isolation, drug and alcohol use, and academic failure (Sánchez-Martínez & Otero, 2009). In sum, mobile phone addiction may exert a deleterious influence on an individual's physiological, mental, and social health as well as daily functions, giving rise to an urgent need to explore mobile phone addiction among college students and clarifying the underlying causes of the addiction.

Shyness is a personality trait and a feeling of tension and

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discomfort when encountering new social environments or when responding to social evaluations. Shy individuals in China as well as other western countries are often ignored by others. Henderson and Zimbardo (2001) defined shyness as discomfort in social situations, accompanied by frustration or inhibition that substantially interferes with the person's ability to achieve ambitions or their willingness to participate in social activities. Many studies verified that shyness can be used as a crucial predictor for Internet addiction (Ayas, 2012; Chak & Leung, 2004; Eldeleklioglu & Vural-Batik, 2013; Tian, Bian, Han, Gao, & Wang, 2017).

The Internet features anonymity, controllability of communications, and the negation of physical presence, making it extremely attractive to shy individuals (McKenna & Bargh, 2000). An empirical study revealed that extremely shy individuals exhibited higher levels of helpfulness in online activities than individuals who are less shy, and individuals tend to exhibit higher scores for helpful behavior when online (Han, Xu, Bian, Gao, & Ren, 2016). In other words, shy individuals prefer social networking environments in the Internet to satisfy their need for socialization without the anxiety and discomfort associated with face-to-face communication.

Shyness negatively affects pleasurable communication, and shy people are more likely to suffer from communication problems, anxiety disorders (Van, Mancini, & Oakman, 1998), feelings of loneliness (Ai, Wen, & Wu, 2016; Cheek & Buss, 1981; Jackson, Fritch, & Nagasaka, 2002; Zhao, Kong, & Wang, 2013), and depression (Alfano, Joiner, & Perry, 1994; Romney & Bynner, 1997). To avoid these negative feelings, some shy individuals immerse themselves in mobile phone use, which consequently leads to mobile phone addiction (Bhardwaj & Ashok, 2015; Bian & Leung, 2015; Darcin, Kose, Noyan, Nurmedov, & Yılmaz., 2016; Liu & Wang, 2011; Öztunç, 2013). These observations indicate that mobile phone addiction is essentially similar to Internet addiction (Pedrero Pérez et al., 2012).

Anxiety and depression are also related to abnormal mobile phone use (Elhai, Levine, Dvorak, & Hall, 2016; Lee et al., 2014). Empirical studies revealed that frequent use of Facebook, a social networking site that allows people to avoid face-to-face communication and interpersonal difficulties, can result in loneliness and shyness (Ryan & Xenos, 2011), while other studies found that preferences for emailing, online chatting, and texting are associated with symptoms of depression (Thomée, Eklöf, Gustafsson, Nilsson, & Hagberg, 2007).

Based on these previous findings, we propose the following hypothesis:

Hypothesis 1. Shyness is positively correlated with mobile phone addiction.

1.1. Mediating role of attachment anxiety

There are three types of attachment styles, namely secure, avoidant, and anxious (Li & Kato, 2006). Attachment anxiety generally refers to insecurity about relationships as well as anxiety and fear of separation from attachment figures (Li & Kato, 2006). Individuals with anxious attachment tend to be uncertain regarding the emotions of attachment figures and often both desire and fear intimacy with these figures (Ainsworth, 1898). Attachment anxiety has critical implications for the internalizing or externalizing of behavior among adolescents. The attachment theory (Bowlby, 1969) states that the perception of close others as unreliable and untrustworthy can heavily threaten attachment security, triggering maladjustment and compensatory responses aimed at restoring security through other sources (Abeyta, Routledge,

Roylance, Wildschut, & Sedikides, 2015; Keefer, Landau, Rothschild, & Sullivan, 2012). In other words, the theory states that insecure attachments mediate the links between interpersonal problems and maladjustment or compensatory responses. The attachment theory has been verified by other empirical studies. For example, Bifulco et al. found that insecure attachments mediate the links between childhood dysfunctional interpersonal style and vulnerability to affective disorders (Bifulco et al., 2006); Sandberg et al. determined that attachment anxiety mediates the links between interpersonal trauma and posttraumatic symptomatology (Sandberg, Suess, & Heaton, 2010); finally, Keefer et al. (2012) found that people paired with unreliable close others reported higher psychological insecurity (or attachment anxiety) that led to increased object attachment (a compensatory response).

Until now, the mediating role of attachment anxiety in the link between shyness and mobile phone addiction has yet to be explored, and few studies have examined the link between attachment anxiety and shyness or mobile phone addiction. Shyness is typically linked with inadequate social skills and is characteristically associated with interpersonal disturbances and dysfunction (Goldberg & Schmidt, 2001; Liao, Zhong, Wang, & Tang, 2016), and mobile phone addiction may be regarded as a result of common externalizing behavior of shy individuals. We therefore propose that attachment anxiety may mediate the link between shyness and mobile phone addiction, especially since some studies have provided indirect evidence for such a mediating role. A significant negative correlation was demonstrated between attachment anxiety and self-esteem (Li & Kato, 2006), and shy individuals were found to often exhibit lower self-esteem (Zhao, Feng, & Wang, 2012). Thus, shyness may be positively associated with attachment anxiety. Other studies indicated that attachment anxiety can be used to predict social anxiety (Li & Kato, 2006), and that social anxiety can further exacerbate mobile phone addiction (Darcin, Kose, Noyan, Nurmedov, & Yılmaz, 2016; Ha, Chin, & Park, 2008; Whiteside & Lynam, 2001). These previous findings indicate that attachment anxiety is positively associated with mobile phone addiction. We therefore propose the following hypothesis:

Hypothesis 2. Shyness is positively correlated with attachment anxiety, which in turn is positively correlated with mobile phone addiction. In other words, attachment anxiety mediates the link between shyness and mobile phone addiction.

1.2. Mediating role of self-control

Self-control is the ability to regulate behavior to fulfill personal values and meet social expectations. According to the limited resource model of self-control (Muraven & Baumeister, 2000), successful self-control requires mental energy and cognitive resources that are both limited. Thus, resource-consuming activities such as emotional control and regulating impulsivity may lead to failures in self-control that in turn results in problematic behaviors (Luczynski & Hanley, 2013). In other words, self-control may mediate the link between psychological or emotional factors and problematic behaviors, as previously indicated by several empirical studies. For instance, Zhu et al. investigated 594 Chinese high school students and found that self-control mediated the links between negative emotions and emotional eating (Zhu, Luo, Cai, Li, & Liu, 2014). Likewise, Mei et al. found that, among Chinese adolescents, both subjective well-being and self-esteem are negatively associated with Internet addiction via the mediating effect of self-control (Mei, Chai, & Guo, 2015). These findings consistently show that shyness is associated with low self-esteem and negative emotions such as anger and loneliness (Bak, 2016; Zhao et al., 2013), with mobile phone addiction identified as an emerging addiction.

Indirect evidence also indicated that self-control may appear to mediate the link between shyness and mobile phone addiction.

Negative emotions induced by shyness, such as depression (Alfano et al., 1994; Romney & Bynner, 1997), may result in reduced levels of self-control as negative feelings may cause individuals to focus on their emotional state (Sinha, 2009; Ward & Mann, 2000). Empirical research verified that depression is a significant predictor of low self-control (Özdemir, Kuzucu, & Ak, 2014). Thus, shyness may be negatively related to self-control. Self-control can thus be regarded as a means of inhibiting or triggering certain behaviors, and is often associated with suppressing belligerence, resisting temptation, and performing adaptive actions (Kopp, 1982). Self-control is also a crucial predictor of problematic and addictive behaviors among individuals (Xi, Guo, & Chi, 2007; Yu, 2006). Baumeister (2003) found that a lower level of self-control can lead to addictive behavior. Previous studies also provided evidence that self-control influences Internet addiction (Li, Dang, Zhang, Zhang, & Guo, 2014; Park, Park, Shin, Li, Rolfe, & Yoo et al., 2016). For instance, Kim et al. found that self-control was negatively associated with online gaming (Kim, Namkoong, Ku, & Kim, 2008). Mehroof and Griffiths (2010) tested the effects of personality traits on addiction to Internet gambling and reported a negative association between self-control and addiction to Internet gambling addiction. Furthermore, modern mobile phones are portable Internet devices and therefore ideal for Internet addicts. Since empirical studies indicated that the degree of self-control can significantly predict mobile phone addiction (e.g., Lee & Park, 2014), we therefore propose the following hypothesis:

Hypothesis 3. Shyness is negatively correlated with self-control, which in turn is negatively correlated with mobile phone addiction. In other words, self-control mediates the link between shyness and mobile phone addiction.

1.3. Multiple mediating effects of attachment anxiety and self-control

After literature review, we proposed that attachment anxiety and self-control play mediating roles for the link between shyness and mobile phone addiction. To yield further insights in the exact association between shyness and mobile phone addiction among Chinese college students, this study adopted an integrated multiple mediation model capable of simultaneously examining multiple influencing mechanisms of shyness on mobile phone addiction (Hayes, 2013). Recent studies have adopted the multiple mediation model to explore the formation mechanisms of consequent variables, making the model a crucial tool for improving the accuracy and applicability of theories (Ahadzadeh, Sharif, & Ong, 2017; Jia et al., 2017).

Despite the scarcity of evidence that two mediating factors can work together, some empirical studies indirectly suggested the presence of for such mechanisms. The multiple mediation model developed by Hayes (2013) showed that two mediators may work together through parallel, sequential, or mixed mediation. Under the parallel mediation model, both self-control and attachment anxiety, which are respectively a cognitive factor and an affective factor, could explain Internet addiction among students (Eichenberg, Schott, Decker, & Sindelar, 2017; Khosroshahi & Nosrat Abad, 2012; Özdemir et al., 2014), and essentially similar explanations could be provided for mobile phone addiction (Pedrero Pérez et al., 2012).

Under the sequential mediation model, attachment anxiety and self-control exert a sequential mediating effect on the link between shyness and mobile phone addiction, with shyness first giving rise to higher attachment anxiety, which in turn lowers self-control, allowing shyness to be treated as a predictor for mobile phone addiction. Some studies provided indirect evidence for this sequential mediation model. Rowe and Carnelley (2003) found that people with secure attachments could better modulate their affective responses to various stimuli, while Blalock et al. found that securely attached people are more focused upon self-improvement (Dan, Franzese, Machell, & Strauman, 2015). Tangney et al. also found significant associations between attachment styles and self-control. Specifically, the research found positive associations between secure attachment styles and self-control as well as negative associations between two insecure attachment styles (such as avoidant and anxiety) and self-control (Tangney, Baumeister, & Boone, 2004). Since these previous studies suggest a negative correlation between attachment anxiety and self-control, we therefore propose the following hypothesis:

Hypothesis 4. Attachment anxiety is negatively correlated with self-control. Thus, the association between shyness and mobile phone addiction is sequentially mediated by attachment anxiety and self-control.

Attachment anxiety and self-control may work together in a mixed mediation model involving both parallel and sequential mediating effects. In other words, attachment anxiety and self-control exert parallel and sequential mediation effects on the link between shyness and mobile phone addiction (Liu & Ling, 2009). A multiple mediation model (Fig. 2) was established for this study in order to test all possible mechanisms of these two mediators.

2. Methods

2.1. Participants

An anonymous, self-report questionnaire was distributed to a cluster random sample of 543 Chinese college students (222 male and 321 female) who volunteered and gave informed consent and were between 17 and 22 years of age (M = 19.85 years, SD = 0.999 years). Each of the students owned and used a mobile phone, and completed all questionnaire items independently in approximately 15 min.

2.2. Measurements

2.2.1. Revised Henderson undergraduate shyness scale

The revised Henderson undergraduate shyness scale (RHUSS), which is based upon the Henderson and Zimbardo shyness scale (Henderson & Zimbardo, 2002), was designed specifically for Chinese participants by Wang and demonstrated high reliability and validity in a Chinese adolescent sample study (Wang, Wang, Han, Gong, & Gao, 2009). The RHUSS consists of 17 items and measures four aspects of college student shyness: (1) need for approval, (2) self-accusation, (3) fear of refusal, and (4) inhibition of self-expression. The RHUSS uses a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Responses of all 17 items were summed to obtain the RHUSS score, with higher scores indicating higher levels of shyness. In this study, the second-order CFA model generated a very good fit, with $\chi^2/df = 3.648$, p < 0.001, RMSEA = 0.070, GFI = 0.911, AGFI = 0.882, IFI = 0.875, CFI = 0.874, and PGFI = 0.685, and both the absolute and value-added adaptation indexes were within the acceptable range. The Cronbach's alpha coefficient for the RHUSS was 0.866.

2.2.2. Mobile phone addiction index

Leung's Mobile Phone Addiction Index (MPAI; Leung, 2008) was found to provide satisfactory reliability and validity in a Chinese

adolescent sample study (Liu & Wang, 2011). The MPAI questionnaire consists of 17 items and assesses four aspects of mobile phone addiction: (1) control craving, (2) anxiety and feeling lost, (3) withdrawal and escape, and (4) productivity loss. The MPAI uses a five-point Likert scale ranging from 1 (completely disagree) to 5 (completely agree). Responses across all 17 items were summed to obtain the MPAI score, with higher scores indicating higher levels of mobile phone addiction. In this study, the second-order CFA model generated a very good fit, with χ^2/df = 2.916, p < 0.001, RMSEA = 0.059, GFI = 0.935, AGFI = 0.911, IFI = 0.937, CFI = 0.936, and PGFI = 0.684, and both the absolute and value-added adaptation indexes were within the acceptable range. The Cronbach's alpha coefficient for the MPAI was 0.864.

2.2.3. Experiences in close relationships inventory

The Chinese version of Brennan's Experiences in Close Relationships Inventory (ECR; Brennan, Clark, & Shaver, 1998) used in this study was developed by Li and Kato and demonstrated high reliability and validity in a Chinese adolescent sample study (Li & Kato, 2006). The ECR consists of 36 items, the first half of the items assesses attachment avoidance while the second half assesses attachment anxiety. This study only summed the second half of 18 items to assess attachment anxiety, with higher scores indicating higher levels of attachment anxiety that includes fear and anxiety of abandonment by an attachment figure. In this study, the Cronbach's alpha coefficient for the attachment anxiety dimension of ECR was 0.893.

2.2.4. Self-control scale for Chinese college students

The self-control scale for Chinese college students (SCS) developed by Tan and Guo (2008) was based upon Tangney's Self-Control Scale (Tangney et al., 2004) and demonstrated high reliability and validity in a Chinese adolescent sample (Tan & Guo, 2008). The SCS consists of 19 items and measures five aspects of self-control abilities: (1) deliberate and non-impulsive action, (2) healthy habits, (3) resistance to temptation, (4) work ethic, and (5) moderation in seeking diversions. The questionnaire uses a five-point Likert scale ranging from 1 (completely disagree) to 5 (completely agree). Responses across the 19 items were summed to obtain the SCS score, with higher scores indicating higher capacity for self-control. In this study, the second-order CFA model generated a very good fit, with χ^2/df = 2.655, p < 0.001, RMSEA = 0.055, GFI = 0.934, AGFI = 0.909, IFI = 0.912, CFI = 0.911, and PGFI = 0.678, and both the absolute and value-added adaptation indexes were in the acceptable range. The Cronbach's alpha coefficient for the SCS was 0.845.

2.3. Statistical analyses

All data collected in this study were recorded on a computer and processed using SPSS 18.0. Data processing was carried out in four steps according to recent literature on multiple mediation analyses (Jia et al., 2017). First, a factor analysis was used to conduct a common variance analysis for testing common method biases. Secondly, scores from the four questionnaires were analyzed using descriptive statistics and correlation analysis. The third step was to use the PROCESS macro for SPSS (Model 4) developed by Hayes (2013) to evaluate the mediation effects of self-control and attachment anxiety. Finally, Model 6 of the PROCESS macro (Hayes, 2013) was used to evaluate a multiple mediation model for the roles of self-control and attachment anxiety in the link between shyness and mobile phone addiction.

