



## Salivary cortisol levels and challenging behavior in children with autism spectrum disorder<sup>☆</sup>



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### ABSTRACT

A relationship between stress and challenging behavior in individuals with autism spectrum disorder (ASD) has been theorized but infrequently examined empirically. The current study sought to examine the relationship between a parent-reported measure of stress, a physiological measure of stress (diurnal salivary cortisol), and various topographies of challenging behavior among 61 children and adolescents diagnosed with ASD between the ages of three and 18 years. Significant differences in cortisol levels between those engaging in high and low rates of stereotyped behavior were observed such that higher levels of stereotypy appeared an overt manifestation of higher levels of stress. A comparison between a subset of participants with ASD and typically developing peers matched on age, gender, and pubertal status failed to yield any differences in diurnal cortisol levels or cortisol variability between the two groups. The results of the current study suggest that similar levels of stress may exist among children with autism and their typically developing peers, but that for a subset of individuals with ASD, stereotyped behavior may be an indicator of elevated cortisol levels.

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Challenging behavior is behavior “of such intensity, frequency or duration that the physical safety of the person or others is likely to be placed in serious jeopardy, or behavior which is likely to seriously limit use of, or result in the person being denied access to, ordinary community facilities” (Emerson et al., 2001, p. 3). The prevalence of challenging behavior has been reported to be high among those with autism spectrum disorder (ASD); Murphy, Healy and Leader (2009) found that among a sample of 157 children with ASD, 82% of participants engaged in at least one form of challenging behavior while 32.5% of the sample engaged in self-injurious behavior (SIB), stereotypy, and aggression. Similarly, Jang, Dixon, Tarbox, and Granpeesheh (2011) found that among 84 children with ASD, 94% engaged in at least one form of challenging behavior including such forms as stereotypy, SIB, aggression, and property destruction. Predictors of challenging behavior include autism severity, cognitive functioning, language ability, level of adaptive functioning, and hyperactivity (Gabriels, Cuccaro, Hill, Ivers, & Goldson, 2005; Jang et al., 2011; McTiernan, Healy, Leader, & Mannion, 2011; Richards, Oliver, Nelson, & Moss, 2012).

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The study of challenging behavior is important given its negative impact on the quality of life of individuals with ASD. Challenging behaviors such as SIB, aggression, and stereotypy have been associated with myriad of negative outcomes such as reduced integration into the community or educational settings, reduced opportunities for social interactions, placement in restrictive service settings, use of intrusive treatment procedures such as chemical or mechanical restraint, and impaired learning (Cunningham & Schreibman, 2008; Koegel & Covert, 1972; Matson & Boisjoli, 2009; Symons, 1995; Thompson, Egli, Symons, & Delaney, 1994; Waters & Healy, 2012). Severe challenging behaviors such as SIB or pica may also result in serious physical harm to the individual (Hyman, Fisher, Mercugliano, & Cataldo, 1990; Williams & McAdam, 2012) while aggressive behaviors may lead to the injury of others in their environment.

