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# The relation between gaze aversion and cortisol reactivity in middle childhood

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ABSTRACT

The present study sought to investigate the relation between ethological observations of children's gaze aversion during a psychosocial stress task and their cortisol reactivity to the task, and how this relation might be moderated by how stressful the children perceived the stress task to be.

Videos of 140 children (74 girls; $M_{age} = 10.60$ years) performing a psychosocial stress task in front of a jury were coded for displays of the children's gaze aversion from the jury, and saliva samples were taken to determine their cortisol reactivity. A questionnaire assessed the children's level of perceived stress. Results showed higher cortisol reactivity in children who perceived the task as more stressful. Furthermore, a quadratic relation between gaze aversion and cortisol was found which depended on the level of perceived stress: for children with low levels of perceived stress, cortisol reactivity was *lowest* with intermediate levels of gaze aversion, whereas for children with high levels of perceived stress cortisol reactivity was *highest* at intermediate levels of gaze aversion. The results suggest a modest association between subjective and physiological stress responses in 9- to 11-year-olds, and indicate that gaze aversion may play only a minor role as a behavioural coping strategy at this age.



## Introduction

Previous studies have indicated that repeated and long-lasting activation of the HPA-axis is related to adverse effects on the immune system (e.g. Sapolsky, 1998), and to the development of psychological and physical problems (Charmandari et al., 2005; McEwen, 1998). As such, it is important to investigate what factors are related to physiological stress regulation. One factor may be a person's ability to cope with stressful situations. Behavioural coping strategies are the earliest available means to voluntarily regulate emotions and deal with stressful situations (Zimmer-Gembeck and Skinner, 2011). One such behavioural strategy is gaze behaviour. When confronted with a stimulus that is threatening or induces stress, a person can adopt a vigilant strategy, by looking more at the stimulus, or an avoidant strategy, by looking away from the stimulus (Wilson and MacLeod, 2003). Being able to voluntarily engage and disengage attention is considered a critical dimension of self-regulation (Posner and Rothbart, 2000). Therefore, the development of adequate use of gaze aversion could be considered an important attainment in children's development. To date, relatively little is known about the relation between gaze aversion and cortisol reactivity. The current study aims to investigate how the use of gaze aversion, as a behavioural response to a stressor, is related to cortisol reactivity to that stressor in middle childhood.

Gaze aversion is one of the first behaviours for coping with stressful stimuli. Infants already use gaze aversion to diminish stimulation. For example, 6-month-old infants use gaze aversion to regulate their emotions when confronted with a stranger, especially if this stranger is insensitive and controlling (Mangelsdorf et al., 1995). Also at older ages gaze aversion seems to be employed as a way of regulating psychosocial stress. For example, 8-year-olds show more gaze aversion during face-to-face questioning than during questioning across a live video link (Doherty-Sneddon and Phelps, 2005). In adults, it has been found that under conditions of social stress, individuals high in social anxiety looked at emotional faces for less time than individuals low in social anxiety, indicating that anxious individuals might use gaze aversion as a strategy to reduce their discomfort (Garner et al., 2006).

Few studies have investigated the relation between cortisol reactivity and gaze aversion. Sgoifo et al. (2003) subjected adult participants to a stress task in which they were asked to describe their own personality features in front of a four-person audience and a video camera. Results showed that participants that displayed more gaze aversion from the audience during the task had lower cortisol reactions to the task. However, this result may not generalize to children, as the use of gaze aversion as a coping strategy might change over age, in relation to cognitive development. For example, in infancy, use of gaze aversion was found to decline with age, while use of distraction by turning to other objects increased (Zimmer-Gembeck and Skinner, 2011). With a further increase in available coping capacities throughout childhood (Zimmer-Gembeck and Skinner, 2011), it is conceivable that the use of gaze aversion as a behavioural coping strategy is—at least partly—replaced by more cognitive and metacognitive coping strategies in the course of development.

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In addition, cortisol reactivity to stressors also shows developmental changes (Gunnar et al., 2009). If both gaze aversion use and cortisol reactivity change with age, the relation between these variables might change accordingly. Indeed, the relation between gaze aversion and cortisol reactivity seems different in a younger population. In a study with healthy 6–15 year old children, cortisol responses to a social challenge stress test were related to the use of gaze during the test: increased cortisol reactivity was found in children who displayed very high or very low levels of gaze aversion, i.e. either continuous staring or total gaze aversion, while lower reactivity was found in children with "good quality" gazing, who kept eye contact with the jury without staring or avoiding (Hessl et al., 2006). This indicates that in childhood, the relation between gaze avoidance and cortisol reactivity might well be U-shaped, with intermediate levels of gaze aversion related to lower cortisol reactivity.

The goal of the present study was to relate ethological observations of children's gaze aversion during a psychosocial stress task to their cortisol reactivity to the task. The current study elaborates on that by Hessl et al. (2006) through the use of ethological observations to quantify gaze aversion, as opposed to a 5-point rating scale to assess gaze quality. Also, the Hessl et al.'s (2006) study was conducted in the child's home, where one experimenter asked the children to answer some questions and sing a few songs. The present study, on the other hand, used an age-appropriate laboratory stress task that has repeatedly proven to be effective in inducing a physiological stress response (Buske-Kirschbaum et al., 1997). The availability of such an age-appropriate stress test was the main reason that middle childhood was targeted as an age group. Based on the results by Hessl et al. (2006) we hypothesized that the relation between gaze aversion and cortisol reactivity would be U-shaped, with lowest levels of cortisol at intermediate levels of gaze aversion.

