PSYCHOLOGICAL AND BIOLOGICAL STRESS DURING MOTHER-DAUGHTER COMMUNICATION ABOUT BREAST CANCER RISK

By

Kate L. Berlin

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Approved:

Professor Bruce Compas

Professor Fiona Yull

Professor Sohee Park

Professor Kathy Hoover-Dempsey

Professor David Schlundt

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CHAPTER I

INTRODUCTION

Psychological and Biological Stress During Mother-Daughter Communication About Breast Cancer Risk

Breast cancer is a national epidemic and the second leading cause of cancer death in American women. In fact, North American women have the highest rate of breast cancer of anywhere in the world (American Cancer Society, 2006). Previous research has demonstrated that the risk of developing this disease may be highly stressful to women at risk and may exert particular stress on the relationships between mothers and daughters in families at heightened risk (Erblich, Bovbjerg, & Valdimarsdottir, 2000; Lichtman, Taylor, & Wood, 1987). The mother-daughter relationship is uniquely positioned to study breast cancer risk, since it is qualitatively different from other family relationships. Unlike other nuclear family members, mothers and daughters must consider their own personal risk for the disease as well as supporting one another. The current empirical study examines psychological and biological stress responses during mother-daughter communication about breast cancer risk. Specifically, this study examines whether certain communication styles between mothers and daughters are associated with increased stress reactivity during a discussion task.

In this introductory chapter, information is first presented about the types and incidence of breast cancer. Second, risk factors, family history, and genetic testing are explored. Third, a brief review of the literature on psychological stress and breast cancer risk is presented. Fourth, the introduction provides a brief overview of stress biology

systems and evidence for the effects of breast cancer risk on stress biology. Fifth, mother-daughter communication about breast cancer and its importance is described. Sixth, a brief overview of coping and breast cancer ensues. Lastly, a description of the current study and hypotheses are presented.

Breast Cancer: Types and Incidence

Breast cancer is a family of diseases, which includes the following breast pathologies either independently or in combination: ductal carcinoma in situ, lobular carcinoma in situ (not a true cancer, but a condition of the breast lobules often leading to invasive breast cancer), infiltrating lobular carcinoma, inflammatory breast cancer, medullary carcinoma, mucinous carcinoma, Paget disease of the nipple, phyllodes tumor, and tubular carcinoma (for a detailed description of these types of cancer, see "Detailed Guide: Breast Cancer. An Online Guide by The American Cancer Society", 2006).

The clinical severity of breast cancer is expressed as a series of stages from zero (localized and non-invasive) to four (highly invasive, the most advanced stage of cancer) with several sublevels in between. Stage zero occurs when breast cancer cells are confined to the ducts or lobules and have not spread throughout the breast. In stage one, the cancerous tumor is small (2 cm or smaller) and has not spread to lymph nodes or other organs. In stage two, the tumor remains small (between 2 and 5 cm) and may have spread to three or less lymph nodes. During stage three, the tumor has grown considerably in size and may have spread to the chest wall and many lymph nodes. Breast cancer is considered inflammatory when it reaches stage three. Stage four is diagnosed when the cancer has spread to distant organs. The levels are further subdivided by

severity (indicated by the letters A, B, and C) and by the classifications T, N, and M. T represents tumor size, N refers to the spread to lymph nodes, and M is for metastasis to other regions of the body (for a full explanation of breast cancer staging, see "Detailed Guide: Breast Cancer. An Online Guide by The American Cancer Society", 2006).

Breast cancer is a major epidemic, as evidenced by the fact that one in eight American women will suffer from invasive breast cancer in her lifetime, and one in 33 women will die from it. In the year 2006 alone, it was predicted by the American Cancer Society that 212,920 women in the U.S. would be diagnosed with invasive breast cancer, and 40,970 women would die from the disease (American Cancer Society, 2006).

Risk Factors, Family History, and Genetic Testing

Prominent risk factors for breast cancer include female gender, age (50+ years), genetic risk, family history, race, previous personal breast cancer history, radiation to the chest area, abnormal biopsy history, menarche before age 12 and menopause after age 55, not having children at all or first parturition after age 30, oral contraceptive use, hormone replacement therapy use, and alcohol consumption (American Cancer Society, 2006). Although the majority of these risk factors are considered uncontrollable (i.e., not changeable through one's own behavior), many women feel that gaining knowledge about their risk is one effective preventative strategy.

The way that many women begin the process of coping with breast cancer risk is by collecting information about their family history of breast cancer occurrence, considered the strongest single predictor of risk. Although only approximately 25% of

women with breast cancer have a relative with the disease, having a familial history of breast and related cancers greatly increases a woman's risk. For instance, it is estimated that having one first degree relative with breast cancer doubles a woman's risk, and having two first-degree relatives with the disease multiplies a woman's risk five times (American Cancer Society, 2006). Therefore, given that an average woman's risk is 12.5% (1 out of 8), having a mother with breast cancer raises this woman's risk to approximately 25%, and having a mother and sister with breast cancer raises this woman's risk to about 63%. The incidence of breast cancer in a family with multiple women therefore has the potential to create a highly stressful situation; not only must female relatives cope with the disease in a loved one, but they must also consider the greatly increased risk for themselves and other female family members. Likewise, the woman who has just received the news that she has breast cancer must also consider her daughters' and sisters' risk for the disease.

One tool that women have in clarifying familial risk is genetic testing. Several genes have been implicated in the increased risk of breast cancer, including BRCA1 and BRCA2, ATM, CHEK-2, p53 tumor suppressor gene, and HER2 oncogene (American Cancer Society 2006). These gene mutations vary in their level of association to breast cancer and also in their inception (e.g., inherited versus acquired during cancer processes). Probably the most publicized example of genetic risk has been the tumor suppressor genes BRCA1 and BRCA2, discovered in 1994 and 1995, respectively (National Human Genome Research Institute, 2006). When these genes mutate, they can no longer complete their function of suppressing tumor growth. While statistics vary depending on the source consulted, most experts estimate that inheriting the BRCA1 or

BRCA2 gene mutation(s) raises a woman's risk of developing breast cancer to around 80% (not reaching 100% because of incomplete penetrance of the gene), and her chance of developing ovarian cancer to about 40% (National Cancer Institute, 2006; National Human Genome Research Institute, 2006). Further, women positive for these mutations are likely to develop cancer earlier in their lives (possibly before age 50).

As with all genetic testing for the purpose of disease risk clarification, many psychological and ethical issues arise in deciding whether to test for BRCA1 and BRCA2. The tests are expensive and do not allow women to know definitively that cancer will develop or the timeframe in which it could develop. There is potential that if positive results are not kept confidential, women could face discrimination from insurance companies or employers (e.g., as in chronic, pre-existing conditions). Furthermore, there is likely a major psychological burden to discovering that one has inherited these genetic mutations. A woman must then cope with difficult decisions such as whom in the family to tell, what (if any) physical treatments must take place (including prophylactic mastectomy, tamoxifen treatment, or increased monitoring activities), while concurrently managing emotions surrounding one's possible illness and mortality. Another important issue concerning genetic testing is that women who test negative may no longer believe they are at risk for breast cancer. This would be a dangerous assumption, considering that only approximately 10% of breast cancers are caused by inherited BRCA1 and BRCA2 genetic mutations (National Cancer Institute, 2006). Further, only between 0.2 and 2% of women carry these gene mutations, with likelihood increasing in certain ethnic populations. Further, it is important to note that the single greatest reason that women elect to have genetic testing for breast cancer is for their

daughters – so they can aid their daughters in early detection and risk management (Lerman et al., 1997).

Breast Cancer Risk and Psychological Stress

Many studies have shown that the diagnosis, course, and treatment of breast cancer can be psychologically stressful for women enduring the condition (e.g., see Andersen, Kiecolt-Glaser, & Glaser, 1994; Carver, Smith, Petronis, & Antoni, 2005; Epping-Jordan et al., 1999; Millar, Purushotham, McLatchie, George, & Murray, 2005; Schulz, Heesen, & Gold, 2005). According to Cordova et al. (2000), 15-20% of cancer patients warrant the diagnosis of lifetime cancer-related posttraumatic stress disorder (PTSD), and in a sample of 142 women, 36 (25.4%) met criteria for at least partial PTSD (Cordova, Studts, Hann, Jacobsen, & Andrykowski, 2000). Another sample of 71 women found that 15% (11 women) met criteria for current or past presence of PTSD as a result of breast cancer (Luecken, Dausch, Gulla, Hong, & Compas, 2004). In comparison, the average 12-month point prevalence of PTSD in American adults is 3.5% (Kessler, Chiu, Demler, Merikangas, & Walters, 2005) and 7.8% prevalence in overall lifetime rate (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). Another study reported that in a sample of 207 women newly diagnosed with breast cancer, 18% met criteria for a current DSM-IV anxiety or depressive disorder (Dausch et al., 2004). Epping Jordan and colleagues (1999) found that distress at diagnosis was stronger in younger women, but distress was not related to age at three and six months post-diagnosis (Epping-Jordan et al., 1999); that is, younger women were more distressed near the time of diagnosis but age differences dissipated as they moved through the process of treatment and recovery.

Further, the risk of breast cancer can be stressful even to women who have never had the disease. It has been shown that women with a family history of breast cancer (but no personal cancer history) often experience psychological stress in relation to breast cancer risk (Cohen et al., 2002; Kim, Valdimarsdottir, & Bovbjerg, 2003). Adolescent daughters are particularly at risk for experiencing stress around their mother's cancer diagnosis (Compas et al., 1994). One study of 1025 British women found that breast cancer is the most feared disease by women (Spittle & Morgan, 1999). From this research, it has been established that breast cancer risk may be experienced as stressful, even in women who have never had the disease.

A Brief Overview of Stress and Stress Biology

In discussing the term "stress," it is important to note that researchers vary greatly in their definition and measurement of this concept. Stress is often described in terms of psychological reactions, as in the studies described above. It is also referred to in the context of physiological reactions exhibited by the body under stressful circumstances. Since the proposed research includes both psychological and biological measures of stress reactions, a brief review of the term stress and biological stress systems is presented below.

