

Human Affection Exchange: XII. Affectionate Communication is Associated with Diurnal Variation in Salivary Free Cortisol

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The present study tested the general hypothesis that, irrespective of the amount of affectionate communication one typically receives, the amount of affectionate communication one typically expresses to others is associated with the body's ability to handle stress. Twenty healthy young adults reported on their trait levels of expressed and received affection and then took four saliva samples over the course of a normal workday. The saliva samples were assayed for levels of free cortisol, an adrenal steroid hormone associated with physiological responses to stress. Controlling for received affection, expressed affection was strongly and positively associated with waking cortisol values and with aggregate values. It was also strongly and positively related to the magnitude of morning-to-evening decrease in cortisol levels, a rhythm indicative of an adaptive ability to handle stress. Theoretic and methodological implications are discussed.

Keywords: Affection; Stress; Cortisol; Affection Exchange Theory

The desire to be loved and appreciated is a part of the human experience so deeply engrained that many have come to consider it a fundamental human need (Baumeister & Leary, 1995; Brown & Levinson, 1987; Maslow, 1970). It is perhaps unsurprising, therefore, that a robust body of research attests to the mental and physical health benefits of receiving expressions of love and appreciation in the form of affectionate communication. Affectionate communication encompasses those verbal and nonverbal behaviors through which humans convey feelings of fondness, support, and love for others, and it serves a host of important functions with respect to the initiation

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and maintenance of personal relationships (for review, see Floyd, in press). Beyond those, however, it also appears to enhance the health and well-being of those who receive such expressions. In a multiwave longitudinal study, for instance, Schwartz and Russek (1998) reported that the amount of love and caring college students had expressed to them by their parents significantly (and inversely) predicted their physical and psychological distress as many as 42 years later. Similarly, Komisaruk and Whipple (1998) reported that those who receive fewer expressions of love than they desire tend to be more susceptible to psychosomatic illness, whereas Shuntich, Loh, and Katz (1998) found affection to be negatively associated with alcohol abuse and physical aggression toward family members. Several studies have found that lack of affection is associated with loneliness (Downs & Javidi, 1990) and depression (Mackinnon, Henderson, & Andrews, 1993; Oliver, Raftery, Reeb, & Delaney, 1993). Conversely, physical affectionate behavior has been shown to play a role in the reduction of pain and psychological anxiety (Spence & Olson, 1997) and to enhance the body's ability to heal itself (see Krieger, 1973; Olson & Sneed, 1995).

Whereas the benefits of receiving affectionate communication are well documented, recent investigations have begun to elucidate some of the mental and physical health benefits associated with expressing affection. Working from affection exchange theory, Floyd (2002) compared known-divergent samples of highly affectionate and nonaffectionate adults on a battery of psychosocial assessments and found that, with every outcome measure, those adults who described themselves as highly affectionate were not only different from but advantaged relative to those who described themselves as nonaffectionate. Compared to nonaffectionate adults, participants in the former group were happier, more self-assured, less stressed, less likely to be depressed, in better mental health, more likely to engage in regular social activity, less lonely, more likely to be in significant romantic relationships, and—among those in romantic relationships—more satisfied with those relationships. Unsurprisingly, highly affectionate adults also received more affection from others, suggesting the rival hypothesis that the observed benefits were not those of giving affection but were, instead, those associated with the affection received in return. To examine this alternative hypothesis, Floyd et al. (2005) reanalyzed the Floyd (2002) data and then presented data from three new surveys in which psychosocial assessments were analyzed for their association with expressed affection while the amount of received affection was held constant. Floyd et al. (2005) reported that although received and expressed affection accounted for shared variance in mental and physical outcomes, expressed affection accounted for significant proportions of unique variance, as well.

