The Effect of MAOA Gene × Gender on the Relationship between Negative Network News Browsing Preference and Aggression among College Students

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Abstract

The present research aims to examine whether and how the negative network news browsing preference (NNNBP) affect individual’s aggression. Two studies were conducted in the current research: study 1 developed a new measurement scale—network news browsing preference questionnaire (NNBPQ). The results indicated it had appropriate reliability (Cronbach’s α = 0.93) and validity ($\chi^2/df = 1.92$, $CFI = 0.94$, $NFI = 0.89$, $GFI = 0.89$, $TLI = 0.94$, $RMSEA = 0.05$), which was conformed to psychometrics standards, and could be used for further study. Study 2 explored the relationship between NNNBP and aggression, and the moderate effect of MAOA gene × gender among 352 college students. The results indicated that: (a) NNNBP could positively predict male college students’ hostility and total score. It also could positively predict female college students’ physical aggression, verbal aggression, hostility and total score. (b) MAOA Gene × gender had moderate effect on the relationship between NNNBP and aggression; more specially, NNNBP could positively predict female G allele carriers’ physical aggression and hostility, while didn’t show significant under other conditions. Finally, the limitations and future prospects of the present research were discussed.

Key words: aggression; network news browsing preference; MAOA gene rs6323 polymorphism; gene × environment interaction; questionnaire development

1. Introduction

Aggression refers to intentional physical or psychological harm to others, which is a common behavior in human society (Crick & Grotpeter, 1995). As a problem behavior, aggression has
many serious negative influences on the mental and behavior health of the victims. Previous studies have indicated that aggression has had many adverse effects on individual’s mental health. For example, the victims may experience depression, social anxiety, low self-esteem, loneliness, sadness, fear, etc. (Broll, Dunlop, & Crooks, 2018; Wong & Mcbride, 2018; Gahagan, Vaterlaus, & Frost, 2016; Bauman, Toomey, & Walker, 2013; Balakrishnan, 2015). The deterioration of these psychological problems may lead to a series of negative consequences including suicide, sleep disorders, substance abuse, decreased academic performance, and tensions among family members (Wong & Mcbride, 2018; Bauman, Toomey, & Walker, 2013; Anderson, Bresnahan, & Musatics, 2014; Broll, Dunlop, & Crooks, 2018). Therefore, it is especially important to explore the influencing factors of aggression.

Compared to the large number of previous researches focused on the negative influences on individuals caused by violent media and online games, few studies have examined the relationship between network news browsing preference and aggression (Anderson & Bushman, 2010; Bushman & Huesmann, 2014; Elson & Ferguson, 2014). Different from violent media and online games, network news often has the characteristics of wider coverage. The report indicated that as of March 2020, the number of network news users in China reached 904 million, with Internet availability rate was 64.5%. The number of mobile network news users reached 897 million, accounting for 99.3% of mobile netizens (45th Statistical Report on the Development of Internet in China, April, 2020). As an important information dissemination platform of the internet, network news is getting more and more attention. Meanwhile, previous studies indicated that individuals have their own preference when browsing network news, such as negative network
news (Li & Su, 2014; Zhou, 2016; Hao & Zhang, 2018). The undesirable impacts of negative network news on society and individuals have gradually emerged (Cao, Zhang, & Zhang, 2012).

Individuals who are often exposed to negative news are more likely to form aggressive cognition and initiate aggressive behaviors. This phenomenon can be interpreted through the following perspective. Firstly, the Implicit Social Cognition theory stresses that implicit aggression is an unconscious structure that has been built up from individual experience. Negative cognition may trigger negative emotion, which is positively related with aggressive behavior. When individuals always browse network news related to aggression, it may automatically enhance their aggressive thoughts or behaviors through unconscious process (Huang, Li, & Ren, 2018). When individuals with aggressive schema encounters provocation or unfair treatment, aggressive behavior may be induced. Secondly, Social Learning Theory indicated that providing negative information is the important way that individuals form their aggressive behavior (Bandura, 1977). For example, a negative news reported a person murdered his roommate by throwing colorless, odorless, but harmful chemicals to his roommate’s bottle, and this method may be followed by those who want to revenge someone by a hidden mean. Therefore, we believe that there is a significant relationship between network news browsing preferences and aggression, and excessive negative news browsing experience may lead to more aggressive behaviors.