In the 1930's, Harvard physiologist Walter Cannon named the body's general reaction to stress as a change in "homeostasis," which literally means steady (homeo) state (stasis). Cannon further coined the famous phrase "fight or flight," describing an organism's tendency to fight back or flee in the face of a physical threat (Cannon, 1932). Cannon pointed out that the fight or flight stress response is initially adaptive; it aids an

organism in translating the physiological experience of stress into an action plan. Around that same time, Hans Selye (1936), a Viennese endocrinologist and physician, began developing his concept of the "general adaptation syndrome," a non-specific bodily response to mental stress (Selye, 1936). It was upon the foundation of these concepts that stress research exploded in popularity and complexity.

Bruce McEwen, considered one of the most influential stress researchers since Selye, has since revised Cannon's idea of homeostasis, introducing the term "allostasis" to the study of stress (e.g., McEwen & Lasley, 2002). McEwen has advocated that the body does not have one point of homeostasis, but rather that the body is constantly reacting and adjusting to stressful circumstances throughout a wide range of acceptable "points" of homeostasis; that is, allostasis reflects a process by which stability is achieved through change. He has shown that chronic stress is deleterious to physical health through a mechanism called "allostatic load" (McEwen, 2003; McEwen, 2004; McEwen & Lasley, 2002). Allostatic load is defined as the toll the body experiences from prolonged dysregulation in physiological stress systems (McEwen, 2003). Dysregulation of physiological responses to stress includes increased sensitivity (heightened activation) or decreased habituation (failure to decrease reactivity upon repeated exposure to stress). One demonstration of the concept of allostatic load is a study by Kudielka and colleagues (2005) showing that physical exhaustion was associated with reduced habituation in stress hormones to a repeated laboratory stressor. The authors hypothesized that exhaustion, combined with repeated exposure to an acute stressor, increased allostatic load in participants by altering normal hormone habituation patterns (Kudielka et al., 2005). In addition, the field has advanced considerably past Selye's general adaptation

syndrome to understand that the stress response is complicated and specific in nature (Dickerson & Kemeny, 2004), and that multiple psychological and biological stress systems are involved (McEwen & Lasley, 2002).

An extensive literature has now accumulated showing that psychological stress is known to activate two main systems in the body, the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic-adrenal-medullary (SAM) axis. The main function of the HPA axis is to regulate the body's energy system and to distribute important hormonal messengers through an anatomical feedback loop. The basic circuit proceeds in the following manner: the body cognitively perceives stimuli as stressful (via the prefrontal cortex and through activation of the amygdala) and emotionally (via the limbic system). The limbic system communicates with the hypothalamus (located in the ventral region of the midbrain), which secretes corticotropin releasing factor (CRF). CRF reaches the pituitary gland (known as the "master gland," found at the base of the brain stem), stimulating the release of adrenocorticotropic hormone (ACTH). ACTH then travels to the adrenal glands (located on top of each kidney, composed of the adrenal cortex and the adrenal medulla), and induces the cortex of these glands to secrete glucocorticoids such as cortisol. The hypothalamus then detects increased glucocorticoids in the blood stream and can adjust its production of CRF in a negative feedback loop, thus completing the cycle (Dickerson & Kemeny, 2004; Sapolsky, Romero, & Munck, 2000). Glucocorticoids are important for the body in regulating energy and metabolism. Their primary function is to convert proteins and lipids to usable carbohydrate energy, and to tell the body to engage in food-seeking behaviors. At dysregulated levels, however, glucocorticoids are implicated in a number of disease states (McEwen, 2004).

In the SAM axis, the sympathetic nervous system stimulates the medulla of the adrenal glands to secrete epinephrine and norepinephrine. In response to the increase in these neurotransmitters and hormones, heart rate increases, blood vessels constrict, digestion slows, pupils dilate, and the body goes into "fight or flight" mode. When the hypothalamus receives news of increased epinephrine, the HPA axis then also activates. In this bodily state, the heart is racing and pounding, sweating increases, and energy is mobilized to prepare a response against bodily threats (McEwen & Lasley, 2002). Both the HPA and SAM axes further interact with the immune system to influence health outcomes.

Biological Effects of Breast Cancer Risk

A number of studies have examined the biological response to stress (either naturally occurring or in laboratory stress paradigms) in women with a family history of breast cancer. Bovbjerg and colleagues found that women with a familial risk of breast cancer, as compared to women without such a history, had increased heart rate, natural killer cell activity, and natural killer cell count after completing a version of the Trier Social Stress Test (Kirschbaum, Pirke, & Hellhammer, 1993) in comparison to women at normal risk (Valdimarsdottir et al., 2002). The study also found that women at increased risk for breast cancer had higher levels of subjective distress during the laboratory stressors than did normal-risk women. The authors hypothesized that women at increased risk for the disease experienced chronic, breast cancer-related stress, and that this stress sensitized them to an unrelated laboratory stressor. However, it is possible that a third,

unknown variable led to both increased familial risk for breast cancer and increased stress vulnerability (e.g., genetic predisposition).

Another study examined the relationship of breast cancer-related stress (as measured by questionnaires), stress hormones, and immune factors in women with breast cancer and their adult daughters (Cohen & Pollack, 2005). Cohen and Pollack found that self-reports of psychological distress were correlated between mothers and daughters. Pairs in which the mother had more advanced breast cancer were found to experience more breast cancer-related distress in both mothers and daughters. Daughters experiencing more breast cancer-related stress had lower natural killer cell activity and decreased IL-2 and IL-12 secretion (cytokines that increase immunity). This difference in immunity was partially mediated by norepinephrine secretion levels, suggesting that the SAM axis was responsible (at least in part) for poorer immune response to stress. In a separate publication based on the same sample of mothers and daughters, the authors reported that in daughters of breast cancer patients, natural killer cell activity and Th1 cytokine secretion were inversely correlated with distress and stress hormones (Cohen et al., 2002), signifying that increased distress and stress hormones were associated with decreased immunity.

There are relatively few studies examining the SAM axis response to stress (either acute or chronic) in women with breast cancer or at familial risk for breast cancer. Currently, the strongest evidence demonstrating increased levels of biological stress reactivity in these women comes from Bovbjerg's group. One study from this group (Gold, Zakowski, Valdimarsdottir, & Bovbjerg, 2003) found that after completing a version of the Trier Social Stress Test (Kirschbaum et al., 1993), women who had a

familial history of breast cancer had higher levels of serum epinephrine and cortisol than did women at normal risk for breast cancer. Norepinephrine followed the same pattern in the high-risk group, but differences between high and normal-risk women did not reach significance. As mentioned above, the authors hypothesized that women at increased risk for breast cancer suffer from chronic, breast cancer risk-related stress, and were therefore sensitized to react more strongly to acute stressors such as those created in the laboratory (Gold et al., 2003). In essence, the authors believe that the burden of chronic stress related to breast cancer risk caused these women to have an exaggerated neuroendocrine response to an unrelated, lab-generated social stressor. Since this study is correlational in nature, it still cannot be determined whether there is a third variable causing a concomitant increase in risk status and stress hormones.

A more recent study by this group (James, Berge-Landry Hv, Valdimarsdottir, Montgomery, & Bovbjerg, 2004) examined catecholamine responses to every day work stress in women with and without a familial history of breast cancer. Women at both risk levels provided three urinary catecholamine samples throughout the day: at work (11:00am-3:00pm), at home (6:00-10:00pm) and during the sleeping period (10:00pm-6:00am). They found that women with a familial history had higher levels of epinephrine excretion at work, and a greater percentage increase of epinephrine and norepinephrine from the sleep period to the time at work. This study served to show that women with familial histories of breast cancer also experience a heightened biological reactivity to stressors in their daily lives. Together, these studies imply that women at increased risk for breast cancer may suffer from chronic stress due to their risk status, and that this

chronic stress increases reactivity to acute stressors (Gold et al., 2003; James et al., 2004).

Lastly, another study found that adult daughters of breast cancer patients had increased norepinephrine and epinephrine levels in comparison to aged-matched controls with no family history (Cohen et al., 2002). These results should be interpreted with caution, however, given their reliance on correlations. A conclusion that can be more firmly drawn from these data is that women at higher risk for breast cancer experience both greater stress levels and increased biologic reactivity to unrelated stressors. However, the etiology of these differences remains unknown at this point.

Mother-Daughter Communication about Breast Cancer

The relationship between mothers and daughters represents an important interpersonal dyad within broader relationships in the family. Although a family history for breast cancer is likely to have an impact on many aspects of family functioning, the relationship between mothers and daughters is important for several reasons. Mothers serve as both role models and emotional confidants for their daughters in many families, and the significance of this relationship is often heightened during adolescence (e.g., Conger & Ge, 1999; Graber & Brooks-Gunn, 1999; Powers & Welsh, 1999; Steinberg, 1989). The relationship between mothers and daughters may be an important resource for effective coping with the stress of a family history of breast cancer. At the same time, however, mothers and daughters may experience significant challenges to their relationships as a result of this stress. An important component of the present research will be to examine

characteristics of the relationships between mothers and daughters who have a significant family history of breast cancer.

Prior research on families coping with stress indicates that adolescents and young women are likely to turn to their families, and most significantly their mothers, for emotional support and assistance in problem-solving and decision making when faced with high risk for breast cancer. The relationships between mothers and daughters are likely to be especially challenged by the stress of familial risk for breast cancer. For example, Lewis et al. (1985) conducted qualitative interviews with children and adolescents and found developmental differences in adjustment to maternal breast cancer (Lewis, Ellison, & Woods, 1985). In a retrospective study of adult women whose mothers had been diagnosed with breast cancer, Wellisch et al. (1992) found adult women who were adolescents when their mothers were diagnosed with breast cancer reported the greatest amount of stress at the time of their mother's diagnosis, and displayed the poorest long-term adjustment to their mother's disease (Wellisch, Gritz, Schain, Wang, & Siau, 1992). Another recent study found that daughters of breast cancer survivors (aged 8-19) were more likely to experience depressive symptoms (or at least more likely to report them) in relation to mom’s cancer than sons (Brown et al., 2006). Lichtman et al. (1987) highlighted strains in the relationships between mothers with breast cancer and their adolescent and young adult daughters (Lichtman et al., 1987). The relationships between mothers and their adolescent daughters were especially strained by the mothers' breast cancer diagnosis. Among the reasons cited for the increased strains between mothers and daughters were the daughters' fears about inheriting the disease and the high level of support that mothers expected from their daughters.

