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# Sensation seeking in fathers: The impact on testosterone and paternal investment

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ABSTRACT

Paternal care is associated with a reduced likelihood of engaging in competitive or mating behavior and an increased likelihood of providing protection when necessary. Over recent years, there has been increasing evidence to assume that the steroid testosterone (T) in men might reflect the degree of mating effort. In line with this, decreased T levels were shown in fathers compared to non-fathers and it was suggested that paternal care, and most behavior positively associated with T, might be incompatible with each other. Independently, the personality trait sensation seeking (SS) has been related to mating behavior and also to elevated T in men. Aiming to integrate these different lines of research in a longitudinal approach, we explored the impact of SS on T levels in the context of the transition to fatherhood. Thirty-seven fathers and 38 men without children but in committed, romantic relationships (controls) were recruited. At two time points (for fathers: four weeks prior to (t1) and eight weeks after birth (t2)), all subjects repeatedly collected saliva samples for T measurement, filled in a protocol of activities during the course of these days and completed an online questionnaire. In line with our hypotheses, the results show significantly lower aggregated (AUC-T) T levels in fathers compared with non-fathers. Furthermore, moderation analyses revealed a significant interaction between group and SS at t2, with the lowest T levels in low SS fathers. These data suggest that adaptation processes of the transition to fatherhood are influenced by individual differences in personality traits.



## Introduction

Parenting effort and personal father–child interactions have significantly increased in fathers in Western societies, and more recently, research has turned towards the biological correlates of reproductive strategies in men (Alvergne et al., 2009; Berg and Wynne-Edwards, 2001; Storey et al., 2000; reviewed in Kentner et al., 2010). In animal research, biological determinants of fathering have been well established over recent years. For example, as early as 1990, Wingfield et al. described the challenge hypothesis in monogamous bird species, which stands for a trade-off between mating effort and parenting effort. Mating effort includes mate attraction, male–male competition and aggression during reproductive phases, whereas paternal effort means the time and energy which males spend on caring for their offspring (see also Wingfield et al., 2001). There are large differences in reproductive strategies between species. For example, in mammals with few offspring, paternal investment can be intense in order to enhance the offspring's survival rates. Most species with intense paternal investment are monogamous and, as a consequence, research has turned towards the neurobiological underpinnings of paternal investment in monogamous vs. polygamous mammals, including humans (c.f., Alvergne et al., 2009; Geary, 2000). This research suggests that particularly the steroid testosterone (T) might be involved in the trade-off between mating and parenting effort, as T is positively associated with mating effort (McGlothlin et al., 2007; Muller et al., 2009) and negatively related to bond maintenance and paternal care (Numan and Insel, 2003; Wynne-Edwards and Reburn, 2000). Levels of T were found to be lower in partnered men than in singles (Booth and Dabbs, 1993; Gray et al., 2002; Mazur and Michalek, 1998) and lowest in fathers who are actively engaged in child care (Berg and Wynne-Edwards, 2001; Gettler et al., 2011; Storey et al., 2000). Interestingly, in the latter, T was triggered by specific stimuli such as infant cries (Fleming et al., 2002; Storey et al., 2000). This is in line with the behavioral modulation of T over the course of the day (Muller et al., 2009), in which morning T levels might reflect endogenous physiology (Gray et al., 2007), whereas afternoon and evening T levels might be influenced by behavior and social contacts (for a review, see Eisenegger et al., 2011).

From a different perspective, personality traits, such as antisocial personality and sensation seeking (SS), have been discussed in relation to T in humans. SS is defined as *"… seeking for varied, novel, complex, and intensive sensations and experiences, and the willingness to take physical, social, legal and financial risks for the sake of such experiences."* (Zuckerman, 1994; p. 27). SS is positively associated with T, and greater diurnal variation in T in high sensation seekers has been reported (Bogaert and Fisher, 1995; Daitzman and Zuckerman, 1980; Daitzman et al., 1978; Gerra et al., 1999; but see also Rosenblitt et al., 2001; Wang

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et al., 1997). In line with this, positive relations between T and risk behavior such as gambling, alcohol use, and multiple sexual partners, all independent criteria for SS, have been established (Dabbs and Morris, 1990; Mazur, 1995). Thus, in relation to the trade-off model presented above, most SS-behavior types represent mating effort rather than paternal care. This corroborates the findings of Zuckerman and Neeb (1980), who discovered in a large-scale survey that married men and women tended to be lower sensation seekers than singles.

Taken together, there is convincing empirical evidence for associations between a) T and mating effort, b) SS and T, as well as c) SS and mating effort. We therefore assumed that decreasing T levels during the transition to fatherhood might be related to individual personality traits, namely SS. In a longitudinal approach, we examined the modulating role of SS in expectant fathers in comparison to men in a committed romantic relationship without any children.