Previous studies indicated that both violent media (including violent game, violent video) and gene may influence individual’s aggressive behavior. Regarding the interaction between gene and environment (GxE interaction), the Diathesis-Stress model aims to reveal whether individuals carrying a certain genotype are more likely to have psychological or behavioral problems under unfavorable growth conditions, and considers that the genotype is a "bad genetic quality" or a
"risk gene" (Phelps, Belsky, & Crnic, 1998). Previous studies indicate that candidate genes like MAOA (Monoamine Oxidase A), DRD4 (D4 dopamine receptor), COMT (catechol-O-methyltransferase) are significantly related to individual’s aggressive behavior (Fresan et al., 2007; Caspi et al., 2002; Albaugh et al., 2010). As an important candidate gene related to aggression, the MAOA gene is located on the X chromosome and plays an important role in monoamine metabolism, such as dopamine (DA), norepinephrine (NE), and 5-hydroxytryptamine (5-HT). Meanwhile, the mutation in the 8th exon of the MAOA gene may directly lead to aggression. Studies indicated that MAOA gene has a significant association with aggression (Frazzetto et al., 2007; Newman et al., 2005; Pingault et al., 2013; Craig & Halton, 2009), antisocial behavior (Lee, 2011; Kimcohen et al., 2006; Wakschlag et al., 2010; Widom & Brzustowicz, 2006; Ducci et al., 2008) and behavioral malady (Delinquency, Aslund et al., 2011; Edwards et al., 2010). Therefore, MAOA has been called “aggression gene” or “evil gene”. In addition, Caspi et al. (2002) found that the life experience of child abuse can interacted with MAOA gene as far as aggression is the dependent variable. Therefore, it is more vital that gene often interacts with environmental factors to jointly influence the generation and development of individuals’ aggression (Cao, 2016).

Furthermore, with the development of molecular genetic research, some researchers believe that gender is an important factor in moderating the relationship between genes and aggressive behavior (Prom-Wormley et al., 2009). For example, previous researches indicated that the interaction of the MAOA-H allele with early negative environmental factors only predicted the emergence of antisocial or aggressive behavior in the female sample (Aslund et al., 2011; Wakschlag et al., 2010). In the framework of molecular genetics, this study aims to explore the
relationship between MAOA gene rs6323 polymorphism and network news browsing preference on college students’ aggression, and further to investigate the moderation effect of gender.

Overall, this study has two objectives. Study 1 aims to develop a questionnaire to measure college students’ Negative Network News Browsing Preference (NNBP). Study 2 aims to explore the relationship between college students’ negative network news browsing preference (NNBP) and aggression, and the effect of MAOA gene rs6323 polymorphism and gender.

2. Study 1: Development of NNBPQ

As mentioned above, previous studies have focused on the outcome of playing violent games on the network, and found its negative influence; but few involved network news. Different from violent games, network news often has the characteristics of wider coverage and deeper influence, with no gender difference. From our knowledge, there was no instrument to measure NNBP, though it is a valuable issue. In order to promote the further research of this field, the NNBPQ was developed based on previous research and college students’ habit of browsing network news.

2.1. Method

2.1.1. Design

In this case study, items of questionnaire were screened at the first stage. Then the questionnaire was reviewed by relevant experts for content validity. After that, two tests were administrated through the questionnaire. In pilot test, item analysis was made with the obtained results and an exploratory factor analysis (EFA) was also carried out. In formal test, a confirmatory factor analysis (CFA) was applied to prove its structural fitness; while, the Cronbach alpha coefficient was computed to show the internal consistency of the questionnaire.

2.1.2. Items
All data were collected from a professional website (www.wjx.cn). We first conducted a simple survey to acquire news websites (e.g., TopBuzz, Sina News) that college students often browse. Next, we chose news from those websites as items of the initial questionnaire. Then college students were asked to finish this initial questionnaire, to choose which news they prefer to browse. Finally, the negative and positive news items were obtained.

The questionnaire was based on a Likert format (Likert, 1974) with five answer options, which is “almost never concerned” (1), “not concerned” (2), “uncertain” (3), “concerned” (4), and “very concerned” (5). It includes 17 items of negative news and 8 items of positive news.

2.1.2.1. Content validation

Before applying the survey to the sample, it was decided to carry out a content validation process by two psychology experts, two journalism professors and four psychology doctors; and all the items were checked by them. These experts evaluated the items for their clarity, importance, and relevance. They were also asked to point out any content errors and make improvements they considered necessary. Based on the experts’ comments and feedback, some changes were made in word choices and sentence structure to improve the quality of the items. Finally, a relatively whole initial version of the questionnaire was formed. The questionnaire contains the items shown in Table 1.
### Table 1.