Given the significance of the mother-daughter relationship for adolescent and young adult women, conflict and hostility in this relationship may be a significant source of stress. This may be even greater in mothers and daughters who experience chronic stress as a result of being at increased risk for breast cancer. Compas and colleagues have carried out the only study using direct observation methods to assess levels of stress, negative emotions, and communication in mothers and daughters at risk for breast cancer (Compas et al., 1999; Dausch, Compas, McKinnon, & Wood, 2001). This methodology, used in the current study as well, proved to be feasible and acceptable for use with this population, and initial findings indicate that brief (15 minute) laboratory discussions about breast cancer risk provided a sensitive index of levels of stress for these mothers and daughters. For instance, hostile interactions were correlated with increased anxiety and depression in both the mothers and daughters (Dausch et al., 2001).

Coping and Breast Cancer Risk

An important factor in examining how women experience the stress of breast cancer risk is the concept of coping. Coping style is an important defense for these women against the stress of breast cancer, and may explain some individual variation in vulnerability to risk-related stress. Compas and colleagues have proposed a dual process model of responses to stress, whereby reactions are categorized as either automatic/involuntary or controlled/voluntary (Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001; Connor-Smith, Compas, Wadsworth, Thomsen, & Saltzman, 2000). The term *coping* refers to those actions which are controlled and volitional on the actor's part. The authors define voluntary coping efforts as "within

conscious awareness and are oriented toward regulating one's cognitive, behavioral, emotional, or physiological responses to a stressor or toward the stressor itself" (Connor-Smith et al., 2000, p. 977).

The concept of coping is further subdivided into Primary Control Coping, Secondary Control Coping, and Disengagement Coping. Primary Control Coping includes efforts that are aimed directly at altering the stressor or one's reaction to the stressor, and represents three domains: Problem Solving, Emotional Expression, and Emotional Regulation (e.g., "I let someone know how I feel"). Secondary Control Coping, in contrast, is focused on adaptation to the problem and includes the subscales of Cognitive Restructuring, Positive Thinking, Acceptance, and Distraction (e.g., "I realize that I just have to live with things the way they are"). Lastly, Disengagement Coping describes one's efforts to actively remove oneself from the stressor, and includes Denial, Avoidance, and Wishful Thinking (e.g., "I try to stay away from people that remind me of the problem"). The authors have developed a measure to examine the above coping factors, entitled the "Responses to Stress Questionnaire" (Connor-Smith et al., 2000). The measure has been tested and validated in numerous populations, including women with a diagnosis of breast cancer (Compas et al., 2006).

To date, the majority of studies on coping and breast cancer have examined women who already carry the diagnosis of breast cancer; very little is known about coping in women who are at increased risk but are currently unaffected. For example, a study of early-stage breast cancer patients found that women who initially reported higher levels of well-being and optimism in comparison to others maintained a higher level of psychosocial adjustment up to 13 years after breast cancer surgery (Carver, Smith, Antoni

et al., 2005). Another study demonstrated that higher levels of avoidance coping at diagnosis were associated with poorer cancer prognosis (including higher rates of cancer recurrence and mortality) at one year after diagnosis (Epping-Jordan, Compas, & Howell, 1994). A recent review by Compas and Luecken (2002) highlighted the importance of coping strategy in psychosocial adjustment to breast cancer.

Although researchers have begun to examine responses to stress in women at risk for breast cancer (e.g., Gold, 2003; Cohen, 2005), these studies typically do not examine coping style. Further, many investigators refer to the term coping in a generic sense without a theoretical model or empirical research to define the concept. This will be the first study, to our knowledge, to examine an empirically-based model of coping in women at risk for breast cancer.

Current Study

The current study empirically examined psychological and biological stress reactions in women during a breast-cancer related stress task. Specifically, mother-daughter dyads engaged in an emotion eliciting discussion about their risk for breast cancer and the experience of the disease in their families. Mothers' and daughters' communication styles from the discussions were coded for several behavioral and affective characteristics and then examined in relationship to psychological and biological stress reactivity. Because the mothers in this study were at higher risk for developing the disease than their daughters by virtue of age, the focus of the hypotheses is on mothers' communication style (subsequent analyses will focus on daughters' communication).

The five hypotheses for the current study examined the effects of mothers' abilities to communicate effectively about breast cancer risk with their daughters across four domains: psychological/emotional distress, coping style, knowledge about breast cancer, and biological stress reactivity. The specific hypotheses were as follows:

(1) Mothers' communication styles will be correlated with emotional distress in their daughters (i.e., negative maternal communication styles will be associated with greater symptoms of anxiety and depression in daughters, and conversely positive communication styles will be associated with decreased anxiety and depression in daughters).

(2) Mothers' communication styles will be correlated with coping style in their daughters (i.e., negative maternal communication will be associated with high levels of Disengagement Coping in daughters, and positive maternal communication will be associated with increased levels of Primary and Secondary Control Coping in daughters).

(3) Mothers' communication styles will be correlated with daughters' knowledge about breast cancer as measured by a knowledge questionnaire. It is hypothesized that positive maternal communication style will be associated with increased knowledge on daughter's part, and negative maternal communication style will be associated with decreased knowledge.

(4) Mothers' communication styles will be predictive of biologic reactivity in daughters (i.e., negative maternal communication will be associated with increased stress hormone levels and longer time to recover in daughters, and positive maternal communication will not be associated with a change in stress hormones in daughters).

(5) In an attempt to better understand the relationships between the above variables (mothers' communication style, daughters' psychological stress responses, coping style, knowledge about breast cancer, and biologic reactivity), a series of linear multiple regression analyses and path analytic models will be generated and tested for goodness of fit. The proposed model is exhibited in Figure 1.

Additionally, in reference to this model, daughters' coping will be tested as a mediator between mothers' communication and daughters' responses to stress and knowledge about breast cancer.

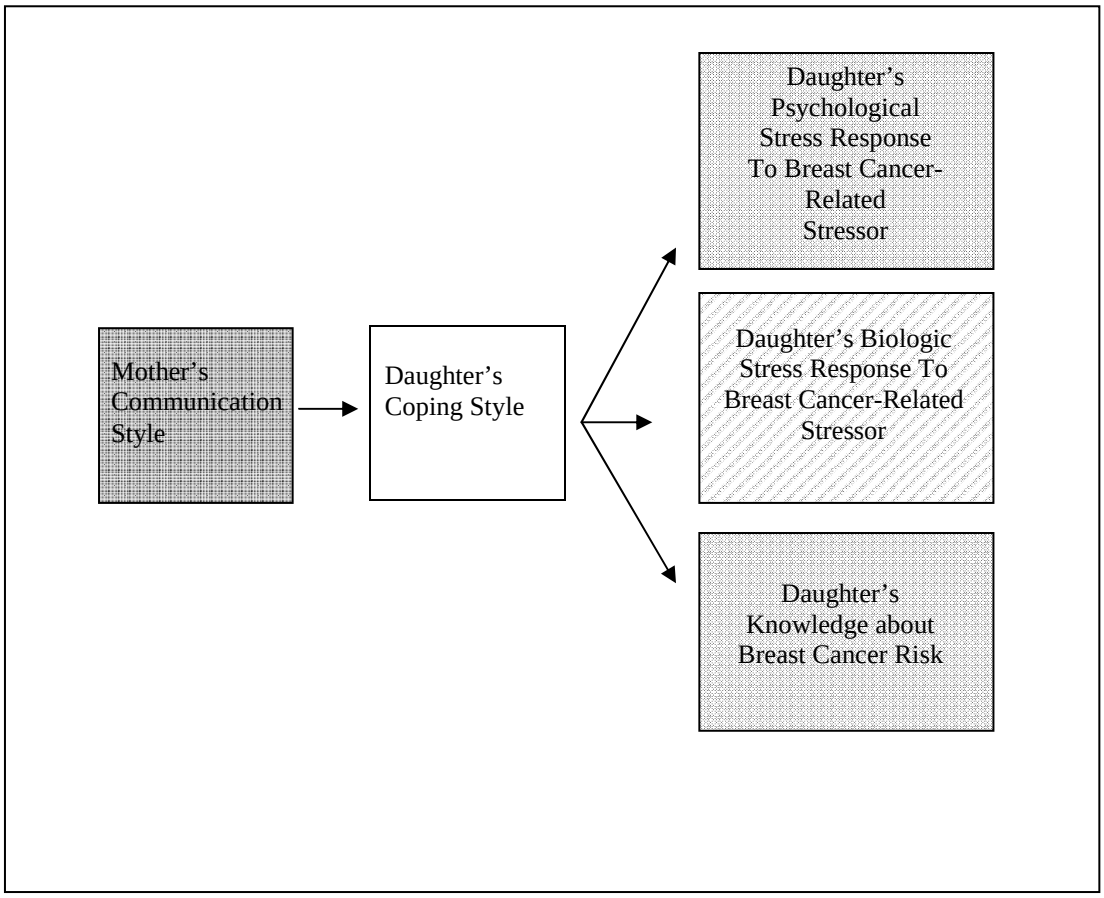


Figure 1. A path analytic model of daughter's responses to breast cancer-related stress as influenced by mother's communication.

CHAPTER II

METHOD

Participants

The sample included 54 mothers with 58 daughters (four mothers had two daughters that both participated in the study), for a total of 58 mother-daughter dyads. Forty-six of these dyads participated through Vanderbilt University, and 12 through Meharry Medical College. Mothers' mean age was 47.9 years (sd = 6.32); mean level of education was 15.74 years (sd = 2.22), or equivalent to high school plus some college; and 78% of mothers were currently employed. Breast cancer risk was calculated as a categorical variable for each dyad and split into two categories: dyads where mother had a personal history of breast cancer, and dyads where mother did not have a personal history of the disease. Twenty-nine (54%) of the mothers had a history of breast cancer and 25 (46%) did not. Mothers with and without a personal history of breast cancer did not differ on any demographic variables except age, $t_{(1,52)} = -3.34$, $p < .01$, as mothers positive for breast cancer had a mean age of 50 years as compared with 45 years for mothers without a history of breast cancer. Further, demographic factors did not differ between the two recruitment sites except for mothers' age ($t_{(1,52)} = 3.25$, $p < .01$, mean of 49 years at Vanderbilt, 42 years at Meharry) and race ($t_{(1,55)} = 9.35$, $p < .001$, primarily Caucasian at Vanderbilt, African American at Meharry). Daughters' mean age was 18.72 years (sd = 5.68, range 11-30) and 57% reported that they currently live with their

mothers. The sample was 76% Caucasian, 20% African American, 2% Asian American, and 2% mixed ethnicity.