3. Results

3.1. Common method biases

Common variance analysis was applied to the four questionnaires through factor analysis. The chi-square statistic of Bartlett's test of sphericity was significant. After principal component analysis, 17 eigenvalues greater than 1 were extracted. The first factor to explain the variance was 18.099%, which was less than the 40% required by the critical standard (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), demonstrating that the questionnaires used in the current study had no significant issue with common method biases.

3.2. Descriptive statistics and correlation analysis

Descriptive statistics and correlation matrix of shyness, mobile phone addiction, self-control, and attachment anxiety are provided in Table 1. Results of bivariate correlation analysis showed that shyness, attachment anxiety, and mobile phone addiction were significantly and positively correlated with each other (p < 0.001) and were significantly and negatively correlated with self-control (p < 0.001).

3.3. Mediating effect of attachment anxiety

The PROCESS macro for SPSS (Model 4) was used to test Hypotheses 1 and 2. Fig. 1 shows the total effect of shyness on mobile phone addiction (total effect = 0.38, 95% CI = 0.30–0.45) and supports Hypothesis 1 as results show that shyness was positively associated with attachment anxiety (b = 0.47, p < 0.001), which in turn was positively related to mobile phone addiction (b = 0.26, p < 0.001). Residual direct effect was also significant (b = 0.25, p < 0.001). Attachment anxiety therefore played a partial mediating role in the link between shyness and mobile phone addiction (indirect effect = 0.12, 95% CI = 0.08–0.17), supporting Hypothesis 2. This model accounted for 19.4% of the variance in mobile phone addiction among Chinese college students.

3.4. Mediating effect of self-control

Hypothesis 3 was also tested using the PROCESS macro for SPSS (Model 4). Results show that shyness was negatively associated with self-control (b = −0.38, p < 0.001), and self-control was negatively associated with mobile phone addiction (b = −0.45, p < 0.001). Residual direct effect was also significant (b = 0.20, p < 0.001). Self-control therefore played a partial mediating role in the link between shyness and mobile phone addiction (indirect effect = 0.17, 95% CI = 0.12–0.22), supporting Hypothesis 3. This model accounted for 31.6% of the variance in mobile phone addiction among Chinese college students.

3.5. Multiple mediation model

The PROCESS macro for SPSS (Model 6) was used to test the multiple mediation model. Table 2 and Fig. 1 show that all the pathways were significant (p < 0.001). Attachment anxiety and self-control mediated the relation between shyness and mobile phone addiction in a parallel manner (attachment anxiety: indirect effect = 0.12, 95% CI = 0.07–0.17; self-control: indirect effect = 0.08, 95% CI = 0.04–0.12). The pathway of "shyness → attachment anxiety → self-control → mobile phone addiction" was therefore significant (indirect effect = 0.04, 95% CI = 0.02–0.06) and supported Hypothesis 4 as the pathway indicated that a higher level of shyness was associated with higher

Table 1
Descriptive statistics and correlation matrix of all variables.

Variables	M	SD	1	2	3	4
1 Shyness	50.14	10.12	1			
2 Attachment anxiety	3.70	0.96	0.467[***]	1		
3 Self-control	60.05	10.07	−0.378[***]	−0.339[***]	1	
4 Mobile phone addiction	50.38	11.02	0.375[***]	0.380[***]	−0.529[***]	1

Note. N = 543.
[***]Correlation is significant at the 0.001 level (2-tailed).
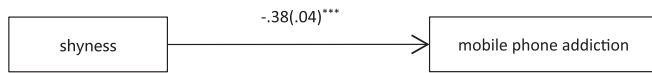
Fig. 1. Total effect model. Path values are the path coefficients (standard errors). [***]Correlation is significant at the 0.001 level (2-tailed).
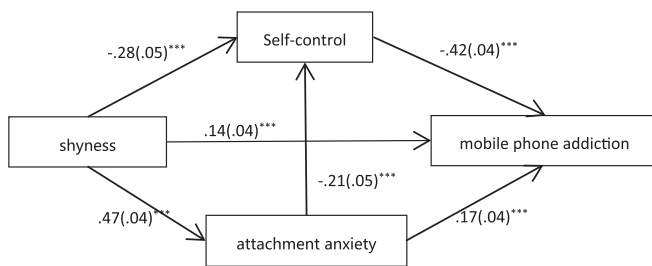

Fig. 2. Multiple mediation model. Path values are the path coefficients (standard errors). [***]Correlation is significant at the 0.001 level (2-tailed).

attachment anxiety (b = 0.47, p < 0.001), lower self-control (b = −0.21, p < 0.001), and mobile phone addiction (b = −0.42, p < 0.001). Residual direct effect was also significant (b = 0.14, p < 0.001). Self-control and attachment anxiety therefore played only partial mediating roles in the link between shyness and mobile phone addiction. This multiple mediation model accounted for a significant amount of variance in mobile phone addiction among Chinese college students (R^2 = 0.338).

4. Discussion

Correlation analysis revealed significant relationships between shyness, mobile phone addiction, self-control, and attachment

anxiety. This result is consistent with the theoretical assumptions of this study. The total effect model showed that shyness is a significant predictor of mobile phone addiction. In other words, a high degree of personal shyness correlates with a high level of mobile phone addiction, thereby supporting Hypothesis 1. This result is also consistent with the results of previous investigations conducted in Hong Kong and Turkey (Bian & Leung, 2015; Öztunç, 2013) as well as other research on Internet addiction (Ayas, 2012; Chak & Leung, 2004; Eldeleklioglu & Vural-Batik, 2013). This consistency confirms that mobile phone addiction is essentially similar to Internet addiction (Pedrero Pérez et al., 2012). Since the mechanisms by which shyness affect mobile phone addiction were unclear, this study explored the mediating roles of attachment anxiety and self-control as well as their combined effects by referencing the attachment theory (Bowlby, 1969) and the limited resource model of self-control (Muraven & Baumeister, 2000).

The multiple mediation model showed that attachment anxiety and self-control have parallel partial mediating roles for the link between shyness and mobile phone addiction, thereby supporting Hypotheses 2 and 3, respectively. Attachment anxiety and self-control also sequentially mediate the link between shyness and mobile phone addiction, supporting Hypothesis 4.

4.1. Mediating role of attachment anxiety

Results are consistent with Hypothesis 2, with shyness positively associated with attachment anxiety, which in turn was positively associated with mobile phone addiction. In other words, attachment anxiety partially mediated the link between shyness and mobile phone addiction. In the first part of the mediation process of shyness → attachment anxiety, the results of this study supported the findings of other related studies and are consistent with the conclusion reached by Rowsell and Coplan (2013) who found negative relationships between shyness and relationship

Table 2
Testing the pathways of the multiple mediation model.

Path	Standardized path coefficient	95% confidence interval	
		Lower	Upper
a. Total effect model			
shyness → mobile phone addiction	0.38	0.30	0.45
b. Multiple mediation mode			
Direct effects			
shyness → mobile phone addiction	0.14[***]	0.06	0.21
shyness → self-control	−0.28[***]	−0.37	−0.19
self-control → mobile phone addiction	−0.42[***]	−0.50	−0.34
shyness → attachment anxiety	0.47[***]	0.39	0.54
attachment anxiety → mobile phone addiction	0.17[***]	0.09	0.25
attachment anxiety → self-control	−0.21[***]	−0.30	−0.12
Indirect effects			
shyness → self-control → mobile phone addiction	0.12	0.07	0.17
shyness → attachment anxiety → mobile phone addiction	0.08	0.04	0.12
shyness → attachment anxiety → self-control → mobile phone addiction	0.04	0.02	0.06

Note. N = 543.
[***]Correlation is significant at the 0.001 level (2-tailed).

quality as well as well-being and a positive relationship between shyness and insecure romantic attachments of avoidance and anxiety. Previous research verified that shy individuals tend to have low self-esteem (Chan, 2012), and that low self-esteem causes severe attachment anxiety (Li & Kato, 2006). A possible explanation is that shy individuals with low self-esteem often view themselves negatively and fear being abandoned, and tend to become anxious, concerned, or even fearful when alone.

For the second part of the mediation process, namely attachment anxiety → mobile phone addiction, results of this study also support the conclusions of previous research. Shy individuals tend to exhibit severe attachment anxiety, which itself is often accompanied by social anxiety (Li & Kato, 2006), hampering participation in real-life social activities and worsening the sense of loneliness (Caplan, 2007; Lim, Rodebaugh, Zyphur, & Gleeson, 2016; Sarıçam, Tarhan, & Soyuçok, 2015). As a result, some individuals become obsessed with mobile phone use to eliminate experiences of loneliness (Bhardwaj & Ashok, 2015; Bian & Leung, 2015; Darcin et al., 2016; Liu & Wang, 2011; Öztunç, 2013), resulting in mobile phone addiction. This result is consistent with previous studies that explored the relationship between the use of communication technology or equipment and attachment styles. For instance, Morey et al. confirmed that frequent use of social networking sites may be especially important for individuals with higher attachment anxiety as the sites offer a sense of greater intimacy and support (Morey, Gentzler, Creasy, Oberhauser, & Westerman, 2013). Likewise, Oldmeadow, Quinn, and Kowert (2013) found that adults with higher attachment anxiety tend to use Facebook more frequently, especially when they experience negative emotions, and ascribe greater importance to other Facebook users' perceptions of them. Moreover, Kowert and Oldmeadow (2015) indicated that anxiously attached people used smart phone functions more frequently and have higher needs for contact scores. However, no significant main effect for attachment avoidance was identified in this research, suggesting that attachment anxiety, rather than attachment avoidance, could be the explanatory mechanism for the effects of shyness on mobile phone addiction.

In addition to the individual links, results of overall mediation are noteworthy. The results of the present study showed that attachment anxiety partially mediates the link between shyness and mobile phone addiction, an observation that is consistent with the attachment theory (Bowlby, 1969) that suggested interpersonal problems such as distrust could present an intense threat to secure attachment, thereby triggering problematic behaviors (Abeyta et al., 2015; Keefer et al., 2012). Shyness, as a form of inadequacy in social skills (Wang et al., 2009), could indicate vulnerability to interpersonal disturbances (Goldberg & Schmidt, 2001; Liao et al., 2016). The present study first demonstrated that attachment anxiety can be used to explain the link between shyness and mobile phone addiction from an emotional perspective. Mobile phone addiction can therefore be regarded as a compensatory response for relieving attachment anxiety (Kardefelt-Winther, 2014) caused by shyness.

4.2. Mediating role of self-control

In line with Hypothesis 3, shyness was negatively associated with self-control, which in turn was negatively associated with mobile phone addiction. In other words, self-control partially mediates the link between shyness and mobile phone addiction. Results of this study for the first part of the mediation process, namely shyness → self-control, indirectly support related investigations. Shy individuals are typically introverted and nervous, which give rise to a poor sense of security. Such individuals are therefore prone

to adopt chronic and negative coping strategies such as withdrawal, escapism, and self-accusation that lower self-control levels (Han et al., 2016). This observation is consistent with the view of Feng, Shaw, and Moilanen (2011) who found that shyness is negatively associated with the strategies of active distraction regulation and passive/dependent regulation that are comparable to self-control (Tice & Bratslavsky, 2000), and is also in line with several investigations carried out in China that identified negative correlations between shyness and self-control (Gao, Ren, Xu, & Han, 2016; Han et al., 2016; Han et al., 2016). Results of the present study on the second part of the mediation process, namely self-control → mobile phone addiction, also directly and indirectly corroborate with results of previous studies that explored the link between self-control and Internet addiction (e.g., Li et al., 2014; Park et al., 2016; Özdemir et al., 2014). Furthermore, another investigation involving students in 20 elementary schools in South Korea found that individuals with lower levels of self-control were more likely to be addicted to mobile phones (Jeong, Kim, Yum, & Hwang, 2016). Possible explanations proposed that low self-control levels can lead to various types of problems and addictions (Dvorak, Simons, & Wray, 2011; Krueger, Caspi, Moffitt, White, & Stouthamer-Loeber, 1996; Özdemir et al., 2014), including mobile phone addiction (Lee & Park, 2014). One study suggested impulsivity as a predictor of mobile phone addiction (Billieux, Van der Linden, & Rochat, 2008). Therefore, low levels of self-control may correlate with high levels of mobile phone addiction.

Results of the analysis of overall mediation are also noteworthy. Self-control partially mediated the link between shyness and mobile phone addiction, supporting the limited resource model of self-control (Muraven & Baumeister, 2000). Under the limited resource model, resource-consuming activities such as emotional control and regulating impulsivity may lead to reduced self-control, which in turn results in problematic behaviors (Luczynski & Hanley, 2013). Although the mediating role of self-control in the link between negative psychological factors and problematic behaviors was explored in relevant investigations (Mei et al., 2015; Zhu et al., 2014), the current study is the first to use this theory to explain how shyness affects mobile phone addiction among Chinese college students. The present findings are in line with Feng's conclusion that active distraction regulation and emotion regulation mediate the link between shyness and internalizing symptoms (Feng et al., 2011). The current study also demonstrated that self-control can be used to explain how shyness may be linked to mobile phone addiction from a cognitive perspective. Mobile phone addiction can therefore be regarded, according to the two-stage model of self-control, as a consequence of unsuccessful self-control strategies (Myrseth & Fishbach, 2009).

4.3. Sequential mediating effect of attachment anxiety and self-control

Findings of the current study revealed that attachment anxiety and self-control mediate the link between shyness and mobile phone addition under both parallel and sequential models. In other words, there is a significant relationship between shyness and attachment anxiety and self-control, and that both attachment anxiety and self-control are significantly associated with mobile phone addiction. In addition, attachment anxiety and self-control sequentially mediated the impact of shyness on mobile phone addiction, thereby supporting Hypothesis 4. These findings revealed that shy individuals often experience high levels of attachment anxiety that consumed cognitive and attentional resources, which then reduced levels of self-control (Muraven & Baumeister, 2000) and ultimately increased the risk of mobile

phone addiction among Chinese college students (Jeong et al., 2016). The multiple mediation model therefore supports important explanatory mechanisms, namely the two consequences of shyness of higher attachment anxiety (affective element) and poorer self-control (cognitive element), involved in the impact of shyness on mobile phone addiction, wherein the affective element of attachment anxiety is inherently related to the cognitive element of self-control.

Despite limited research on the sequential mediating effect of attachment anxiety and self-control in the link between shyness and mobile phone addiction, findings of such research indirectly supported the results of analysis performed in the present study. The sequential mediation model suggests that attachment anxiety is negatively associated with self-control, which is consistent with the results of previous studies (Tangney et al., 2004). A possible explanation is that shy individuals with attachment anxiety are less able to modulate their affective responses to various stimuli (Rowe & Carnelley, 2003), and that anxiously attached shy individuals are immersed in negative emotions, losing the energy that could be otherwise used to advance and better themselves (Dan et al., 2015). Both eventualities can damage the capacity for self-control, further increasing the risk of mobile phone addiction (Jeong et al., 2016).

4.4. Practical implications and future directions

Shy individuals are more susceptible to mobile phone addiction due to their severe attachment anxiety and weaker self-control. To help such individuals overcome their dependence on mobile phones, two types of intervention should be performed, namely strengthening self-control and mitigating attachment anxiety. Self-control training can improve self-awareness and self-monitoring (Alberts, Martijn, & Vries, 2011; Wan & Sternthal, 2008) and effectively strengthen self-control. Trainers may also use cognitive restructuring, social skills training, relaxation therapy, and family counseling to transform irrational and negative beliefs held by shy individuals, instill trust, and mitigate attachment anxiety.

In general, our outcomes were consistent with those of previous studies and fully verified their conclusions, reinforcing the authenticity and credibility of the present study. Nevertheless, the present study had several limitations. Firstly, under the multiple mediation model, attachment anxiety and self-control only partially mediate the link between shyness and mobile phone addiction, suggesting the presence of other mediators. To intervene and prevent mobile phone addiction in shy individuals, future studies should explore other possible mediators to explain the mechanisms involved in the impact of shyness on mobile phone addiction. Secondly, this study was performed in a Chinese cultural setting, and cross-cultural applicability of the conclusions must be properly verified. Finally, only young adults were sampled in the present study. Although a sound explanation was provided for the reasons behind the tendency of shy teenagers to become addicted to mobile phone usage, care should be exercised when extrapolating these conclusions to describe the same phenomena in other demographics such as middle and later adulthood.