While applied behavior analysis has had much success in treating challenging behavior (e.g., Brosnan & Healy, 2011; Lydon, Healy, O'Reilly, & McCoy, 2013; Kahng, Iwata, & Lewin, 2002; Scotti, Ujchich, Weigle, Holland, & Kirk, 1996), many scholars have remarked that the ability to treat challenging behavior far outweighs our understanding of these behaviors (e.g., Duerden et al., 2012; Janssen, Schuengel, & Stolk, 2002; Rapp & Vollmer, 2005; Schroeder and Tessel, 1994). Barrera, Violo, and Graver (2007, p. 31) cautioned against confusing "treatment with causation, and effective therapy with etiology". One avenue for exploration which may further our understanding of challenging behavior in ASD is the examination of the relationship between physiological activity or states and challenging behavior. Theories linking physiological activity and challenging behavior have been put forward. These first emerged in the 1960s, with Hutt and colleagues' (Hutt, Lee, & Ounsted, 1964; Hutt & Hutt, 1968) suggestion that individuals with ASD experience physiological hyper-arousal that contributes to their behavioral reactivity to stimuli, avoidance of social interactions and novel stimuli, and engagement in stereotypy. In the years that followed, other researchers (e.g., Romanczyk, 1986; Guess & Carr, 1991; Groden, Cautela, Prince, & Berryman, 1994; Haines, Williams, Brain, & Wilson, 1995; Lydon, Healy, & Dwyer, 2013; Sugarman, Garrison, & Williford, 2014) have proposed alternative mechanisms which may explain, or account for, the potential relationship between physiological activity, primarily autonomic nervous system or limbic-hypothalamic-pituitary-adrenal (LHPA) axis functioning, and challenging behavior. A full account of these theories is beyond the scope of the current paper but can be found elsewhere (e.g., Cohen, Yoo, Goodwin, & Moskowitz, 2011). Few studies have empirically assessed the relationship between physiological activity and challenging behavior. Those which have measured physiological activity have primarily used measures of autonomic reactivity such as measures of heart rate (e.g., Barrera et al., 2007; Lydon, Healy, & Dwyer, 2013; Freeman, Horner, & Reichle, 1999) and electrodermal activity (e.g., Hirstein, Iverson, & Ramachandran, 2001; Romanczyk & Matthews, 1998). The results of these studies have been mixed with some suggesting that challenging behaviors, which have included stereotypy, SIB, and aggression, are negatively reinforced by the decreases in physiological arousal which they induce (e.g., Barrera et al., 2007) while other suggest that such behaviors are positively reinforced by the increases in physiological arousal observed following their occurrence (e.g., Lydon, Healy, & Dwyer, 2013; Freeman et al., 1999).

Of primary relevance to the current study, are a number of theoretical and experimental papers which have proposed a relationship between stress or anxiety and challenging behavior among those with developmental disabilities. Groden et al. (1994) theorized that individuals with ASD have a unique vulnerability to stress and anxiety, due to impairments in social, communicative, cognitive, and sensory functioning, and that these feelings and experiences likely contribute to the symptoms of ASD and the engagement in challenging behavior. The authors further suggest that challenging behaviors may be understood as overt manifestations of internal stress or as a maladaptive coping response. Janssen and colleagues (2002) have proposed a model of challenging behavior which implicates stress and attachment style in the development of challenging behavior among individuals with intellectual disabilities. This model, derived from previous research, highlights studies showing that individuals with severe or profound intellectual disabilities are at greater risk of both experiencing stress and of developing poor attachment styles. Previous research has suggested that these two factors in combination may predispose an individual to the development of behavioral problems and this may be the case for some individuals with intellectual disabilities and co-morbid challenging behavior (Janssen et al., 2002).

A number of studies have empirically examined the relationship between challenging behavior and physiological measures of stress. The activation of the LHPA in response to stress or challenge has been found to result in enhanced release of cortisol, a steroid hormone, from the adrenal glands. Cortisol levels can be assessed readily in several biological fluids including saliva, urine or blood. Elevated levels of cortisol have been found to directly correlate with levels of stress. Verhoeven and colleagues (1999) examined the relationship between baseline levels of various hormones and neurochemicals, including cortisol, and SIB or stereotyped behavior exhibited by individuals with intellectual disabilities. The authors noted a tendency toward lower values of total cortisol among those engaging in a high level of SIB or a high level of stereotyped behavior. Symons, Sutton, Walker, and Bodfish (2003) compared cortisol levels among individuals with developmental disabilities and chronic, severe SIB and those with developmental disabilities and no SIB. A trend for those with SIB to have higher cortisol levels was observed. Further, morning and evening cortisol levels were positively correlated with SIB severity. Symons, Wolff, Stone, Lim, and Bodfish (2011) examined cortisol and salivary  $\alpha$ -amylase among 51 adults with intellectual and developmental disabilities, 34 of whom engaged in severe SIB and 17 of whom acted as controls. Cortisol levels were found to be significantly higher among those with SIB than among the matched controls. However a more recent study by Gabriels and colleagues (2013) examined the relationship between repetitive behaviors and cortisol levels among 21 children with ASD. It was found that participants with high levels of repetitive behavior had lower levels of cortisol than participants who engaged in low levels of repetitive behaviors. Thus, research suggests that there may exist specific biomarkers for different types of challenging behaviors among persons with developmental disabilities.

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