Research report

Parental control and the dopamine D2 receptor gene (*DRD2*) interaction on emotional eating in adolescence

Tatjana van Strien [a,b,*], Harriëtte M. Snoek [a], Carmen S. van der Zwaluw [a], Rutger C.M.E. Engels [a]

[a] Behavioural Science Institute, Radboud University Nijmegen, P.O. Box 9104, 6500 HE Nijmegen, The Netherlands
[b] Institute for Gender Studies, Radboud University Nijmegen, P.O. Box 9104, 6500 HE Nijmegen, The Netherlands

ABSTRACT

The present study addresses the emergence of emotional eating in adolescence in relation to maternal or paternal psychological control. A reduction of food intake is considered the biological natural response to distress, therefore we tested whether the a-typical stress response of emotional eating develops in interaction with genetic vulnerability. Carrying the A1 allele of the dopamine D2 receptor (*DRD2*) gene Taq1A polymorphism (rs1800497) is associated with reduced dopamine D2 receptor availability in the brain. We hypothesized that carrying this allele would confer risk for the development of emotional eating, particularly so in adolescents with adverse rearing experiences. Participants were 279 Dutch adolescents (average age of 13.4) that participated in a prospective study with a four-year follow-up. We found a moderator effect of *DRD2* genotype on the relation between both maternal and paternal psychological control and increases in emotional eating in both sexes. Adolescents showed only an increase in emotional eating in relation to high psychological control if they carried at least one *DRD2* A1 allele. This study is the first to show that the relationship between adverse rearing experiences and emotional eating might be dependent on genetic make-up.

© 2009 Elsevier Ltd. All rights reserved.

Introduction

Distress induced eating – emotional overeating (i.e. eating in response to negative emotions such as depressive feelings) – is highly prevalent in adults who are binge eaters or obese (Bohon, Stice, & Spoor, 2009; van Strien, Engels, van Leeuwe, & Snoek, 2005; van Strien, Herman, & Verheijden, 2009) but has only a low prevalence in young children (Sleddens, Kremers, & Thijs, 2008; van Strien & Oosterveld, 2008; Wardle, Carnell, Haworth, & Plomin, 2008). This would suggest that most young children show the biologically natural response to distress (loss of appetite), since the normal distress response is associated with physiological reactions that are designed to prepare the individual for a fight or flight reaction, thereby suppressing feelings of hunger and satiety (Gold & Chrousos, 2002). It has been suggested that the biologically unnatural response to distress of emotional eating is acquired as a possible result of inadequate parenting (Bruch, 1973; Snoek, Engels, Janssens, & van Strien, 2007). The present study addresses the emergence of emotional eating in early adolescence in relation to the inadequate parenting practice of psychological control.

Adverse rearing experiences early in life may indeed have lasting effects on stress-responsive neurobiological systems, particularly when they pertain a perturbed parent–infant relationship (Cicchetti & Rogosch, 2001; Yehuda et al., 2000). This may include a hypoactivation, rather than hyperactivation of the hypothalamic–pituitary–adrenal axis (HPA) axis, with reverse neurovegetative symptoms: increased food intake (hyperphagia) and weight gain, instead of hypophagia and weight loss (Gold & Chrousos, 2002). These alternations generally do not become manifest before puberty (Silveira, Portella, Goldani, & Barbieri, 2007).

Parental psychological control can be conceived as an adverse rearing experience, because this manipulative and suppressive type of parental control includes guilt induction and withdrawal of love, thereby intruding into the psychological and emotional development of the child (Barber, 1996). There is ample evidence that this parenting practice is associated with delinquency (Hoeve et al., 2009) and internalizing problems in adolescents (Pettit, Laird, Dodge, Bates, & Criss, 2001; Shek & Lee, 2005). Further, paternal psychological control was shown to be associated with emotional symptoms, difficulty in emotional regulation and eating disorder symptoms (McEwen & Flouri, 2009). Additionally, in a study on young adolescents, both maternal and paternal psychological control were indeed related to the adverse stress response of emotional eating (Snoek et al., 2007), though, as with other

* Corresponding author at: Behavioural Science Institute, Radboud University Nijmegen, P.O. Box 9104, 6500 HE Nijmegen, The Netherlands.
 E-mail address: t.vanstrien@psych.ru.nl (T. van Strien).

adverse experiences (Miller, Chen, & Zhou, 2007), effects were only small. Evidently not all people with adverse rearing experiences develop emotional eating patterns, suggesting a possible role for genetics.

There is some evidence that the dopamine system, especially the dopamine D2 receptor (DRD2) gene may be involved in the pathogenesis of emotional eating (Davis et al., 2008; Volkow et al., 2003). Scholars disagree, however, on whether emotional eating reflects a deficit of reward (Volkow et al., 2003) or a heightened sensitivity to reward (Davis, Strachan, & Berkson, 2004). In a study on brain dopamine measures, emotional eating was negatively associated with baseline dopamine D2 receptor availability in the dorsal striatum (Volkow et al., 2003). This finding was taken to support the view that hypo-dopaminergic functioning underlies the development of emotional eating which would explain why emotional eaters are more receptive to the reinforcing value of food (Volkow et al., 2003), and use food as 'self-medication' to blunt effects of negative emotions. Reduced brain dopamine of emotional eaters has, however, also been explained as possible outcome of an adaptive downregulation of the dopaminergic system: a reflection of a neuroadaptation secondary to over-stimulation with food as result of a heightened sensitivity to reward (Bohon et al., 2009; Davis et al., 2004).