5. Conclusion

This study contributes substantially to the understanding of the roles of self-control and attachment anxiety in preventing mobile phone addiction in shy individuals, and is especially important given the lack of empirical research exploring the relationship between shyness and mobile phone addiction. Results of this study provide evidence that self-control and attachment anxiety exert multiple mediating effects on the impact of shyness on mobile phone addiction. In other words, self-control and attachment anxiety mediate the link between shyness and mobile phone in parallel as well as sequential manners, and reveals that strengthening self-control and mitigating attachment anxiety may be effective in helping shy individuals recover from mobile phone addiction.

Acknowledgments

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Associations between personality, sports participation and athletic success. A comparison of Big Five in sporting and non-sporting adults

Patrizia Steca, Dario Baretta*, Andrea Greco, Marco D'Addario, Dario Monzani

Department of Psychology, University of Milano-Bicocca, Italy

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ABSTRACT

The present study investigates whether the Big Five personality traits are different among diverse sports populations. A sample of 881 male athletes and non-athletes completed a self-report questionnaire measuring their personality traits. The Exploratory Structure Equation Modeling (ESEM) approach is adopted to test measurement invariance and mean differences among groups. The results indicate that athletes who had experienced the most success in their sport scored higher than non-athletes in each personality dimension of the Big Five, with the exception of openness, while less successful athletes scored higher than non-athletes only in extraversion and agreeableness. The more successful athletes showed higher agreeableness, conscientiousness, and emotional stability than the less successful athletes. Individual-sport athletes were found to be more energetic and open than team-sport athletes. The current findings help clarify the relationships between personality traits, sports participation and athletic success.

1. Introduction

The study of personality in sports psychology is primarily focused on investigating the associations between personality, participation, and athletic achievement (Aidman & Schofield, 2004; Allen, Greenlees, & Jones, 2013; Allen & Laborde, 2014).

Previous research is either framed in the theory of the Big Five personality traits (Goldberg, 1993; McCrae & Costa, 1996) or Eysenck personality theory (Eysenck, 1970). The Big Five theory presents a model in which personality is organized into five factors: extraversion, agreeableness, conscientiousness, emotional stability and openness.[1] Meanwhile, the Eysenck personality theory states that personality is made up of three main factors: extraversion, neuroticism – corresponding to extraversion and emotional stability in the Big Five theory (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993) – and psychoticism.

Although associations between personality traits and natural variations in physical activity have been consistently shown – for example, between participation in regular exercise and extraversion, conscientiousness, emotional stability, and openness (Rhodes & Smith, 2006; Wilson & Dishman, 2015) – the association between personality and participation in organized sports has received modest attention and remains less clear. Taken together, previous findings referring to the

context of organized sports have suggested that athletes score higher on extraversion (Egloff & Gruhn, 1996; Paunonen, 2003), conscientiousness (Kajtna, Tušak, Barić, & Burnik, 2004; Malinauskas, Dumciene, Mamkus, & Venckunas, 2014), emotional stability (Egan & Stelmack, 2003; Kajtna et al., 2004; Mckelvie, Lemieux, & Stout, 2003), and openness (Kajtna et al., 2004) than non-athletes. Moreover, further results have suggested that personality traits are also related to the participation in specific types of sports. More specifically, individual-sport athletes demonstrated higher conscientiousness, openness and emotional stability as well as lower levels of extraversion than team-sport athletes (Allen, Greenlees, & Jones, 2011; Eagleton, McKelvie, & De Man, 2007).

In sports psychology, investigation of the association between personality and athletic success is a very attractive issue that permits an understanding of whether and which personality traits coincide with greater levels of success. The association is rather complex, and a variety of motivational and dispositional variables that are correlated with sports performance and success has been investigated (e.g., Baretta, Greco, & Steca, 2017). Athletic success has mainly been operationalized in terms of the competition level at which athletes compete (Allen et al., 2013), and previous results on the Big Five have shown that high-level athletes (e.g., athletes competing at a national or international level) are more agreeable, conscientious, and emotionally

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stable (Allen et al., 2011; Kirkcaldy, 1982) than low-level athletes (e.g., athletes competing at a county or regional level).

Although previous findings evidenced associations among personality and various sporting populations, some critical flaws limit the conclusions that can be drawn from the available research. A first concern regards the sample sizes adopted in previous studies. While research regarding personality and physical activity usually involves hundreds or even thousands of participants per study (Rhodes & Smith, 2006), research on personality and sports participation uses sample sizes that barely exceed 200 participants (Allen et al., 2011; Malinauskas et al., 2014; Paunonen, 2003) and, in the worst cases, can amount to a mere 40 subjects per sports population (Eagleton et al., 2007).

Second, samples involved in previous studies were extremely heterogeneous because various sports were included in each study (Allen et al., 2011; Eagleton et al., 2007). Sports differ from each other in several ways, and each sport has its own specificity and requirements. For instance, sports may differ in terms of pressure (i.e., some sports are performed on multiple trials while other ones are one-shot trials against time) and in terms of intensity and duration (i.e., some sports last few seconds or minutes, while other ones may last hours). This type of heterogeneity affects comparisons between different studies because the sports considered are not equivalent. Thus, it is possible to argue that various results may be due, at least partially, to distinctive features that characterize each sport. An extreme example illustrating the lack of consideration placed on sport specificity involves cases in which the types of sports considered in studies are not even mentioned (Allen et al., 2011; Kirkcaldy, 1982). Another issue regards the operationalization of sports participation; indeed, within the sporting population there may be great variability regarding athletic success and performance that should be taken into account instead of grouping all sport participants in one *sporting* group. These omissions make comparisons among studies difficult and prevent researchers from reaching valid conclusions about the relationship between traits and sports practice. More specifically, this issue is reflected by a lack of effect size synthesis referring to the difference in personality traits (Allen et al., 2013). To manage these issues, it is necessary to i) accumulate a more substantial body of literature reporting effect sizes and ii) precisely define the outcome variables (e.g., sport performance, success, training time) and find an agreement on how to operationalize them. In this direction, a further aspect that deserves consideration is the adoption of statistical methodologies that take into account the latent psychometric constructs and subsequent systematic tests of measurement invariance (Meredith, 1993). Specifically, a comparison between groups as is usually performed (i.e., *t*-test, ANOVA) requires prerequisite assumptions of invariant measurement operations across the groups being compared (Vandenberg & Lance, 2000). If such invariance across sports populations is not achieved, it is not possible to draw scientific conclusions as to how the group differences may be associated with personality dimensions. To test invariance, in recent years, a few studies (Marsh et al., 2010; Marsh, Morin, Parker, & Kaur, 2014) have noted that the classic Confirmatory Factor Analysis (CFA) is inappropriate for testing structure and invariance across groups of Big Five measures. This suggestion is in line with the position argued by Big Five researchers for years (e.g., Church & Burke, 1994; McCrae, Zonderman, Costa, Bond, & Paunonen, 1996) and with previous unsuccessful attempts to test Big Five measure structures through CFA (e.g., Cooper, Smillie, & Corr, 2010; Vassend & Skrondal, 1997). To overcome these limits, recent research has started to apply Exploratory Structure Equation Modeling (ESEM; Asparouhov & Muthén, 2009) to Big Five data (Chiorri, Marsh, Ubbiali, & Donati, 2016; Marsh et al., 2010;

Table 1
Sample size information for each sports group and subgroup.

	Individual sport (*n* = 135)	Team sport (*n* = 620)	
	Track and field (*n* = 135)	Soccer (*n* = 230)	Basketball (*n* = 390)
Low-level athletes (*n* = 558)	73	179	306
High-level athletes (*n* = 197)	62	51	84

Marsh, Nagengast, & Morin, 2013). The advantages of the ESEM approach rely on exploiting the advanced statistical methods typically associated with CFAs and SEMs (e.g., testing for measurement invariance across groups, incorporate latent factors into subsequent analysis) without relying on excessively restrictive CFA constraints (i.e., secondary loadings fixed to zero). For these reasons, the ESEM approach has been proposed to be particularly suitable for testing the dimensionality and measurement invariance for Big Five measures (Marsh et al., 2014).

1.1. The present study

The purpose of the present study was to explore the relationship among Big Five personality traits and involvement and success in organized sports, a context that has received little attention in the large array of physical activity. The present study aims to overcome most of the limitations of previous research to derive clearer and more valid conclusions on the associations between personality and sports participation. In particular, as claimed by Allen et al. (2013), the present research provides detailed information about the effect size related to population-based differences. Moreover, in line with recent suggestions (Marsh et al., 2010), the ESEM approach has been adopted to test measurement invariance and mean differences across the groups considered.

Based on the most consistent results from available literature, the following hypotheses were developed:

- It was expected that non-athletes would have lower levels of extraversion, conscientiousness, and emotional stability than athletes.
- High-level athletes were expected to be more agreeable, conscientious, and emotionally stable than low-level athletes.
- It was expected that individual-sport athletes would report more conscientiousness, openness, and emotional stability than team-sport athletes.

2. Material and methods

2.1. Participants

Participants who took part in this study were Italian male athletes (*n* = 755; mean age = 22.62; *SD* = 3.56) and non-athletes (*n* = 126; mean age = 23.78; *SD* = 2.84) aged between 18 and 30. The athletes (see Table 1) competed in individual (track and field; *n* = 135; mean age = 22.07; *SD* = 3.45) or team sports (soccer and basketball; *n* = 620; mean age = 22.74; *SD* = 3.58). Athletes competing at regional levels were categorized as low-level athletes (LLA; *n* = 558; mean age = 22.25; *SD* = 3.42), while those competing at the national

level were categorized as high-level athletes (HLA; $n = 197$; mean age = 23.68; $SD = 3.77$).[2]

2.2. Procedure

2.2.1. Sampling procedures

Athletes were contacted during sporting competitions. They were asked if they would be willing to participate in a study on sports and personality. Participants were also told that all of the questionnaires would be anonymous. Non-athlete sampling was based on the "snowball" method with a ratio of 1:1 (i.e., one participant was asked to find another participant). All participants were provided with an informed consent form and a questionnaire for self-reporting. Both athletes and non-athletes were asked to carefully read and sign the informed consent form, individually complete the measures, and then return them to the researcher responsible for questionnaire administration. The time required for filling the questionnaire was between 3 and 4 min. During the assessment, participants were told that they could ask the researcher regarding any issue, doubt, or incomprehension. Participants received no incentive for their participation.

2.2.2. Measures

Athletes were asked to answer socio-demographic (gender and age) and sports-related (type and category of sport) questions. Non-athletes were asked to report socio-demographic factors (gender and age). Their personality was assessed through a list of 25 adjectives used in a previous study (Barbaranelli, Caprara, Vecchione, & Fraley, 2007). These adjectives (see Appendix) included those most frequently used to describe human personality traits, as well as those most representative of each dimension of the Big Five in the Italian lexicon (Caprara & Perugini, 1994). Furthermore, they overlap considerably with markers used in other languages (Peabody & De Raad, 2002). The list includes five markers for each of the following dimensions: energy, agreeableness, conscientiousness, emotional stability, and openness. Adjectives are rated for how characteristic they are of each target on a 1 (not at all) to 5 (at all) scale. This instrument was chosen because of its brevity, which made it particularly useful when there was only a short time available for questionnaire administration.

2.2.3. Statistical analyses

Analyses were conducted with Mplus 7.3 (Muthén and Muthén, 1998–2012). Preliminary analyses consisted of ESEM on the total group of participants to verify the five-factor structure of the personality measure. A robust maximum likelihood estimator (MLR) and oblique GEOMIN rotation were used.

Measurement invariance over the level of sport success (i.e., non-athletes, LLA, HLA) and type of sport (i.e., individual- and team-sport) was tested adopting the ESEM framework through a 13-nested model taxonomy of invariance tests that integrated factor and measurement invariance traditions (for a more detailed discussion of the invariance models see Marsh et al., 2010; Meredith, 1993). These models vary from the least restrictive model of configural invariance to a model of complete invariance that posits strict invariance, together with the invariance of the latent means and of the factor variance-covariance matrix. In this study, the sequence of measurement invariance was tested comparing the following models from Marsh et al. (2010): model-1 (configural invariance), model-2 (weak measurement invariance), model-5 (strong measurement invariance), model-7 (strict measurement invariance), and model-9 (strict and invariance of the factor variance-covariance matrix). If model-9 invariance is reached,

the variances are equal to 1 in all groups, so that the mean differences are expressed in SD units as a function of the SD of the whole sample.[3] Big Five mean differences are compared by constraining the means of one group at zero and freeing them in the other group(s).

In line with previous studies testing Big Five structure and measurement invariance through ESEM (Chiorri et al., 2016; Marsh et al., 2010; Marsh et al., 2013), the fit indices considered are the root-mean-square error of approximation (RMSEA), Tucker-Lewis index (TLI), and comparative fit index (CFI). For TLI and CFI, values > 0.90 and 0.95 are typically interpreted to reflect acceptable and excellent fit to the data, respectively. For the RMSEA, value of < 0.05 and 0.08 are typically interpreted to reflect a close fit and reasonable fit to the data, respectively (Marsh, Hau, & Wen, 2004). The comparison of fit across the different nested models (i.e., model-1 vs model-2, model-2 vs model-5, model-5 vs model-7, model-7 vs model-9) was based on CFI and TLI comparison. A CFI and TLI diminution of 0.01 or less between a more parsimonious model and the preceding more complex model indicated that the invariance hypothesis should not be rejected (Chen, 2007; Cheung & Rensvold, 2002).

3. Results and discussion

3.1. Results

3.1.1. Total group analyses to verify the five-factor structure of the personality measure

The fit of the total group ESEM was acceptable ($\chi2 = 478$, $df = 185$, $p < 0.001$; CFI = 0.95; TLI = 0.92, RMSEA = 0.04), supporting the five-factor structure underlying the list of 25 adjectives. The internal consistency of the five-factor solution was corroborated by the factor scores determinacy coefficients (see Muthén & Muthén, 1998), which provide a measure of internal factor consistency: coefficients of 0.70 or better indicate stable factors (Tabachnick & Fidell, 1989). In the present study, these coefficients were 0.91 for energy, 0.86 for agreeableness, 0.89 for conscientiousness, 0.89 for emotional stability and 0.92 for openness. Cronbach's alpha coefficients were lower, but still adequate, at 0.79 for energy, 0.68 for agreeableness, 0.73 for conscientiousness, 0.73 for emotional stability and 0.81 for openness (see Appendix for factor loadings and sub-groups reliability information).

3.1.2. Measurement invariance over the level of sport success and type of sport

Table 2 reports the results of measurement invariance analysis across the non-athletes, LLA and HLA groups (i.e., level of sport success) and across the team- and individual-sport groups (i.e., type of sport). As shown, the measurement through the different nested models (i.e., from model-1 to model-9) was achieved for both the level of sport success and type of sport. Comparisons of each of these pairs of the models (i.e., model-1 vs model-2, model-2 vs model-5, model-5 vs model-7, model-7 vs model-9) resulted in an equivalent CFI and TLI (i.e., ΔCFI and ΔTLI < 0.01). The most invariant model (i.e., model 9) provided a satisfactory level of approximate fit to the data, with CFI and TLI > 0.90, and RMSEA < 0.05.

3.1.3. Mean differences

3.1.3.1. Differences in Big Five among non-athletes, LLA, and HLA.
Examining the model in which the means were constrained to 0 in one group (non-athletes) and freely estimated in the other groups (LLA and HLA), it was apparent that LLA displayed significantly higher scores on energy ($d = 1.07$, $p < 0.001$) and agreeableness ($d = 0.36$, $p < 0.01$) than non-athletes, while HLA demonstrated higher levels of energy ($d = 1.17$, $p < 0.001$), agreeableness ($d = 0.58$, $p < 0.001$),

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[2] Sports-specific criteria for being included in the high-level group:
Soccer – participation in leagues: Serie A, Serie B, Serie C;
Basketball – participation in leagues: Serie A, Serie A2, Serie B;
Track and Field – meeting the performance requirements for taking part at the Italian Athletics Championship.