## Methods

### *Subjects*

Based on an a priori power analysis ("g-power", Buchner et al., 1998) with a preset effect size of f = 0.35, power of .80, and alpha = 0.05 (optimal calculated sample size N = 68), ninety-four healthy men (aged 23–54 years) participated in this study (46 expectant fathers and 48 men in a committed romantic relationship as controls). They were recruited from the Zurich area through prenatal classes in different hospitals, through advertisements in newspapers, and through posters and flyers. Inclusion criteria for expectant fathers were that the female partner was nulliparous pregnant in the third trimester with no history of in-vitro fertilization or any pregnancy disturbances. Controls had been in committed exclusive dating relationships for at least six months. Exclusion criteria for all participants were medical or psychiatric illness, substance abuse, medication, smoking, and shift work.

In the group of expectant fathers, five subjects became fathers before the first measurement point, three did not provide the second (t2) set of saliva samples and one did not fill out the second set of questionnaires, resulting in thirty-seven subjects. In the group of controls, ten participants dropped out of the analysis because one couple separated, one female partner became pregnant, two did not fill out the second set of questionnaires and six were not available for the second part of the study.

At the end of the study, seventy-five healthy men were included in the analysis. Thirty-seven participants were expectant fathers (mean age = 34 years, SD = 5 years; mean duration of relationship = 6 years, SD = 3.1) and 38 were control participants (mean age = 32 years, SD = 7 years; mean duration of relationship = 5.5 years, SD = 5.6).

There were no significant differences in baseline characteristics in those subjects who completed the study and those who dropped out of the analyses or were excluded.

Following the first interview, each subject received CHF 50. — for participation. The study was approved by the Ethics Committee of the Canton of Zurich, Zurich, Switzerland.

### *Study procedures*

Firstly, a telephone screening was conducted to clarify the exclusion criteria. Following this, a meeting took place. After signing the informed consent document, all subjects were requested to answer questions in a semi-standardized interview protocol regarding sociodemographic data, duration of partnership, personal living situation and the desire to have a child.

Subjects were advised on how to use the sampling devices in order to collect saliva samples at home. On two work-free days, all men collected a set of 3 saliva samples (awakening; 5 pm; 9 pm) and filled out a protocol about activities during the day. In the group of expectant fathers, saliva collection was scheduled one month before the due date (t1) and two months after the birth of their child (t2). In parallel, in the control group, there were three months between the two days of saliva collection. All subjects were asked to refrain from sexual activities and consumption of alcohol the evening before and during the assessment days. In addition, subjects completed several online questionnaires (for the personality trait of SS and for control variables) within the same week of the assessment days. Around the time of the second assessment day, a telephone interview was conducted to assess special changes or events over the last three months.

### *Questionnaires*

Questionnaires were presented online and were completed at home. All questionnaires were password-protected and could only be accessed by the subject and the study administrators.

#### *Sensation seeking*

The SS personality trait was measured with the German version of Zuckerman's Sensation Seeking Scale SSS-V (Beauducel et al., 1999), an inventory with 40 forced-choice items to be summarized in the four subscales "Thrill and Adventure Seeking" (TAS, Cronbach's alpha = 0.80), "Experience Seeking" (ES, alpha = 0.61), "Disinhibition" (DIS, Cronbach's alpha = 0.69) and "Boredom Susceptibility" (BS, Cronbach's alpha = 0.46). The Total Score (TS, Cronbach's alpha = 0.82) ranges between 0 and 40.

#### *Protocol of activities*

Since T is influenced by environmental factors, and variation in T may last for several hours, all subjects were advised to fill out a protocol about their activities during the days of saliva sampling. They were asked to indicate whether their partner, the baby or any other person had been present on the day in question, the amount of time they had spent together and/or engaged in paternal care, sleep duration, sleep interruption during the night, and sexual activities (control variable).

### *Endocrine measures*

T was repeatedly assessed in saliva. Measuring free T in saliva is a convenient method for avoiding repeated venipuncture, as would be necessary when measuring T in blood.

Participants collected saliva at home by means of a commercially available sampling device (Salicaps©, Sarstedt, Seleven, Switzerland). Salicaps are made of ultra-pure polypropylene and have been well evaluated for the sampling of steroids in saliva. To minimize the effects of diurnal fluctuations and the influence of activities or external stimuli, participants were requested to collect saliva three times during the day at awakening (Mean: 08.27 am, SD: 1 h, 22 min), 5 pm and 9 pm. All subjects received envelopes for sending the samples back to our lab, where they were stored at −20 °C until biochemical analyses in a laboratory of the Technical University of Dresden. Analyses were conducted using a standard luminescence immunoassay. Intra- and interassay coefficients were below 10% for all assays and sensitivity was at 1.8 pg/ml.

### *Data analysis*

Prior to statistical data analysis, data were tested for normal distribution and homogeneity of variance using Kolmogorov–Smirnov and Levene's test. For each of the two assessment days (t1 and t2), circadian T secretion was computed as area under the total response curve with respect to ground (AUCg; ground meaning "baseline"), using the trapezoid formula according to Pruessner et al. (2003).