Due to the high cost of biological analyses, biological data was only collected from a subset of the larger sample. This subset included 64 individuals or 32 mother-daughter dyads.

Recruitment

Eligible women were recruited from the Breast Diagnostic Center at Vanderbilt University Medical Center and the Breast Health Center of Nashville Metropolitan General Hospital (NMGH) and Meharry Medical College. The Vanderbilt Breast Center includes a multidisciplinary regional referral program for breast cancer screening and diagnosis. Women may be self-referred or physician-referred to this program. Individuals are evaluated by a nurse practitioner and all cases are reviewed by Susan Caro, RN, Director of the Family Risk Service. The Breast Health Center at NMGH provides breast cancer screening and diagnostic services under the direction of surgical oncologist Dr. Ana Grau (who has since relocated to Vanderbilt Medical Center). Women at both centers are given an assessment of breast cancer risk and a program of medical management including a tailored screening program and options for risk reduction/cancer prevention. All patients were given a copy of the recruitment brochure when they checked into the clinic. Either Dr. Grau, a staff member of the clinic, or a research assistant from the study provided eligible and interested women with information about the study. If they chose to, the women filled out a form with their contact information and left it in a locked box at the front desk of the clinic. A research assistant from the study checked the boxes and called interested

participants. Posters for the study were also placed in the waiting room for the clinic and in each of the exam rooms for patients to read while they were waiting for their physician.

Another mechanism included recruiting through local cancer support organizations such as Gilda's Club, the Komen Foundation, Sister's Network, and After Breast Cancer. Recruiting through these organizations occurred in a variety of formats, including brochure dissemination at support group meetings and health fairs, emails through member list-serves, and through presentations by a research assistant from the study at organizational events.

An additional source of study participants included our relationship with Vanderbilt-Ingram Cancer Center (VICC) and Vanderbilt University Medical Center (VUMC). VICC listed the study under a clinical trials website where interested participants could search for research studies. VICC also routinely distributed materials from the study at VICC-sponsored events such as the Breast Cancer Forum and Women's Health Fashion Show. Brochures from the study were available at the VICC tent at these community events, and were distributed along with other Cancer Center materials. Lastly, an email description of the study was sent out through the Medical Center Communications Office email list to all VUMC personnel.

Measures

The current study utilized a multi-method, multi-informant process of data collection including direct observations of behavior, self-reports of mothers and daughters in interviews and in response to questionnaires, and biological measures of stress reactivity. For example, stress responses in daughters were measured through

clinician interview, self-report questionnaire, questionnaires filled out by mothers about their daughters' experiences of stress, and through biological sampling.

Mothers completed a total of 16 measures, 14 of which were self-report questionnaires and two of which were interviews conducted by research staff. Daughters completed 14 measures, 12 of which were self-report questionnaires and two of which were interviews. The measures are summarized in Table 1 and those used in analyses are explained in detail below.

Table 1
List of Measures Completed by Participants

Mothers	**Daughters**
Breast Cancer Screening Questionnaire	Breast Cancer Screening Questionnaire
*General Questionnaire (Demographic questions)	*General Questionnaire (Demographic questions)
Assessment of Cancer Risk	Assessment of Cancer Risk
*Communication Questionnaire	*Communication Questionnaire
Irrational Health Beliefs Scale	Irrational Health Beliefs Scale *(except for daughters aged 11-13)*
*Impact of Events Scale	*Impact of Events Scale
*Knowledge About Cancer Questionnaire	*Knowledge About Cancer Questionnaire
*Response to Stress Questionnaire	*Response to Stress Questionnaire
Life Orientation Test-Revised	Life Orientation Test-Revised
Attributional Style Questionnaire-Revised	Child Attributional Style Questionnaire-Revised *(daughters aged 11-13)* Attributional Style Questionnaire-Revised *(daughters 14+)*
Attribution for Cancer Incidence	Attribution for Cancer Incidence
*Child Behavior Checklist *(has daughter aged 11-17)* or Young Adult Behavior Checklist *(has adult daughter 18+)*	*Youth Self Report *(daughters aged 11-17)* or Young Adult Self Report *(adult daughters 18+ years old)*
Communication Interview	Communication Interview
Health Practices Interview	Health Practices Interview
*Beck Depression Inventory-II	------
*Beck Anxiety Inventory	------

*These questionnaires were used for analyses in the current study

Breast Cancer Risk

Breast cancer risk was calculated as a dichotomous variable and coded as either positive for the dyad if mother had a personal history of breast cancer or negative if she did not.

Demographic Factors

Demographic information was collected from all mothers and daughters in the form of a self-report questionnaire. Mothers were asked to report age, marital status, gender and birth date of both children and siblings, employment status, occupation, number of years of education, and ethnicity. Adult daughters (18 years and older) were asked the same demographic questions as mothers, with the additional question "Do you live with your mother?" Daughters 17 years of age and younger were asked to report age, grade in school, living situation (with or without mother), and ethnicity.

Age of daughters was indexed in two ways. First, chronological age was used as a continuous variable in correlational and linear multiple regression analyses. Second, for some analyses comparisons of daughters were made across specific age groups, divided into adolescent daughters (11-17 years) and young adults (18-30 years).

Self-Reports of Psychological Variables

Self-reports of mother-daughter relationship. To assess the nature of the mother-daughter relationship, participants completed a series of items assessing the quality of this relationship. Because there is not a standardized measure of mother-daughter relationships, the Compas lab developed a set of items for a study of daughters and sisters of breast

cancer patients (Dausch et al, 2001). These questions provided information about the degree of closeness and level of support shared between mothers and daughters.

Anxiety/depression symptoms. Daughters' symptoms of affective distress were assessed by the Youth Self-Report (YSR, Achenbach, 1991) completed by adolescents, the Young Adult Self-Report (YASR, Achenbach, 1996) completed by young adult women, and the Child Behavior Checklist (CBCL; Achenbach, 1991) and the Young Adult Behavior Checklist (YABCL; Achenbach, 1996) completed by mothers. All of these measures have been shown to have excellent reliability and validity, and normative data based on nationally representative community samples are available. Furthermore, these measures allow for direct comparisons of the reports of adolescents/young adults about their own emotional and behavioral problems with reports of their adjustment obtained from their mothers. The Anxious/Depressed, Somatic, Internalizing, Externalizing, Total Problems, DSM Depression, DSM Anxiety, and DSM Somatic scales were used as the primary measure of emotional distress in all analyses.

Mothers completed the Beck Depression Inventory-II (BDI-II, Beck, Steer, & Brown, 1996) and the Beck Anxiety Inventory (BAI, Beck & Steer, 1990), two well standardized and widely used measures of symptoms of depression and anxiety in non-psychiatric samples. The Compas lab has used the BDI-II and BAI in ongoing research with women with breast cancer and internal consistencies (coefficient α) have been greater than .85 for both measures.

Cancer worries and fears. The intrusion scale from the Impact of Events Scale (IES, Horowitz, Wilner, & Alvarez, 1979) was used as an index of worries, fears, and intrusive thoughts related to breast cancer. These items reflect cognitive and emotional

preoccupation with a specific stressor, in this case one's risk for breast cancer. The intrusion scale of the IES has been shown to have adequate internal consistency and is correlated with self-reported symptoms of anxiety and depression (Compas et al., 1994; Epping-Jordan et al., 1994; Primo et al., 2000). An additional set of three items developed by Lerman to assess worries and fears specific to breast cancer was also administered (Cancer Studies Consortium, 1994).

Coping Style. Coping style was assessed using the Responses to Stress Questionnaire (RSQ) (Connor-Smith et al., 2000). This version of the RSQ used "breast cancer risk" as the target stressor to which all the items refer. The questionnaire contains either 57 items (daughters) or 60 items (mothers). Participants were asked to rate how often they use certain coping strategies on a scale from one to four and to occasionally generate written answers to open-ended questions. RSQ data were scored and examined for three domains of coping: Primary Control Coping (Problem-solving, Emotional Expression, Emotional Modulation), Secondary Control Coping (Acceptance, Distraction, Cognitive Restructuring, Positive Thinking), and Disengagement Coping (Avoidance, Denial, Wishful Thinking).

Additional Measures

In order to assess participants' knowledge about breast cancer, they completed a 47-item self-report measure called the Knowledge About Cancer Questionnaire. This measure was developed by the Compas laboratory based on information presented on the National Cancer Institute and American Cancer Society websites. Women were asked to answer the items using the scale "true, false, don't know" for questions relating to

conditions that increase a woman's chance of getting breast cancer (e.g., genes, hormone replacement therapy), guidelines for detection, breast changes that women should notice, statements about treatment and prevention, and knowledge about genetic testing.

Biological Measures

Salivary cortisol and α-amylase. Saliva samples were collected before the interaction task, directly after, and at three 15 minute follow-up intervals after the task for use in analyses of salivary cortisol and norepinephrine (as measured by levels of α-amylase). The five data points allowed for analyses of both reactivity to stress (as reflected in increases from pre- to post-stress) and recovery from stress (as reflected in the rate of decrease in cortisol and α-amylase after the interaction). Extensive research has established that salivary levels of α-amylase serve as a reliable proxy for levels of norepinephrine, which cannot be extracted from saliva (e.g., Chatterton, Vogelsong, Lu, Ellman, & Hudgens, 1996; Skosnik, Chatterton, Swisher, & Park, 2000).

To control for diurnal fluctuations in cortisol, the researchers attempted to schedule all of the breast cancer discussions for the afternoon (2-5pm) whenever possible. This time restriction controlled for diurnal patterns and it also accommodated work and school schedules of the participants. Participants were instructed to refrain from eating, alcohol use, smoking, exercise, or prescription drugs for at least one hour prior to participation.

Participants arrived at the laboratory and signed informed consent forms. Following a standardized method used in previous research, five saliva samples were collected from each participant for determination of cortisol and α-amylase baseline levels and reactivity to the task. Samples were taken approximately every 15 minutes,

and corresponded to baseline, immediately post-task, and 3 additional recovery samples (15, 30, and 45 minutes post-task; See Kiecolt-Glaser et al., 1997, for an example of the collection of multiple samples before, during and after a laboratory stress task for the assessment of stress hormones). Saliva collection was chosen for determination of cortisol and α-amylase levels because it is simple, non-invasive, non-aversive to the subject, and could be collected repeatedly throughout the study.