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[3] The standardized difference between means is a measure of the effect size and is equivalent to Cohen's *d*.

Table 2

Summary of the goodness-of-fit statistics for the total group ESEM and measurement invariance over the level of sport success and type of sport.

	$\chi2$	df	CFI	ΔCFI	TLI	ΔTLI	RMSEA
Total group ESEM	478	185	0.951		0.921		0.042
Measurement invariance across level of sport success							
Model-1 (configural invariance)	1028	555	0.923		0.875		0.054
Model-2 (weak measurement invariance)	1124	755	0.923	0.000	0.909	0.034	0.046
Model-5 (strong measurement invariance)	1304	795	0.917	− 0.003	0.906	− 0.003	0.047
Model-7 (strict measurement invariance)	1393	845	0.911	− 0.006	0.905	− 0.001	0.047
Model-9 (strict measurement invariance, factor variance-covariance)	1453	875	0.906	− 0.005	0.903	− 0.002	0.047
Measurement invariance across type of sport							
Model-1 (configural invariance)	723	370	0.934		0.893		0.050
Model-2 (weak measurement invariance)	849	470	0.929	− 0.005	0.910	0.017	0.046
Model-5 (strong measurement invariance)	903	490	0.923	− 0.006	0.906	− 0.004	0.047
Model-7 (strict measurement invariance)	961	515	0.917	− 0.006	0.903	− 0.003	0.048
Model-9 (strict measurement invariance, factor variance-covariance)	984	530	0.915	− 0.002	0.904	0.001	0.048

Note: CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root-mean-square error of approximation.

Table 3

Mean differences as a measure of the effect size with confidence intervals (CI) among non-athletes, low-level athletes and high-level athletes.

	Non-athletes (N = 126)	Low-level athletes (N = 558)		High-level athletes (N = 197)	
	Constrained mean	Mean	95% CI	Mean	95% CI
Energy	0	1.07***	[0.80, 1.33]	1.17***	[0.89, 1.46]
Agreeableness	0	0.36**	[0.10, 0.62]	0.58***	[0.28, 0.87]
Conscientiousness	0	− 0.13	[− 0.40, 0.15]	0.32*	[0.01, 0.62]
Emotional stability	0	0.03	[− 0.23, 0.28]	0.31*	[0.03, 0.59]
Openness	0	− 0.06	[− 0.27, 0.15]	0.05	[− 0.19, 0.29]

	Non-athletes (N = 126)		Low-level athletes (N = 558)	High-level athletes (N = 197)	
	Mean	95% CI	Constrained mean	Mean	95% CI
Energy	− 1.07***	[− 1.33, − 0.80]	0	0.11	[− 0.07, 0.28]
Agreeableness	− 0.36**	[− 0.62, − 0.10]	0	0.22*	[0.01, 0.42]
Conscientiousness	0.13	[− 0.15, 0.40]	0	0.44***	[0.25, 0.64]
Emotional stability	− 0.03	[− 0.28, 0.23]	0	0.29**	[0.10, 0.48]
Openness	0.06	[− 0.15, 0.27]	0	0.11	[− 0.07, 0.29]

Note: Mean differences between non-athletes and low-level athletes and between non-athletes and high-level athletes are expressed as the number of *SD* units (equal to Cohen's *d*) and are analyzed by constraining the means of non-athletes at zero. Mean differences between low-level athletes and high-level athletes are expressed in number of *SD* units (equal to Cohen's *d*) and are analyzed by constraining the means of low-level athletes at zero.

* < 0.05 (two-tailed).
** < 0.01 (two-tailed).
*** < 0.001 (two-tailed).

Table 4

Mean differences as a measure of the effect size with confidence intervals (CI) between team- and individual-sport athletes.

	Team-sport athletes (N = 620)	Individual-sport athletes (N = 135)	
	Constrained mean	Mean	95% CI
Energy	0	0.38**	[0.14, 0.61]
Agreeableness	0	− 0.08	[− 0.32, 0.16]
Conscientiousness	0	0.21	[− 0.04, 0.46]
Emotional stability	0	0.06	[− 0.18, 0.30]
Openness	0	0.36**	[0.14, 0.58]

Note: Mean differences between team- and individual-sport athletes are expressed as the number of *SD* units (equal to Cohen's *d*) and are analyzed by constraining the means of team-sport athletes at zero.

* < 0.05 (two-tailed).
** < 0.01 (two-tailed).
*** < 0.001 (two-tailed).

emotional stability ($d = 0.31$, $p < 0.05$), and conscientiousness ($d = 0.32$, $p < 0.05$) than non-athletes. When the means were constrained to 0 in the LLA group and freely estimated in the other groups, it was possible to examine the differences between LLA and HLA. The results suggested that HLA scored higher in agreeableness ($d = 0.22$, $p < 0.05$), emotional stability ($d = 0.29$, $p < 0.01$), and conscientiousness ($d = 0.44$, $p < 0.001$) than LLA (see Table 3).

3.1.3.2. Differences in Big Five traits between individual- and team sport athletes. To analyze the mean differences between individual- and team-sport athletes, the means were constrained to 0 in team-sport group and freely estimated in the individual-sport group. The results suggested that individual-sport athletes are more energetic ($d = 0.38$, $p < 0.01$) and open-minded ($d = 0.36$, $p < 0.01$) than team-sport athletes (see Table 4).

3.2. Discussion

The present study sought to outline personality differences among various sports populations: non-athletes and athletes, lower success and higher success athletes, and team-sport and individual-sport athletes. The first notable finding was that high-level athletes scored higher than non-athletes in each personality dimension of the Big Five, with the exception of openness, while low-level athletes scored higher than non-athletes only in extraversion and agreeableness. A large to very large effect size indicated that energy is the most important factor differentiating athletes from non-athletes, but not low-level from high-level athletes, suggesting that the level of energy is associated with participation in organized sport activities rather than with sport success, confirming that sports and physical activity are elective contexts of expression and development of energy features. The small to medium effect size in agreeableness was probably because athletes, by taking part in organized sport activities, attend to a social context that typically facilitates relationships with other sport mates. Conversely, conscientiousness and emotional stability differed only between non-athletes and high-level athletes, pointing out that such factors are more associated with athletic success rather than sports participation. According to most of the previous literature, no differences emerged in terms of openness. Taken together, the first results partially confirmed the first hypothesis, and suggested that different findings in the literature (Egan & Stelmack, 2003; Egloff & Gruhn, 1996; Kajtna et al., 2004; Malinauskas et al., 2014; Mckelvie et al., 2003; Paunonen, 2003) may be because comparisons between athletic and non-athletic populations were usually made without controlling for success within the athletic population.

Concerning the association between personality and sports success, the present results confirmed those of the literature (Allen et al., 2011), indicating that more successful athletes are significantly more agreeable, more conscientious, and more emotionally stable than less successful athletes. Such differences may be related to specific characteristics that typically distinguish sports played at a higher level, such as a higher number of sport competitions, more time spent practicing and travelling, and more frequent stressful events (e.g., injuries). Facets of conscientiousness, such as perseverance and diligence, as well as the capacity to manage stress and emotions (emotional stability) and find relational support in case of need (agreeableness), are particularly relevant to managing these high-level sport characteristics. Conversely, these characteristics might provide athletes with frequent occasions to stimulate and improve their trait-related capacities as well as manage emotional disruptive states, foster interpersonal relationships, and pursue tenaciously ambitious goals. Among these personality differences, the largest effect size was related to conscientiousness, suggesting that characteristics such as diligence and responsibility are skills that primarily characterize high-level athletes. This result also confirms the pivotal role of conscientiousness in relation to successful outcomes in various life domains, such as career success and health (Martin & Friedman, 2000).

Finally, regarding the personality differences between individual- and team-sport athletes, the results indicated that the former group scored higher in energy and openness. The observed difference in energy is not in line with the previous literature (Allen et al., 2011; Eagleton et al., 2007). A possible explanation for this divergence might be represented by the different sports considered in the studies. Indeed, the present research focused on three specific sports, while previous studies considered several sports (Allen et al., 2011). As far as openness is concerned, the current result confirmed the result of Allen et al. (2011), supporting the idea that team-sport athletes are less open-minded than individual-sport athletes. A possible explanation may rely on the fact that soccer and basketball are the most popular sports in Italy; thus, the choice to take part in such sports reveals conformity rather than openness to experiment with less common sports.

4. Conclusions

Personality differences were observed between male athletes and male non-athletes, between high- and low-level athletes, and between individual- and team-sport athletes. The current findings suggest that the Big Five personality traits can help distinguish various levels of athletic involvement and achievement.

The present study contributed to the accumulation of relevant findings that may be integrated with previous research on personality and sports. One relevant characteristic of the present study was the adoption of a sample size that was much larger than any other study in the previous literature. Second, to the best of our knowledge, the current study is the first in sports and personality research to adopt advances in statistical methodologies to test for measurement invariance and mean differences among groups. More specifically, the ESEM approach was used to verify the dimensionality, measurement invariance and mean differences among groups. Multiple advantages are associated with such methodologies: first, ESEM provides a better fit of Big Five data in comparison with traditional CFA, and second, it provides the opportunity to test mean differences evaluating latent variables' measurement instead of manifest variables' measurement.

Some limitations of the study should also be noted. First, the individual-sport category included one type of sport, whereas the team-sport category included two types of sports. Additionally, because only three sports were considered, the team- and individual-sport variable may be affected by the sport specificity. These issues limit the generalization of the current results to other sport contexts or, at least, offers a caveat. The generalization of the results is also limited by the gender composition of our sample. As we only included male participants we cannot exclude that different findings could arise considering females, also due to gender differences in personality traits (Caprara, Caprara, & Steca, 2003). Moreover, the sampling of athletes during competitions may have led to a considerable amount of state-variance due to the specific context in which the personality assessment occurred. Competitions may play a not negligible role in fostering specific personality facets, especially those related to emotional stability. Finally, the study used a cross-sectional sampling, so it is not possible to infer cause and effect when interpreting these findings, thus restricting any conclusion to an association level.

Further longitudinal research with the adoption of advances in statistics framed into the structure equation modeling approach may help shed light on the association between sports involvement and personality. In this direction, future studies may consider consistently measuring other crucial behavioral outcomes, such as multiple sports performance indicators, amount of time spent on sports activities and past sports practice. Moreover, the adoption of a typological approach aimed at finding prototypical profiles may be useful in testing the replicability of well-known personality typologies (Steca, Alessandri, & Caprara, 2010) in the sporting population.

Appendix A

Table 1

Big Five observed scores, ESEM factor scores determinacy coefficients, and ESEM standardized factor loadings and factor correlations based on responses to the 25-adjecitves personality measure.

	E	A	C	ES	O
Observed scores					
Overall (M, SD)	(3.62, 0.66)	(3.96, 0.55)	(3.64, 0.64)	(3.34, 0.68)	(3.43, 0.69)
α	0.79	0.68	0.73	0.73	0.81
Non-athletes (M, SD)	(3.29, 0.74)	(3.83, 0.58)	(3.53, 0.71)	(3.21, 0.73)	(3.33, 0.65)
α	0.82	0.71	0.76	0.76	0.73
Lower-level athletes (M, SD)	(3.71, 0.61)	(3.94, 0.56)	(3.59, 0.61)	(3.43, 0.64)	(3.45, 0.70)
α	0.77	0.66	0.70	0.70	0.82
Higher-level athletes (M, SD)	(3.82, 0.58)	(4.09, 0.57)	(3.84, 0.64)	(3.60, 0.67)	(3.54, 0.65)
α	0.78	0.74	0.75	0.75	0.79
Individual-sport athletes (M, SD)	(3.91, 0.61)	(3.97, 0.56)	(3.74, 0.70)	(3.53, 0.74)	(3.68, 0.70)
α	0.79	0.73	0.77	0.77	0.82
Team-sport athletes (M, SD)	(3.70, 0.59)	(3.98, 0.56)	(3.63, 0.61)	(3.47, 0.63)	(3.43, 0.68)
α	0.77	0.68	0.70	0.70	0.81
ESEM factor scores determinacy coefficients					
Overall	0.91	0.86	0.89	0.89	0.92
Non-athletes	0.89	0.87	0.88	0.89	0.92
Lower-level athletes	0.89	0.87	0.86	0.89	0.92
Higher-level athletes	0.89	0.87	0.88	0.89	0.92
Individual-sport athletes	0.89	0.88	0.88	0.89	0.93
Team-sport athletes	0.89	0.88	0.88	0.89	0.93
ESEM solution					
Item					
8. Determined	**<u>0.70</u>**	− 0.03	0.19	− 0.05	− 0.06
20. Resolute	**<u>0.64</u>**	0.01	0.21	0.04	− 0.02
13. Energetic	**<u>0.59</u>**	0.15	0.03	− 0.13	0.04
16. Dominant	**<u>0.53</u>**	− 0.08	0.02	− 0.08	0.16
15. Entreprising	**<u>0.49</u>**	0.00	0.03	− 0.02	0.29
21. Friendly	0.08	**<u>0.72</u>**	− 0.08	− 0.02	0.01
18. Cordial	− 0.11	**<u>0.58</u>**	**0.30**	0.04	− 0.01
10. Affectionate	0.02	**<u>0.48</u>**	0.12	0.00	0.17
23. Loyal	− 0.02	**<u>0.38</u>**	0.19	− 0.02	0.05
4. Unselfish	0.06	**<u>0.36</u>**	0.17	0.12	− 0.02
19. Conscious	− 0.03	0.22	**<u>0.63</u>**	0.00	− 0.01
12. Scrupolous	0.02	− 0.05	**<u>0.62</u>**	− 0.11	0.09
22. Diligent	0.08	0.16	**<u>0.60</u>**	0.00	− 0.05
7. Responsible	0.10	0.05	**<u>0.59</u>**	0.03	− 0.03
17. Precise	0.06	− 0.05	**<u>0.59</u>**	− 0.01	0.06
9. Calm	− 0.04	− 0.05	0.25	**<u>0.75</u>**	0.01
1. Relaxed	0.21	− 0.03	− 0.03	**<u>0.70</u>**	0.01
3. Patient	− 0.11	0.05	**0.32**	**<u>0.58</u>**	− 0.01
25. Serene	**0.41**	0.15	− 0.02	**<u>0.49</u>**	− 0.02
5. Optimistic	**0.58**	0.02	− 0.06	**<u>0.32</u>**	0.04
11. Creative	− 0.01	0.00	0.04	0.02	**<u>0.84</u>**
2. Immaginative	− 0.08	0.07	− 0.08	− 0.05	**<u>0.74</u>**
6. Innovative	0.23	− 0.08	0.06	0.05	**<u>0.63</u>**
14. Original	0.20	0.04	− 0.08	− 0.02	**<u>0.62</u>**
24. Modern	0.29	0.22	− 0.04	0.06	<u>0.23</u>
Correlation with A	0.18				
Correlation with C	0.25	0.21			
Correlation with ES	− 0.14	0.28	0.05		
Correlation with O	0.37	0.20	− 0.05	− 0.03	

Note: ESEM = exploratory structural equation modeling; E = energy; A = agreeableness; C = conscientiousness; ES = emotional stability; O = openness. α = Cronbach's Alpha. Underlined coefficients in the ESEM solution are target loadings while factor loadings higher than 0.30 are in boldface.

Table 2
Mean (M), standard deviation (SD), and correlations among the 25 adjectives.

