



Facebook behaviors associated with diurnal cortisol in adolescents: Is befriending stressful?



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ABSTRACT

Facebook® is changing the way people interact and socialize. Despite great interest in psychology and sociology, little is known about Facebook behaviors in relation to physiological markers of stress. Given that the brain undergoes important development during adolescence and that glucocorticoids—a major class of stress hormones—are known to modulate its development, it is important to study psychosocial factors that may influence secretion of stress hormones during adolescence. The goal of the present study was to explore the associations between Facebook behaviors (use frequency, network size, self-presentation and peer-interaction) and basal levels of cortisol among adolescent boys and girls. Eighty-eight adolescents (41 boys, 47 girls) aged between 12 and 17 (14.5 ± 1.8) were recruited. Participants provided four cortisol samples per day for two non-consecutive weekdays. Facebook behaviors were assessed in accordance with the existing literature. Well-validated measures of perceived stress, perceived social support, self-esteem, and depressive symptoms were also included. A hierarchical regression showed that after controlling for sex, age, time of awakening, perceived stress, and perceived social support, cortisol systemic output (area under the curve with respect to ground) was positively associated with the number of Facebook friends and negatively associated with Facebook peer-interaction. No associations were found among depressive symptoms, self-esteem, and cortisol. These results provide preliminary evidence that Facebook behaviors are associated with diurnal cortisol concentrations in adolescents.

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1. Introduction

Friendships are a core source of social support for people of all ages that promote better health and well-being (House et al., 1988; Seeman 1996). Among adolescents, friendships are especially important for the normal development of social and emotional competencies (Way and Greene, 2006). A critical pathway by which friendships foster social support and can thus provide benefits on

positive health psychology is through their influence on biological mechanisms related to stress physiology.

Response to stress involves activation of the hypothalamic–pituitary–adrenal (HPA) axis that leads to the secretion of glucocorticoids (GCs; cortisol in humans) from the adrenal glands. Diurnal cortisol represents natural fluctuations secreted on a day-to-day basis by individuals in their home, work, and/or school environments at different times of the day. Such sampling methods allow researchers to assess diurnal cortisol rhythms. Among these is the ‘cortisol awakening response’ (CAR) that represents the cortisol increase observed 30–45 min after awakening (Pruessner et al., 1999). By contrast to naturalistic variations, reactive GC represents the hormonal dynamics produced in response to an acute stressor usually in a controlled laboratory environment.

Chronic secretion of GCs can have damaging effects on mental health because GCs rapidly access the brain to influence learning,

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memory, and emotional processing by binding to GC receptors in the prefrontal cortex, amygdala, and hippocampus (for a review, see (Lupien et al., 2009)). Given the slow development of the amygdala and frontal lobes during adolescence, the developing brain is especially sensitive to the effects of elevated GCs (Lupien et al., 2009).

Psychoneuroendocrine studies show that high perceived social support has positive effects on the HPA axis. A large body of research reveals that social support is associated with decreased cortisol reactivity to acute stressors (Kirschbaum et al., 1995; Roy et al., 1998; Eisenberger et al., 2007) as well as to lower basal levels of cortisol in adults (Seeman and McEwen, 1996; Turner-Cobb et al., 2000; Evans and Steptoe, 2001). In adolescents, the nature of peer relationships undergoes significant change at puberty when adolescents spend increasingly more time in the company of their peers (Larson and Richards, 1991). Studies of adolescents show that the presence of a best friend buffers the effects of negative experiences on cortisol reactivity to stress (Adams et al., 2011). This suggests that integration into interpersonal networks may contribute to better health through buffering effects of social support on the biological stress system (Cobb 1976; Cohen and Wills, 1985).

Over the last decade, there has been a dramatic increase in the use of social networking websites such as Facebook® among adolescents. Facebook (FB) was launched in 2004 and made available to everyone over age 13 in 2006. Since then, it has been one of the fastest-growing websites in history, attaining one billion users in 2012 (Fowler, 2012). As of 2012, 95% of adolescents worldwide are active on FB (Sterling 2013). To date, it is unclear (1) whether the integration of adolescents into virtually mediated social networks has effects on biological pathways related to stress and (2) whether these effects are similar to findings observed among more direct interpersonal networks. While no published evidence has linked FB behaviors to cortisol levels in either adolescence or adulthood, a growing number of studies have assessed the association between FB behaviors and psychological well-being.