Salivary cortisol concentrations were independent of flow rate, and reflect unbound "free" levels in plasma. Saliva samples were obtained with the Salivette sampling device (Sarstedt, Rommelsdorf, Germany). Participants were instructed to place a small cotton swab in their mouths and chew on it for one minute. The swabs were immediately frozen and stored at -80 °C for 1-3 months prior to analysis. Saliva samples were frozen and later assayed by Salimetrics (Penn State University). Analysis of cortisol and α-amylase levels (μg/dL and U/mL, respectively) were conducted in duplicate and the mean level of the two tests were used in all analyses. The assays conducted in this lab have been designed to specifically address the following three problems that have been observed in the use of salivary cortisol analyses. First, the majority of available immunoassays for saliva cortisol are modifications of protocols developed for the use with serum/plasma. The calibrators used in those assay kits are suspended in a human serum matrix. Given that the composition of serum is markedly different from saliva, these calibrators are likely to produce results that are influenced by matrix differences. To ensure the most accurate results, this salivary immunoassay is designed using a matrix that matches saliva. Second, the level of cortisol in saliva is significantly lower than levels in the general circulation. The use of a standard curve developed to capture the range of values expected in

serum/plasma samples is often not sensitive enough to capture the complete range of individual differences in the level expected in saliva. This assay is designed to capture the full range of salivary cortisol levels while using only 25 µl of saliva per test. Third, the pH of saliva is easily lowered or raised by the consumption of food or drink. Performance of immunoassays becomes compromised as the pH of samples to be tested drops below 4. This results in artificially inflated levels. This assay system is designed to be very sensitive to the effects of interference caused by collection techniques that affect pH. In addition, a built-in pH indicator warns the user of acidic or basic samples.

Procedure

All women presenting to the Vanderbilt Breast Diagnostic Center and the Health Center of Nashville Metropolitan General Hospital (NMGH) or recruited through other methods were screened for a family history of breast cancer. Those women who had daughters in the appropriate age range were given a brief description of the study by either the nurse practitioner or genetic counselor associated with the Center or a research assistant on the project. Women interested in the study were asked for written or verbal consent to be contacted by the research staff associated with the study. A research assistant or graduate student contacted interested women and explained the purpose and procedure of the study. After written consent was obtained mothers and daughters were mailed several questionnaires to complete, summarized in the Table 1.

Subsequent to sending out questionnaire packets, a laboratory visit was scheduled for each mother-daughter pair. Mother/daughter dyads came to the behavioral laboratory at Vanderbilt University (Jesup Hall) or at Meharry Medical College (designated space

was available in the Department of Surgery) to participate in a breast cancer-specific stress task (mother-daughter interaction).

An observation room equipped with videotaping equipment was used at each site for this aspect of the project. Upon arrival at the laboratory, the experimenter provided an overview of the procedures for that session to the participants. A saliva sample was taken by having each participant keep a salivette in her mouth for one minute. Participants then completed the stress task and a second saliva sample was obtained from each participant upon completion of the task. Mothers and daughters were then seated in separate rooms where they viewed a neutral video (a documentary about national parks) for a 45-minute recovery period. Saliva samples were collected at 15-minute intervals throughout the recovery period. Mothers and daughters then met together with the experimenter for debriefing. Participants were thanked and compensated for their participation.

Breast cancer-specific stress: Behavioral observation of mother-daughter interactions. Based on extensive research on observational methods of assessing dyadic interactions, a procedure was used to assess the quality of several aspects of the relationship between daughters and their mothers. The observation procedure was based on methods developed by Conger and colleagues in studies of families coping with stress (Reuter & Conger, 1995a; Reuter & Conger, 1995b).

Mothers and daughters were instructed to spend 15 minutes discussing their feelings and concerns about breast cancer, as well as their thoughts on the best way to monitor for the disease. Specifically, mothers and daughters were asked to respond to the following questions: (1) What kinds of feelings do we each have about breast cancer and

the chance that we might get breast cancer? (2) How often do we talk about our feelings about breast cancer? If we don't talk about it, then why not? What prevents us from talking about it? (3) What is it about breast cancer that has most affected our lives? (4) What has been the most emotional or difficult time in our family regarding breast cancer? (5) Do we feel that we have any control over the chance of getting breast cancer? (6) Mom: Do you worry about your daughter and her risk of breast cancer? Daughter: Do you worry about your mom and her risk of breast cancer?

In addition to this breast cancer-specific discussion, mother-daughter pairs engaged in a 15-minute discussion about a topic on which they experienced disagreement, conflict, or stress. This topic was selected based on a questionnaire filled out by mothers and daughters and included issues such as finances, religion, and daughter's choice of a romantic partner. The rationale for including this discussion topic was originally to provide a "warm-up" for mothers and daughters to begin discussing an emotional topic prior to participating in the discussion of breast cancer risk. However, in order to counteract an order effect of always having this alternate discussion first, discussion order (breast cancer task, issue task) was counterbalanced across mother-daughter pairs. Therefore, approximately half of the pairs discussed the issue task first, and half of the pairs discussed breast cancer risk first. The hypotheses for the current research did not directly evaluate communication during the stressful issue task, and therefore data from this task was not considered in the dissertation project. However, the possible effects of the issue discussion on stress responses are addressed in the discussion section.

All mother-daughter interactions were videotaped and independently coded for communication and emotions. The Iowa Family Interaction Rating Scales (IFIRS, Melby &

Conger, 1993; Melby & Conger, 2001) was used as the manual for coding emotion, communication, and behavior in the mother-daughter interactions. Trained observers rated several dimensions of the mother-daughter interaction and individual member characteristics using scales ranging from 1 (the behavior is not at all characteristic of the person) to 9 (the behavior is very characteristic of the family member). These ratings were used to derive scores for each mother-daughter pair on several dimensions, including hostile interaction style, warm interaction style, prosocial behavior, and antisocial behavior.

Coding of Behavioral Interactions

Trained research assistants conducted coding of the videotapes of the mother-daughter discussions of breast cancer risk using the Iowa Family Interaction Rating Scales (IFIRS; Melby & Conger, 2001). A member of our research team (Compas) has received a week of intensive training at the Iowa State lab from Dr. Janet Melby. He supervised the behavioral interaction component of the study for the current project. Dr. Compas trained a team of research assistants to conduct the mother-daughter interactions and to code the tapes. Reliability was established in a series of steps. First, all coders read the IFIRS manual and passed a proficiency test to insure that they achieved at least an 85% level of knowledge of the specific behavioral codes. Second, two pilot tapes were viewed jointly by the coding team and ratings were applied and assessed for accuracy. Third, two additional pilot tapes were rated independently by Dr. Compas and the level of agreement of each rater with his codes was calculated. A minimum level of 85% agreement was established for each rater; raters who failed to achieve this minimal level repeated the rating of the pilot

tapes until they were able to reach this criterion. All tapes from the project were coded by two raters and any disagreements were resolved through consensual coding.

Seventeen codes describing specific aspects of communication were utilized for this project. However, only 16 of the codes were used for analyses, because the last one (rater response) examined the rater's subjective opinion about the participants. The codes used in the current study and an example of each are listed in Table 2.

Table 2
List of IFIRS Codes and Examples

IFIRS Behavioral Codes	
Code	**Example**
Sadness	*"It was really hard when you went through chemotherapy."*
Anxiety	*"I was very nervous when I thought I felt a lump in my breast."*
Hostility	*"You don't take care of your body like you should."*
Denial	*"It wasn't really an issue for me when you were sick."*
Externalized Negative	*"I blame my doctor for not pushing me to get mammograms."*
Whine/Complain	*"I really hate exercising. I just don't have the time."*
Avoidance	*Daughter looks away when mother discusses breast cancer.*
Antisocial	*"I'm so bored of this topic. It's all you ever talk about."*
Lecture/Moralize	*Mother engages in a long monologue about how researchers need to go about finding a cure for breast cancer.*
Prosocial	*"Let's remind each other to do our breast self-exams every month."*
Communication	*"I really like how you talk to me about your feelings about breast cancer."*
Listener Responsiveness	*"Mmm hmmm, yes, I hear what you are saying. How did that make you feel?"*
Positive Mood	*"Having breast cancer really made me a stronger person. It made me realize the things that are truly important in life."*
Warmth/Supportiveness	*"I love you and I want to help you stay healthy."*
Parental Influence (mother only)	*"I'd like you to be aware of the symptoms of breast cancer."*
Sensitive/Child-centered (mother only)	*"You look sad right now. What are you thinking?"*
Emotional Caretaking (daughter only)	*"No matter what happens, it will be o.k."*
Instrumental Caretaking (daughter only)	*"I did the dishes and cleaned the house when you were sick."*
Rater Response	---

CHAPTER III

RESULTS

Missing Data

Although 58 dyads participated in the study, four mothers and four daughters did not complete their questionnaire packets and were excluded from analyses involving self-report measures. Additionally, two mothers did not complete all of the self-report questionnaires and were removed for analyses involving those particular measures. Since no subject had more than 20% of items missing on any completed questionnaire, mean imputation was utilized to estimate missing items on individual questionnaires.

Descriptive Statistics and Preliminary Analyses

Psychological Symptom Measures.

Means, standard deviations, and a measure of internal consistency reliability (coefficient α) are reported in Table 3 for all subjects on psychological symptom checklists. There were no differences on any of these measures between mothers with and without a personal history of breast cancer. Daughters differed by recruitment site on one variable, the Anxiety/Depression scale from the CBCL/YABCL, a scale on which mothers described symptoms of anxiety and depression in their daughters. Vanderbilt mothers (M = 55.61, sd = 7.17) described their daughters as more anxious/depressed than did Meharry mothers (M = 50.50, sd = 1.17), $t_{(1,54)} = 2.45$, $p < .05$.