In the present study we will prospectively examine the moderator effect of the DRD2 genotype in relation to maternal versus paternal psychological control on the emergence of emotional eating in adolescence. Since emotional eating has a female preponderance (van Strien, 2002), we were also interested in a possible moderator effect of sex.

Using a longitudinal four-year follow-up design we examine the change in emotional eating from early to middle adolescence. We hypothesized that DRD2 genotype, like psychological control, has a main effect on emotional eating at follow-up (T2). Additionally we hypothesized that DRD2 genotype acts as a moderator, in that the relationship between psychological control and emotional eating would be stronger if adolescents carried at least one A1 allele. We also hypothesized that the moderator effect of DRD2 genotype on the relation between psychological control and emotional eating is stronger in girls than in boys.

To get an indication of the direction of causality between reward sensitivity and emotional eating and to reduce the risk that a history of overeating would explain any prospective results, we controlled in our prospective analyses not only for initial emotional eating, but also for initial BMI. Additionally, to rule out possible effects of modeling and personality, we controlled for parental emotional eating and parental overweight and person-ality and depressive feelings of the child. In earlier research, emotional eating and overweight of parents and children were found to be interrelated (Snoek et al., 2007; Wardle et al., 2008). Further, emotional eating was found to be associated with personality and depressive feelings (Heaven, Mulligan, Merrilees, Woods, & Fairooz, 2001; Ouwens, van Strien, & van Leeuwe, 2009), which are in turn related to genetics (Krueger, South, Johnson, & Iacono, 2008). In additional analyses, we controlled for possible confounding effects of the other eating styles (external eating; eating in response to external food-related cues such as sight and smell of attractive food) and restrained eating: eating less than desired to maintain or loose body weight), and other styles of parenting (support and behavioral control).

Methods

Participants and procedure

Participants were 428 Dutch adolescents with an average age of 13.4 years (SD = 0.6) at baseline measurement. The adolescents participated with their parents and older sibling in the longitudinal Family and Health study, which was designed in 2002 to measure various socialization processes underlying health-related adoles-cent behaviors (van der Vorst, Engels, Meeus, Dekovic, & van Leeuwe, 2005; van der Zwaluw et al., 2009). Approximately 5000 families, consisting of both parents and at least two adolescents, were approached through municipalities in The Netherlands, to participate in the Family and Health study. A total of 885 families agreed to participate. We excluded families in which the family members were not biologically related, had physical or mental disabilities, or in which the children were twins. A further selection was made to accomplish an equal distribution of sibling dyads (girl–girl, girl–boy, boy–boy, boy–girl). In this manner, a total of 428 families were included at T1. Attrition was low, with 347 families (81%) participating in the four-year follow-up (T2).

At both assessment dates the participating families were visited by trained interviewers, who made sure that the questionnaires were filled out separately and individually. In return of their completion of the questionnaires, the families received a voucher of 30 Euros. In the follow-up (T2), DNA samples were collected by means of saliva. A total of 309 adolescents could be genotyped after written informed consent by the parents and the adolescents.

Attrition analyses were conducted to examine whether adolescents who were genotyped (participants) differed from the adolescents who were not genotyped (drop-outs; $n = 119$). t-Tests showed no significant differences ($p > .05$) in emotional eating, BMI, sex or age between participating and dropout adolescents. Participating subjects did have a slightly higher level of education at T1 than those who had not been genotyped ($t(420) = 2.01$, $p = .04$). For the present study, complete data were available for 279 sibling adolescents. Approval on data collection was obtained from the Central Committee on Research Involving Human Subjects in the Netherlands.

Measures

Emotional eating, external eating and restrained eating

Emotional, external and restrained eating were assessed with the Dutch Eating Behaviour Questionnaire (DEBQ) (van Strien, 2002; van Strien, Frijters, Bergers, & Defares, 1986). This questionnaire has 33 items, 13 on emotional eating (e.g., "Do you have a desire to eat when you are irritated?"), 10 on external eating (e.g., "If food smells and looks good, do you eat more than usual?") and 10 on restrained eating (e.g. "Do you try to eat less at mealtimes than you would like to eat"?). All items have to be rated on a 5-point scale with response categories that range from 1 'never' to 5 'very often.' The DEBQ is easy to fill out by adolescents and has been used in ample studies involving adolescents (Lluch, Herbeth, Mejean, & Siest, 2000; Snoek et al., 2007). The DEBQ scales have high reliability, good validity for food consumption and high convergent and discriminative validity (van Strien, 2002). Also in the present study, the DEBQ-scales had high Cronbach's alphas at T1. For the adolescents, Cronbach's alpha at T1 were for emotional, external and restrained eating, $\alpha = .92$, $\alpha = .85$ and $\alpha = .92$, respectively. Cronbach's alpha at T2 was for emotional eating $\alpha = .95$. For maternal and paternal emotional eating (reported by the parents themselves) Cronbach's alpha's were $\alpha = .95$ and $\alpha = .94$, respectively.

Psychological control, behavioral control and support

Perceived parenting was reported by adolescents on both parents separately at T1. Psychological control was measured with an instrument of Steinberg, Lamborn, Darling, and Mounts (1994) (Dutch translation: Beyers & Goossens, 1999). On a 5-point scale ranging from 1 'completely not true' to 5 'completely true', adolescents had to report on 8-items on coercive, non-democratic