| Item                                      | Almost never concerned | not concerned | uncertain | concerned | very concerned |
|-------------------------------------------|------------------------|---------------|-----------|-----------|----------------|
| 1. public figure scandal                   | 1                      | 2             | 3         | 4         | 5              |
| 2. animal abuse                            | 1                      | 2             | 3         | 4         | 5              |
| 3. fraud / touch porcelain / swearing      | 1                      | 2             | 3         | 4         | 5              |
| 4. fire/explosion                          | 1                      | 2             | 3         | 4         | 5              |
| 5. sexual abuse                            | 1                      | 2             | 3         | 4         | 5              |
| 6. domestic violence                       | 1                      | 2             | 3         | 4         | 5              |
| 7. professional discrimination             | 1                      | 2             | 3         | 4         | 5              |
| 8. industry shady                          | 1                      | 2             | 3         | 4         | 5              |
| 9. sexism                                  | 1                      | 2             | 3         | 4         | 5              |
| 10. child abuse                            | 1                      | 2             | 3         | 4         | 5              |
| 11. infringement                           | 1                      | 2             | 3         | 4         | 5              |
| 12. sexual orientation discrimination      | 1                      | 2             | 3         | 4         | 5              |
| 13. theft of property                      | 1                      | 2             | 3         | 4         | 5              |
| 14. child trafficking                      | 1                      | 2             | 3         | 4         | 5              |
| 15. disruption of public order             | 1                      | 2             | 3         | 4         | 5              |
| 16. suicide and self-mutilization          | 1                      | 2             | 3         | 4         | 5              |
| 17. fights                                 | 1                      | 2             | 3         | 4         | 5              |
| 18. social welfare                         | 1                      | 2             | 3         | 4         | 5              |
| 19. anti-crime act                         | 1                      | 2             | 3         | 4         | 5              |
| 20. passionate in one's job                | 1                      | 2             | 3         | 4         | 5              |
| 21. Support the elderly                    | 1                      | 2             | 3         | 4         | 5              |

*Note: 1-17 represents the items of negative network news; 18-21 represents the items of positive network news.*

#### 2.1.3. Data analysis

A validity and reliability analysis is included to analyze the psychometric properties of the tool presented. In order to evaluate the contribution of each item to the scale total, item-total score correlation indices were analyzed. With regard to factor validity, prior conditions for factor analysis were checked (Hernandez-Ramos et al., 2014): Barlett test; KMO index. The most suitable extraction method technique was applied: EFA using the principal component method, and CFA with maximum likelihood estimation (MLE). For reliability analysis, the Cronbach alpha
coefficient was calculated, to check scale internal consistency. All the analyses were carried out using IBM SPSS 23.0 and IBM SPSS Amos 17.0 statistics software.

2.2. Pilot test

2.2.1. Participants

In the pilot test, the initial sample consisted of 240 college students aged between 16 and 25 years. The valid sample consisted of 229 students (59.35% women, 40.65% men) with a mean age of 19.15(SD = 1.07).

2.2.2. Item analysis

When items have a very low discrimination index (<0.3), as these items have a very low correlation with the rest of the total scores on the scale, the items should be considered the possibility of eliminating them (Ping, Han, & Zhou, 2012). In Table 2, we can conclude that all item-total correlation indices of NNNBP are between 0.48 and 0.76, of PNNBP (positive network news browsing preference) are between 0.33 and 0.73, which means that the scale has achieved good discrimination, no items need to be eliminated.

Table 2.

| Item | M   | SD  | r     | Item | M   | SD  | r     | Item | M   | SD  | r     |
|------|-----|-----|-------|------|-----|-----|-------|------|-----|-----|-------|
| N01  | 3.02| 1.09| .478**| N10  | 3.70| 1.03| .721**| P02  | 3.26| 1.01| .327**|
| N02  | 3.34| 1.08| .610**| N11  | 3.31| .97 | .720**| P03  | 3.10| .99 | .593**|
| N03  | 3.36| 1.00| .719**| N12  | 3.40| 1.14| .619**| P04  | 3.11| 1.00| .651**|
| N04  | 3.36| 1.00| .725**| N13  | 2.83| .96 | .625**| P05  | 3.24| .98 | .648**|
| N05  | 3.52| .99 | .713**| N14  | 3.56| 1.01| .724**| P06  | 3.81| .96 | .575**|
| N06  | 3.45| 1.03| .762**| N15  | 3.14| .90 | .693**| P07  | 3.39| 1.00| .730**|
| N07  | 3.17| 1.02| .622**| N16  | 2.91| 1.07| .633**| P08  | 3.24| .95 | .724**|
| N08  | 3.68| .95 | .598**| N17  | 2.63| .97 | .575**| N total| 55.91| 11.67| .971**|
| N09  | 3.55| 1.02| .696**| P01  | 3.22| .91 | .664**| P total| 26.37| 5.53 | .864**|

Note: N= negative network news; P= positive network news; r: correlation item-total.

2.2.3. Exploratory Factor Analysis (EFA)

EFA is a multivariate statistical technique used mainly to specify the underlying structure in a
data matrix. It is commonly used by researchers when developing a new scale. From Table 3, it can be seen that all items had excellent or very good loadings on a single factor which values above 0.4, reached an acceptable range (Field, 2013).

