

Human Affection Exchange: XIII. Affectionate Communication Accelerates Neuroendocrine Stress Recovery

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Contemporary theory in interpersonal communication and health psychology supports the prediction that engaging in affectionate behavior within established relationships has a direct effect on the alleviation of stress symptoms following exposure to an acute stressor. Participants in this study were exposed to a series of standard laboratory stressors and were subsequently assigned either to an experimental group or to 1 of 2 control groups. Those in the experimental group were instructed to write a letter to a loved one in which they expressed their feelings of affection for that person. Those in 1 control group thought about a loved one but did not engage in any communicative behavior, and those in the other control group simply sat quietly. All 3 conditions were compared with respect to their levels of salivary free cortisol, an adrenal steroid hormone that is instrumental in the body's neuroendocrine stress response. Results indicated that, compared to the control groups, those in the experimental group experienced accelerated cortisol recovery following exposure to the acute stressors.

It is nearly impossible to overstate the importance of affectionate communication in the formation and management of satisfying personal relationships. Indeed, many consider the desire to be loved and appreciated to be a fundamental human need (Baumeister & Leary, 1995; Maslow, 1970), so it is unsurprising to find that receiving expressions of love and appreciation, in the form of affectionate behavior, is associated with a host of mental, physical, relational, and psychosocial benefits (for review, see Floyd, 2006a). Although the advantages associated with *receiving* affec-

tionate messages are well documented, however, recent research has examined the potential benefits associated with *expressing* affection, particularly as they relate to the ability of the body to manage and react to stress. As the fourth in a series of studies focusing on stress and the expression of affection, this experiment examines the efficacy of conveying verbal affectionate messages in the reduction of a physiological stress symptom.

This review begins with an overview of theory linking affectionate behavior with the management of stress. Prior research on the relationship between affection and stress is detailed subsequently, and then goals, predictions, and questions for this study are explicated.

AFFECTIONATE COMMUNICATION, HEALTH, AND STRESS

The prediction that expressing affection can be instrumental in alleviating acute stress (independent of the effects of affectionate messages received in return) is derivable from at least two separate theories. First, *affection exchange theory* (AET; Floyd, 2006a; Floyd et al., 2005) conceives of affectionate communication as an adaptive behavior contributing to humans' superordinate motivations for viability and fertility. AET presumes the neo-Darwinian principle providing that organisms who are best adapted to the demands of their physical and social environments are the most likely to survive and reproduce. The theory proposes specific relationships between the communication of affection and human viability, offering that both giving and receiving affection within an optimal range of expression activates physiological pathways that fortify the body's ability to defend itself against genuine or perceived threats (see Floyd, 2006a).

Second, *tend and befriend theory* (TBT; Taylor et al., 2000) offers alternatives to "fight or flight" as adaptive responses to stressors. Although males may have benefited evolutionarily from either fighting or fleeing from environmental challenges, TBT proposes that neither response would have been as adaptive for females because of the peril to which either approach would subject their offspring. For instance, if a mother is fighting a threat or fleeing from it, offspring are likely to be left unprotected in the process; thus, these tendencies would eventually have been selected against. Instead, TBT argues that the complexity of protecting and caring for offspring (particularly in threatening situations) has made it adaptive for females to adopt two related strategies for responding to stress. The first, *tending*, involves calming and caring for offspring and working to blend into the environment and is theorized to be particularly adaptive insofar as it reduces the children's stress responses, maximizing their capacity to survive to reproductive maturity. The second, *befriending*, refers to creating and maintaining social relationships that can provide resources and protection for the mother and her children during stressful times.

Both theories suggest that communication behaviors that build and maintain significant social relationships should be related to health and well being not only for those who receive them but also for those who convey them. As Floyd (1997; 2006a; Floyd & Burgoon, 1999) has argued, one of the most instrumental communicative behaviors in the development and maintenance of significant personal relationships is the expression of affection; thus, affectionate communication is a plausible operational definition of TBT's befriending concept. One approach to examining the relationship between affectionate behavior and health that both theories suggest is to ascertain the body's ability to handle stress. Although mental health, immunocompetence,

and other aspects of well being are similarly important, the study of stress holds much promise for improving the human condition, due to its robust relationships with a number of other physical problems. These include, among others, coronary artery disease and hypertension (Blascovich, Shiffert, & Katkin, 1989; Potempa, 1994); elevated cholesterol and cardiovascular disease (Roy, Kirschbaum, & Steptoe, 2001); and immunosuppression (Kiecolt-Glaser et al., 1987). In fact, McEwan (1999) estimated that stress and stress-related disorders take an annual economic toll of nearly \$200 billion in the United States alone. To the extent that communicative behaviors can operate toward the alleviation of stress, therefore, a more complete understanding of this process can aid researchers and clinicians in the development of techniques to help people to manage stress more efficiently. Stress and the ways in which it affects the body physically are addressed subsequently.

