The association between romantic relationship status and 5-HT1A gene in young adults

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What factors determine whether or not a young adult will fall in love? Sociological surveys and psychological studies have shown that non-genetic factors, such as socioeconomic status, external appearance, and personality attributes, are crucial components in romantic relationship formation. Here we demonstrate that genetic variants also contribute to romantic relationship formation. As love-related behaviors are associated with serotonin levels in the brain, this study investigated to what extent a polymorphism (C-1019G, rs6295) of 5-HT1A gene is related to relationship status in 579 Chinese Han people. We found that 50.4% of individuals with the CC genotype and 39.0% with CG/GG genotype were in romantic relationship. Logistic regression analysis indicated that the C-1019G polymorphism was significantly associated with the odds of being single both before and after controlling for socioeconomic status, external appearance, religious beliefs, parenting style, and depressive symptoms. These findings provide, for the first time, direct evidence for the genetic contribution to romantic relationship formation.

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I n the 1980's, student romantic relationships were prohibited in Chinese universities. Nowadays such restrictions are long gone, yet many students (as many in American or European schools) stay single. What factors determine whether a young adult falls in love? Sociological surveys show that an individual's demographics and personal attributes, such as socioeconomic status and external appearance, partly determine dating opportunities[1]. Psychological research shows that personality traits, such as secure attachment orientation and optimism, are also crucial in romantic relationship formation[2,3]. Here we demonstrate that genetic variants also contribute to the formation of romantic relationships.

Love-related behaviors, such as pair bonding and affective affiliation, are shown to be associated with the serotonin levels in the brain[4–9]. In non-human animals, decreasing serotonin levels via 5-HT1A receptor agonists diminishes female sexual receptivity and induces aggression towards male mates[6,8]. The G allele of the C-1019G (rs6295) polymorphism, which leads to higher expression of 5-HT1A gene, is related to higher serotonin levels. Given that the distribution of genotypes by gender. As Table 1 shows, we found that 50.4% of individuals with the CC genotype were in a relationship. We combined CG and GG (5.7%) and because the likelihood for being single in the GG genotype was significantly associated with an increase genotype, odds ratio = 1.59, 95% CI = [1.13, 2.24]. The distribution of the genotype and relationship status,

$$x^2 = 7.139, p = .008.$$

To make sure that the effect of genotype on relationship status survived even when we partialed out non-genetic factors such as the contributions of socioeconomic status, external appearance, religious beliefs, parenting style, and depression, we collected data concerning parents' levels of education, parents' occupation, household income, average monthly expenditure, height, body mass index (BMI), religious beliefs, perceived mother's and

father's parenting styles, and depressive symptoms, and entered them as control variables into the logistic regression (see . M). The logistic model which included both genotype and control variables as predictors was more effective in predicting relationship status than the model which included only control variables, as revealed by the likelihood ratio test, $\chi^2 = 6.314$, $= 1$, $= .012$. The former model revealed a significant association between the C-1019G polymorphism and relationship status, $B = .450$, $E = .180$, $= 1$, Wald's $\chi^2 = 6.249$, $= .012$, odds ratio = 1.569. The Nagelkerke ^{2} change index showed that 1.4% of the variance in the log odds of being single could be explained by the C-1019G polymorphism. To sensibly interpret the odds ratios of the polymorphism, we also examined whether the genotype interacted with the predictors that were significant in the logistic model[10]. No significant interactions were observed, all $> .20$.

To confirm the above analyses, we also derived the predicted probabilities of being single for different genotypes from the logistic regression equation, after controlling for other variables (see . M Table S5). Figure 1 shows that the predicted probability for CG/GG carriers was significantly higher than that for CC carriers, $(572) = 12.73$, $< .001$.

Discussion

Individuals carrying the G allele (CG/GG) of C-1019G polymorphism were more likely to be single than CC carriers. This is consistent with the finding that G allele carriers are less comfortable in close relationships with others[9]. Indeed, G allele carriers are more likely to develop neurotic personalities[11] and psychiatric disorders such as major depression[12,13] and borderline personality disorder[14]. As pessimism and neuroticism are detrimental to the formation, quality, and stability of relationships[3,15], this connection between G allele and psychological disorders might decrease carriers' dating opportunities or lead to romantic relationship failure. Given that the G allele is

13. Lemonde, S. _et al._ Impaired repression at a 5-hydroxytryptamine 1A receptor gene polymorphism associated with major depression and suicide. _J. N ._ **23**, 8788–8799 (2003).
14. Joyce, P. R., Stephenson, J., Kennedy, M., Mulder, R. T. & McHugh, P. C. The presence of both serotonin 1A receptor (HTR1A) and dopamine transporter (DAT1) gene variants increase the risk of borderline personality disorder. _F . G ._ **4**, 313 (2014).
15. Lehnart, J. & Neyer, F. J. Should I stay or should I go? Attachment and personality in stable and instable romantic relationships. _E . J. P ._ **20**, 475–495 (2006).
16. Walum, H. _et al._ Genetic variation in the vasopressin receptor 1a gene (AVPR1A) associates with pair-bonding behavior in humans. _P . N . A . A. A._ **105**, 14153–6 (2008).

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