**Table 3.** Factor analysis component matrix.

|     | Component 1 | Component 2 |
|-----|-------------|-------------|
| N01 | .461        |             |
| N02 | .488        |             |
| N03 | .620        |             |
| N04 | .552        |             |
| N05 | .734        |             |
| N06 | .721        |             |
| N07 | .637        |             |
| N08 | .552        |             |
| N09 | .773        |             |
| N10 | .768        |             |
| N11 | .661        |             |
| N12 | .685        |             |
| N13 | .581        |             |
| N14 | .665        |             |
| N15 | .636        |             |
| N16 | .659        |             |
| N17 | .540        |             |
| P01 | .508        |             |
| P02 | .617        |             |
| P03 | .663        |             |
| P04 | .741        |             |
| P05 | .742        |             |
| P06 | .671        |             |
| P07 | .557        |             |
| P08 | .591        |             |

*Note:* Extraction by principal components. N= negative network news; P= positive network news.

2.3. **Formal test**

2.3.1. **Participants**

In formal tests, the initial sample consisted of 400 college students aged between 17 and 24 years. The valid questionnaire consisted of 347 students (57.6% women, 42.4% men) with a mean age of 19.14($SD = 0.94$).
2.3.2. Construct validity

CFA, the other form of factor validity analysis aimed at testing whether the data fit a hypothesized measurement model. This hypothesized model is based on theory and/or previous analytic approach (Byrne, 2013); in the present study, the confirmatory analysis was based on the previous exploratory results. Several goodness-of-fit tests were applied to evaluate the model fit of each model (i.e., relying on fit indices that have different measurement properties; Jackson, Arthur, & Purc-Stephenson, 2009). The root mean square error of approximation (RMSEA), comparative fit index (CFI), and Tucker-Lewis index (TLI) were used as these are the most widely accepted (Brown & Moore, 2012) and most commonly reported measures of fit (Jackson et al., 2009).

![Figure 1. Confirmatory factor analysis standardized solution of NNBPOQ.](image)

N= negative network news; P= positive network news.

With regard to the fact loadings (Fig. 1), we find adequate values for all the items. Given the sensitivity of Chi Squared to the lack of normality of some of the variables (Tejedor et al., 2009), we can resort to the freedom ratio $\chi^2/df$, which reaches acceptable values 2.132(Schreiber et al., 2012).
2006). On the other hand, the RMSEA points to acceptable values 0.05(<0.08). As for the incremental fit of the unifactorial model being tested, CFI is the one normally used, because it compares several fit coefficients (Rodríguez Conde et al., 2012), and 0.96 obtained indicates good fit. Finally, TLI compares fit by freedom degree of the model proposed and the null model, and 0.95 obtained indicates positive goodness of fit. The results present high validity, which is conformed to psychometrics standards.

2.3.3. Reliability

Reliability is an indicator of internal consistency, for which Cronbach alpha coefficient is applied. This statistic evaluates the degree of harmonization between the items of the scale. The fact that good reliability indices were obtained indicates that the measuring tool is precise and that it shows results, which are consistent in the different applications. The Cronbach’s α coefficient of NNNBP and PNNBP is 0.88 and 0.95 respectively, and of the total questionnaire is 0.96, as they are higher than 0.7 can be considered valid, indicating high internal consistency (Zhang & Huang, 2014).

2.4. Discussion

The main purpose of this study was to develop and validate an instrument for measuring college students’ NNBP. This is the first questionnaire that examines NNBP from a comprehensive perspective. The results showed a structure composed of two factors with acceptable internal consistency coefficients. With regard to reliability, after selecting the most consistent items both on a theoretical and empirical level, by means of item analysis and EFA, a highly acceptable Cronbach’s α value was obtained. As for validity, content validity is guaranteed
by the carrying out of a sound validation process by experts in the field. In CFA, the acceptable fit indices were obtained. Therefore, the research aims would seem to be satisfactory.

In conclusion, given the psychometric characteristics discussed, we consider that we have achieved our objective to create a valid and reliable instrument to assess the NNBP under Chinese context. Then, the NNBPQ was used in the next study.

3. Study 2: The effect of MAOA Gene × gender on the relationship between NNNBP and aggression

To our knowledge however, no studies have directly explored the relationship between NNNBP, MAOA Gene rs6323 polymorphism and aggression. Considering the adverse effects of NNNBP and MAOA Gene rs6323 polymorphism on college students’ aggression, the present study was aimed to explore how the MAOA gene and gender moderate the relationship between NNNBP and college students’ aggression under the theory of G × E interaction. The following hypotheses were proposed:

H1. NNNBP could positively predict individual’s aggression;

H2. MAOA Gene rs6323 polymorphism could moderate the association between NNNBP and aggression;

H3. Gender could moderate the association between NNNBP and aggression.