Table 3
Descriptive Statistics for Mothers and Daughters on Psychological Symptom Measures

Measure	Coefficient α	N	mean	sd
Mothers:				
BDI-II	0.89	58	9.08	7.82
BAI	0.86	58	8.23	6.64
IES	0.80	54	21.2	11.74
IES-avoidance scale	0.81	54	12.11	7.96
IES-intrusion scale	0.75	54	9.09	6.67
Daughters:				
IES	0.88	52	18.75	13.88
IES-avoidance scale	0.87	52	11.23	9.23
IES-intrusion scale	0.82	52	7.52	7.14
YSR/YASR anxiety-depression scale	---	57	54.82	6.78
YSR/YASR somatic scale	---	57	55.58	5.81
YSR/YASR internal scale	---	57	52.09	9.5
YSR/YASR external scale	---	57	51.47	9.12
YSR/YASR total problems scale	---	57	51.70	8.99
YSR/YASR DSM depression scale	---	57	54.91	7.20
YSR/YASR DSM anxiety scale	---	57	53.63	4.68
YSR/YASR DSM somatic scale	---	57	55.72	5.72
CBCL/YABCL anxiety-depression scale	---	56	54.52	6.70
CBCL/YABCL somatic scale	---	56	55.66	8.22
CBCL/YABCL internal scale	---	56	49.86	13.26
CBCL/YABCL external scale	---	56	50.02	8.90
CBCL/YABCL total problems scale	---	56	49.38	11.16
CBCL/YABCL DSM depression scale	---	56	54.64	7.83
CBCL/YABCL DSM anxiety scale	---	56	53.75	6.07
CBCL/YABCL DSM somatic scale	---	56	55.63	8.47

Note. BDI-II: Beck Depression Inventory II. BAI: Beck Anxiety Inventory. IES: Impact of Events Scale. YSR: Youth Self-Report. YASR: Young Adult-Self Report. CBCL: Child Behavior Check List. YABCL: Young Adult Behavior Check List. Scores for YSR, YASR, CBCL, and YABCL are normalized *T*-scores.

On the CBCL/YABCL and the YSR/YASR, mothers' reports of daughters' symptoms and daughters' self-reports were moderately associated (mean correlation of approximately $r = .40$, correlations ranging from $r = .35$ to $r = .50$). Only mothers' and daughters' reports on the DSM anxiety scale were not significantly correlated ($r = .08$, p= ns). This level of association between parent and child reports of symptoms is typical of

that found across many empirical studies (e.g., De Los Reyes & Kazdin, 2005; Verhulst & van der Ende, 1992).

The CBCL/YABCL and YSR/YASR scales are standardized such that a *T*-score of 50 is the population mean and a *T*-score above 65 is considered in the clinical range. Mean scores for mother and daughter reports were well within the normal non-clinical range on all scales, although slightly higher on the anxiety, depression, and somatic scales, and slightly lower on the internalizing, externalizing, and total problems scales.

Mothers' scores on the BDI-II and BAI were consistent with those found in normal (non-clinical) samples. Both mothers' and daughters' scores on the IES, a measure of intrusive thoughts and avoidance of reminders of breast cancer, were higher than that of a non-clinical population exposed to a situational stressor (Horowitz et al., 1979), but lower than in women newly diagnosed with breast cancer (Compas et al., 2006; Epping-Jordan et al., 1999).

Mother-Daughter Communication.

Descriptive statistics for measures of communication (the Communication Questionnaire and IFIRS codes) are reported in Table 4. The Communication Questionnaire consisted of two scales, one which measured communication about an important issue discussed over the last six months identified by the participant (e.g., school, romantic relationships, or friends) named the Issue Scale, and one that measured communication about cancer (e.g., my mother and I avoid the topic of cancer) named the Cancer Scale. The scales were then summed to produce an overall communication score,

on which a higher score indicated a better level of communication and a lower score indicated more strained communication levels.

Table 4
Descriptive Statistics for Mothers and Daughters on Measures of Communication

Measure	Coefficient α	N	mean	sd
Mothers:				
Communication Questionnaire	0.83	51	35.87	8.11
Communication Questionnaire- Scale 1	0.83	53	16.02	5.07
Communication Questionnaire- Scale 2	0.63	51	19.81	4.09
IFIRS codes:	Percent reliability: 73.07 ± 13.75	58		
Sadness	---	58	4.90	1.85
Anxiety	---	58	5.29	1.60
Hostility	---	58	2.50	1.83
Denial	---	58	2.45	1.61
Externalized negative	---	58	3.09	1.42
Avoidance	---	58	2.69	1.57
Lecture/moralize	---	58	3.12	1.99
Whine/complain	---	58	2.21	1.65
Antisocial	---	58	2.98	1.46
Positive mood	---	58	4.97	1.75
Warmth/supportiveness	---	58	4.22	1.78
Listener responsiveness	---	58	5.98	1.46
Communication	---	58	6.22	1.35
Prosocial	---	58	5.78	1.38
Parental influence	---	58	4.57	1.61
Child centered	---	58	4.95	1.65
Daughters:				
Communication Questionnaire	0.88	45	42.04	8.64
Communication Questionnaire- Scale 1	0.86	48	19.45	4.64
Communication Questionnaire- Scale 2	0.81	46	22.39	4.81
IFIRS codes:	Percent reliability: 74.53 ± 13.94	58		
Sadness	---	58	3.48	1.80
Anxiety	---	58	5.31	1.47
Hostility	---	58	3,83	2.44
Denial	---	58	3.59	2.13
Externalized negative	---	58	3.07	1.64
Avoidance	---	58	3.84	2.07
Lecture/moralize	---	58	2.38	1.79
Whine/complain	---	58	2.88	1.72
Antisocial	---	58	4.26	1.93
Positive mood	---	58	4.19	1.81
Warmth/supportiveness	---	58	3.22	1.86
Listener responsiveness	---	58	5.26	1.72
Communication	---	58	5.19	1.85
Prosocial	---	58	4.86	1.79
Instrumental caretaking	---	58	1.90	1.41
Emotional caretaking	---	58	2.47	1.82

Note. IFIRS: Iowa Family Interaction Rating Scale.

Mother and daughter scores were significantly correlated on total communication (r = .39, p = .01) and the Cancer Scale (r = .45, p < .01), but not on the Issue Scale (r = .14, p = ns). Paired *t*-tests showed significant differences between mother and daughter scores on all three scales (total: $t_{(1,40)}$ = -4.49, p < .001; Issue Scale: $t_{(1,45)}$ = -3.35, p < .01; Cancer Scale: $t_{(1,42)}$ = -3.39, p < .01) with daughters believing that communication levels were better on all three scales than mothers.

On a series of individual questions from the Communication Questionnaire (not included in any of the scales) about the closeness of the mother-daughter relationship and any changes since the dyad began discussing breast cancer, 22 out of 51 (43.1%) of mothers believed that their relationship had changed since discussing breast cancer. All of these mothers reported that their relationship with their daughter had grown closer, and none indicated that their relationship had grown more distant. On another item where participants were asked to rate their relationship as *extremely close, somewhat close, close, somewhat distant, or extremely distant*, 91% of mothers (44/48) described their relationship with their daughter as extremely or somewhat close, 6.3% (3/48) described their relationship as close, and one mother as somewhat distant. Twenty-four out of 46 (52.2%) daughters indicated that their relationship had changed as a result of discussing breast cancer; all of these daughters indicated their relationship with their mother had changed for the better. Eighty-one percent (38/47) of daughters described their relationship with their mother as extremely or somewhat close, 10.6% (5/47) as close, 6.4% (3/47) as somewhat distant, and one as extremely distant. Mothers' and daughters' descriptions of the closeness of their relationship were significantly correlated (r = .35, p

< .05). A comparison of means indicated that mothers and daughters did not differ in their reports of closeness to one another on average.

In regard to the above communication variables, only the responses to the question "has your relationship changed since you started discussing breast cancer?" differed as a function of mothers' breast cancer history. Both mothers and daughters in families where mom had a personal history of breast cancer were more likely to report that their relationship had changed (and changed positively) than in families with no personal breast cancer history (mothers: $t_{(1,36)} = -2.04$, $p < .05$; daughters: $t_{(1,44)} = -2.79$, $p < .01$). None of the communication variables above differed as a function of recruitment site (Vanderbilt versus Meharry).

For the 58 videotaped interactions that were all double-coded by two research assistants, mean reliability between coders was 73.82% (sd = 10.80) overall, 73.07% (sd = 13.75) for mothers, and 74.53% (sd = 13.94) for daughters (see Table 4). This signifies that across 16 codes with possible scores ranging from 1-9 for each subject, coders were within one point on the rating scales approximately 74% of the time. This average exceeds the 60% reliability suggested by the IFIRS coding system for the double-coding of interactions (Melby & Conger, 1993).

Means and standard deviations for each IFIRS code are reported in Table 4. The coders rated mothers with a personal history of breast cancer as exhibiting significantly more sadness, whining/complaining, positive mood, better communication, and more prosocial behavior, but less avoidance than mothers without a history of breast cancer (all significant *t*-tests, $p < .05$). There were no differences in ratings made by the coders for mothers on the basis of recruitment site.

Coders rated daughters of dyads where mother had a personal breast cancer history as demonstrating more sadness, emotional caretaking of mother, and positive mood than in dyads with no personal breast cancer history (all significant *t*-tests, $p < .05$). None of the codes for daughters differed as a function of recruitment site.

Many of the individual codes were correlated with different types of behaviors for both mothers and daughters (see Tables 5 and 6). For example, communication and warmth/supportiveness were correlated in mothers ($r = .60$, $p < .001$) and hostility and externalized negative were correlated in daughters ($r = .53$, $p < .001$). Only positive mood, hostility, warmth, externalized negative, and avoidance were correlated (positively) between mothers and daughters, such that *both* members of the dyad tended to display the behavior. However, many separate individual codes were correlated between mothers and daughters (e.g., mothers' positive mood and daughters' avoidance, $r = -.39$, $p < .01$; see Table 7).