	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1. Relaxed	3.13	0.87	1																								
2. Immaginative	3.40	0.95	0.04	1																							
3. Patient	3.37	1.07	0.34	−0.09	1																						
4. Unselfish	3.89	0.82	0.16	0.09	0.29	1																					
5. Optimistic	3.62	0.98	0.29	0.15	0.16	0.20	1																				
6. Innovative	3.27	0.88	0.08	0.49	−0.03	0.07	0.33	1																			
7. Responsible	3.95	0.89	0.07	−0.07	0.23	0.21	0.11	0.09	1																		
8. Determined	4.07	0.83	0.03	0.08	−0.02	0.14	0.35	0.30	0.36	1																	
9. Calm	3.37	1.01	0.50	−0.08	0.59	0.18	0.12	0.03	0.18	−0.04	1																
10. Affectionate	3.69	0.98	0.11	0.20	0.15	0.25	0.17	0.15	0.18	0.16	0.14	1															
11. Creative	3.40	0.93	0.07	0.63	−0.03	0.04	0.20	0.56	0.02	0.17	−0.01	0.25	1														
12. Scrupolous	3.40	0.90	−0.02	−0.01	0.10	0.15	0.06	0.11	0.31	0.23	0.03	0.14	0.07	1													
13. Energetic	3.83	0.86	0.01	0.18	−0.06	0.16	0.34	0.30	0.18	0.51	−0.11	0.22	0.23	0.20	1												
14. Original	3.49	0.92	0.03	0.47	−0.07	0.04	0.22	0.54	0.00	0.21	−0.06	0.18	0.58	0.04	0.34	1											
15. Entreprising	3.53	0.83	0.03	0.30	−0.04	0.09	0.35	0.42	0.12	0.42	−0.06	0.17	0.38	0.13	0.41	0.44	1										
16. Dominant	3.15	0.98	0.01	0.18	−0.17	0.02	0.28	0.32	0.06	0.39	−0.11	0.13	0.30	0.14	0.40	0.31	0.44	1									
17. Precise	3.46	1.00	0.01	−0.05	0.17	0.13	0.07	0.09	0.36	0.22	0.14	0.13	0.06	0.45	0.19	0.05	0.13	0.19	1								
18. Cordial	3.89	0.82	0.16	0.03	0.26	0.29	0.09	0.03	0.27	0.08	0.23	0.37	0.06	0.20	0.11	0.03	0.06	0.00	0.21	1							
19. Conscious	3.73	0.82	0.09	−0.03	0.25	0.24	0.09	0.06	0.45	0.20	0.20	0.25	0.01	0.37	0.13	−0.02	0.09	0.10	0.34	0.43	1						
20. Resolute	3.80	0.84	0.09	0.12	−0.01	0.12	0.36	0.27	0.28	0.58	0.08	0.14	0.19	0.23	0.44	0.23	0.38	0.42	0.28	0.13	0.28	1					
21. Friendly	4.10	0.81	0.12	0.15	0.15	0.29	0.17	0.10	0.09	0.12	0.13	0.39	0.17	0.00	0.22	0.19	0.16	0.05	0.05	0.43	0.18	0.19	1				
22. Diligent	3.63	0.81	0.08	−0.08	0.21	0.22	0.18	0.08	0.44	0.27	0.18	0.19	0.02	0.44	0.18	−0.01	0.17	0.09	0.36	0.31	0.49	0.27	0.21	1			
23. Loyal	4.23	0.80	0.08	0.09	0.13	0.29	0.09	0.13	0.24	0.11	0.11	0.24	0.09	0.09	0.11	0.08	0.07	0.04	0.14	0.27	0.26	0.15	0.30	0.23	1		
24. Modern	3.70	0.89	0.14	0.20	0.01	0.17	0.22	0.36	0.07	0.22	0.02	0.23	0.29	0.10	0.25	0.36	0.30	0.29	0.11	0.17	0.08	0.25	0.26	0.10	0.18	1	
25. Serene	3.70	0.91	0.46	0.05	0.26	0.21	0.42	0.16	0.13	0.20	0.33	0.23	0.14	0.09	0.21	0.17	0.19	0.16	0.11	0.24	0.17	0.26	0.25	0.16	0.15	0.30	1

Appendix B

Additional supplemental materials are available at DOI 10.17605/OSF.IO/YMHNC.

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PLOS ONE

Shyness in Early Infancy: Approach-Avoidance Conflicts in Temperament and Hypersensitivity to Eyes during Initial Gazes to Faces

Yoshi-Taka Matsuda[1,2,3]*, Kazuo Okanoya[1,2,4], Masako Myowa-Yamakoshi[1,5]*

1 Okanoya Emotional Information Project, Exploratory Research for Advanced Technology (ERATO), Japan Science and Technology Agency (JST), Saitama, Japan, 2 Emotional Information Joint Research Laboratory, RIKEN Brain Science Institute, Saitama, Japan, 3 Center for Baby Science, Doshisha University, Kyoto, Japan, 4 Department of Life Sciences, Graduate School of Arts and Sciences, The University of Tokyo, Tokyo, Japan, 5 Graduate School of Education, Kyoto University, Kyoto, Japan

Abstract

'Infant shyness', in which infants react shyly to adult strangers, presents during the third quarter of the first year. Researchers claim that shy children over the age of three years are experiencing approach-avoidance conflicts. Counter-intuitively, shy children do not avoid the eyes when scanning faces; rather, they spend more time looking at the eye region than non-shy children do. It is currently unknown whether young infants show this conflicted shyness and its corresponding characteristic pattern of face scanning. Here, using infant behavioral questionnaires and an eye-tracking system, we found that highly shy infants had high scores for both approach and fear temperaments (i.e., approach-avoidance conflict) and that they showed longer dwell times in the eye regions than less shy infants during their initial fixations to facial stimuli. This initial hypersensitivity to the eyes was independent of whether the viewed faces were of their mothers or strangers. Moreover, highly shy infants preferred strangers with an averted gaze and face to strangers with a directed gaze and face. This initial scanning of the eye region and the overall preference for averted gaze faces were not explained solely by the infants' age or temperament (i.e., approach or fear). We suggest that infant shyness involves a conflict in temperament between the desire to approach and the fear of strangers, and this conflict is the psychological mechanism underlying infants' characteristic behavior in face scanning.

Introduction

During the third quarter of the first year, many infants start reacting shyly to adult strangers, which is a behavior known as infant shyness [1–9]. Infant shyness is an early developing form of shyness that is induced by strangers and is distinct from later-developing forms of shyness, such as self-conscious shyness, that appear at approximately 4 or 5 years of age [10]. The definitions and/or criteria for infant shyness vary depending among studies and include, for example, inhibited approach, low sociability or a fear of strangers. Shyness and fear temperaments are conceptually similar in that both promote inhibition or withdrawal. A longitudinal study showed that parent-reported shyness correlated with the degree of fear at 18 months of age and that this relationship weakened at 30 months of age [11]. This study indicates that infant shyness can be explained by a fear temperament to some extent, but that shyness and fear temperaments are fundamentally different. One characteristic difference between infant shyness and fear is the respective relationships to approach. Fear is a separate temperament from approach behavior [12], whereas shyness seems to relate to both approach behavior and fear. Indeed, shy children may possess high

avoidance tendencies that are induced by social fear and high approach tendencies. That is, although shy children desire social interaction, their approach-motivation is simultaneously inhibited by a competing avoidance-motivation, which is triggered by social fear and anxiety, i.e., conflicted shyness [13–17]. This approach-avoidance conflicted model of shyness has been adapted for shy children over 3 years of age but has not been studied in young infants, even though it may explain infant shyness, given that 4-month-old infants occasionally show positive shyness by coyly smiling at adult strangers [18]. This coy smile may reflect a feeling of ambivalence between pleasure and aversion during the social interaction [19]. Thus, shy infants may possess the approach-avoidance conflict that is observed in shy children. One aim of our study was to investigate whether the conflicted model of shyness can explain infant shyness.

Our second purpose was to investigate face scanning in shy infants. One characteristic of shy behavior is the avoidance of eye contact [20–25]. However, few studies have used eye tracking to reliably capture precise face scanning patterns in relation to shyness. Brunet et al. [26] investigated 11-year-old shy children and found that shyness was associated with longer dwell times in the eye region than in the mouth region, which suggests that some

shy children are not avoiding the eyes (at least in a laboratory setting). We wondered whether highly shy infants also increase their time spent looking at the eyes when compared with less shy infants. We further questioned whether shy infants scan the faces and facial parts of their mothers and strangers differently from non-shy infants, given that shy behavior is typically evident with strangers but not with familiar individuals in a cue-dependent manner. We also investigated how face/gaze direction affects face preferences in shy infants as an index of face-to-face contact with strangers. Given that shyness is characterized as a tendency to escape from social interaction with strangers [10,27], shy infants may prefer the averted gaze/face of strangers to the direct gaze/face.

To investigate these questions, we recruited infants across a range of ages (7 to 13 months old; m.o.) because the timing of the appearance and the strength of infant shyness vary [5]. The Colorado Child Temperament Inventory (CCTI) [10,27] was used to assess the degree of shyness for each infant, and fear and approach temperament characteristics were measured by the Infant Behavior Questionnaire Revised (IBQ-R) [12], based on scores from maternal reports. A preferential-looking paradigm was used to investigate infants' face scanning by presenting a pair of faces side-by-side on an eye-tracking screen. We presented the following three types of face stimuli: mothers, strangers and faces that are intermediately between mothers and strangers. Intermediate faces were created using a morphing technique with a physical composition of 50 percent of the mother's face and 50 percent of the stranger's face. Previous studies have demonstrated that infants spend *less* time looking at these hybrid faces than at either their mother or a stranger's face [28]. We used the intermediate faces to assess how shyness affects infants' sensitivity to their mothers' faces. If shy infants are sufficiently sensitive to their mothers' faces, they should prefer their mothers' faces to the intermediate faces (as observed in normal infants). Furthermore, we expected that shy infants may prefer intermediate faces to strangers' faces despite the imperfectness of the hybrid pseudo-mothers' faces, which would differ from the preference of less-shy infants.

Materials and Methods

Ethics Statement

The participants' parents provided written informed consent and the Behavioral and Social Science Ethical Review Committee of Kyoto University specifically approved this study (Application #20090901). Subjects presented in the photographs in figures provided written informed consent, as outlined in the PLOS consent form, regarding the publication of their photographs.

Participants

We recruited infants from a wide range of ages (7–13 m.o., average of 9.8 m.o., SD = 1.9) because the appearance of shy behaviors in infancy varies from individual to individual [5]. Fifty-seven infants (23 male, 34 female; ages 7.0 to 13.3 m.o.) and their mothers were invited to visit the lab twice. On the first day, the mothers' photographs were taken for use as visual stimuli. The experiments were conducted approximately 1 week after the first visit. Six additional infants were excluded from the experimental analysis because they did not complete the eye-tracking protocol.

Measures: Parent Questionnaires

Both the CCTI and IBQ-R questionnaires were provided to mothers during their second visit to the laboratory. The mothers

were asked to answer each item about their infants' behavior with regard to the past seven days.

CCTI [10,27]: The shyness scale from the CCTI consists of the following five items: "My child takes a long time to warm up to strangers", "My child tends to be shy", "My child makes friends easily (reversed)", "My child is very friendly with strangers (reversed)" and "My child is very sociable (reversed)". Each item was scored from 1 (not at all) to 5 (very much). The scores were summed across the 5 items for each infant was as a shyness score, which had 5 as the minimum score, 25 as the maximum score and 15 as the intermediate score. Although the CCTI was designed for children aged 1–6 years [10,27], we adapted the shyness questionnaire for our current sample of 7- to 13-month-old infants given that the inter-individual variation of scores (i.e., standard deviations) and the internal consistency of the shyness scale (i.e., the Cronbach's alpha) were consistent with those of a published sample [27]. The standard deviations were 4.6 for our sample and 5.1 for the published sample, and the Cronbach's alpha was 0.85 for our sample and 0.88 for the published sample. In the face preference experiments, we divided infants into two subgroups based on their CCTI scores: infants with high (score >15; intermediate score) and low (score ≤15) shyness. Age did not differ between the two subgroups ($t_{31} = 1.98$, P>0.05) (mean = 10.63 m.o., SD = 1.86, N = 17 in the high shyness subgroup) (mean = 9.56 m.o., SD = 1.78, N = 34 in the low shyness subgroup).

IBQ-R [12]: We also asked mothers to answer the items from the *Fear* and *Approach* scales of the IBQ-R, which is a questionnaire designed for infants in the first year of life and is suitable for use with our sample. The fear scale consisted of 16 questions regarding both social and non-social contexts (e.g., "When your baby was approached by an unfamiliar person when you and s/he were out, how often did the baby cry?" and "When visiting a new place, how often did the baby continue to be upset for 10 minutes or more?"). The approach scale consisted of 12 questions regarding both social and non-social contexts (e.g., "When familiar relatives/friends visited, how often did the baby get excited?" and "When given a new toy, how often did the baby get very excited about getting it?"). Each item was scored from 1 (not at all) to 7 (very much), and the average score was calculated for each scale. The values of Cronbach's alpha for the *Fear* and *Approach* scales of the IBQ-R for the present sample were 0.88 and 0.82, respectively, and were generally similar to the values reported by Garstein and Rothbart (2003) [12].

In the face preference experiments, we divided infants into two subgroups based on their IBQ-R scores as follows: infants with high (score ≥4; intermediate score) and low (score <4) fear, infants with and high (score ≥5) and low (score <5) approach. We adopted the borderline score of '5' for the approach temperament based on the average value for all of the infants as opposed to taking the intermediate score of '4', given that the lower score imbalanced the number of infants categorized as having high (48 infants) and low (3 infants) approach scores. In the two subgroups for fear temperament, age was significantly different between the subgroups ($t_{36} = 2.79$, P<0.01) (mean = 10.81 m.o., SD = 1.80, N = 19 in the high fear subgroup) (mean = 9.39 m.o., SD = 1.71, N = 32 in the low fear subgroup). Age did not differ between the high and low approach subgroups ($t_{32} = 0.77$, P>0.77) (mean = 9.86 m.o., SD = 1.80, N = 33 in the high approach subgroup) (mean = 10.03 m.o., SD = 2.01, N = 18 in the low approach subgroup).

In our current study, *temperament* refers to the individual personality differences in infants and young children that are present prior to the development of more sophisticated cognitive

and social aspects of personality [29], whereas *trait* refers to a more mature form of personality differences and habitual patterns of behavior, thought and emotion that is are relatively stable over time [30].

Apparatus

A Tobii (Stockholm, Sweden) X60 Eye Tracker was used to record the infants' looking behavior. The eye tracker was integrated with a 23-inch LCD monitor that displayed the stimuli using Tobii Studio AVI presentation software. Infants were seated on a parent's lap approximately 60 cm from the monitor that presented the stimuli. During the experiment, parents were asked to look below the monitor to avoid influencing which stimulus their infant looked at. A video camera was placed near the top of the screen, through which the experimenter monitored the infant's face. A five-point calibration was administered before the recording (for technical details about the apparatus and the calibration procedure, see [31,32]).

Visual Stimuli

Color photographs of the mothers and female strangers were taken prior to the experiments. Images of smiling and neutral faces with both direct and averted head/gaze postures (i.e., faces looking toward or away from the subjects) were taken for each individual. The photographs showed a face with the individual's hair pinned up and the individual's face without glasses. Rather than using still images of smiling faces, we created movie stimuli for both the mothers and strangers, which were termed dynamic facial expressions [33] because infants are more responsive to moving faces than to static faces [34]. Movie stimuli were created in the following manner. Using the neutral and smiling expressions for each person, 24 intermediate images in 4% steps were created using computer-morphing techniques (Sqirlz Morph 2.1: Xiber-pix, Solihul, UK, www.xiberpix.com). To create a moving clip, 26 images (i.e., 1 neutral image, 24 intermediate images and the final smiling image) were presented in succession. Each image was presented for 40 ms, and the first and last images were additionally presented for 480 ms. Thus, each animation clip lasted for 2,000 ms. Each clip was repeated 5 times (i.e., for a 10-second duration) during the main experiments. For adults, this presentation speed sufficiently reflects natural changes in the dynamic facial expressions of happiness [33].

To create the intermediate faces, the faces of a mother and a stranger were morphed together to produce a new face that consisted of 50% of the mother's face and 50% of the stranger's face [28]. Then, movie stimuli for the dynamic facial expressions were created using the neutral and smiling expressions for each intermediate face according to the procedure outlined previously.