The purpose of the present investigation is to examine affectionate communication more closely for its associations with health and well-being. In particular, this study looks at the relationship between affectionate behavior and people's ability to manage stress efficiently. For communication scholars, this focus is pragmatic for at least two reasons. First, affectionate communication and stress are both pervasive experiences. As Floyd et al. (2005) detail, affectionate behavior characterizes human communicative interaction across cultures and across the life span. Similarly, as explained below, adults and children alike experience stress and its negative effects, many on a chronic

basis. Indeed it is nearly impossible to imagine any individual in any cultural or social group who does not from time to time throughout his or her life both give or receive affectionate gestures and experience the effects of stress. Second, whereas many of the effects of affectionate communication are positive, many of the effects of stress are highly detrimental. These include not only the range of mental and physical problems that are stress related, but also the quality-of-life reduction that stress can represent and the financial burdens of treating stress-related problems. Indeed McEwan (1999) estimated the economic cost of stress and stress-related disorders in the United States alone at nearly \$200 billion annually. Therefore, if affectionate communication can play even a small part in helping people to manage the effects of stress more effectively, then this information could potentially have far-reaching utility not only for communication scholars but also for clinicians and the populations they treat.

An important methodological goal of the present study is to extend research on the health correlates of expressed affection beyond the realm of self-reported health outcomes. Specifically, the current study examines associations between trait levels of expressed affection—that is, how affectionate a person typically is in his or her communication with others—and a physical, neuroendocrine marker of susceptibility to stress: 24-hour variation in the stress hormone cortisol. Although research on biological properties has become increasingly common in communication scholarship (e.g., Bodary & Miller, 2000), surprisingly few studies have actually collected physiological data so that their relationships with communicative processes can be ascertained. This was an important goal of the present project. This review begins with a theoretic overview linking expressed affection to mental and physical well-being; this is followed by a summary of the body's physical reaction to environmental challenges and an explanation of variation in cortisol as a marker of susceptibility. Specific hypotheses and research questions regarding the association between affectionate communication and cortisol variation follow.

On the Relationship between Affectionate Communication and Health

At least two theoretic perspectives converge on the prediction that expressing affection should be positively associated with health and well-being. First, *affection exchange theory* (AET) (Floyd, 2001, 2002; Floyd et al., 2005; Floyd & Morman, 2001, 2003; Floyd & Morr, 2003; Floyd & Ray, 2003; Floyd, Sargent, & Di Corcia, 2004) conceives of affectionate communication as an adaptive behavior that contributes to humans' superordinate motivations for viability and fertility. The theory assumes the Darwinian principle of selective fitness, whereby organisms that are best adapted to the demands of their social and physical environments are the most likely to survive and procreate. AET draws specific links between the expression of affection and human viability, proposing that both giving and receiving affection within an optimal range of expression activates physiological pathways that fortify the body's fight-or-flight system and thereby its ability to defend itself against threats (whether genuine or merely perceived; see Floyd, in press).

Second, *tend and befriend theory* (TBT) (Taylor et al., 2000) challenges the centrality of fight or flight as the most adaptive responses to stress. Whereas males may have benefited evolutionarily from either fighting or fleeing from potential threats, TBT argues that neither response would have been as adaptive for females, due to the peril to which either approach would subject offspring. That is, if a mother is fighting a threat or fleeing from it, offspring are likely to be left unprotected in the process; thus, these tendencies on the part of females would eventually have been selected against. Rather, the theory proposes that the complexity of protecting and caring for offspring (particularly under threatening circumstances) has made it adaptive for females to adopt two related strategies for responding to stress. The first, *tending*, involves “quieting and caring for offspring and blending into the environment” (Taylor et al., p. 412) and is theorized to be adaptive particularly insofar as it reduces the offspring’s stress response, maximizing its capacity to survive to reproductive age. The second, *befriending*, refers specifically to creating and maintaining social relationships that can provide resources and protection for the mother and her children under stressful circumstances.

Both theories advance the general conclusion that communication behaviors intended to build and maintain significant social relationships should covary with health and well-being not only for those who receive them but also for those who express them. As Floyd (in press) has argued, perhaps the principal communicative behavior in the development and maintenance of important personal relationships is the expression of affection; thus, it is logical to consider affectionate communication to be one behavioral manifestation of the befriending concept. One avenue for examining the potential relationships between affectionate behavior and health, suggested by both theories, is to look at the body’s ability to handle stress. To be certain, this is not the only possible approach—depression, susceptibility to illness, immunocompetence, and other health outcomes would also provide fruitful avenues for investigation. However, the study of stress holds much promise for improving the human condition, given its robust associations with a number of other physical problems, including coronary artery disease and hypertension (Blascovich, Shiffert, & Katkin, 1989; Hotz, 1995; Krantz & Manuck, 1984; Potempa, 1994), elevated cholesterol and cardiovascular disease (Roy, Kirschbaum, & Steptoe, 2001), and immunosuppression (Kiecolt-Glaser et al., 1984; Kiecolt-Glaser et al., 1987). To the extent that communicological behaviors play a role in the exacerbation or alleviation of stress, therefore, a more complete understanding of how these behaviors are linked to stress-management outcomes is a worthy goal. The topic of stress and its physiological correlates is addressed below.