3.1. Materials and Methods

3.1.1. Participants

A total of 352 college students from Shandong Province were invited to participate in the test, and 15 of them were eventually excluded because of unfinished questionnaires or refused to participate in genetic testing. A total of 337 (95.9%) valid data were obtained. Among them,
137(40.7%) are males and 200(59.3%) are females. Their age range is 18-21(\(M = 19.14, SD = 0.93\)).

3.1.2. Measures

The Chinese version of aggression questionnaire (AQ) was used to test college students’ aggression. It includes 5 subscales: Physical Aggression (PHY), Verbal Aggression (VER), Indirect Aggression (IND), Anger (ANG), and Hostility (HOS). A total of 34 items were scored with 5 points (1 “not like me at all” - 5 “almost like me”), and the higher the score, the higher the level of aggression. CFA was applied to the questionnaire and the results were satisfactory: \(\chi^2/df = 1.90\), \(CFI = 0.87\), \(NFI = 0.76\), \(GFI = 0.86\), \(TLI = 0.85\), \(RMSEA = 0.05\). The Cronbach’s alpha coefficients of each subscale were 0.74 for physical aggression, 0.63 for verbal aggression, 0.62 for indirect aggression, 0.70 for anger and 0.73 for hostility. The Cronbach’s alpha coefficient of the total scale was 0.91.

Meanwhile, the developed NNBPQ was applied to college students to test their preference on negative and positive network news.

3.1.3. Genetic Testing

DNA was extracted by saliva sampling. The DNA extraction and typing instruments are Pico17 microcentrifuge (Thermofisher), ST16R high-speed refrigerated centrifuge (Thermo Sorvall), PCR instrument (c1000 Touch, BioRad), Mass Array TM Nanodis Penser (AGENA), Mass. ARRAY compact System (AGENA), G384+10 spectrohip TM (AGENA), and pipetting gun (Gilson).

DNA extraction and typing reagents are N96 Swab Genomic DNA kit (TIANGEN), Hotstar Taq DNA polymerase (1000 U) (including 4x250 units Hotstar Taq DNA Polymerase, 10xPCR
Buffer, 25Mm Mg Cl2, AGENA), iPlex Reagent Kit (including 10×SAP Buffer, IU/u L SAP enzyme, 10×i Plex Buffer, iPlex Termination mix, iPlex enzyme, AGENA), Clean Resin (AGENA), d NTP Mixture (AGENA).

The SNP classification was completed by a medical laboratory inspection company in Shanghai using the Mass ARRAY system of AGENA of the United States. All DNA samples that need to be typed are diluted to 5 ng/μL, and 1 μL of DNA sample is taken with 1.800 μL of water, 0.400 μL of PCR buffer (containing 20 m MgCl2), 0.1 μL of 25 m d NTP, 0.400 μL of 25 m Mg Cl2, 1 μL of PCR primer solution and 0.2 μL of Hot Star Taq enzyme (Agena). The MAOA gene rs6323 polymorphism was used as a candidate gene locus. The genetic locus information was determined by SNP detection. The PCR primer design was as follows:

F: ACGTTGGATGTGACTTAAATGACAGTCCC,
R: ACGTTGGATGGATTCCTCAGACAAGAGC.

PCR reaction conditions: 94°C for 2 minutes; 94°C for 30 seconds, 56°C for 30 seconds, 72°C for 1 minute, a total of 45 cycles; finally, 72°C for 5 minutes. After PCR amplification, the remaining dNTPs will be digested by dephosphorylation. The reaction system includes 1.53 μL of water, 0.17 ul of SAP buffer, and 0.3 units of alkaline phosphatase (AGENA). The reaction was carried out at 37°C for 40 minutes and then at 85°C for 5 minutes to inactivate the enzyme. After alkaline phosphatase treatment, single base extension primers for SNP were performed in the following reaction system: 0.7395 μL water, 0.2 μL 10×i PLEX buffer, 0.1 μL stop mixture, 0.0205 μL i PLEX enzyme (AGENA), 0.940 ul 10u M extension primer. The single base extension reaction was carried out under the following conditions: 94°C for 30 seconds, 94°C for 5 seconds, 52°C for 5 seconds, 80°C for 5 seconds for 5 cycles, for a total of 40 cycles; and finally, 72°C for 3 minutes.
6 mg of cation exchange resin (AGENA) was added to the termination reaction to desalt, and after mixing, 20 μL of water was added to suspend. The final typed product was spotted onto a 384-well spectro CHIP (AGENA) using Mass ARRAY Nanodispenser (AGENA) and analyzed by matrix-assisted laser desorption ionization time-of-flight mass spectrometry. The final results were read in real time by the Mass ARRAY RT software system (version 3.0.0.4) and genotyping was performed by the Mass ARRAY Typer 4.0 software system.