Procedure

The infants saw the following three pairs of stimuli: mother *vs.* stranger, mother *vs.* intermediate face and stranger *vs.* intermediate face. The presentation was repeated twice with photographs of different strangers used as the stimuli representing the strangers and intermediate faces. Each face stimulus subtended a visual angle of $11.13° \times 12.50°$ from a distance of 60 cm. Each test trial was presented for 10 seconds. Each trial was preceded by a stimulus that was intended to attract the infants' visual attention. The order of the six test trials and the side that a given face appeared were random and counterbalanced across participants. A mother's face was used as the stranger's face for the other participants to furnish a homogeneous set of stimuli in this study. After the experiment, we confirmed with each mother that the

strangers whose faces were presented were not acquaintances of her infant.

The total time spent looking at each stimulus type was averaged across all of the test trials for each individual and then normalized to calculate proportions. The proportions were transformed with the arcsine function to achieve a normal distribution.

Results

Infants' Shyness Scores

Shyness scores for the infants in the second half of the first year (N = 57) are depicted as a function of the infants' ages in Figure S1. No significant correlation was found between the shyness scores and age (R = 0.18, t_{55} = 1.36, P>0.10), which indicates that there was large individual variation. No significant differences in gender were found for the shyness score (t_{55} = 0.12, P>0.90, Cohen's *d* = 0.03).

Relationships between Shyness Scores and Fear and Approach Scores

We also investigated the fear and approach scores for the same subjects. The fear scores showed a subtle but significant positive correlation with the infants' age in the second half of the first year (R = 0.32, t_{55} = 2.50 P<0.05), whereas the approach scores did not show a significant correlation with age during this period (R = 0.09, t_{55} = 0.67, P>0.4). These results are consistent with previous reports that approach motivation appears very early in development and stays stable over time, whereas fear does not emerge until later developmental stages, specifically around the third quarter of the first year [5,8,35,36].

We then compared the shyness scores with the fear and approach scales. The shyness scores were significantly correlated with the fear scores (R = 0.69, t_{55} = 7.07, P<0.001, Fig. 1a), which may reflect similarity in the questionnaire items between the CCTI shyness scale and the IBQ-R fear scales with regard to social contexts [10,12,27]. However, the shyness scores also showed a significant secondary correlation with the approach scores (R = 0.50, t_{55} = 4.28, P<0.001, Fig. 1a), which indicates that both extremely high- and low-scoring shy infants had high approach scores. Notably, the fear and approach scores had a significant but modest correlation (linear correlation, R = 0.28, t_{55} = 2.16, P<0.05; secondary correlation, R = 0.28, t_{55} = 2.16, P<0.05), which indicates that they are independent of each other [12]. Taken together, the results of these questionnaire experiments reveal that highly shy infants possess conflicted temperaments with both high fear and high approach behaviors, as
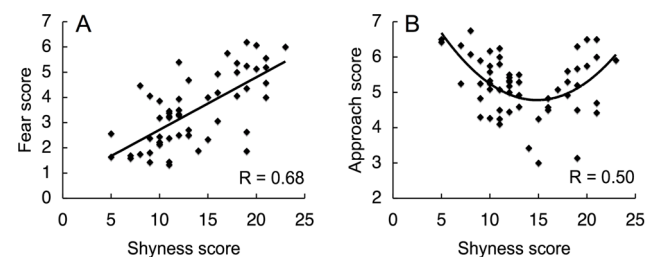

Figure 1. Relationship between shyness and other temperaments. (A) Fear scores (vertical axis) correlate linearly with shyness scores (horizontal axis). The solid line represents a regression line of the distribution. (B) Approach scores (vertical axis) correlate secondarily with shyness scores (horizontal axis). The solid line represents a secondary regression curve of the distribution. R: Correlation coefficient. doi:10.1371/journal.pone.0065476.g001
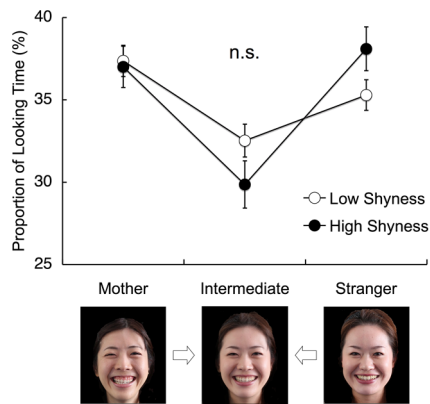
Figure 2. Infants' visual preferences for different face types. This figure shows the mean percentile fixation durations for the following three face stimuli: mother, intermediate and stranger. The bottom pictures present examples of the face stimuli. The open and filled circles represent the mean fixation durations for the infants with low and high shyness, respectively. Error bars indicate the S.E. of the mean. n.s.: no significant difference.
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observed in shy children who are experiencing the approach-avoidance conflict [13–17].

Face Preferences for Familiar and Novel Individuals

We next examined shy infants' preferences for looking at the faces of familiar and novel persons using the eye-tracking system. We divided and classified the subjects on the basis of their shyness scores, irrespective of their age (Figure S1), into groups with high (score >15, N = 17) and low (score $\leq$ 15, N = 34) shyness.

Given that infants generally prefer both familiarity and novelty in objects [37], shy infants may be expected to show a preference for familiar persons (e.g., caregivers) over strangers. However, our results show that both the highly shy infants (>15 score in shyness) and the low-scoring infants ($\leq$ 15 score) looked at the mothers and strangers' faces for equal durations. Indeed, a 2 (shyness: high, low) $\times$ 2 (object: mother, stranger) repeated-measures analysis of variance (ANOVA) showed that there was neither a significant main effect of object ($F_{1,98} = 0.19$, $P = 0.67$, $\eta_p^2 < 0.01$) nor an interaction between shyness and object ($F_{1,98} = 1.94$, $P = 0.17$, $\eta_p^2 = 0.02$) (Fig. 2).

The equal preference of the infants to look at their mother's and a stranger's face indicates that infants' looking time did not certify their ability to discriminate facial stimuli. By presenting faces that are intermediately between mothers and strangers [28], we confirmed that the infants indeed discriminated the stimulus faces. The intermediate faces were created using a morphing technique to synthesize a new face that consisted of 50% of the mother's face and 50% of the stranger's face (see Methods). Infants spend less time looking at the intermediate faces if they recognize the facial stimuli adequately [28]. Indeed, both the high and low shyness groups showed a significantly lower preference for the intermediate faces relative to both the mothers and strangers' faces. A 2 (shyness: high, low) $\times$ 3 (object: mother, intermediate, stranger) repeated-measures ANOVA revealed a significant main effect of object ($F_{2,147} = 16.21$, $P < 0.001$, $\eta_p^2 = 0.18$) and no significant interaction between shyness and object ($F_{2,147} = 2.76$, $P = 0.07$, $\eta_p^2 = 0.04$) (Tables S1 and S2). Post-hoc testing (Bonferroni) showed that infants preferred intermediate faces less than the faces of mothers ($P = 0.001$) and strangers ($P = 0.009$). These results indicate that, when the infants recognized that the strangers were
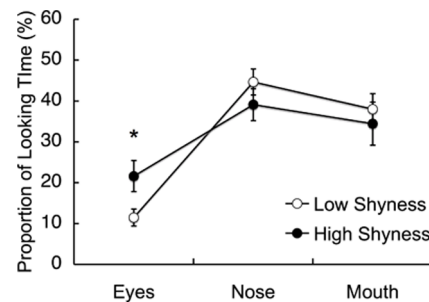

Figure 3. Infants' visual preferences for different facial regions. This figure shows the mean percentile fixation durations for the following three types of facial regions: eyes, nose and mouth. The open and filled circles represent mean fixation durations for the infants with low and high shyness, respectively. *$P < 0.05$. Error bars indicate the S.E. of the mean.
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novel, both the highly shy infants and the low-scoring infants increased their time spent looking at the strangers.

There were no significant differences in face preference with respect to the infants' age, fear temperament and approach temperament (ANOVA and correlational analysis, Table S3).

Different Facial Scanning Patterns

Although both the high and low shyness groups spent equal time looking at the strangers' faces, we wondered whether the same type of looking was occurring, especially with regard to the component facial regions. We defined three areas of interest (AOIs) for the eyes, nose and mouth and conducted a 2 (shyness) $\times$ 2 (object) $\times$ 3 (facial region) repeated-measures ANOVA that revealed a significant interaction between shyness and facial region ($F_{2, 294} = 3.81$, $P < 0.03$, $\eta_p^2 = 0.03$, Fig. 3) (Tables S4 and S5). Post-hoc testing (Bonferroni) showed that the group with high shyness looked at the eye regions longer than the group with low shyness ($P < 0.02$), whereas the looking time was not significantly different for the other regions (i.e., the nose and mouth) between the high and low shyness groups ($P > 0.30$ for both cases). Neither a main effect of object (i.e., mother or stranger) nor an interaction between object and shyness was observed, which indicates that the highly shy infants were sensitive to the eye region irrespective of whether the viewed faces were of their mothers or strangers. Importantly, this difference between the high and low shyness groups in the time spent looking at the eye region was observed only when we measured the first fixation duration after the stimulus presentation, and it was not observed when we measured the full fixation duration during the presentation period (10 s) ($F_{2,294} = 1.13$, $P > 0.32$). This result indicates that shyness is associated with an initial impulse to scan the eyes of others.

All of the infants looked longer at the nose and mouth regions than the eye region ($P < 0.001$ for both cases, post-hoc comparisons with a Bonferroni correction). This result is consistent with previous findings that talking faces, which are similar to smiling faces with moving mouths, attract infants' attention more to the mouth region than to the other regions in the second half of the first year of life [38]. Preferences for the facial region vary with infants' ages, as 4 m.o. infants prefer eyes over the mouth and 6 m.o. infants prefer both eyes and mouth [39–42].

There were no significant differences in facial region preferences with regard to the infants' age, fear temperament and approach temperament (ANOVA and correlational analysis, Table S6).
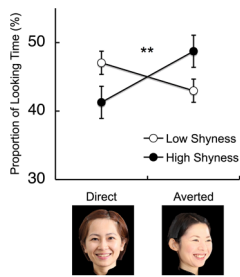
Figure 4. Infants' visual preferences for different directions of the face and gaze. This figure shows the mean percentile fixation duration for the different types of face stimuli, including strangers' faces with direct and averted gaze. The bottom pictures are examples of the face stimuli. The open and filled circles represent the mean fixation durations for the infants with low and high shyness, respectively. **P<0.01. Error bars indicate the S.E. of the mean.
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Scanning Patterns with Different Gaze Directions

We also examined differences in gaze direction preferences between infants with high shyness and those with low shyness. When two strangers, one with a direct gaze and the other with an averted gaze, were presented simultaneously, the infants showed a significant interaction between shyness and gaze direction ($F_{1, 98} = 8.14$, P<0.01, $\eta_p^2 = 0.08$, Fig. 4) (Tables S7 and S8). *Post-hoc* testing (Bonferroni) showed that the infants with low shyness looked longer at strangers with a direct gaze than the infants with high shyness (P<0.05), whereas the infants with high shyness looked longer at strangers with an averted gaze than the infants with low shyness (P<0.05).

There were no significant differences in gaze direction preferences with regard to the infants' age, fear temperament and approach temperament (ANOVA and correlational analysis, Table S9).

Discussion

This study is the first to show that shy infants possess an approach-avoidance conflict in their temperament. Infant shyness has been viewed as a simpler form of withdrawal, an inhibited approach or a fear of strangers. However, we found that shy infants had a more complex repertoire in that they experienced the seemingly opposing constructs of both high approach and high fear, which has only been observed in children in later developmental stages [13,14,16,17]. We further demonstrated that this conflicted shyness in infancy was associated with an initial hypersensitivity to the eye region, regardless of whether mothers or strangers were fixated on, and with a preference for an averted gaze over a directed gaze when viewing strangers' faces. Importantly, neither the infants' age nor their individual temperament (i.e., fear or approach) explained this initial hypersensitivity to the eyes.

At approximately 8 months of age, many infants start reacting shyly to adult strangers, with interindividual differences ranging from extreme shyness to the complete absence of shyness [5]. These differences may be the result of differing thresholds for sympathetic nervous system activation [43,44]. However, this individual variation in shyness to strangers does not show enough temporal stability over the first 18 months to be considered a stable personality trait [45]. It is only later in development that the shyness trait can first be observed, which has led many researchers to focus on concurrent and predictive correlates [46–48]. In contrast, our study focused on the early form of infant shyness,

which may be a phenotype present during the developmental process in which infants exhibit an affective state rather than a stable personality trait in socially unfamiliar situations. Thus, the onset and intensity of infant shyness with interindividual differences may reflect developmental changes and thresholds in infants' neurophysiological responses to strangers, possibly in the amygdala. A human patient with amygdala damage failed to look normally at the eye region when viewing facial expressions [49]. The amygdala also participates in processing information from faces' eye regions [50–52]. Thus, the observed initial hypersensitivity to the eye regions in shy infants may be the result of hyperactivity of the amygdala with a low threshold of response to strangers. Longer looking times toward the eye region in shy infants were observed only during the first fixation to the stimuli. A plausible function of the amygdala is to direct one's own gaze immediately to the eyes of others and to seek out potential sources of salient social information [49]. We speculate that the initial hypersensitivity and over-seeking of eyes in shy infants may subsequently induce a negative response, such as fear or anxiety, to the direct gaze from a stranger and a preference for the averted gaze. This initial hypersensitivity to eyes may decline with increasing age and with the functional maturation of the emotion regulation systems that are controlled by the prefrontal cortex [53].

As shyness behaviors are induced in real, intense social situations with a heightened arousal level [18], our results from a laboratory setting, in which infants looked at stimulus faces on a monitor, may differ from natural situations. The two-dimensional virtual face stimuli may be insufficient with regard to attention level to induce infants' shy experiences and subsequent gaze avoidance, and as a result, shy infants may have spent the same amount time looking as infants with low shyness. This possibility suggests that shy infants are more sensitive to human faces, given that they initially increased their time spent looking at the eyes when compared with infants with low shyness.

We previously provided evidence that infants spend *less* time looking at intermediate faces between mothers and strangers than at the prototypes (i.e., the mother's or stranger's face) [28]. In this study, we used the intermediate faces to assess how shyness affects infants' sensitivity to their mothers' faces. We speculated that if shy infants are sufficiently sensitive to their mothers' faces, they should prefer their mothers' faces to the intermediate faces (as observed in typical infants). We also expected that shy infants may prefer intermediate faces to strangers' faces despite the imperfectness of the hybrid pseudo-mothers' faces, which would differ from the preference shown by less-shy infants. However, shy infants did not prefer the intermediate faces to the prototypes, which was also observed for the infants with low shyness (Fig. 2). This result indicates that the lower preference for the intermediate faces relative to the prototypes is a robust phenomenon in early infants, irrespective of shyness.

Most work on infant shyness has postulated that this shyness is conceptually identical to a fear of strangers or to behavioral inhibition of the socially unfamiliar, but it is rarely thought to result from social-approach motivation concomitantly with behavioral inhibition. The lack of research regarding this topic may stem from a widely accepted assumption that approach and inhibition reside on two ends of a single continuum. However, evidence from other sources suggests that approach and inhibition may be more appropriately viewed as separate entities. For example, the behavioral approach system [54], the behavioral facilitation system [55] and the expectancy-foraging system [56] describe structures that lead to approach in response to cues or that motivate exploratory activity. Conversely, the harm avoid-

ance dimension [57] and the behavioral inhibition systems [54,55] halt the appetitive approach to stimuli, which signals punishment or non-reward. Similarly, Kinsbourne [58] asserted that approach was largely controlled by activity in the left hemisphere of the brain, whereas the inhibition of approach was primarily under the influence of the right hemisphere. Furthermore, important findings regarding the dissociated entities of approach and inhibition have been reported in infant studies. Approach and inhibition follow different developmental trajectories, with greater gains in inhibition between 6 and 12 months, whereas approach is relatively stable over this time period [5,8,29,36].