A recent meta-analysis on studies performed with adults found that perceived stress during a stress task was related to physiological reactivity (Hellhammer and Schubert, 2012). To explore whether this was also the case in children, we included a measure of perceived stress in our analyses. In addition, we reasoned that gaze aversion as a strategy to cope with a stressful task might depend on how stressful children experience the task. That is, for children who do not experience the task to be stressful gaze aversion may be unrelated to cortisol reactivity, whereas children who do experience the task as stressful may show the expected U-shaped relation. Therefore, we also explored whether perceived stress moderated the relation between gaze aversion and cortisol reactivity.

## Method

### *Participants*

Children (age 9–11) were recruited through 31 mainstream primary schools in Nijmegen and surrounding areas (The Netherlands) to participate in a study on responses to stress and their consequences for cognitive functioning. Exclusion criteria were the use of psychotropic or corticosteroid medication, stuttering, and a diagnosis of a developmental disorder. Recruitment (for details see de Veld et al., 2012) resulted in 165 participants. Two children were excluded because during data collection it was discovered that they met one of the exclusion criteria. Furthermore, children were excluded from the present analysis for different reasons: five because they did not complete the entire data collection protocol, six because they were too distressed to complete the stress task, and twelve because observational data were missing or incomplete due to technical problems. The final sample for this study therefore consisted of 140 children (74 girls; $M_{age} = 10.60$ years, $SD = .53$). The majority of the participants was Caucasian (94%), and had at least one parent with a college or university degree (77%).

The study was approved by the ethics committee of the Faculty of Social Sciences of the Radboud University Nijmegen, The Netherlands. All children participated voluntarily, and all parents provided written informed consent prior to their child's participation.

### *Procedure*

A week before the stress test, all children completed questionnaires and memory tasks during a home visit (not relevant for the current study).

Testing for the present study took place after school ($Med = 15.45$ h, $IQR = 14.34$ h–16.03 h) in the laboratory of the Behavioural Science Institute of the Radboud University Nijmegen. On arrival, children were led to a separate room, where the experimenter explained that they would be asked to do some tasks and fill out several questionnaires. After this introduction, children provided a saliva sample (S1; within 5 min after arrival), filled out several questionnaires, and performed a memory task. This was followed by a 30 min relaxation period during which children listened to relaxing music, and could read a magazine or make puzzles. Right after relaxation they filled in a short questionnaire and provided a second saliva sample (S2). After this, children were taken to an adjacent room where an adapted and extended version of the Trier Social Stress Test for Children (TSST-C; Buske-Kirschbaum et al., 1997) was initiated to induce stress. The TSST-C consists of a public speaking task in which children are asked to provide an ending to a story read out loud by the experimenter, and a mental arithmetic task. Both tasks are performed in front of a jury of two confederates in white lab coats. If children were unable to come up with a story ending or finished their story within 5 min, one of the jury members calmly requested the child to try to extend the story. In the present study, children were asked to pick a favourite and least preferred present out of six small items (e.g. an inflatable ball or toilet brush) right before entering the TSST-C room (Jones et al., 2006), and were told that a favourable judgement by the jury would earn them their favourite present, whereas in case of an unfavourable judgement they would get the least preferred present. After the TSST-C, children were seated in front of the TSST-C jury. There they performed a working memory task, supplied a saliva sample (S3), filled out a short questionnaire, and performed an additional memory task. This entire procedure took approximately 34 min. Afterwards, the children went back to the first room. There they provided another saliva sample (S4), completed the perceived stress questionnaire (see Instruments and measures section), another questionnaire, provided a fifth saliva sample (S5), completed another questionnaire, received positive feedback on their performance during the stress task, and completed a short questionnaire. Then, a 25 min post-stress relaxation period was initiated. Ten minutes into this relaxation period, a saliva sample was obtained (S6). After relaxation, children completed several questionnaires, performed a memory task, provided a last saliva sample (S7), completed a last questionnaire, and were debriefed, and received their favoured present. The entire procedure took approximately 2.5 h. More details on the laboratory session can be found in De Veld et al. (2012).

### *Instruments and measures*

#### *Behavioural observations*

The TSST-C procedure was recorded by a wall-mounted camera placed in between and slightly above the two jury members. Recordings were scored afterwards by two trained assistants and the first author using The Observer 9.0 (Noldus, 2009). Observers were blind to the other study variables. As studies indicate that people often gaze upwards just prior to answering a mental arithmetic question (e.g. Previc and Murphy, 1997), and this was confirmed by our own observations, the mental arithmetic task was not used for the present study. Observations therefore started at the initiation of the public speaking component of the TSST-C, and ended when the jury indicated that the public speaking component of the TSST-C was over. Data were coded using interval coding (Bakeman and Gottman, 1997). For every 2-s interval, the observer coded whether the child's gaze had been towards