The Stress Response

As first articulated in the pioneering works of Bernard (1865/1961), Cannon (1929), and Selye (1936), stress can be understood to involve an organism's 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. It is important to note that 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 multi-phasic reaction along the hypothalamic–pituitary–adrenal (HPA) axis. First, the hypothalamus secretes corticotrophin-releasing hormone (CRH), which stimulates the pituitary gland to release adrenocorticotrophic hormone (ACTH) into general circulation. ACTH, in turn, prompts the adrenal cortex to secrete the glucocorticoid *cortisol* (also known as hydrocortisone) into the bloodstream. Most of the cortisol (approximately 95%) immediately binds to corticosteroid binding globulin and albumin, which renders it biologically inactive. The remainder stays biologically active 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 circulating level of cortisol is high, it initiates a negative feedback loop, prompting the HPA axis to suppress further secretion of CRH, ACTH, and cortisol (Chrousos & Gold, 1992).

When it is released in response to a stressor, cortisol functions to mobilize the body's energy resources to mount an adequate defense against the stressor. The assessment

of the free cortisol response to an acute stressor therefore provides an opportunity to examine the body's ability to react efficiently to environmental challenges. This experiment takes this approach to studying the relationship between stress and affectionate communication, so as to circumvent the reliance on self-report measures and the potential for social desirability bias that they introduce in the measurement of stress. Previous research on the association between affectionate communication and stress is elaborated subsequently.

Affection and Stress

To date, at least three studies have taken up the question of whether the amount of affectionate communication one expresses to others is inversely associated with one's own stress level, as AET and TBT would predict. Floyd (2002) tested this prediction by recruiting known-divergent groups of adults who were highly affectionate and nonaffectionate (a discrimination confirmed through manipulation testing). Each group responded to a battery of psychosocial assessments and mean comparisons revealed that, as expected, those in the highly affectionate group reported significantly lower levels of stress (and related constructs, such as depression and loneliness) than those in the nonaffectionate group. Although the effect size for stress was moderate (partial $\eta^2 = .28$), this initial study suffered from three deficiencies that legitimately call its inference into question. The first of these is the unexplored rival hypothesis that the benefits of expressing affection are, in fact, simply those of the affectionate communication received in return. Cultural expectations for reciprocity of positive acts are strong (Gouldner, 1960), so it is unsurprising to find that people's reports of how much affection they express and how much they receive are strongly linearly related (see Floyd, 2006a).

To address this first limitation, Floyd et al. (2005) reexamined the Floyd (2002) data and then presented results from three other data collections in which the effects of expressed affection on psychosocial outcomes were examined while the effects of *received* affection were controlled. In the Floyd (2002) data, expressed affection was correlated at $-.39$ with stress; the correlation was reduced to $-.31$, but was still statistically significant when the effect of received affection was controlled for. Stress was measured only in the third of the three new studies presented by Floyd et al.; for that study, stress showed a correlation of $-.56$ with expressed affection, and the correlation went up to $-.75$ when received affection was covaried out. These results indicate that, although expressed and received affectionate communication share some variance with respect to stress, expressed affection accounts for unique variance, as AET and TBT would predict.

A second limitation to both of these studies is that the outcome measure of interest—stress—was ascertained by self-report measure, subjecting it to the pressures of

the social desirability bias. That is, participants may have altered their reports of the amount of stress they feel to appear socially desirable. Although self-report measures are often maligned due to this possibility, it must be recalled that any form of assessment is vulnerable to the effects of the social desirability bias if (a) participants know they are being observed, and (b) if the behavior being measured can be controlled. Thus, an important means of advancing the knowledge generated by Floyd (2002) and Floyd et al. (2005) on the inverse relationship between affection and stress is to measure the outcome variable in such a way that the social desirability bias is ruled out as a rival hypothesis.