Physiological Components of the Stress Response

The concept of stress has its roots in the pioneering work of Claude Bernard (1865/1961), Walter Cannon (1929), and, perhaps most notably, Hans Selye (1936, 1956), who conceived of it as a means of appreciating the body’s physiological regulatory responses to environmental threats. Environmental threats represent

any type of challenge to an organism's physical, mental, emotional, financial, or relational well-being—thus, they can range from the rapid approach of a wild animal to the anxiety of test taking and from the possibility of losing one's job to the perception that one's romantic partner is being unfaithful. Importantly, these threats—which may be referred to as *stressors*—need not be genuine but only perceived as genuine to elicit the series of physiological reactions collectively known as a *stress response*.

Physiologically, perception of a stressor initiates a multistage reaction along the hypothalamic-pituitary-adrenal (HPA) axis that results in the secretion of cortisol into the bloodstream. Most of the cortisol (approximately 95%) immediately binds to corticosteroid binding globulin (CBG) and albumin, which renders it biologically inactive. The remainder stays biologically active in order to affect tissues throughout the body; this portion is referred to as *free cortisol*, and it is readily detectable in body fluids such as blood, saliva, or urine (Lovallo & Thomas, 2000). When the body's circulating level of cortisol is high, it initiates a negative feedback loop that suppresses the secretion of more cortisol (Chrousos & Gold, 1992).

When it is released in response to a stressor, cortisol mobilizes the body's energy resources to mount an adequate defense against the stressor. This has various effects on the body, including an increase in blood sugar and the diversion of energies from bodily systems that are nonessential in responding to a stressor, such as the metabolic, digestive, or reproductive systems (Johnson, Karmilaris, Chrousos, & Gold, 1992). Cortisol also mobilizes the immune system to increase bodily defense mechanisms, but at the same time, it suppresses the immune system to prevent it from overreacting to the stressor and needlessly damaging tissue or organs (Sapolsky, 2002).

In the absence of acute stressors, however, cortisol levels in the body follow a diurnal, or 24-hour, rhythm wherein they peak in the hour after waking and drop continually during the day, reaching their lowest point around midnight (Kirschbaum & Hellhammer, 1989). This diurnal pattern is established early in life (around the age of three months; see Price, Close, & Fielding, 1983) and appears to be independent of time or mode (spontaneous vs. alarm) of awakening (Hucklebridge, Clow, Rahman, & Evans, 2000).

Several researchers have investigated patterns of individual variance in (a) basal cortisol levels (i.e., one's average level, aggregated across time periods), (b) diurnal-rhythm-specific cortisol levels (particularly waking cortisol), and (c) diurnal variation (i.e., how much an individual's cortisol levels change from morning to evening). Conclusions vary according to which of these three aspects of cortisol level is examined and the outcomes to which it is correlated. With respect to basal cortisol level, it makes intuitive sense to predict that, because cortisol is secreted in response to stress, higher basal levels reflect greater overall stress (and therefore, correlate with corresponding forms of physical or social dysfunction, such as depression, loneliness, or social anxiety). There is some evidence to support this view. In two experiments, Brown et al. (1996) found that basal cortisol was positively associated with anxiety and emotional repression. High basal cortisol levels have also been found to characterize children who are particularly shy or behaviorally inhibited (Kagan, Reznick, & Snidman, 1988; Schmidt et al., 1997).