3.1.4. Procedure

First, all the participants were informed by their teachers not to eat, smoke, drink or chew gum within 30 minutes before the test. The students were then assembled in a large classroom for testing. A total of 6 highly trained examiners (2 doctors and 4 masters in psychology) collected saliva samples from the participants by using the DNA sample collection packages (containing one sampling swab, one sampling tube, one sealed bag and three QR code barcodes for remarking the participant number). All the packages were collected and checked at the end of the test. Then, all the students completed the NNBPQ and the AQ through the www.wjx.cn (a Chinese professional questionnaire website). All testing procedures lasted approximately 35 minutes. All questionnaires and saliva extraction were carried out on the premise of obtaining informed consent from students and college ethics committee. The protocol was approved by the Ethics Committee of Shandong Normal University in China. All participants gave written informed consent forms for participation. Participants older than 18 years old received informed consent from themselves whereas participants younger than 18 years old received informed consent from their parents.

3.1.5. Statistical Analysis

Firstly, SHEsis software was used to test whether the MAOA gene rs6263 polymorphism
consistent with Hardy-Weinberg equilibrium law. Secondly, correlations were computed between these variables. Finally, hierarchical regression was used to test the relationship between the MAOA gene rs6263 polymorphism and NNNBP on college students’ aggression with PNNBP was treated as a control variable.

3.2. Results

3.2.1. Genotypic distribution of MAOA gene rs6323 polymorphism

Previous studies have showed that this gene locus is associated with the X chromosome gene, so only the results of the Hardy-Weinberg equilibrium need to be reported in the female sample. The results ($\chi^2 = 1.23, p = 0.27$) are in accordance with the Hardy-Weinberg equilibrium law. The number of males’ carriers of GG and TT genotypes were 70 and 67, and the number of females’ carriers of GG, TT and GT genotypes were 74, 37 and 89. Previous studies in the female sample indicated that the MAOA gene acts in a similar way to low-activity genotypes (Sjoberg et al., 2007). This study, consistent with previous studies, combined females’ GT heterozygotes with low-activity TT homozygotes (TT & GT: 126) (Frazzetto et al., 2007).

3.2.2. Correlation Analysis

The correlation matrix (Table 4) showed that NNNBP is positively correlated with hostility ($r = 0.124, p < 0.05$). PNNBP is negatively correlated with physical aggression ($r = -0.125, p < 0.05$) and indirect aggression ($r = -0.120, p < 0.05$). The total score of the aggression is positively correlated with its subscales as well as all the subscales are positively correlated with each other.
**Table 4.** correlation matrix of all variables.

|       | rs6323 | NNNBP   | PNNBP | AGG   | PHY   | VER   | IND   | ANG   | HOS   |
|-------|--------|---------|-------|-------|-------|-------|-------|-------|-------|
| rs6323| 1      |         |       |       |       |       |       |       |       |
| NNNBP | -0.020 | 1       |       |       |       |       |       |       |       |
| PNNBP | -0.029 | 0.718** | 1     |       |       |       |       |       |       |
| AGG   | 0.023  | 0.056   | -0.075| 1     |       |       |       |       |       |
| PHY   | 0.024  | -0.024  | -0.125*| 0.761**| 1     |       |       |       |       |
| VER   | 0.004  | 0.087   | 0.023 | 0.678**| 0.389**| 1     |       |       |       |
| IND   | -0.035 | -0.018  | -0.120*| 0.803**| 0.509**| 0.509**| 1     |       |       |
| ANG   | 0.026  | 0.053   | -0.006| 0.812**| 0.489**| 0.530**| 0.569**| 1     |       |
| HOS   | 0.061  | 0.124** | -0.028| 0.781**| 0.434**| 0.427**| 0.580**| 0.601**| 1     |

*Note: AGG = Aggression, PHY = Physical Aggression, VER = Verbal Aggression, IND = Indirect Aggression, ANG = Anger, HOS = Hostility.*

\[**p < 0.01, *p < 0.05.\]

3.2.3. The main effect of MAOA gene and NNNBP on college students’ aggression

The main effect of MAOA gene on male and female college students’ aggression was all explored and the results indicated that it can positively predict male verbal aggression and negatively predict female indirect aggression.

The NNNBP can significantly positively predict the male total score of aggression and hostility, and it can also positively predict the female total score of aggression, physical aggression, verbal aggression and hostility.