To address this second limitation, Floyd (2006b) examined the effects of expressed and received affection on an objective physiological marker of stress, the diurnal variation in adults' levels of the adrenal steroid hormone cortisol. In the absence of acute stress, cortisol follows a strong diurnal (i.e., 24-hour) rhythm wherein it peaks in the hour after awakening and drops continually during the day, reaching its lowest point around midnight (Kirschbaum & Hellhammer, 1989). Healthy regulation of the HPA axis is indicated by a high degree of morning-to-evening change in cortisol levels. Consequently, "flattened" diurnal curves, showing little change in cortisol values from morning to evening, are associated with dysregulation of the HPA axis and are indicative of higher degrees of chronic stress (Chrousos & Gold, 1992; Giese, Sephton, Abercrombie, Duran, & Spiegel, 2004). Floyd (2006b) thus predicted that, with the influence of received affection controlled for, expressed affection would be linearly related to the magnitude of morning-to-evening change in cortisol. Instead of self-reporting on their levels of stress, participants in the Floyd (2006b) study provided four saliva samples over the course of a normal workday: one on awakening, one at noon, one in the late afternoon, and one before retiring. These were analyzed for the levels of salivary free cortisol, and Floyd found a strong linear relationship ($r = .56$) between expressed affection and diurnal cortisol variation.

The Floyd (2006b) study addressed both of the first two limitations: it controlled for the effects of received affection, and it measured the outcome variable in such a way that the social desirability bias could be ruled out (because salivary free cortisol levels are not under the willful control of the participants). It remained limited in a third way, however, which is that the results supported no causal inference. AET and TBT both predict that engaging in affectionate behavior with others has the effect of reducing stress, but the results from the first three studies (Floyd, 2002, 2006b; Floyd et al., 2005) were correlational and cannot, therefore, support the inference of a causal relationship between affection and stress reduction.

Although data from these first three studies are promising in their demonstration of a strong inverse relationship between expressed affection and stress, an experimental design is required to address the third limitation and test the

causal claim that AET and TBT offer. This experiment was designed to meet this need while simultaneously addressing both of the first two limitations that plagued the earlier studies (social desirability and control for the effects of received affection). Specific predictions and questions are advanced subsequently.

HYPOTHESIS AND RESEARCH QUESTION

This study was designed to address one principal prediction, drawn from both AET and TBT, that engaging in affectionate communication after being exposed to acute stress will accelerate the reduction of the stress response. As noted below, we tested the stress-reducing effects of expressing affection against two alternatives, either sitting quietly and doing nothing, or sitting and thinking about the object of one's affection (without expressing affection to that person). Consequently, we hypothesized the following:

H1: Following exposure to an acute stressor, expressing affection to a loved one leads to more pronounced reductions in free cortisol, compared to thinking about a loved one or sitting quietly.

Although we hypothesized that expressing affection would accelerate stress recovery *relative to* thinking about a loved one or sitting quietly, AET and TBT provide little guidance in the way of predicting the absolute effects of these other activities on stress-reduction processes. We thus addressed this issue in the form of a research question:

RQ1: What effects do thinking about a loved one or sitting quietly have on free cortisol levels following acute stress?

Finally, due to the possibility that biological sex may moderate the influence of various activities on the reduction of the stress response, we posed two additional questions:

RQ2a: What effect, if any, does biological sex have on baseline cortisol level?

RQ2b: What effect, if any, does biological sex have on cortisol reactivity to expressing affection, thinking about a loved one, or sitting quietly following acute stress?

METHOD

Participants

Participants ($N=30$) were equal numbers of male and female undergraduate students at a large university in the southwestern United States. They ranged in age from 19 to 35 years, with an average age of 22.73 years ($SD=3.81$). The majority ($n=28$) were White, whereas one participant was Hispanic and one was African American.

Prescreening Procedures

Participants were recruited via a prescreening questionnaire distributed in communication courses. One hundred sixty eight prospective participants completed a screening questionnaire, which they subsequently sealed in an envelope and returned to the researchers. To be considered eligible for the laboratory study, prospective participants had to meet stringent inclusion criteria. Specifically, all participants (a) were normotensive; (b) were nonsmokers; (c) reported never having had chemotherapy or chest radiation; (d) reported no history of hepatitis, endocrine disease, kidney or liver disease, cancer, cardiovascular disease, rheumatological disorders, respiratory problems, or diabetes; and, (e) reported no current use of alpha-blockers, beta-blockers, or steroids. In addition, all female participants (a) were nulliparous; (b) were not currently pregnant; (c) were not currently breastfeeding; and (4) were currently using oral contraceptives. (A larger number of qualified female participants was using oral contraceptives than not, so for consistency's sake we included only those in the former group.) Perhaps because the screening sample consisted of relatively healthy young adults, more than half of the prospective participants who returned a screening questionnaire ($n=90$, or 53.6%) met all of the inclusion criteria and were judged eligible for the laboratory study. Among these, 15 men and 15 women were randomly selected, using a random numbers table, to receive invitations to participate in the laboratory procedure. Any who were unwilling or unable to take part were replaced with randomly selected alternates drawn from the pool of eligible prospective participants. Male and female prospective participants were equally likely to be eligible for the study ($p > .05$).