Table 5
Correlations Among Mothers' IFIRS Communication Codes

Code	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1. Sadness (sd)	1.0															
2. Anxiety (ax)	**.43*** **	1.0														
3. Positive Mood (pm)	.02	.07	1.0													
4. Hostility (hs)	.09	-.03	-.19	1.0												
5. Denial (de)	.03	.05	0	.01	1.0											
6. Warmth (wm)	.21	**.43*** **	**.33***	.08	-.09	1.0										
7. Externalized negative (ex)	-.15	.06	.08	.16	.21	-.15	1.0									
8. Listener responsiveness (lr)	.08	.25	**.41****	-.16	-.18	**.60*** **	-.14	1.0								
9. Communication (co)	.14	**.26***	**.35****	-.11	-.05	**.61*** **	-.05	**.80*** **	1.0							
10. Avoidance (av)	-.14	.01	-.25	.01	.07	**-.40****	.04	**-.62*** **	**-.78*** **	1.0						
11. Lecture moralize (lm)	-.23	-.07	-.14	-.05	-.08	**-.28***	.01	**-.27***	-.09	0	1.0					
12. Whine/complain (wc)	**.27***	.20	-.17	.24	.22	.10	**.33***	**-.27***	-.12	.14	-.07	1.0				
13. Parental influence (pi)	-.15	.02	.20	.18	.06	**.33****	.07	**.30***	**.40****	**-.32***	**.30***	.01	1.0			
14. Child centered (cc)	.03	.25	**.28***	-.21	-.19	**.60*** **	-.10	**.66*** **	**.60*** **	**-.37****	**-.30***	**-.27***	.22	1.0		
15. Prosocial (pr)	.21	.19	**.44*** **	-.14	-.14	**.65*** **	-.07	**.86*** **	**.84*** **	**-.72*** **	-.25+	-.16	**.33***	**.56*** **	1.0	
16. Antisocial (an)	-.17	.02	-.17	**.35****	**.27***	**-.32***	**.31***	**-.66*** **	**-.65*** **	**.72*** **	-.04	**.35****	-.15	**-.42*** **	**-.76*** **	1.0

+ p < .10, * p < .05, ** p < .01, *** p< .001 (remains significant after Bonferroni correction)

Table 6
Correlations Among Daughters' IFIRS Communication Codes

Code	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1. Sadness (sd)	1.0															
2. Anxiety (ax)	**.32***	1.0														
3. Positive Mood (pm)	.06	-.08	1.0													
4. Hostility (hs)	-.21	.13	**-.32***	1.0												
5. Denial (de)	-.18	-.01	-.22	**.39****	1.0											
6. Warmth (wm)	**.31***	.12	**.68*****	**-.33***	**-.33***	1.0										
7. Externalized negative (ex)	-.10	.09	**-.28***	**.53*****	.14	**-.36****	1.0									
8. Listener responsiveness (lr)	.20	-.05	**.65*****	**-.56*****	**-.37****	**.64*****	**-.45*****	1.0								
9. Communication (co)	**.36****	.08	**.64*****	**-.49*****	**-.40****	**.62*****	**-.38****	**.82*****	1.0							
10. Avoidance (av)	-.10	.06	**-.57*****	**.45*****	**.38****	**-.51*****	**.29***	**-.78*****	**-.68*****	1.0						
11. Lecture moralize (lm)	-.23	-.01	-.01	.13	-.10	-.10	**.33***	-.03	.07	-.21	1.0					
12. Whine/complain (wc)	.05	.20	**-.32***	**.69*****	**.27***	**-.32***	**.56*****	**-.48*****	**-.48*****	**.36****	-.04	1.0				
13. Emotional Caretaking (ec)	.20	.10	**.44*****	**-.30***	-.17	**.68*****	**-.32***	**.51*****	**.47*****	**-.36****	-.10	-.26	1.0			
14. Instrumental Caretaking (ic)	-.06	-.06	**.38****	-.08	**-.26***	**.39****	**-.32***	**.26***	**.26***	**-.28***	-.05	-.06	**.29***	1.0		
15. Prosocial (pr)	**.30***	.08	**.65*****	**-.56*****	**-.48*****	**.72*****	**-.40****	**.88*****	**.90*****	**-.74*****	.04	**-.52*****	**.55*****	**.37****	1.0	
16. Antisocial (an)	**-.29***	-.05	**-.50*****	**.73*****	**.53*****	**-.58*****	**.58*****	**-.80*****	**-.77*****	**.74*****	.07	**.60*****	**-.40****	**-.31***	**-.82*****	1.0

+ p < .10, * p < .05, ** p < .01, *** p< .001 (remains significant after Bonferroni correction)

Table 7
Correlations of IFIRS Communication Codes Between Mothers and Daughters

Mothers' Codes														
Daughters' Codes														
Code	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Sadness (sd)	.22	.14	-.07	.06	**-.35****	**.29***	-.07	.05	.11	-.07	-.07	-.02	.09	-.07
2. Anxiety (ax)	-.02	.15	.02	.22	-.02	.14	.12	.05	.06	.02	.09	.07	.04	.03
3. Positive Mood (pm)	.18	.19	**.63*****	-.17	-.11	**.31***	.01	**.35****	.23	-.25	**-.32***	-.06	**.36****	-.13
4. Hostility (hs)	-.15	-.03	-.25	**.44*****	.10	.07	.25	.12	.07	-.03	-.09	**.28***	.04	.08
5. Denial (de)	.01	-.22	.01	.06	.24	-.09	.08	-.04	.05	.04	-.06	.21	0	.04
6. Warmth (wm)	**.31***	**.37****	**.38****	.09	-.18	**.41*****	.09	.23	.08	-.08	-.24	.07	.23	.03
7. Externalized negative (ex)	-.20	-.05	-.18	.13	.02	-.14	**.39****	.07	-.01	.07	0	.01	-.02	.07
8. Listener responsiveness (lr)	**.33***	**.28***	**.42*****	**-.27***	-.11	.19	-.05	.21	.13	**-.29***	-.07	-.16	.25	**-.27***
9. Communication (co)	.25	**.32***	**.31***	**-.30***	-.21	.23	0	.25	.13	-.20	-.15	-.11	.22	-.18
10. Avoidance (av)	**-.29***	-.20	**-.39****	.22	.05	-.12	.03	**-.30***	-.18	**.32***	.15	.17	**-.33***	**.33***
11. Lecture moralize (lm)	.01	.19	.13	-.10	.02	.14	-.07	**.27***	.06	.06	-.24	-.08	.19	-.14
12. Whine/complain (wc)	-.10	-.12	-.18	**.43*****	-.01	.06	**.26+**	.07	.10	-.02	.01	.11	.03	.09
13. Prosocial (pr)	.21	**.35****	**.37****	**-.29***	-.23	.23	-.02	.21	.07	-.13	-.12	-.17	.20	-.16
14. Antisocial (an)	**-.28***	-.16	**-.27***	**.27***	.14	-.16	.12	-.04	-.03	.18	.09	.16	-.18	.24

+ p < .10, * p < .05, ** p < .01, *** p< .001 (remains significant after Bonferroni correction)

Coping with Breast Cancer Risk

Descriptive statistics for a measure of coping (the Responses to Stress Questionnaire) are reported in Table 8. There were trends (not reaching significance) for mothers with a history of breast cancer to engage in more Primary and Secondary Control Coping and less Disengagement Coping than women without a personal history. There were no differences in daughters of mothers with and without a history of breast cancer. There were also no differences in coping as reported on the RSQ by recruitment site for either mothers or daughters.

Table 8
Descriptive Statistics for Mothers and Daughters on the Responses to Stress Questionnaire (RSQ)

Measure	Coefficient α	N	mean	sd
Mothers:	0.88	---	---	---
Primary Control Coping	---	52	23.33	4.83
Secondary Control Coping	---	52	34.40	5.54
Disengagement Coping	---	52	15.92	3.96
Involuntary Engagement	---	52	24.49	7.02
Involuntary Disengagement	---	52	16.57	4.70
Daughters:	0.92	---	---	---
Primary Control Coping	---	51	32.54	6.41
Secondary Control Coping	---	51	17.12	4.99
Disengagement Coping	---	51	22.03	6.83
Involuntary Engagement	---	51	17.68	5.01
Involuntary Disengagement	---	51	21.05	5.02

There were four correlated variables between mothers' coping and stress responses and daughters' coping style: mothers' Primary Control Coping and daughters' Secondary Control Coping ($r = .31$, $p < .05$), mothers' Secondary Control Coping and daughters' Primary Control Coping ($r = -.30$, $p < .05$), mothers' Involuntary Engagement

and daughters' Secondary Control Coping (r = -.30, $p < .05$), and mothers' Involuntary Engagement and daughters' Involuntary Engagement (r = .31, $p < .05$).

In comparison to a sample of women newly diagnosed with breast cancer (Compas et al., 2006), the women from this sample demonstrated a lower proportion of Primary Control Coping, a comparable ratio of Secondary Control and Disengagement Coping, and almost the twice the proportion of Involuntary Engagement and Involuntary Disengagement.

Knowledge About Breast Cancer

Mothers and adult daughters (aged 18 and above) completed a 47-item questionnaire testing their knowledge about epidemiology, risk factors, symptoms, treatment, and genetic testing in relation to breast cancer. Daughters aged 17-years-old and younger completed a similar 22-item measure tailored to developmental level. Participants could endorse the choices "true," "false," or "I don't know" for each item. Descriptive statistics for percentages of items answered correctly, incorrectly, "I don't know," and left unanswered are reported in Table 9.

Table 9
Descriptive Statistics for Mothers and Daughters on the Knowledge Questionnaire

Measure	Coefficient α	N	mean	sd
Mothers:	0.91			
Percentage correct items		54	70.88	17.08
Percentage incorrect items		54	11.23	5.49
Percentage marked "don't know"		54	17.18	16.51
Percentage unanswered items		54	0.71	1.85
Daughters:				
(all ages together)				
Percentage correct items		51	56.32	16.86
Percentage incorrect items		51	14.62	8.50
Percentage marked "don't know"		51	27.27	18.57
Percentage unanswered items		51	1.78	7.50
(daughters 17 and younger- 22-item form)				
Percentage correct items	84%	26	51.22	17.51
Percentage incorrect items		26	16.08	10.22
Percentage marked "don't know"		26	29.20	20.33
Percentage unanswered items		26	3.50	10.31
(daughters 18 and older – 47-item form)				
Percentage correct items	89%	25	61.62	14.68
Percentage incorrect items		25	13.11	6.07
Percentage marked "don't know"		25	25.28	16.71
Percentage unanswered items		25	n/a	n/a

Daughters scored an average of 15 percentage points lower than mothers on the percentage of correct answers, which was a significant difference (daughters: mean 56.3%, sd = 16.9; mothers: mean = 70.9%, sd = 17.1; $t_{(1,49)} = 5.91$, $p < .001$). There was also an effect of age for daughters, whereby adult daughters scored significantly better than daughters 17-years-old and younger (adult daughters: mean = 61.6%, sd =14.7; younger daughters: mean = 51.2%, sd = 17.5; $t_{(1,49)} = -2.29$, $p < .05$). Additionally, a correlation showed that percentage of items answered correctly was correlated between mothers and daughters ($r = .42$, $p < .01$).