3.2.4. The interaction between MAOA gene rs6323 polymorphism and NNNBP on college students’ aggression

The MAOA gene rs6323 polymorphism interacts with the NNNBP on female college students’ physical aggression and hostility (see Table 5). Further simple slope test indicated that the NNNBP positively predicts physical aggression \((\beta = 0.185, \ t = 3.589, \ p < 0.001)\) and hostility \((\beta = 0.223, \ t = 4.080, \ p < 0.001)\) on female G allele carriers, but did not significantly predict physical aggression \((\beta = 0.059, \ t = 1.077, \ p > 0.05)\) and hostility \((\beta = 0.106, \ t = 1.838, \ p > 0.05)\) in
female T allele carriers (see Fig. 2).

Table 5. Hierarchical Regression Analysis of College Students’ Aggression on MAOA gene rs6323 Polymorphism and NNNBP.

| subscale          | gender | predictor                  | b    | SE   | β     | ΔR²  | △F   |
|-------------------|--------|----------------------------|------|------|-------|------|------|
| Total score       | male   | rs6323 × negative news     | .014 | .262 | .007  | .000 | .003 |
|                   | female |                           | .393 | .266 | .156  | .010 | 2.182|
| Physical Aggression| male   | rs6323 × negative news     | .011 | .063 | .023  | .000 | .031 |
|                   | female |                           | .130 | .064 | .213* | .019 | 4.087*|
| Verbal Aggression | male   | rs6323 × negative news     | -.015| .043 | -.046 | .001 | .124 |
|                   | female |                           | .025 | .052 | .051  | .001 | .228 |
| Indirect Aggression| male   | rs6323 × negative news     | -.057| .051 | -.142 | .009 | 1.271|
|                   | female |                           | .045 | .052 | .093  | .004 | .745 |
| Anger              | male   | rs6323 × negative news     | .034 | .060 | .074  | .002 | .323 |
|                   | female |                           | .016 | .069 | .026  | .000 | .058 |
| Hostility          | male   | rs6323 × negative news     | .003 | .069 | .005  | .000 | .001 |
|                   | female |                           | .156 | .068 | .237* | .024 | 5.209*|

Note: *p < 0.05.

Figure 2. Interactions between MAOA gene rs6323 polymorphism and negative network news browsing preference on female college students’ physical aggression and hostility.

3.3. Discussion

3.3.1. The main effect of NNNBP on college students’ aggression

The results of regression analysis indicated that both male and female college students who frequently browse negative news on the Internet may be more negative, have more distrust of society and others, and thus generate more hostility or particular type of aggression. For example, Hao and Wang (2018) found that negative news browsing preference is negatively correlated with doctor-patient trust based on the research of network news big data and CSS2013(2013 China
Social Situation Comprehensive Survey). These results are consistent with both hypotheses and previous studies. Some researchers have indicated that individuals prefer to browse negative network news, and excessive browsing of these negative content is harmful to the development of individual social trust and altruistic behavior (Zhou, 2016). However, there are few studies exploring the relationship between NNNBP and aggression. The present study innovatively focuses on the relationship between NNNBP and aggression and found the significant relationship, which may provide some implications for future studies.

3.3.2. The interaction between MAOA gene and gender on NNNBP and aggression

The GAM indicates that environmental and individual factors interact with individual cognition, and then trigger individual aggressive behavior (Anderson, & Bushman, 2003). Many studies have indicated that environmental variables like negative life situations, violent games can interact with personality factors and finally lead to individual’s aggression (Bushman, & Anderson, 2002; Anderson, & Bushman, 2010). However, this study found that the MAOA gene rs6323 polymorphism can interact with NNNBP, and this interaction can affect the specific aggression behavior of female college students. This result indicates that, not only negative life situations and violent games can lead to individual’s aggression, but also the environmental variables that college students often experience, that is, NNNBP will also interact with gene and have an impact on individual’s aggression.

This study only found the existence of interaction in female college students, which may be caused by the different patterns of the same gene’s influence on the psychology and behavior of male and female. For example, the MAOA high activity allele increases the risk of male engaging in antisocial behavior (Caspi et al., 2002), while the MAOA low activity allele increases the risk
of female engaging in antisocial behavior (Ducci et al., 2008). Besides, the moderating effect of the brain may also lead to this phenomenon. According to Raine (2008) "Gene-Brain-Antisocial Behavior" model, genes can cause changes in the structure and function of certain brain regions, which further affect the individual’s cognition, emotion and behavior, thus leading to the occurrence of antisocial behavior. For example, Chen et al. (2004) autopsy of 118 subjects found that the activity of COMT in the prefrontal lobe of the male brain was 17% higher than that of the female brain. Therefore, it may be that there are gender differences in the association between MAOA gene and brain structure and function, which leads to gender specificity.