Those eligible participants who agreed to take part in the laboratory procedure were scheduled for a 1.5-hour session in the communication sciences laboratory. Prior to their appointments, they were given a short questionnaire to complete and bring with them to their laboratory session. Participants were also instructed to abstain from alcohol and caffeine for at least 8 hr prior to their laboratory appointments, and from food, tobacco, and exercise for at least 1 hr prior.

Laboratory Procedures

Each laboratory session was attended by the participant, a technician who collected and catalogued all saliva samples, and an experimenter who gave instructions and conducted the stress induction. On arrival at the laboratory, participants were administered consent forms and were asked to complete a compliance form indicating whether they had complied with the instructions to abstain from alcohol, caffeine, food, tobacco, and exercise prior to their appointments. If any participants had indicated a failure to comply with one or more of these instructions, they would have had their laboratory appointments rescheduled; however,

all participants indicated their compliance with all directives. After completing paperwork and turning in their questionnaires, participants were asked to sit quietly for a few minutes. They were asked not to do homework or any other activities, but simply to relax and clear their minds.

After approximately 5 min, a technician returned to collect the first of 10 saliva samples for the analysis of salivary free cortisol. Cortisol can be measured from blood, urine, and/or saliva (Baum & Grunberg, 1995), with strong consistency between these types of measurements (Kirschbaum & Hellhammer, 1989); consequently, saliva samples were used because they are the least invasive. The samples were collected using Salivettes (Sarstedt, Inc.), plastic 5 ml test-tube-shaped collection receptacles containing a sterilized cotton pledget and a stopper. To collect a saliva sample, participants were directed to chew on the cotton pledget for at least 60 sec and to saturate it with saliva. The technician then returned the saturated pledget to the plastic cylinder, attached the stopper to the end, and refrigerated the sample. Several studies (e.g., Chatterton, Vogelsong, Lu, & Hudgens, 1997; van Eekelen, Kerkhof, & van Amsterdam, 2003) have demonstrated that free cortisol measured in saliva accurately reflects free cortisol in the bloodstream. Although saliva is not considered a hazardous material, all technicians employed universal precautions, including the use of lab coats and latex gloves while handling saliva samples and the disposal of used gloves in a locked biohazard receptacle. In addition, because saliva can contain trace amounts of blood, all laboratory personnel (technicians and experimenters) had completed a university-sponsored risk management course in the avoidance of bloodborne pathogens.

Because cortisol follows a strong diurnal rhythm, we expected that baseline cortisol values would vary according to the time of day each laboratory session began. Consequently, the experimenter noted the clock time at the start of each session so that variance associated with diurnal variation could subsequently be covaried out. After the baseline saliva measure was taken, participants were told that they would be going through a series of moderately stressful activities, and that the technician would continue to take saliva samples during the activities. The experimenter then administered the stress induction, which is described subsequently.

Stress Induction

The stress induction consisted of six standard laboratory stressors presented sequentially: a cold pressor test, a mental arithmetic challenge, a Stroop color word test, a second mental arithmetic challenge, a series of conflict video clips, and a second Stroop color word test. With the exception of the cold pressor test, each stressor lasted 5 min. At the conclusion of each stressor, the technician took a saliva sample (using the same procedure described above) before

the next stressor began. Details on each stress activity are provided below.

Cold pressor test. The cold pressor test requires participants to immerse a forearm into a bucket of ice water and to hold it there for a period of time (see Denton, Burleson, Hobbs, Von Stein, & Rodriguez, 2001). Participants in this study held the forearm of their nondominant hand in a 3-gallon galvanized steel bucket filled with water and eight frozen Airgas Ice gel refrigerant packets for 75 sec.