A related body of research supports the opposite conclusion, however: that dysfunction is associated with lower basal cortisol levels, not higher. Research on antisocial adults, for instance, has shown that deviant behavior is inversely related to basal cortisol (Virkkunen, 1985). Other studies demonstrate that basal cortisol levels are inversely associated with aggression, delinquency, or antisocial tendencies in children (Moss, Vanyukov, & Martin, 1995; Vanyukov et al., 1993). This body of findings supports the perspective that low basal cortisol levels reflect underarousal of the body's stress system, which indicates that the mechanisms typically activated to suppress maladaptive behaviors are less effective than normal (Gorenstein & Newman, 1980; Moffitt, 1993).

Hypothesis and Research Questions

Theoretic work on the importance of affectionate communication leads to the prediction that affection communicated to others is associated with benefits to the communicator that are independent of those associated with affection elicited in return. The purpose of the present study was to investigate this general hypothesis with respect to physical susceptibility to stress as indicated by basal and diurnal variation in cortisol levels. Because chronic stress can be indicated by either high or low aggregate cortisol levels, the relationship between trait expressed affection and basal cortisol level was addressed in the form of a question:

RQ1: Controlling for trait affection received, how is trait affection given associated with basal levels of salivary free cortisol, if at all?

With respect to specific cortisol values taken over the course of the day, most research has focused on waking cortisol (e.g., Kaspers & Scholz, 2004). It is possible to argue that dysfunction of the body's stress defenses is associated with either higher or lower morning values; whereas higher waking values may correspond to greater acute stress, they may also allow for a more differentiated 24-hour rhythm than lower waking values, which are indicative of healthy regulation (e.g., Giese, Sephton, Abercrombie, Duran, & Spiegel, 2004). Therefore, it is unsurprising that, as with aggregated basal cortisol values, some research has shown that high waking cortisol is unhealthy (e.g., Deshauer et al., 2003; Steptoe, Owen, Kunz, Sabine, & Brydon, 2004), whereas other studies have indicated that low waking cortisol is problematic (e.g., Backhaus, Junghanns, & Hohagen, 2004; Delahanty, Bogart, & Figler, 2004), and still other studies have found no association between waking cortisol values and health (e.g., Coupland, Hegadoren, & Myrholm, 2003; Giese et al.). Given the inconsistency of these findings, as well as a lack of guidance for making directional predictions about the effects of other specific cortisol values, the relationship between trait expressed affection and individual cortisol values was addressed in the form of a second research question:

RQ2: Controlling for trait affection received, how is trait affection given associated with morning, noon, afternoon, and evening levels of salivary free cortisol, if at all?

Of final interest in the present study was the potential relationship between affectionate behavior and the amount of variation in the diurnal cortisol rhythm. Although findings have been inconsistent regarding the association between stress and average basal levels of cortisol, research has fairly consistently shown that healthy regulation of the body's stress defenses is indicated by a high degree of morning-to-evening change in cortisol levels. That is, "flattened" diurnal curves, showing little change in cortisol values from morning to evening, are associated with poor stress regulation (Chrousos & Gold, 1992; Giese et al., 2004; Heim, Ehler, & Hellhammer, 2000). To the extent that expressing affection is inversely associated with stress, as both affection exchange theory and tend-and-befriend theory suggest and as previous investigations have shown with self-report measures (e.g., Floyd, 2002; Floyd et al., 2005), it should likewise be positively associated with the amount of morning-to-evening change in observed cortisol values:

- H1: Controlling for trait affection received, trait affection given is directly correlated with morning-to-evening change in cortisol levels.

Method

Participants

Participants ($N = 20$) were 12 female and 8 male adults ranging in age from 20 to 34 years ($M = 23.44$ years, $SD = 3.33$) who were recruited from an upper-division communication course at a large university in the southwestern United States. Sixteen participants were Caucasian, one was Hispanic, one was African American, and two did not indicate their ethnic background. Two of the female participants had biological children at the time of the study.