4. General Discussion

With the proliferation of the Internet, the dark side of the internet using emerges. Previous study focused on the negative influence of network game, particularly violent game. However, there is a dearth of research on the specific impact of network news browsing, especially negative network news browsing. Therefore, the main purpose of this study was to advance the knowledge in this research area by studying the relationships between negative news network browsing preference and aggression behavior in the sample of college students, also introduce gene variable (MAOA gene rs6323 polymorphism) to probe environment and gene interaction in aggression behavior.

The first aim of this research was to develop and validated a new questionnaire of NNBPQ, which can be used to test college students’ preference when browsing network news. Following a formal developed process, a NNBPQ including two dimensions (NNNBP and PNNBP) was developed, which had good reliability and validity, and met the psychometric standards. At the applied level, this instrument provides a useful tool to measure the impact of negative network
news; to define different types of negative network news; further to design effective intervention plans with other variables taking into account.

Building on previous studies examining G×E effects on aggression, in study 2 we investigated the relationship between NNNBP and aggression, and the moderating role of MAOA gene rs6323 polymorphism. Meanwhile, G×E interaction model was used as a framework to examine whether individuals carrying a certain genotype are more likely to have psychological or behavioral problems under unfavorable growth conditions. As expected, the results indicate that both male and female college students who frequently browse negative news on the Internet may be more negative, and thus generate more aggression.

With the development of behavioral genetics, the problem of the interpretation rate of genes and G×E interactions has gradually attracted the attention of more and more researchers. Another important finding of our study is that the MAOA gene rs6323 polymorphism could interact with NNNBP on college students’ aggression; namely, NNNBP can positively predict female G allele carriers’ physical aggression and hostility. It provides evidence that support the Diathesis-Stress model, which holds that individuals carrying a certain genotype are more likely to have psychological or behavioral problems under unfavorable growth conditions (Phelps et al., 1998).

Taken together, this research not only innovatively explored the relationship between the vital environmental variables of NNNBP and aggression, but also verifies applicability G×E interaction on the network and expands its application range. Briefly speaking, the current research offers a useful instrument to test college students’ NNBP, and it also provides empirical evidence for our understanding of the relationship between NNNBP, MAOA, gender and aggression.

4.1. Limitation and future direction
It is also important to consider the limitations of the present research. First, sampling limitations existed in both study 1 and 2. Since sampling is only carried out among college students, it brings about the problem of promotion limitations. Specifically, the NNNBP of different age groups are quite different. For example, middle school students are less likely to browse network news and be affected because of their heavy study pressure. Older individuals gradually recognize the responsibility behind aggression and thus take less aggressive behaviors. Therefore, the interaction pattern of MAOA gene rs6323 polymorphism and NNNBP in other groups will also have its unique mechanism. Future study should pay more attention to the study of other age groups, especially the interaction model between genes and network variables in primary and secondary schools.

Although we found that the MAOA gene rs6323 polymorphism could significantly positively predict male college students’ verbal aggression and negatively predict female college students’ indirect aggression, the interpret rate of rs6323 polymorphism and network news browsing preferences on female college students’ physical attacks and hostility is relatively small. This may be because the subjects selected in this study are all normal college students, and their aggressive behavior may not be as much weighted as genetic and G×E interactions as violent or mentally ill patients. On the other hand, human problem behavior may be more susceptible to more complex interactions between multiple genes and the environment, rather than just the interaction of a single gene with the environment. Nevertheless, the results of this study indicate that female college students’ physical aggression and hostility have specific mechanisms, i.e., the MAOA gene rs6323 polymorphism and network news browsing preferences only interact with physical
aggression and hostility. We will further examine the interaction between multiple genes and the environment in the future study.

In addition, the results of this study also indicated that the NNNBP positively predict the female G allele carriers’ physical aggression and hostility. However, there is an unknown relationship between female G allele carriers’ physical aggression and hostility. Future research can further investigate whether female G allele carriers’ physical aggression are caused by their high hostility.

4.2. Implication

We suggest that society, school and students should take some measures to decrease the occurrence of NNNBP. First, society and school should control the channel of students’ negative network news browsing, specifically, society should try to report less negative news, while school should correctly guide college students’ network news browsing preferences. Second, according to the result of our research, school should pay more attention to female G allele carriers who are more likely to formulate physical aggression and hostility when exposed to negative network news. Third, as for the students, they should understand the negative impacts of browsing negative network news having individual difference, adopting active adjustment strategies when suffered from negative network news.
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**Author contributions**

FG and PW are the research designers. ZG is in charge of writing. XZ and JW analyzed the data. HS, YY and YS revised the manuscript. All authors contributed to the article and approved the submitted version.

**Additional Information**

**Competing Interests:** The authors declare that they have no conflicts of interest.

**Ethical approval:** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.