Mental arithmetic. Participants were given two different mental math challenges (Kelsey, Soderlund, & Arthur, 2004). In the first challenge, participants were instructed to begin with the number 2,400 and then to continually subtract 17 and call out the new value (i.e., 2400, 2383, 2366, etc.). If any answers were incorrect, participants were told to start over with 2,400. In the second challenge, participants were instructed, beginning with the number 123, to add the three digits together ($1+2+3$) and then add the sum (6) to the original number ($6+123$). Then, with the resulting value (129), they were to do the same (add 1, 2, and 9, then add the sum to 129) continually. If any answers were incorrect, participants were told to start over with 123. During both mental arithmetic challenges, the experimenter used mild verbal harassment (e.g., “go faster,” “say the numbers louder,” “keep going”) and violated the personal space of the participant to increase the stress response (see Bishop & Robinson, 2000).

Stroop color word test. Next, participants were given a Stroop color word test (Alansari, 2004), in which they were presented with a series of words on a computer screen that are names of colors. Most of the names were printed in letters of a color different from the one being named (e.g., the word “blue” written in yellow letters), and participants were instructed to call out the color of the letters, not the color named in the word. The words flash on the computer screen at varying speeds and appear at varying places on the screen. During the 5-min sequence, there are three “runs” of words that are so fast it is nearly impossible to keep up with the naming task accurately, so participants fall behind and must continue on having failed to name some of the words.

Marital conflict episodes. Participants were shown a series of video segments from a documentary entitled “Couples Arguing” (View Film & Video, Inc., 1985). For each, participants were instructed to pay attention to the behavior of the couple in the video and to “try to put yourself in their position.” Each segment featured the same couple engaging in conflict ranging from mild disagreement to mutual screaming and swearing at each other. This procedure has been successfully used in other studies to induce stress (see Denton et al., 2001).

After each of the six stressors, the technician took a saliva sample. The total stress inducted lasted approximately 40 min, after which time participants were assigned to one of three experimental manipulation groups, described subsequently.

Experimental Manipulation

After the stress induction, participants were randomly placed into one of three manipulation conditions: expression, cognition, or control. Assignment to conditions had been completed prior to the start of the laboratory study, using ID numbers and a random numbers table. Five male and five female participants were assigned to each of the three conditions, and each participant's assignment was sealed in an envelope with that participant's ID number on the outside. At the conclusion of the stress induction, the experimenter opened the envelope for that particular participant, and assigned him or her accordingly. This ensured that neither the experimenter nor the technician knew the condition to which the participant would be assigned until the moment of assignment.

In the *expression condition*, participants were asked to think of the person with whom they have the closest, most affectionate relationship, and to write that person a letter in which they express their feelings of love and affection for him or her. Participants were given a notepad and pen and were given 20 min in which to write their letters. Participants in the *cognition condition* were given instructions that were identical, except that they were asked only to sit and think about their target person and how much they care about him or her, but not to express those feelings in writing like participants in the expression condition were doing. This condition provided a control to determine whether any observed benefits of expressing affection were separable from those associated with merely experiencing affectionate feelings. Finally, participants in the *control condition* were instructed to sit quietly for the 20-min duration of the manipulation and not to read, do homework, or do any mentally stimulating activity.

The technician took additional saliva samples at the 10th and 20th min of the manipulation. At the conclusion of the manipulation, participants were thanked for their participation, given additional information about the study, and were paid \$10 in exchange for their participation. A final saliva sample was taken prior to their departure (approximately 10 minutes after the completion of the manipulation).

Affectionate Target Measure

All participants completed a short questionnaire prior to their arrival at the laboratory. Most of the measures included in the questionnaire were for ancillary research purposes and are thus not reported here. However, as part of the questionnaire, participants were asked to identify the one person

with whom they currently have the most affectionate relationship. Most often identified was a nonmarital romantic partner ($n = 13$) or a close platonic friend ($n = 10$). Also identified were a spouse ($n = 3$), a parent ($n = 2$), or a nonparental family member, such as a sibling ($n = 2$). There were no sex differences in the tendency to nominate any of these relationship types (all p 's $> .05$). The person identified in this portion of the questionnaire was the person participants in the expression condition were instructed to write to and participants in the cognition condition were instructed to think about.