A similar conceptualization of shy subtypes was articulated by Asendorpf [13,14], who argued that high and low social approach and avoidance lead to different behavioral combinations. For example, individuals who score high on both approach and avoidance are described as shy (or conflicted shy), those who score low on approach and high on avoidance are described as avoidant, those who score low on both approach and avoidance are introverts and those who score high on approach and low on avoidance are sociable. Physiological studies support this classification of shy subtypes, particularly with regard to the difference between conflicted shyness (i.e., high-approach/high-avoidance) and avoidant (i.e., low-approach/high-avoidance) subtypes [59,60]. Schmidt [59] found that, although participants with conflicted shyness an avoidant participants both exhibited a pattern of greater relative right frontal EEG activity at rest, which is a marker of fear dysregulation [61], the two subtypes were distinguishable based upon their pattern of activity in the left, but not the right, frontal area. The participants with conflicted shyness exhibited significantly higher activity in the left frontal EEG site than the avoidant participants. In addition, the conflicted participants exhibited a significantly faster and more stable heart rate than the avoidant participants in response to an anticipated unfamiliar social situation [60].

Our results are consistent with the previously mentioned studies. Infant shyness is not a single form of behavioral inhibition; rather, it is well explained by the combination of approach and avoidance, i.e., high-approach and high-avoidance temperaments as observed in conflicted shyness. Indeed, infants with high and low fear scores did not show a significant difference in their initial hypersensitivity to the eyes, which could be a psychological marker of shy behavior in children [26] and infants. An interesting aspect of our research is that infants were exposed to only positive facial expressions. Thus, the infant's approach-avoidance conflict appeared even in the presence of positive emotions by strangers without neutral or negative emotions.

Supporting Information

Figure S1 Cross-sectional depiction of the relationship between infant age and shyness scores. Shyness scores are plotted as a function of infant age in months. The solid line represents a regression line of the distribution. No obvious relation was found between shyness and infant age. R: correlation coefficient.
(PDF)

Table S1 Descriptive statistics for Fig. 2.
(PDF)

Table S2 Result of two-way ANOVA for Fig. 2.
(PDF)

Table S3 Results of ANOVA/correlational analysis for infant's characteristics and face preference (related to Fig. 2).
(PDF)

Table S4 Descriptive statistics for Fig. 3.
(PDF)

Table S5 Result of three-way ANOVA for Fig. 3.
(PDF)

Table S6 Results of ANOVA/correlational analysis for infant's characteristics and facial region preference (related to Fig. 3).
(PDF)

Table S7 Descriptive statistics for Fig. 4.
(PDF)

Table S8 Result of two-way ANOVA for Fig. 4.
(PDF)

Table S9 Results of ANOVA/correlational analysis for infant's characteristics and gaze/face direction preference (related to Fig. 4).
(PDF)

Acknowledgments

Author Contributions

Conceived and designed the experiments: YM KO MMY. Performed the experiments: YM. Analyzed the data: YM. Contributed reagents/materials/analysis tools: YM. Wrote the paper: YM.

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Big five personality and adolescent Internet addiction: The mediating role of coping style

Yueyue Zhou [a], Dongping Li [a,*], Xian Li [b], Yanhui Wang [c], Liyan Zhao [d]

[a] School of Psychology, Central China Normal University, Wuhan, Hubei, China
[b] Department of Educational and Counseling Psychology, University at Albany, SUNY, Albany, New York, USA
[c] School of Educational Science, Jiaying University, Meizhou, Guangdong, China
[d] School of Education, Arts and Sciences College of Chengdu, Chengdu, Sichuan, China

HIGHLIGHTS

- Big five personality have differential roles in adolescent Internet addiction (IA).
- Emotion-focused coping mediated the associations of big five personality with IA.
- Practitioners should attend to the roles of big five personality and coping in IA.

ARTICLE INFO

ABSTRACT

This study examined the unique associations between big five personality traits and adolescent Internet addiction (IA), as well as the mediating role of coping style underlying these relations. Our theoretical model was tested with 998 adolescents. Participants provided self-report data on demographic variables, big five personality traits, coping style, and IA. After controlling for demographic variables, it was found that agreeableness and conscientiousness were negatively associated with IA, whereas extraversion, neuroticism, and openness to experience were positively associated with IA. Mediation analyses further indicated that conscientiousness had an indirect impact on adolescent IA through decreased emotion-focused coping, whereas extraversion, neuroticism, openness to experience had indirect impacts on adolescent IA through increased emotion-focused coping. In contrast, problem-focused coping had no mediating role. These findings suggest that emotion-focused coping may, in part, account for the association between big five personality and adolescent IA.

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1. Introduction

As the usage of the Internet is growing rapidly each year, adolescent Internet addiction (IA) has become a serious public health concern worldwide (Tsitsika, Janikian, Greydanus, Omar, & Merrick, 2013). IA can be defined as an inability to control one's use of the Internet which lead to psychological, social, school and/or work difficulties in a person's life (Spada, 2014). IA is a unique disorder that is distinguishable from the sheer amount of time that people spend on the Internet or other psychological vulnerabilities such as substance addiction (Baggio et al., 2015; Rumpf et al., 2015). Recent research has indicated that adolescent IA is linked to a variety of maladaptive outcomes, including physical health difficulties, academic failures, and emotional

and behavioral problems (Ko, Yen, Yen, Chen, & Chen, 2012). Therefore, it is important to identify risk factors and mechanisms that place adolescents at increased risk for IA.

Although many factors can contribute to IA (see Kuss, Griffiths, Karila, & Billieux, 2014 for a review), personality characteristics may be particularly relevant. Theorists have proposed that personality traits are closely related to addictive behaviors (Floros & Siomos, 2014). Consistent with this perspective, a recent meta-analysis found that neuroticism was positively associated with IA, whereas extraversion, agreeableness, conscientiousness and openness to experience were negatively associated with IA (Kayiş et al., 2016). However, this review is mainly based on adult samples and the results may not necessarily be generalized to adolescents (Kuss, Shorter, van Rooij, van de Mheen, & Griffiths, 2014), therefore it is necessary to conduct research specifically tailored to adolescents. Meanwhile, from the perspective of intervention, personality traits show greater plasticity during adolescence. Therefore it is more cost-effective to alter Internet addiction through the intervention of personality in adolescence period.

* Corresponding author at: School of Psychology, Central China Normal University, Wuhan, Hubei, 430079, China.
E-mail address: lidongping@mail.ccnu.edu.cn (D. Li).

To date, only a handful of studies have examined the relationship between big five personality and Internet addiction in adolescent samples (Kuss, van Rooij, Shorter, Griffiths, & van de Mheen, 2013; Kuss, Shorter et al., 2014; Zamani, Abedini, & Kheradmand, 2011). For example, Kuss et al. (2013) found that high neuroticism, low agreeableness, low conscientiousness, and high openness to experience were positively associated with IA, whereas extraversion was not related to IA. In addition, Zamani et al. (2011) found that low extraversion, high neuroticism, and low conscientiousness are risk factors of IA, whereas agreeableness and openness to experience were not associated with IA. These findings highlight the important role played by big five personality in adolescent IA. However, except for conscientiousness and neuroticism, the relations between other three personality traits and Internet addiction are mixed. The reasons for the inconsistent findings are not clear, due to the limited number of such studies. More research is needed to replicate and validate previous findings.

In addition, the mediating mechanisms through which big five personality traits impact adolescent IA are still unclear. This kind of research, however, is essential to inform better understanding of how big five personality is related to IA and design effective interventions to reduce IA. Coping style, which has short-term effects on the resolution of the stressors as well as long-term effects on mental and physical well-being, may be one of the mediating variables. Specifically, coping style refers to the strategies people employ to manage their cognition, emotion, and behavior when they contend with stressful events (Skinner, Edge, Altman, & Sherwood, 2003). In general, coping styles include problem-focused coping and emotion-focused coping. Problem-focused coping refers to strategies that deal with the problem that causes emotional distress (e.g., problem solving, use of social support, and cognitive restructuring), and emotion-focused coping refers to strategies that regulate emotions (e.g., wishful thinking, withdrawal, and denial). Personality-coping-outcome theory (Gallagher, 1996) proposes that, when faced with stress, personality may influence one's coping style in several ways, which in turn influences adjustment outcomes that are positive when coping is successful, and negative when coping is unsuccessful. In other words, coping style mediates the relationship between personality and adjustment outcomes. This theoretical model has been verified by some empirical research (Gallagher, 1996; Zanini & Forns, 2014). For example, Zanini and Forns (2014) found that personality can influence internalizing and externalizing problems through emotion-focused coping. However, whether this theory can be applied to the study of adolescent IA, has yet to be determined by empirical investigation.

Some indirect evidence has implied that coping style mediates the relation between big five personality and adolescent IA. On one hand, previous research has documented that personality may impact one's coping style (Carver & Connor-Smith, 2010; Skinner & Zimmer-Gembeck, 2007). In a meta-analytic study, Connor-Smith and Flachsbart (2007) found that big five personality traits were significantly associated with coping style. Specifically, extraversion, conscientiousness, and openness to experience were associated with greater use of problem-focused coping. In addition, conscientiousness and agreeableness were associated with less use of emotion-focused coping, whereas neuroticism was associated with greater use of emotion-focused coping. On the other hand, previous research has demonstrated that coping style may impact one's addictive behaviors (Wills, Sandy, & Yaeger, 2001). For instance, Li and Lei (2005) found that adolescents who used more emotion-focused coping or fewer problem-focused coping strategies were at increased risk for IA. Tang et al. (2014) found that emotion-focused coping style increased the risk of IA, whereas no significant relation was found between problem-focused coping and IA. Taken together, big five personality may be related to coping style, which in turn is related to IA. However, to our knowledge, no published research has directly examined the mediating role of coping style in the relation between big five personality and adolescent IA.

In summary, the purposes of the present study were twofold: (a) to examine the direct associations between big five personality traits and IA among adolescents; and (b) to examine the mediating role of coping style in the relationships between big five personality traits and adolescent IA. We propose the following hypotheses:

Hypothesis 1. Conscientiousness would negatively predict adolescent IA; neuroticism would positively predict adolescent IA. Because previous findings regarding extraversion, agreeableness, openness to experience and IA were inconsistent, we do not propose specific hypotheses about these personality traits.

Hypothesis 2. Neuroticism would be positively associated with IA through increased emotion-focused coping; conscientiousness would be negatively associated with IA through decreased emotion-focused coping/increased problem-focused coping. Because the direct relations between the other three personality traits and IA are mixed, we do not propose specific mediating hypotheses regarding these personality traits.

2. Method

2.1. Participants and procedures

This study was approved by the Research Ethics Committee of the corresponding author's institution. Participants were recruited from five middle schools in Wuhan and Shanghai, China. Informed consent was obtained from school administrators and adolescents before data collection. The survey was conducted in classroom. A total of 998 adolescents participated in this study. Four hundred and seventy (47.1%) of the participants were males. The mean age of the participants was 15.15 years ($SD = 1.57$, range $= 12$–19). The average daily Internet use time for participants was 2.23 h on weekdays, and 4.58 h on weekends.

2.2. Measures

2.2.1. Demographic information

All adolescents completed questions requesting information about their gender, age, family structure, father's education, mother's education, father's occupation, mother's occupation and family income.

2.2.2. Big five personality

Adolescent personality was measured by the Chinese Big Five Personality Inventory (Zhou, Niu, & Zou, 2000). It consists 50 items assessing five personality dimensions. A sample item of the extraversion dimension was: "I like to play with classmates". Adolescents rated each item on a 5-point scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. An average score for each dimension was calculated, with higher scores indicating higher levels of that personality dimension. This measure has demonstrated good reliability and validity in Chinese adolescents (Li, Zou, & Yang, 2005; Yang & Lei, 2007). Cronbach's alpha values for the five subscales were 0.85 (95% confidence interval [CI] = [0.84, 0.86]), 0.81 (95% CI = [0.79, 0.83]), 0.85 (95% CI = [0.84, 0.86]), 0.79 (95% CI = [0.77, 0.81]) and 0.79 (95% CI = [0.77, 0.81]), respectively.

2.2.3. Coping style

Adolescent coping style was measured by the Simplified Coping Style Questionnaire, which has been adapted in Chinese culture (Xie, 1999). Problem-focused coping (12 items) refers to strategies that actively resolve the stressful situation, such as "trying to find several different ways to solve the problem". In contrast, emotion-focused coping (8 items) refers to strategies that palliate event-related distress, such as "dreaming that miracles would occur and the status quo could change". All responses were measured on a scale from 1 = *never* to

4 = *always*. The mean score of each dimension was calculated, with higher scores representing more frequent use of the corresponding coping style. This questionnaire has demonstrated good reliability and validity in samples of Chinese adolescents (Sun & Tao, 2005; Zheng et al., 2012). Cronbach's alpha values for the two subscales were 0.79 (95% CI = [0.77, 0.81]) and 0.71 (95% CI = [0.68, 0.74]), respectively.

2.2.4. IA

Adolescent IA was assessed with 10 items adapted from Young's (1996) IA Diagnostic Questionnaire (Li, Zhang, Li, Zhen, & Wang, 2010). A representative item was: "Have you made unsuccessful efforts to control, cut back, or stop Internet use?" Items were rated on a 6-point scale ranging from 1 = *not at all true* to 6 = *always true*. Responses across the 10 items were averaged, with higher scores representing higher levels of Internet addiction. This measure has demonstrated good reliability and validity in Chinese adolescents (Chen, Li, Bao, Yan, & Zhou, 2015; Li et al., 2013). Cronbach's alpha value for this measure was 0.90 (95% CI = [0.89, 0.91]).

2.3. Statistical analysis

Because of the very low proportion of missing data (<1%), mean substitution was used to handle missing data. We first presented descriptive statistics for our variables of interest and control variables, followed by bivariate associations among these variables. Second, we followed Hayes's (2013) procedure to test the direct and mediating effect between personality and IA. Bootstrapping method was used to identify mediation effects. This method produced 95% bias-corrected confidence intervals of these effects from 1000 resamples of the data. Confidence intervals that do not contain zero indicate effects that are significant at $\alpha = 0.05$. Finally, we also performed a path analysis, that is structural equation model for observed variables, to further validate our theoretical model.

3. Results

3.1. Descriptive analyses

According to the criteria of Young (1996), we find the proportion of Internet addiction in the present study was 6.1%, which is close to the incidence of national representative sample (Li, Zhang, Lu, Zhang, &

Wang, 2014). Table 1 presents means, standard deviations, and correlations among all study variables.

3.2. Testing for direct associations

The first aim of this study was to examine the unique relationships between big five personality traits and adolescent IA. To do this, we conducted multiple regression analysis using SPSS 21.0. The results (see Model 1 of Table 2) supported both of our hypotheses. Specifically, after controlling for demographic variables, conscientiousness negatively predicted adolescent IA, whereas neuroticism positively predicted IA. In addition, although the standardized regression coefficients were relatively small, agreeableness negatively predicted IA, while extraversion and openness to experience positively predicted IA.

3.3. Testing for mediated associations

To examine whether coping style mediated the link between big five personality traits and adolescent IA, we followed the two-step procedure proposed by Hayes (2013) to establish this mediation. In the first step, multiple regression analyses (see Models 2 and 3 of Table 2) revealed that extraversion, agreeableness, conscientiousness, and openness to experience predicted problem-focused coping, whereas neuroticism did not significantly predict problem-focused coping. In contrast, conscientiousness, neuroticism, extraversion and openness to experience predicted emotion-focused coping, whereas agreeableness did not significantly predict emotion-focused coping. In the second step, multiple regression analysis (see Model 4 of Table 2) indicated that after controlling for covariates and personality traits, problem-focused coping did not predict IA, while emotion-focused coping predicted IA. Bootstrapping mediation analyses further indicated that emotion-focused coping mediated the link between extraversion and IA ($\beta = 0.02$, 95% CI = [0.01, 0.04]), conscientiousness and IA ($\beta = -0.04$, 95% CI = [−0.06, −0.01]), openness to experience and IA ($\beta = 0.03$, 95% CI = [0.01, 0.05]), neuroticism and IA ($\beta = 0.10$, 95% CI = [0.06, 0.14]). In contrast, problem-focused coping did not mediate the relationship between big five personality traits and IA (all $ps > 0.05$). Therefore, our Hypothesis 2 was partially supported.

To further illustrate the mediational paths between personality traits and adolescent IA, we conducted a path analysis in LISREL 8.72. Multiple fit indices were used to assess model fit, including chi-square with its degrees of freedom, comparative fit index (CFI), goodness of fit index

Table 1
Means, standard deviations, and bivariate correlations of study variables.