The first studies performed in this new era of cyberpsychology suggested that FB use may promote negative psychosocial well-being and lead to depression (O'Keeffe et al., 2011). Such studies focusing on the proposed *negative* association of FB use concentrated on a measure of 'FB use frequency' calculated as 'time spent on FB'. The implications here are that greater time spent on FB appears to be significantly associated with greater psychological distress (Kontos et al., 2010; O'Keeffe et al., 2011; Pantic et al., 2012). Yet, not all studies report such associations (see Jelenchick et al., 2013) and none of these studies have considered the potential buffering role of social support on the association between FB use frequency and psychological well-being.

In order to assess whether perceived social support is provided by FB, researchers have also assessed 'number of FB friends' as a measure of 'FB network size'. In so doing, researchers found the presence of dynamic relationships between FB network size, perceived social support, and psychological well-being (Edwards et al., 1990; Kim and Lee, 2011; Manago et al., 2012; Wright, 2012). Moreover, Nabi et al. (2013) demonstrated that the number of FB friends an individual has appears to be associated with stronger perceptions of social support. In turn, social support is associated with less subjective distress, less physical illness, and strong well being (Nabi et al., 2013). Importantly, these buffering effects were minimized when interpersonal network size (number of friends in real life) was taken into consideration. This nuance is critical, as it shows the importance of considering perceived social support outside of the virtual domain when assessing the association between FB network size and psychological well being.

Social support is qualitatively and quantitatively intertwined and made all the more complicated by the recent advent of social media networks that shape how we express ourselves. For example,

Kim and Lee (2011) suggest that while the number of FB friends can have a positive influence on subjective well being, this association was not mediated by perceived social support. Instead, the authors focused on measuring 'FB self-presentation behaviors' as represented by FB behaviors where individuals present themselves to others through profile construction, status updates, photo album management, and message posting on the users' own album (Ellison and Boyd, 2006; Strano 2008). Using this measure, they found that FB self-presentation behaviors had a significant effect on subjective well-being through increased perceived social support (Kim and Lee, 2011). This indicates that how one presents oneself on FB modulates their perceived social support.

Other studies assessing FB self-presentation behaviors report effects on psychological well-being. Specifically, such FB behaviors have positive effects on subjective well being by increasing self-esteem among adolescents, especially when users receive positive feedback from FB friends (Valkenburg et al., 2006; Strano, 2008). Another study found that participants who were allowed to update their profile and view their own profile during an experiment reported greater self-esteem than participants viewing other users' profiles (Gonzales and Hancock, 2011). Interestingly, high self-esteem is associated with lower cortisol reactivity to stress in adults (Pruessner et al., 2004) and adolescents (Lindahl et al., 2005). Self-esteem therefore represents an additional personality trait that researchers must consider when assessing the positive or negative effects of FB behaviors.

Beyond the aforementioned FB behaviors, FB use can allow users to engage their peers via various activities. This can include active and passive behaviors such as viewing other people's FB page, posting comments on other people's FB page, and adding photos of friends on their own FB page. In accordance, engagement in 'FB peer-interaction behaviors' may help users gather and garner social support from their FB network. As such, this is an important FB behavior to take into account given the nuances between received versus provided social support (for a review, see Abu Sadat Nurullah, 2012). For example, recent results report that women who receive much social support but provide little support to others report lower feelings of self-efficacy than women who provide high amounts of social support but who receive low amounts themselves (Jaekela et al., 2012). Taken together, this ensemble of FB behaviors must be considered collectively in relation to psychological factors and biological markers of stress that we innovate in the current study.

1.1. Research goals

The main goal of this study was to measure the association between FB behaviors and diurnal cortisol levels among adolescents. Specifically, we assessed how (1) FB use frequency, (2) FB network size, (3) FB self-presentation, and (4) FB peer-interactions would be associated with diurnal cortisol levels in adolescents that experience critical developmental changes in brain maturation of regions sub-serving the HPA axis and emotional regulation. Based on the existing FB literature, we predicted that FB behaviors would be similarly associated with diurnal cortisol profiles. Specifically, we expected that after controlling for sex, age, awakening times, perceived stress and perceived social support all known to modulate cortisol concentrations, FB use frequency would be associated with higher cortisol levels in adolescents. By contrast, we expected that FB network size, FB self-presentation behaviors, and FB peer-interaction behaviors would be associated with lower cortisol levels. Given that no study has measured the associations between FB behaviors and diurnal cortisol in adolescence, we were tentative in the proposed directionality of our hypothesis given that both hyper- and hypo-cortisolemic profiles can be functionally significant.

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