Cortisol Analyses

Concentrations for salivary free (unbound) cortisol were determined by commercially prepared coated-tube radioimmunoassay (RIA; MP BioMedicals, Irvine, California) in the Exercise Endocrinology Laboratory at Arizona State University. On delivery, the Salivettes were centrifuged at 3,000 RMP for 30 min and the aliquots of saliva were extracted and stored at -80°C until analysis. On the day of the analyses, the samples were thawed and duplicate 225- μl samples were pipetted into test wells. Because the RIA kits were designed for analysis of plasma cortisol, an alternate protocol recommended by the manufacturer was used. This included the addition of 200 μl of phosphate-buffered saline, pH 7.5, to bring the 25 μl standards and controls to the volume of the samples, and the addition of 25 μl of steroid-free serum (stripped serum) to all 200 μl saliva samples. In addition, the standard curve was extended to increase the sensitivity of the assay, and the incubation time was increased to 24 hr at 4°C . 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. Inter- and intraassay coefficients of variation were all below 10%, indicating high internal reliability.

RESULTS

Manipulation Checks

The stress induction was designed—using standard laboratory stressors—to elevate free cortisol levels so that the experimental and control groups could be compared for their ability to reduce cortisol levels following the induction. Therefore, to test the efficacy of the induction, we compared baseline (T_1) cortisol levels to those observed during the induction (T_2 through T_7). We created two indexes for comparison; the first was the aggregate of the free cortisol levels across the six data collection points of the induction. Second, however, because salivary cortisol typically has a 10- to 15-min delayed onset following exposure to a stressor (Sapolsky, 2002), we created a second index, which was the aggregate of the cortisol levels across the latter

three time periods of the induction (T_5 – T_7). We compared baseline values to each index within $2 \times 2 \times 3$ mixed-model analyses of variance (ANOVAs), with time as the within-subjects factor and sex and manipulation (expression, cognition, control) as the between-subjects factors. Success for the stress induction would be indicated by significant main effects for time, the appropriate direction for the mean comparison (i.e., baseline value is lower than induction value), and the absence of other significant main or interaction effects that would qualify the main effect of time.

Using the aggregate of all six induction data points as the comparison, the first ANOVA produced a significant main effect for time, $F(1, 22) = 6.82, p = .016$, partial $\eta^2 = .24$. The baseline measure of free cortisol was $1.008 \pm .691 \mu\text{g/dL}$, whereas the induction produced a mean cortisol value of $1.298 \pm .549$. No other main or interaction effects were significant. Due to delayed onset of the salivary cortisol response, we anticipated that comparing baseline values to the aggregate of the last three induction data points would return an even stronger result. The second ANOVA produced a significant main effect for time, $F(1, 22) = 9.46, p = .006$, partial $\eta^2 = .30$. The last three data points of the induction (T_5 – T_7) produced an average cortisol value of $1.406 \pm .732$. No other main or interaction effects were significant. The measures therefore indicate success for the stress induction.

No direct measures were taken for the success of the experimental manipulations (expression, cognition, control), as these simply involved participants responding to different sets of instructions. Two research assistants were present when each participant was read his or her instructions for the appropriate manipulation, so they were able to verify that the instructions were given appropriately, and the instructions were read verbatim each time to minimize error. All 10 participants assigned to the expression condition produced handwritten letters in accordance with instructions. Those in the cognition and control groups were checked periodically to ensure that they were not writing, reading, doing homework, or otherwise occupying their time. However, we did not directly query those in the cognition group as to how much they thought about their target others; we deemed their direct instruction to think about their target others (and the absence of such an instruction in the control group) as sufficient to create a difference between these two groups in how much participants thought about their target other during the manipulation.

Hypothesis and Research Questions

We began our analyses by examining the cortisol value distributions for deviations from normality. Physiological data are often abnormally distributed, and our examination revealed that cortisol score distributions were substantially

skewed at several time points. Consequently, we used log-transformed values in the analyses, but for ease of interpretation, we have reported uncorrected values for means and standard deviations. Next, we verified that there were no sex or condition effects on baseline cortisol values. Because H1 calls for those in the expression condition to experience more pronounced declines in postinduction cortisol levels than the other groups, we would need to have corrected for any differences in baseline values before proceeding. A 2×3 ANOVA comparing T_1 cortisol values by sex and condition produced no significant main or interaction effects (all p 's $> .05$), indicating a lack of significant differences in baseline levels. This analysis provided an answer to RQ2a by indicating that sex had no effect on baseline cortisol values.