Procedure

Participants were recruited for a study of "communication style and personality" and were asked to complete a questionnaire regarding their communication behaviors and return it to the researcher. In addition, participants were given materials and instructions to take four saliva samples over the course of a typical day. Cortisol can be measured from blood, urine, and saliva (Baum & Grunberg, 1995), with strong consistency between these types of measurements (Kirschbaum & Hellhammer, 1989, 1994); consequently, saliva samples were used because they are the least invasive and permit participants to collect the samples at home, without the aid of a researcher. The saliva samples were collected using Salivettes (Sarstedt, Inc.), plastic 5-ml test-tube-shaped collection receptacles containing a sterilized cotton roll and a stopper. Participants were instructed to abstain from caffeine on the day of the saliva collections and not to eat or drink anything except water for at least one hour prior to taking each sample. To collect a saliva sample, participants were directed to chew on the cotton roll for at least 60 seconds and to saturate it with saliva. They then returned the saturated roll to the plastic cylinder, attached the stopper to the end,

and refrigerated the sample. Participants took four samples each: once upon awakening (between 8 and 10 a.m.), once at noon (between 11 a.m. and 12 p.m.), once in the afternoon (between 4 and 5 p.m.), and once in the evening (between 10 p.m. and 12 a.m.). Each was collected in a prelabeled Salivette to minimize collection error. Participants were directed to refrigerate their samples after collection and to return them to the researcher the following day, where they were immediately refrigerated in the researcher's laboratory. Participants received course credit in exchange for their participation.

Although the number of participants was small, the longitudinal nature of the design provided repeated data points for each participant. In addition, concerns about error variance introduced by participants modifying their data to fit social desirability biases were assuaged in this study by the use of an objective physiological marker. As discussed below, although a larger sample would provide greater sensitivity for detecting small effects, the current sample was sufficient for the objectives of this study.

Measures

Trait affection given was assessed in the questionnaires with the TAS-G (Floyd, 2002), a 10-item self-report measure of the extent to which one is, by nature, an affectionate person. Items included "I am always telling my loved ones how much I care about them," and "Anyone who knows me well would say that I'm pretty affectionate." A principal-components factor analysis conducted on the current data extracted only one factor with an eigenvalue exceeding one. Coefficient alpha was .94. To control for its potential moderating effects, *trait affection received* was also measured, using the six-item TAS-R scale (Floyd, 2002), which assesses the extent to which people tend to receive affectionate expressions from other people. Items included "I frequently receive affection from others," and "People are always telling me how much they like, love, or care about me." Coefficient alpha was .92. Psychometric information for both scales appears in Floyd (2002) and Floyd et al. (2005).

Cortisol Analyses

Concentrations for salivary free (unbound) cortisol were determined by commercially prepared radioimmunoassay (RIA; MP Biomedicals) in the Exercise Endocrinology Laboratory at Arizona State University. Upon delivery, the Salivettes were centrifuged at 3,000 rpm for 10 minutes, and the extracted salivary samples were frozen. On the day of the analyses, the samples were thawed and duplicate 225- μ l samples were pipetted into test wells. 125 I-labeled cortisol was then added and the assay tubes were incubated for 100 minutes. Standard second antibody techniques were then used to separate free from bound cortisol. To minimize variability, all samples were assayed in the same assay batch. Intra-assay coefficients of variation ranged from 0.22 to 7.19, with an average of 2.02, indicating high internal reliability.

Table 1 Minimum and Maximum Values, Means, and Standard Deviations for Salivary Free Cortisol Across Four Time Periods ($N = 20$)

Sample	Minimum	Maximum	Mean	SD
Morning	.08	1.13	.52	.34
Noon	.09	.78	.35	.20
Afternoon	.10	.46	.22	.11
Evening	.05	.55	.19	.15

Note. Cortisol values are represented as $\mu\text{g/dL}$.

Results

Descriptive Statistics

Means and standard deviations for each of the four cortisol measures appear in Table 1. The cortisol measures had an average intercorrelation (Pearson's r) of .31 and an Ebel's intraclass correlation of .52. Cortisol levels showed the expected diurnal variation of peaking in the morning and gradually declining throughout the day. One-tailed pairwise mean comparisons indicated significant decreases in salivary free cortisol levels from morning to noon, $t(19) = 1.91$, $p = .036$, partial $\eta^2 = .18$; and from noon to afternoon, $t(19) = 2.49$, $p = .012$, partial $\eta^2 = .27$. The decrease from afternoon to evening was nonsignificant, $t(19) = 0.96$, $p = .17$, partial $\eta^2 = .05$. There were no significant sex differences in any of the four cortisol measures. Participant age showed a significant association only with the afternoon salivary sample, $r(18) = -.47$, $p = .048$ (two-tailed). The aggregate diurnal rhythm is illustrated in Figure 1.

