Searching for Genes by Environment Interactions that Predispose to Prosocial Behavior: The Role of COMT and DRD4 Allelic Variants

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Humans are by nature prosocial. Nevertheless, prosocial behavior is greatly variable among individuals[1]. Two allelic variants, COMT rs4680 and DRD4-exon-III VNTR, have been described to modulate altruism[2,3], but the evidence of a direct link between these variants and altruism is modest[4]. Environmental factors probably mediate the influence of dopamine pathway on prosocial behavior, as COMT rs4680 and DRD4-exon-III VNTR seem to act as plasticity alleles in response both to stressful and to favorable environments[5-6].

Here we investigated whether DRD4-exon-III VNTR and COMT rs4680 modulate altruistic behavior in response to stressful situations, such as having suffered traumatic experiences with or without receiving social support. We recruited 194 subjects actively engaged in volunteering and 159 controls with no history of volunteering. Each participant filled out the Altruistic Personality Scale (APS) and the Traumatic Experience Checklist (TEC) and donated a saliva sample to obtain DNA for genotyping.

Volunteers, as compared to Controls, scored higher at APS ($p<0.001$). Moreover, the more often Volunteers had been exposed to traumatic experiences, the more they scored high at APS (pBonferronicorrected=0.036), and even more if they had received greater support (pBonferroni-corrected=0.001). Genetics mediates this relation, as only carriers of rs4680 Val/Val (pBonferroni-corrected=0.044) or DRD4 7-repeat (pBonferroni-corrected=0.044) showed the positive correlation between number of traumas and APS scores. The combined effect of these alleles was even more significant (pBonferroni-corrected= 0.02). Furthermore, it allowed bringing out the positive correlation between social support and APS scores (pBonferroni-corrected=0.024) that did not reach significance by analyzing the single variants.

In summary, a reduced dopamine signaling seems to increase prosocial behavior in response to suffered traumatic experiences, even more after receiving greater social support. We might hypothesize that a decrease in dopamine transmission favors emotionality[7], thus making people more sensitive to the environment and more prone to help others that undergone similar traumatic experiences.

References

[1] Schroeder DA, Graziano WG. 2018. Prosocial Behavior as a Human Essence. The Oxford Handbook of the Human essence (Ed. M van Zomeren and JF Dovidio).

[2] Bachner-Melman R, Gritsenko I, Nemanov L, Zohar AH, Dina C, Ebstein RP. 2005. Dopaminergic polymorphisms associated with self-report measures of human altruism: a fresh phenotype for the dopamine D4 receptor. Mol Psychiatry.

[3] Reuter M1, Frenzel C, Walter NT, Markett S, Montag C. 2011 Investigating the genetic basis of altruism: the role of the COMT Val158Met polymorphism. Soc Cogn Affect Neurosci.

[4] Jiang Y, Chew SH, Ebstein RP. 2013. The role of D4 receptor gene exon III polymorphisms in shaping human altruism and prosocial behavior. Front Hum Neurosci.

[5] He Q1, Xue G, Chen C, Lu ZL, Chen C, Lei X, Liu Y, Li J, Zhu B, Moyzis RK, Dong Q, Bechara A. 2012. COMT Val158Met polymorphism interacts with stressful life events and

parental warmth to influence decision making. Sci Rep.

[6] Bakermans-Kranenburg MJ, van Ijzendoorn MH. 2011. Differential susceptibility to rearing environment depending on dopamine-related genes: new evidence and a meta-analysis. Dev Psychopathol.

[7] Pellegrini S, Palumbo S, Iofrida C, Melissari E, Rota G, Mariotti V, Anastasio T, Manfrinati A, Rumiati R, Lotto L, Sarlo M, Pietrini P. 2017. Genetically-Driven Enhancement of Dopaminergic Transmission Affects Moral Acceptability in Females but Not in Males: A Pilot Study. Front Behav Neurosci.