To examine the effects of time and condition on cortisol values (H1 and RQ1), along with any potential main or moderating effects of sex (RQ2b), we utilized a $2 \times 3 \times 10$ mixed-model analysis of covariance (ANCOVA), with sex and condition as between-subjects factors, time (with 10 levels) as the within-subjects factor, and beginning hour (in military time) as the covariate. Because cortisol follows a strong diurnal rhythm, we were not surprised to find that participants' average cortisol levels (i.e., aggregated across the 10 time periods in the experiment) were lower the later in the day the experimental sessions began, $r(28) = -.47, p = .004$ (one-tailed). This significant association led us to include beginning hour as a covariate. The ANCOVA produced a significant multivariate Time \times Sex \times Condition interaction, $\Lambda = .18, F(18, 28) = 2.06, p = .042$, partial $\eta^2 = .57$. The univariate Time \times Sex \times Condition interaction was likewise significant, $F(18, 189) = 1.66, p = .049$, partial $\eta^2 = .14$. In addition, the covariate was significant, $F(1, 21) = 16.11, p = .001$, partial $\eta^2 = .43$; and the ANCOVA produced a significant between-subjects interaction effect between sex and condition, $F(2, 21) = 5.11, p = .016$, partial $\eta^2 = .33$, which was rendered uninterpretable by the disordinal Time \times Sex \times Condition interaction. No other main or interaction effects were significant.

To ascertain the pattern of the cortisol means, we graphed baseline scores, the aggregate of the induction scores, and the aggregate of the manipulation scores over time for each sex in each condition. These values appear in Figure 1. Because our interest is in the comparison of these three time periods (baseline, stress induction, and manipulation), this graph provides a cleaner look at the pattern of means than one that includes all 10 time periods. Consistent with H1, both men and women in the expression condition experience increases in cortisol during the induction and then decreases during the manipulation. In fact, the aggregate scores for the manipulation are lower for both men and women in the expression condition than are their baseline scores (women's slightly so, men's more so).

In reference to RQ1 and RQ2a, men and women in the cognition group (by contrast to those in the expression

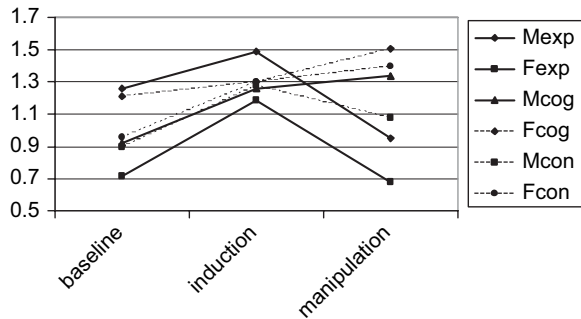


FIGURE 1 Salivary Free Cortisol across Baseline, Stress Induction, and Manipulation Periods for Men and Women in Three Experimental Conditions. Note. “Mexp” and “Fexp” are males and females, respectively, in the expression condition. “Mcog” and “Fcog” are males and females in the cognition condition. “Mcon” and “Fcon” are males and females in the control condition.

group) experienced increased cortisol levels from baseline to the stress induction, and then further increased levels during the manipulation. That is, time exerted a direct linear effect on cortisol values for both men and women in the cognition condition. Finally, in the control group, both men and women experienced increased cortisol levels from baseline to the stress induction. During the manipulation, however, cortisol values decreased for males (consistent with the expression condition) but increased for females (consistent with the cognition condition).

Of importance, however, H1 suggested that cortisol values during the manipulation should be lower for those in the expression condition than for those in the other two groups (irrespective of sex). To verify this pattern, we conducted a focused, 1-*df* contrast comparing the three conditions on their aggregate manipulation period (i.e., T_8 – T_{10}) cortisol values. Contrast coefficients were -2 for the expression group, 1 for the cognition group, and 1 for the control group. The contrast was significant, $t(27) = 2.15$, $p = .02$. The average cortisol value during the manipulation in the expression group ($0.820 \pm .523$ $\mu\text{g/dL}$) was lower than that of the cognition ($1.421 \pm .729$) and control ($1.240 \pm .604$) groups. H1 is supported.

DISCUSSION

Both affection exchange theory and tend-and-befriend theory support the prediction that engaging in behaviors designed to fortify significant social relationships following exposure to stressors is beneficial in the reduction of the physiological stress response. As Floyd (2006a) has pointed out, one of the principal communicative behaviors serving this relational purpose is the expression of affection. Thus, to ascertain the efficacy of communicating affection in the reduction of acute stress symptoms, we subjected participants to a series of stressors intended to elevate their circulating levels of free cortisol, and then

examined the influence of expressing affection to a loved one on the magnitude of reduction in cortisol values, relative to two control groups. Our results supported the hypothesis that communicating affection following exposure to an acute stressor accelerates adrenocortical recovery to a greater extent than does merely thinking about a loved one (but not communicating one’s feelings) or sitting quietly.