Hypothesis and Research Questions

The hypothesis and research questions proposed the examination of three aspects of salivary free cortisol and its relationship to expressed affection, and so three analytic approaches were employed. First, to examine basal cortisol levels, disregarding diurnal variation, the area under the curve (AUC_G) was computed for ground reference using the trapezoidal formula recommended by Pruessner, Kirschbaum, Meinlschmid, and Hellhammer (2003). The specific formula used was:

$$AUC_G = \sum_{i=1}^{n-1} \frac{(m(i+1) + mi)}{2}.$$

The four cortisol samples showed an average correlation of .68 with the AUC_G .

The associations between cortisol and expressed affection predicted in the hypothesis and proposed in the research questions were tested while controlling for the effects of trait received affection, or the amount of affectionate communication one typically elicits from others. Previous research has demonstrated that received affection and expressed affection share significant variance in their mental and

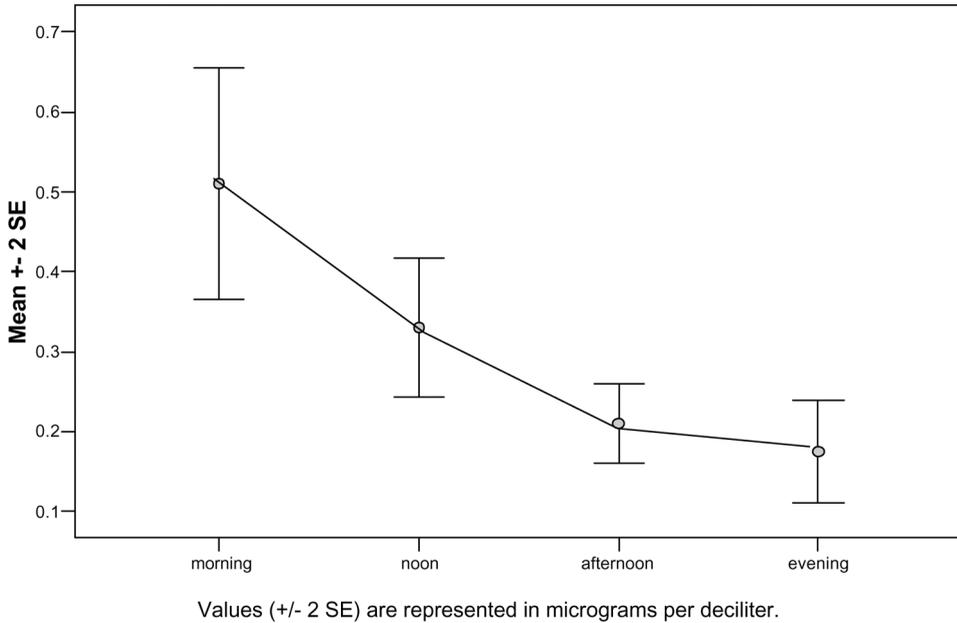


Figure 1 Diurnal Cortisol Rhythm ($N = 20$).

physical health correlates, although they typically still account for significant unique variance (see Floyd et al., 2005). In the present study, expressed affection and received affection were moderately intercorrelated, $r(18) = .48$, $p = .021$ (one-tailed; disattenuated correlation = .52). In reference to the first research question and with trait received affection controlled for, trait expressed affection showed a moderately strong association with average cortisol level, as represented by the AUC_G , $r(18) = .51$, $p = .027$ (two-tailed; disattenuated correlation = .53).

The approach for testing the second research question, which considered diurnal variation, was to examine associations between affection and each of the four cortisol samples individually. Controlling for trait received affection, trait expressed affection was linearly related to waking cortisol, $r(18) = .50$, $p = .046$ (two-tailed; disattenuated correlation = .52). Two-tailed partial correlations were nonsignificant with cortisol levels at noon, $r(18) = .27$, $p = .28$; afternoon, $r(18) = .17$, $p = .52$; and evening, $r(18) = -.06$, $p = .84$ (disattenuated correlations were .28, .18, and $-.06$, respectively).

