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The interaction of *DRD2* and parenting style in predicting creativity☆

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ABSTRACT

The present study examined the interaction of dopamine D2 receptor gene (*DRD2*) and parenting style on creativity. Participants were 427 Chinese undergraduate students from a project designed to identify the genetic basis of creativity. The result showed that there was significant interaction between *DRD2* and authoritarian parenting when predicting creativity. Specifically, it was found that the negative effect of mother/father authoritarianism on creativity was only present when individuals were carriers of *DRD2* Del (rs1799732) allele. No significant interaction of *DRD2* and authoritative or permissive parenting was found. In conclusion, the present study provides the first preliminary evidence for the effect of *DRD2*-parenting interaction on creativity; future studies are warranted to validate these findings.

1. Introduction

Creativity refers to the ability to produce something that is both novel and useful (Sternberg & Lubart, 1999; Plucker, Beghetto, & Dow, 2004). It is of great importance to human development and achievement at both the individual and societal level (Sternberg & Kaufman, 2010). Despite its importance, the scientific research of creativity has not received enough attention until P. J. Guilford delivered his famous speech on creativity in the 1950s. Since then, the creativity research began to flourish, and great efforts have been made to reveal how creativity works.

Among the topics of creativity research, one central issue is the individual differences in creativity. Like other human behaviors and psychological traits, the origin of individual differences in creativity could be attributed to the influence of genetic and environmental factors. Through the investigation of great eminences, Galton (1874) first put forward the question of nature or nurture, and declared the importance of heredity (genetic properties) to creativity. However, in the following years much of psychological research was still permeated by the environmentalist perspective, and only the role of environmental factors in creativity was emphasized. In the 1980s, as behavioral genetics became more main stream, a more balanced view emerged, in which both genetic and environmental factors were crucial to achieve creativity. To elucidate the roles of genetic and environmental factors to creativity, twins study design has been employed to assess the relative contributions of genetic and environmental factors, and it has been shown that there were modest genetic influences and substantial environmental effects on the development of creativity. However, one potential deficiency of the twins study design is that it assumes there is no gene-environment interaction (Plomin, DeFries, McClearn, & McGuffin, 2008). Since creativity is an emergenic trait that determined by the interaction of genetic and environmental factors, the exact mechanism by which genetic and environment factors coordinate to influence creativity is still unknown.

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Fortunately, recent advances in molecular genetics have permitted direct testing of hypotheses regarding the genetic basis of individual differences, and psychologists have begun to explore genes that related to creativity. This further makes it possible to directly examine the interactions of specific genes and environmental factors. However, to the best of our knowledge, no such study has been published although there is urgent need for such information to reveal the potential mechanism by which genetic and environmental factors work together to influence creativity. To fill this gap in the literature, the present study was designed as the first attempt to investigate the effect of gene-environment interaction on creativity. And it is hoped that the finding of the present study may lead to a better understanding of the origin of individual differences in creativity.

1.1. *DRD2* and creativity

The searching of creativity-related genes was largely inspired by the cognitive neuroscience study of creativity. Since findings from cognitive neuroscience studies generally support the involvement of dopamine (DA) and DA-related brain regions (such as prefrontal cortex and striatum) in the cognitive processes of creativity (Flaherty, 2005; Chermahini and Hommel, 2010; Takeuchi et al., 2015), genes involved in DA transmission have been of particular interest to explain individual differences in creativity. Among the candidates, the dopamine D2 receptor gene (*DRD2*) has been studied most extensively (Murphy, Runco, Acar, & Reiter-Palmon, 2013; Reuter, Roth, Holve, & Hennig, 2006; Runco et al., 2011; Zhang, Zhang, & Zhang, 2014).

The *DRD2* gene is located on chromosome 11q22-23. The DA receptor encodes by this gene is highly expressed on the dopaminergic neurons of striatum and prefrontal cortex, and plays an important role in mediating synaptic DA signaling. By employing divergent thinking tests as a measure of creativity, several attempts have been made to investigate the association of *DRD2* with creativity. Reuter et al. (2006) first examined the influence of *DRD2* on creativity, and demonstrated that *DRD2* was associated with total creativity score. And this finding has been further replicated by Zhang, Zhang et al. (2014) and Takeuchi et al. (2015). However, there have also been studies providing negative results. For example, Runco et al. (2011) extended Reuter et al.'s work by investigating the effect of *DRD2* on the three common indexes (fluency, originality, and flexibility) of divergent thinking tests, but the result indicated that there was no association between *DRD2* and creativity.

1.2. Parenting style and creativity

Parenting style refers to the child-rearing practices and interactive behaviors developed and implemented by parents. As one of the most important factors contributing to a person's development, parenting style has consistently been shown to be related to various outcomes such as child psychological problems and academic performance (Baumrind, 1967, 1991; Dornbusch, Ritter, Leiderman, Roberts, & Fraleigh, 1987; Querido, Warner, & Eyberg, 2002).

Baumrind (1978) described three major different parenting styles: authoritative, permissive, and authoritarian. The authoritative parenting style is characterized as high levels of warmth and autonomy encouragements toward the child. Authoritative parents often set clear standards for their children but also encourage independence and open communication between the children and parents. Conversely, the permissive parenting style is characterized as high levels of warmth but lacking in control toward the child. Permissive parents are often extremely tolerant of the impulses of the child, and allow high degrees of self-regulation. The authoritarian parenting style tend to fall somewhere between the two extremes, and is characterized as low levels of warmth but high levels of control toward the child. Authoritarian parents often exhibit highly directive behaviors, high levels of restriction and rejection behaviors. According to previous research, authoritative parenting style was the optimal choice for a variety of individual positive outcomes (Carlson, Uppal, & Prosser, 2000; Steinberg, Elmen, & Mounts, 1989; Uji, Sakamoto, Adachi, & Kitamura, 2014) while authoritarian and permissive parenting were often associated with negative outcomes (Barton & Hirsch, 2016; Georgiou, Fousiani, Michaelides, & Stavrinides, 2013; Hinnant, Erath, Tu, & Sheikh, 2016; Pong, Johnston, & Chen, 2010; Wischerth, Mulvaney, Brackett, & Perkins, 2016).

As for creativity, existing studies generally supported a negative role of authoritarian parenting style as well as a positive role of authoritative and permissive parenting style in creativity. For example, Nichols (1964) showed that authoritarian was negatively related to creativity. Miller, Lambert, and Speirs Neumeister (2012) demonstrated that permissive parenting style was positively associated with creativity, while authoritarian parenting style was negatively associated with creativity. Mozafari (2014) indicated a negative relationship between authoritarian style and creativity as well as a positive relationship between authoritative style and creativity. Mehrinejad, Rajabimoghadam, & Tarsafi (2015) recently showed that authoritative parenting style could positively predict creativity; while authoritarian parenting style could negatively predict creativity. However, it should also be noted that, there were still controversial and mixed findings regarding the relationship of parenting styles and creativity. For instance, in Fearon, Copeland, and Saxon (2013) study, although the negative relationship between authoritarian parenting style and creativity was replicated, no effect of authoritative and permissive parenting style was observed. In Mozafari (2014) study, it has been shown that permissive style could negatively predict creativity, rather than positively predict creativity. Moreover, Mehrinejad et al. (2015) also did not reveal a relationship between permissive parenting style and creativity.

1.3. The present study

As seen from the above literature review, previous research on the role of *DRD2* or parenting style in creativity has both produced mixed results. Although there are many possible explanations for the conflicting findings (e.g. sample size, age, and gender), the discrepancy might also arise from the neglect of contributions of potential gene-environment interactions. Gene–environment