These findings are of particular relevance to interpersonal communication scholars because they contribute to a growing literature attesting to the associations between relational communication and physical health. A host of studies, for instance, has demonstrated that patterns of engaging in marital conflict are differentially beneficial, or detrimental, to cardiovascular health, hormonal regulation, and immunocompetence (see, e.g., Kiecolt-Glaser et al., 1997; Levenson & Gottman, 1983). Similarly, research in nonverbal communication has indicated a number of health benefits associated with therapeutic touch (Krieger, 1975; Spence & Olson, 1997). This study’s demonstration that engaging in affectionate communication (even when it is not reciprocated) can accelerate stress recovery adds to this literature, and this literature is important to interpersonal communication scholars because it significantly bolsters the case for the utility of studying interpersonal behavior. If the field is limited to understanding interpersonal communication behaviors (e.g., touch, deception, attribution-making) only with respect to other behaviors or perceptions of behavior, then the body of findings is somewhat limited in its utility. If, however, researchers can identify ways of communicating in social and personal relationships that are beneficial to people in terms of their physical health, mental health, or other arenas of value, then the utility of interpersonal communication research is strongly fortified. We believe that studies such as this experiment contribute to this broader goal.

Strengths, Limitations, and Conclusions

This study is characterized by three important strengths, the first of which is that it allows for the examination of a theorized causal connection between expressing affection and experiencing a reduction in stress symptoms. Earlier investigations, such as those by Floyd (2002) and Floyd et al. (2005), verified strong inverse relationships between stress and the tendency to express affection, but no causal direction can be inferred from these findings. Although AET and TBT hypothesize that the act of communicating affection to a loved one *causes* a reduction in symptoms of stress, correlational analyses equally support the proposition that having low levels of stress causes one to be affectionate. Results from this experiment indicate, however, that engaging in an affectionate expression exercise leads to reductions in salivary free cortisol, for both men and women, to a greater extent than merely thinking about the object of one’s affections or doing nothing.

Second, unlike some earlier studies of the benefits associated with affectionate communication, this study is distinguished by its use of an objective, physiological marker of stress reactivity, the secretion of the steroid hormone cortisol. Whereas the Floyd (2002) and Floyd et al. (2005) investigations relied on self-report pencil-and-paper measures of stress, which are subject to social desirability bias, later studies, such as Floyd (2005) and this experiment, have extended this inquiry into measures that are more objectively associated with the physiological stress response (and are not under the conscious control of participants, exempting them from social desirability biases). The congruence in results from self-report and objective physiological measures adds to our confidence in the association between affectionate behavior and health.

Finally, the experimental design allowed for examination of the effects of expressing affection in the absence of any affection received in return. Floyd (2002) failed to control for the possibility that benefits associated with expressing affection shared significant variance with those associated with receiving affection in return, a tenable rival hypothesis. Although subsequent research by Floyd et al. (2005) verified that expressing and receiving affection accounted for significant unique variance in mental health and psychosocial well-being, the design of this investigation allowed for the isolation of affectionate expression as a focus of study, ruling out the possibility that observed adrenocortical activity was influenced by any affectionate communication received in return.

Although the sample size was small relative to that typically seen in interpersonal communication research, it was within the norm for psychoneuroendocrinology studies, a large percentage of which employ similarly small samples (e.g., Kurup & Kurup, 2003; Marazziti & Canale, 2004; van Niekerk, Huppert, & Herbert, 2001). However, the small sample does 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 findings, although larger samples would provide greater sensitivity for identifying smaller effects. The possibility that the results would fail to generalize to other populations calls for their replication, efforts toward which can be taken up in future projects.

The measurement of free cortisol is perhaps the most commonly employed physiological assessment of stress in neuroendocrine research (Sapolsky, 2002); however, it is not the only candidate for assessing the stress response. One alternative outcome measure is 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). In fact, the cortisol/DHEA-S ratio might actually be a more accurate

indicator of HPA axis activity than 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 decrease in DHEA-S as a result. These and other hormones that are implicated in the management of stress (e.g., oxytocin, prolactin) can provide valuable avenues for research aimed at more complete understandings of the relationships between health and interpersonal behavior.

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