Finally, to address the hypothesis, I examined the association between affection and the magnitude of morning-to-evening variation in cortisol level. First, I subtracted the evening cortisol value from the morning value to create an index (Δ) of the magnitude of diurnal change (see Gray, Kahlenberg, Barrett, Lipson, & Ellingson, 2002). The resulting variable, wherein higher values indicated a greater morning-to-evening change, ranged in value from 0.26 to 0.88 $\mu\text{g}/\text{dL}$, with a mean of 0.34 ($SD = 0.29$). Controlling for trait received affection, trait expressed affection was linearly related to Δ , $r(16) = .56$, $p = .009$ (disattenuated correlation = .58). The hypothesis is supported.

Discussion

To augment the robust body of research attesting to the health benefits of receiving affection, recent studies have investigated some of the mental and physical health correlates of expressing affection. Although this research has relied heavily on self-report measures, it has consistently indicated that those whose typical communicative patterns are characterized as highly affectionate are advantaged, relative to low-affection communicators, on various aspects of physical health and mental well-being. The present study sought to extend this research by examining the relationships between affectionate communication and one physical marker of health, diurnal variation in the steroid hormone cortisol.

With respect to average and time-specific levels of cortisol and their association with health, extant research provided conflicting results: in some studies, well-being was related to lower average cortisol values and lower time-specific values (particularly at awakening); in others, higher values were indicative of health. Consequently, two research questions guided examination of the relationship between trait expressed affection and average and time-specific cortisol values. Participants' average levels of cortisol over the course of the day were strongly (and positively) related to their trait expressed affection levels. That is, after controlling for how much affection they typically receive from others, participants who were typically more affectionate with others also showed higher average cortisol values over the course of the day than did those who were less affectionate. Similarly, trait expressed affection showed a strong positive association with waking cortisol, although its correlations with other time-specific values were nonspecific.

Although these findings by no means provide a final word on whether higher or lower average and waking cortisol values are preferred, they do suggest the possibility that affectionate communication is a moderately arousing activity and that when individuals engage in affectionate expression on a fairly regular basis, it may elevate their cortisol levels. Informative in this regard is Marazziti and Canale's (2004) study showing that people who had recently fallen in love also experienced elevated cortisol levels, relative to a control group. Both of these findings suggest that even seemingly positive emotional or behavioral experiences, including those associated with love and affection, can induce activity of the HPA axis as a means of managing physiological arousal. Of course, the current findings do not support a causal claim; it may just as easily be the case that elevated average and waking cortisol encourage affectionate behavior as an avenue for managing arousal.

By contrast, research has fairly consistently supported the notion that a strong diurnal rhythm in cortisol values is adaptive, so the present study applied this knowledge to test AET and TBT's hypothesis that expressed affection is associated with physical health. As predicted, trait expressed affection (with trait received affection controlled for) was strongly associated with the magnitude of decrease in cortisol values over the course of the day.

Considered together, these findings provide important evidence that communicative patterns characterized by high amounts of expressed affection are associated with

one psychoneuroendocrine marker of physical health, the production of cortisol. On a purely methodological level, this study represents a significant advance in research linking affection with health by demonstrating associations with objectively measured (rather than self-reported) health indices. At the theoretic level, however, these preliminary findings suggest that particular patterns of interpersonal behavior may affect and be affected by variables beyond those that are socioculturally constructed or are within the conscious control of the communicator. Rather, as the burgeoning area of psychophysiology has shown (see, e.g., Cacioppo, Tassinary, & Berntson, 2000; Hugdahl, 1995), social behavior interacts with the endocrine, immune, and central nervous systems in complex and compelling ways that often transcend the influences of culture, gender, class, or other socially significant variables. Indeed, the study of these and other body systems holds much promise for the fuller understanding of social behavior and its associations with health and well-being.

Strengths, Limitations, and Conclusions

As noted, perhaps the most important strength of the study was its escape from the complete reliance on self-report measures that characterizes much interpersonal communication research (including the author's). Rather, this project represents an important advance in the study of interpersonal behavior by demonstrating that self-assessed levels of affectionate communication correspond to physiological aspects of the endocrine stress response. Most notably, the moderately strong correlation between expressed affection and diurnal cortisol variation (which was significant even after controlling for the effects of received affection) suggests that the trait of being highly affectionate corresponds to an adaptive, healthy cortical rhythm. These results warrant further investigation of course, but they are promising in their implication of a systematic relationship between communicative behavior tendencies and physiological profiles indicative of physical well-being.