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. Gender	–											
2. Age	−0.03	–										
3. Family structure	0.04	−0.09**	–									
4. Socioeconomic status	−0.07*	0.18***	−0.06	–								
5. Extraversion	0.01	−0.11***	−0.01	0.12***	–							
6. Agreeableness	−0.09**	−0.02	0.01	0.14***	0.57***	–						
7. Conscientiousness	−0.03	−0.08*	0.02	0.12***	0.32***	0.56***	–					
8. Openness to experience	0.03	0.02	−0.04	0.20***	0.54***	0.54***	0.46***	–				
9. Neuroticism	−0.18***	0.08*	−0.05	−0.01	−0.12***	−0.03	−0.11***	−0.06	–			
10. Problem-focused coping	−0.10**	−0.02	0.05	0.15***	0.45***	0.51***	0.51***	0.43***	−0.09**	–		
11. Emotion-focused coping	−0.02	0.07*	−0.00	0.01	0.08**	0.08*	−0.08*	0.10***	0.43***	0.16***	–	
12. IA	0.13***	0.19***	0.04	0.04	−0.07*	−0.22***	−0.35***	−0.07*	0.33***	−0.19***	0.30***	–
M	0.47	15.15	0.87	0.00	3.41	3.94	3.30	3.63	2.88	2.70	2.04	2.36
SD	0.50	1.57	0.34	1.00	0.75	0.59	0.68	0.67	0.78	0.53	0.56	1.04

Note. $N = 998$. Gender was dummy coded such that 1 = *male* and 0 = female. Family structure was dummy coded such that 1 = intact family and 0 = nonintact family. Socioeconomic status was a factor score derived from factor analysis of the father's education, mother's education, father's occupation, mother's occupation and family income, with higher scores indicating higher levels of socioeconomic status. The same below. Multicollinearity was not found.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

Table 2
Testing the mediation effects of personality on adolescent IA.

Predictor variables	Model 1 (IA)			Model 2 (problem-focused coping)			Model 3 (emotion-focused coping)			Model 4 (IA)		
	B	SE B	β	B	SE B	β	B	SE B	β	B	SE B	β
Gender	0.36	0.06	0.17***	−0.09	0.03	−0.09***	0.07	0.03	0.06*	0.33	0.06	0.16***
Age	0.10	0.02	0.15***	0.01	0.01	0.02	0.02	0.01	0.04	0.10	0.02	0.14***
Family structure	0.24	0.08	0.08**	0.08	0.04	0.05	0.04	0.05	0.02	0.24	0.08	0.08**
Socioeconomic status	0.06	0.03	0.05	0.02	0.01	0.04	−0.01	0.02	−0.02	0.06	0.03	0.06*
Extraversion	0.15	0.05	0.11**	0.14	0.02	0.20***	0.07	0.03	0.09*	0.15	0.05	0.11**
Agreeableness	−0.25	0.07	−0.14***	0.15	0.03	0.17***	0.06	0.04	0.07	−0.25	0.07	−0.14***
Conscientiousness	−0.46	0.05	−0.30***	0.23	0.03	0.30***	−0.11	0.03	−0.14***	−0.39	0.06	−0.26***
Openness to experience	0.13	0.06	0.09*	0.08	0.03	0.10**	0.09	0.03	0.11**	0.11	0.06	0.07*
Neuroticism	0.44	0.04	0.33***	−0.03	0.02	−0.04	0.32	0.02	0.44***	0.34	0.04	0.25***
Problem-focused coping										−0.12	0.07	−0.06
Emotion-focused coping										0.31	0.06	0.17***

Note. N = 998. Each column is a regression model that predicts the criterion at the top of the column. Multicollinearity was not found.
* p < 0.05.
** p < 0.01.
*** p < 0.001.

(GFI), non-normed fit index (NNFI), standardized root mean square residual (SRMR), root mean square error of approximation (RMSEA). Usually, the fit is considered good when $\chi^2/df < 3$, CFI > 0.95, GFI > 0.95, NNFI > 0.95, SRMR < 0.08, RMSEA < 0.06 (Hu & Bentler, 1999). Our model demonstrated sufficient fit to the data, $\chi^2_{(10)} = 21.77$, CFI = 1.00, GFI = 1.00, NNFI = 0.98, SRMR = 0.01, RMSEA = 0.03, 90% CI of RMSEA = [0.01, 0.05]. As shown in Fig. 1, the results were same with the multiple regression.

3.4. Supplementary analyses

We investigated product terms of personality traits and coping styles with adolescent gender (e.g., Extraversion × Gender, Emotion-Focused Coping × Gender) to rule out gender differences in our mediation model. We also constructed product terms among the five personality

traits and the two coping styles (e.g., Extraversion × Problem-Focused Coping) to examine whether personality might act as a moderator in the relations between coping styles and IA (Bolger & Zuckerman, 1995). Results indicated that all the interaction terms were non-significant and our current mediation model was further validated.

4. Discussion

In the present study, we examined the impact of big five personality traits on adolescent Internet addiction, as well as the mediating role of coping style underlying these associations. Our findings contribute to the literature of big five personality and adolescent Internet addiction in several ways.

First, we found that the big five personality traits play an important role in adolescent IA. Specifically, in line with previous research (Kuss et
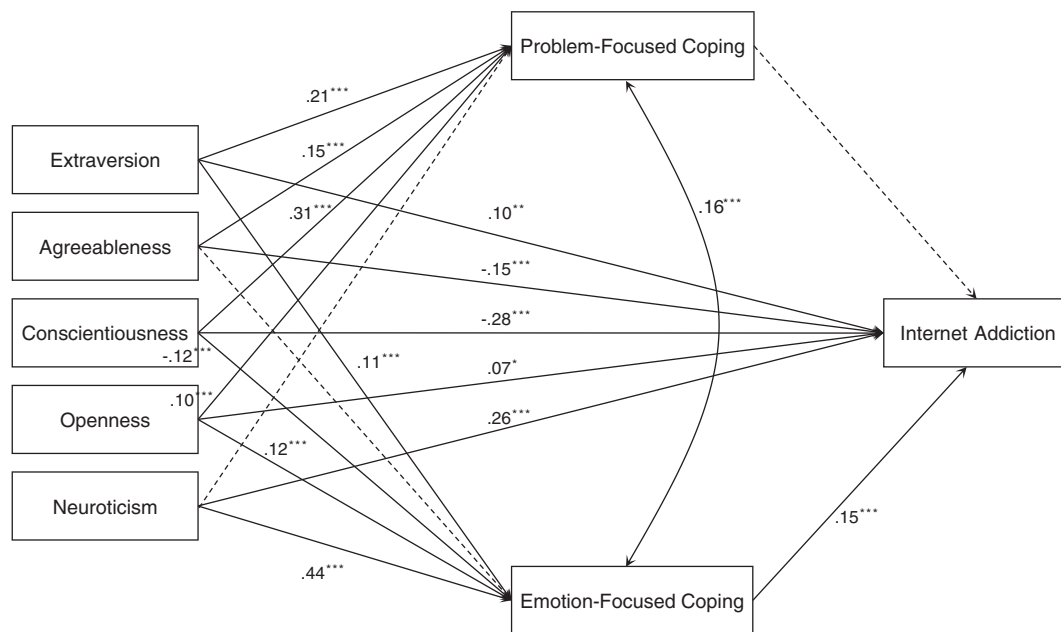

Fig. 1. Path analysis depicting direct and indirect effects of big five personality on IA. Standardized coefficients are presented. Covariates were included in the model but are not presented for simplicity. Solid lines indicate statistically significant associations, whereas dashed lines indicate nonsignificant associations. Note. N = 998. *p < 0.05. **p < 0.01. ***p < 0.001.

al., 2013; Zamani et al., 2011), conscientiousness negatively predicted adolescent IA. Adolescents who score high on conscientiousness often place high priority on academic and educational goals, have better planning and self-control skills, and have sophisticated understanding of the consequence of excessive Internet use. Therefore, they are less inclined to indulge in Internet world and suffer from addiction. Also, consistent with previous research, neuroticism positively predicted adolescent IA (Kuss et al., 2013; Zamani et al., 2011). Individuals with neuroticism experience more troubled relationships and distressed situation. Hence, they are more likely to indulge in Internet to avoid these unpleasant experiences. In addition, low agreeableness individuals usually are more hostile that causes dissatisfactory peer relationships, interpersonal conflict and friendship dissolution in the real world (Ozer & Benet-Martinez, 2006). Consequently, they are more likely to compensate the need of friendship and relatedness in the virtual world, and eventually lose themselves over time.

It is worth noting that in correlation analysis, extraversion and openness to experience were negatively associated with IA. However, in regression analysis, the unique associations of extraversion and openness to experience with IA were positive. Indeed, the relationships of extraversion and openness to experience with adolescent IA were mixed in previous research. Although some researchers found that extraversion and openness to experience are beneficial factors that reduce IA (Chen, 2009), others found that they are risk factors that promote IA (Ozturk, Bektas, Ayar, Oztornacı, & Yagci, 2015). These findings can be explained by the *dual nature* of extraversion and openness to experience. Essentially, extraverted individuals often have good interpersonal relationships and adequate social support in real life, thus they do not need to seek more friends and social support online. On the other hand, these individuals are often impulsive (Eysenck & Eysenck, 1963) and tend to seek out new stimulation (Eysenck, 1967), which makes them more likely to addicted to the Internet. Likewise, adolescents with high openness to experience often have a wide range of interests and spare time activities, which limit their chance of IA. However, these adolescents are also imaginative, curious, attuned to inner feeling and prefer new stimulation and activities, which put them at increased risk for IA (Carver & Connor-Smith, 2010). Nonetheless, the unique associations of extraversion and openness to experience with adolescent IA are relatively small, so these findings should not be overstated and more research is needed to replicate these complex findings.

Second, this study found that emotion-focused coping mediated the relationship between big five personality traits (neuroticism, conscientiousness, extraversion, openness to experience) and adolescent IA. These findings support the personality-coping-outcome theory (Carver & Connor-Smith, 2010; Gallagher, 1996). In addition to the overall mediation results, each of the individual links in our mediation model is noteworthy. In the first stage of the mediation analysis, neuroticism was associated with greater use of emotion-focused coping, whereas conscientiousness was associated with less use of emotion-focused coping. These findings are congruent with previous research (Carver & Connor-Smith, 2010) as well as the biological view of Skinner and Zimmer-Gembeck (2007) which suggests that neuroticism grounded in an avoidance temperament with the tendencies to experience fear, sadness and distress. In contrast, conscientious individuals are persistent, self-disciplined, organized and success-achieved, which may reduce the use of emotion-focused coping (Carver & Connor-Smith, 2010). Interestingly, extraversion and openness to experience were significantly associated with greater use of emotion-focused coping style. These findings may counter to intuition, however, they are congruent with some previous research (Li, Niu, & Zou, 2000; Li & Zhang, 2004). Specifically, individuals with extraversion have distinct characteristics of impulsiveness (Eysenck & Eysenck, 1963) and sensitivity to rewards (Carver & Connor-Smith, 2010), which are risk factors for emotion-focused coping (denial, blaming, and social withdrawal)

(Xue & Liang, 2012). Openness to experience contains the tendency to be imaginative, creative, curious, flexible, attuned to inner feelings, and inclined toward new activities and ideas. It is these tendency that have been found to facilitate emotion-focused coping such as wishful thinking (Carver & Connor-Smith, 2010). In the second stage of the mediation analysis, emotion-focused coping significantly predicted adolescent IA. Emotion-focused coping as a risk factor of IA has been documented in several studies (Li & Lei, 2005; Tang et al., 2014). Our finding and those of others are congruent with the stress-coping theory (Wills et al., 2001). When distressed, emotion-focused coping may lead to undesirable situations which further trigger negative emotions. In this case, individuals are more likely to indulge themselves to the Internet to escape from the negative emotions (Lightsey & Hulsey, 2002).

In contrast, the mediation effect of problem-focused coping was not found in our result. In the first stage of mediation analysis, agreeableness, conscientiousness, extraversion, and openness to experience were associated with greater use of problem-focused coping, whereas neuroticism has no significant relationship with problem-focused coping. Agreeable individuals generally evocate fewer interpersonal conflicts and receive more social support, thus they are more likely to handle stressors with problem-focused coping (Carver & Connor-Smith, 2010). In addition, people with high conscientiousness are persistent, self-disciplined, organized, achievement-oriented, and deliberative. As one can expect, the proactive and disciplined features of this trait may facilitate problem-focused coping. From the biological perspective (Skinner & Zimmer-Gembeck, 2007), extraversion grounded in an approach temperament, strong approach tendency may promote initiation and persistence in problem-focused coping such as problem solving (Vollrath, 2001). Also, characteristics of openness to experience may facilitate problem-focused coping, such as problem solving and cognitive restructuring (Carver & Connor-Smith, 2010). In the second stage of the mediation analysis, no significant relationship was observed between problem-focused coping and adolescent IA. Although some studies have documented that adolescents with IA tend to use less problem-focused coping (Li & Lei, 2005; Wu, Wu, Yuan, Zheng, & Zheng, 2009), we and others have found a non-significant relationship between problem-focused coping and IA (Tang et al., 2014; Wang, Zhang, & Hua, 2012). One possible explanation is that the relation between problem-focused coping and IA is not robust and may partly depend on other yet to be carefully investigated factors such as online incentives or self-control (Wang et al., 2012). This explanation mirrors the view that although emotion-focused coping has a direct impact on psychopathology, the impact of problem-focused coping on psychopathology is often moderated by personal or environmental factors (Aldwin & Revenson, 1987; Zanini & Forns, 2014). Another explanation is that problem-focused coping may play both beneficial and adverse roles in Internet addiction, which cancel out each other. Specifically, problem-focused coping helps reduce or eliminate stressors in one's real life, which reduces the risk of IA. On the other hand, it may promote individuals' online social support seeking, which increases the risk of IA. Further research is needed to disentangle which of these explanations account for the present results.

Several limitations of the present study must be noted. First, our study was cross-sectional and cannot establish causal relationships. Although we were guided by theory and examined the impact of personality on coping and IA, it is also possible that one's coping style will shape the development of personality (Sturrock, Francis, & Carr, 2009). Therefore, future studies should use cross-lagged longitudinal designs to better delineate the relationships among personality, coping style, and IA. Second, all measures in this study were based on adolescent self-report. Although the "problem of shared variance" can be corrected for in multivariate analyses (Luthar, Crossman, & Small, 2015), future studies should use multi-method and multi-informant approaches to better replicate our findings. Third, although the adapted Internet Addiction Diagnostic

Questionnaire has been validated in previous studies (Chen et al., 2015; Li et al., 2013), the original tool (Young, 1996) has been criticized for its lack of a theoretical basis (Kuss, Shorter, et al., 2014). Therefore, future studies in this filed should use more theoretically-based tools such as the Generalized Problematic Internet Use Scale 2 (Pontes, Caplan, & Griffiths, 2016) to assess IA. Fourth, although general IA is worthy of studying (because different subtypes of IA share common characteristics), future research should test the links between big five personality and different subtypes of IA. Finally, our study was conducted in Chinese adolescent sample, the generalizability of the findings should be further verified with samples from other countries.

Despite these limitations, our findings have important practical implications. First, parents and teachers should pay attention to the differential roles of big five personality traits on adolescent IA: not only the beneficial impact of conscientiousness and agreeableness, but also the adverse impact of neuroticism. We should also be aware of the complex roles of extraversion and openness to experience in adolescent IA. Second, our findings can help practitioners understand pathways by which big five personality traits impact adolescent IA, suggesting a possible avenue for interventions. For example, reducing adolescent emotion-focused coping style through outreach programs may be an effective way to reduce adolescent IA.

Contributors

Yueyue Zhou wrote the first draft of the manuscript and conducted literature searches. Dongping Li designed the study, conducted statistical analyses and literature searches. Xian Li revised language and improved the manuscript substantially. Yanhui Wang and Liyan Zhao did vital work for the improvement of manuscript. All authors contributed to and have approved the final manuscript.

Conflict of interest

Authors declare that they have no conflicts of interest.

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