Although the sample size was small relative to that typically seen in mainstream interpersonal communication research, it was within the norm for psychophysiological studies (e.g., Kurup & Kurup, 2003; Marazziti & Canale, 2004; van Niekerk, Huppert, & Herbert, 2001), including psychophysiological studies conducted within the field of interpersonal communication (e.g., Tardy, Thompson, & Allen, 1989). The longitudinal nature of the current study and the relative inability of participants to introduce error variance in their cortisol data by social desirability biases both argue for the adequacy of the sample size; however, they do raise legitimate questions about statistical power and external validity (see, e.g., Murphy & Myros, 2004). Concerns about power are assuaged by the emergence of several statistically significant correlations and mean comparisons in the results, although larger samples would provide greater sensitivity for identifying smaller effects. The possibility that the findings would fail to generalize to other populations demands replication of the results, efforts toward which are currently underway in our laboratory.

The sample was young and healthy and was instructed to abstain from caffeine on the day of the salivary collections and from food or drinks other than water for an

hour before each collection. However, some other potential sources of extraneous variance were not controlled for. For instance, participants who regularly smoke were not excluded. Some investigations have suggested that repeated exposure to nicotine can lead to chronically elevated cortisol, to blunted responses to stress, or to both (see Kirschbaum, Strassburger, & Langkrär, 1993; Kirschbaum, Wüst, & Strassburger, 1992), whereas others have failed to show an effect of smoking on cortisol values (Pruessner et al., 1997). In addition, the female participants were not screened for oral contraceptive use, which has been shown to have small effects on waking cortisol values (Pruessner et al., 1997) and cortisol responsiveness to acute stress (Kirschbaum, Pirke, & Hellhammer, 1995). Replication in paradigms controlling for these additional sources of potential variance can indicate the extent to which they may have affected observed cortisol values.

The current findings may be particularly relevant for those in the field of health communication given that they demonstrate strong associations between communicative behavior and physical health. Although the majority of health communication research has focused either on patient–provider interaction (e.g., Beisecker, 1990) or on the persuasive effects of health messages (e.g., Morgan, Miller, & Arasaratnam, 2002), this study fits within a small but growing third focus area, which is the direct connection between communicative behavior and health. From an applied perspective, this focus holds great promise for improving the human condition. To the extent that communication researchers can identify patterns of behavior that have causal (not just correlational) associations with physical or mental health, they can apply this knowledge in programs designed to help people adopt healthier communicative behaviors in their social and personal relationships.

There are at least two promising ways to extend the current study in future research on the association between affectionate communication and stress. One approach (currently underway in our lab) is to examine the ability of affectionate behavior at the interaction level to return elevated cortisol levels to baseline values following exposure to an acute stressor. With proper controls, this approach can begin to illuminate the potential causal relationship between affectionate behavior and stress reduction (knowledge that could be applied in communicative interventions, as mentioned above). Since the current study establishes a pattern of covariation between affectionate communication and physiological stress, the examination of a potential causal relationship is a natural and important next step. Such work may also begin to illuminate individual variation in responses to affectionate behaviors; for instance, if particular people are more prone than others to respond positively to expressed affection, variance in their hormonal responses may partially account for such a difference. A second approach is to examine, as an outcome measure, the ratio of cortisol to a second stress hormone, dehydroepiandrosterone (DHEA) (see Cruess et al., 1999). DHEA and the derivative in which it is most often found in the bloodstream, dehydroepiandrosterone-sulfate (DHEA-S), are the most abundant naturally occurring steroids produced by the adrenal gland (Ebelin & Koivisto, 1994). Some have suggested that the ratio of cortisol to DHEA-S is a more accurate indicator of HPA axis activity than is cortisol level alone, because even

though DHEA-S is also initially elevated during acute stress, it converts to cortisol, producing a relatively pronounced increase in cortisol and a decrease in DHEA-S as a result. These and other hormones implicated in the management of stress (e.g., oxytocin, prolactin) provide valuable avenues for research aimed at fuller understandings of the relationships between health and interpersonal behavior.

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