Whether or not mother had a personal history of breast cancer significantly impacted both daughters' and mothers' scores on the Knowledge questionnaire, such that

if mother had a history of breast cancer, both members of the dyad scored higher on the measure (see Table 10). Additionally, mothers recruited from Vanderbilt scored significantly higher than mothers from Meharry (Vanderbilt: 73.8%, sd = 15.6; Meharry: 56.5%, sd = 17.9; $t_{(1,52)} = 2.96$, $p < .01$), a difference that was not found in daughters. This is likely confounded by the fact that only one mother at Meharry had a history of breast cancer, whereas 28 of the mothers from Vanderbilt were positive for personal history.

Table 10
Differences in Knowledge Questionnaire Scores (Percent Correct) Between Dyads Where Mom Had Breast Cancer Versus Did Not Have Breast Cancer

	Breast Cancer History		No Breast Cancer History			
	Mean	SD	Mean	SD	*t* value	*p* value
Mothers	78.08	10.96	59.57	19.00	-4.54	.001
Daughters	60.51	15.70	49.82	16.91	-2.31	.03

Biological Stress Measures.

Descriptive statistics for salivary cortisol and α-amylase measurements are reported in Table 11. Changes in hormonal levels across time were analyzed by using repeated measures ANOVA with time as the within-subjects factor. Neither cortisol nor α-amylase varied across time significantly for mothers. However, in daughters, both cortisol and α-amylase varied significantly across time. Cortisol varied across time ($F_{(1,27)} = 5.82$, $p < .01$) linearly such that levels began high at baseline and fell across time. In contrast, α-amylase varied across time ($F_{(1,22)} = 3.69$, $p < .05$) in a U-shaped

quadratic fashion such that levels began high, fell, and then rose again towards the end of the interaction (see Table 11).

Table 11
Descriptive Statistics for Mothers and Daughters on Measures of Biological Stress

Measure	N	mean	sd
Mothers:			
Salivary Cortisol (ug/dL):			
1. baseline	32	0.25	0.46
2. post-discussion	32	0.17	0.25
3. 15 min post-discussion	31	0.16	0.35
4. 30 min post-discussion	31	0.17	0.33
5. 45 min post-discussion	31	0.24	0.76
Salivary α-amylase (U/mL):			
1. baseline	30	33.08	28.87
2. post-discussion	31	36.68	33.25
3. 15 min post-discussion	31	35.60	31.28
4. 30 min post-discussion	31	38.76	34.88
5. 45 min post-discussion	31	38.01	36.70
Daughters:			
Salivary Cortisol (ug/dL):			
1. baseline	33	0.28	0.68
2. post-discussion	32	0.27	0.82
3. 15 min post-discussion	31	0.16	0.23
4. 30 min post-discussion	31	0.10	0.08
5. 45 min post-discussion	32	0.15	0.34
Salivary α-amylase (U/mL):			
1. baseline	33	40.26	32.28
2. post-discussion	31	33.77	26.59
3. 15 min post-discussion	29	29.61	21.33
4. 30 min post-discussion	29	33.07	25.88
5. 45 min post-discussion	31	34.97	26.59

Note: ug/dL = micrograms per deciliter. U/mL = units per milliliter

Repeated measures ANOVAs were then calculated with time as the within-subjects factor and mother's breast cancer history (either positive or negative) as the between-subjects variable. Hormone levels in daughters were not affected by mother's breast cancer history. The same was found for cortisol levels in mothers. However, there

was a trend for an interaction of breast cancer history by time in mothers' α-amylase levels ($F_{(4,25)} = 2.54$, $p = .07$) such that mothers without a history followed a U-shaped curve, and mothers with a history rose across time (see Figure 2). Descriptive statistics for mothers with and without a history of breast cancer are reported in Table 12. As seen in Table 12, none of the comparisons between mothers with a history and those without reached statistical significance at any of the five time points.

Figure 2

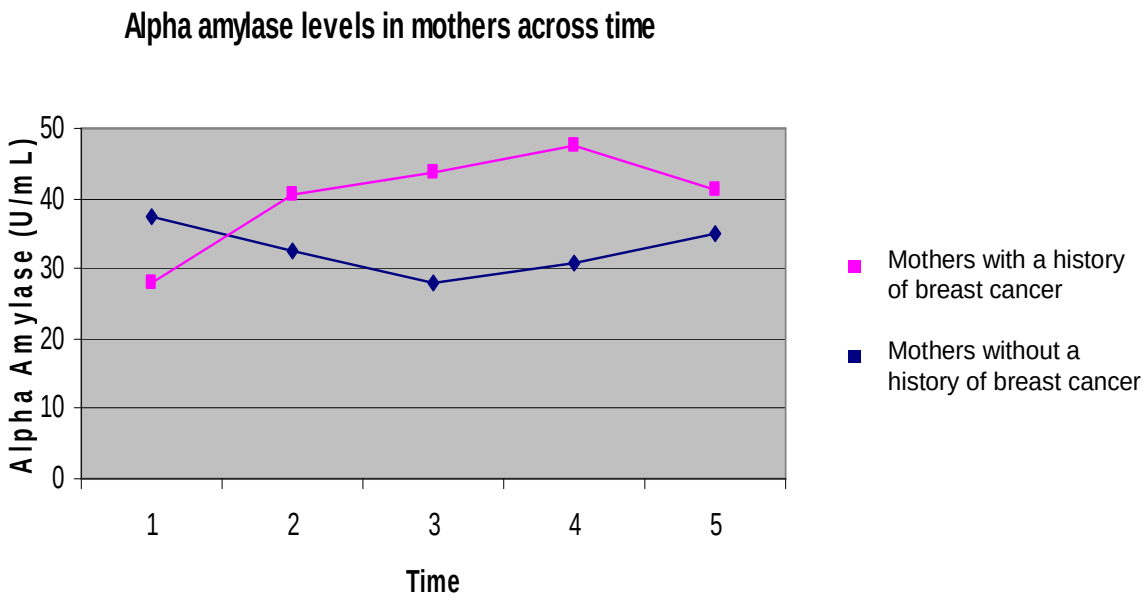


Table 12
Differences in α-amylase Levels in Mothers Based on Breast Cancer History

	Breast Cancer History		No Breast Cancer History			
	Mean	SD	Mean	SD	*t* value	*p* value
Mothers						
Baseline	28.13	24.29	37.42	32.51	.89	ns
Post-discussion	40.66	29.14	32.44	37.70	-.68	ns
15 min post	43.85	34.62	27.86	26.58	-1.44	ns
30 min post	47.39	34.83	30.66	34.00	-1.35	ns
45 min post	41.41	32.67	34.83	40.93	-.49	ns

Mothers' hormone levels did not vary as a function of recruitment site (Vanderbilt or Meharry), and neither did daughters' cortisol. However, there was a trend for daughters' α-amylase to vary by recruitment site (time x recruitment site interaction: $F_{(4,25)} = 2.25$, $p = .09$, see Table 13). Daughters recruited from Meharry exhibited lower baseline α-amylase levels that subsequently rose linearly, while daughters from Vanderbilt had alpha amylase levels that started high, fell, and rose again toward the end of the interaction (see Figure 3). Levels of α-amylase were significantly different between the two groups of daughters at baseline and directly after the interaction (time points 1 and 2, see Table 13). This finding may have been caused by a difference in procedure for the study between the two sites. At Meharry Medical College, it was significantly more difficult to recruit subjects. Because of this, participants were offered more flexibility regarding appointment times in order to increase the chances of recruiting a larger sample there. The appointments at Meharry varied more in terms of time (some as early as 9:00 am or as late as 6:00 pm) while the appointments at Vanderbilt were kept strictly between

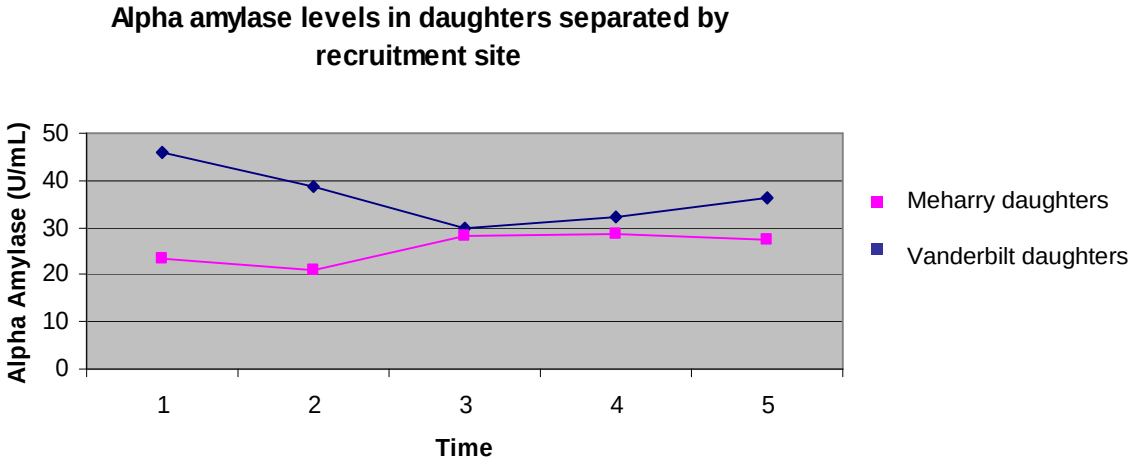
4:00 and 6:00 pm. This difference in appointment timing may have been a confounding variable in comparing hormonal levels between the two sites.

Correlational analyses showed that there were no associations at any time points between mothers' hormone levels and daughters' hormone levels, for either cortisol or α-amylase.

Table 13
Differences in α-amylase Levels in Daughters Based on Recruitment Site

	Vanderbilt		Meharry			
	Mean	SD	Mean	SD	*t* value	*p* value
Daughters						
Baseline	45.86	33.10	23.55	18.26	2.46	**.02**
Post-discussion	38.76	28.85	21.01	16.67	2.13	**.04**
15 min post	29.77	22.16	28.40	21.88	.16	ns
30 min post	32.28	24.94	28.46	23.78	.37	ns
45 min post	36.27	28.71	27.53	17.11	1.04	ns

Figure 3



*two groups of daughters differed significantly at time points 1 and 2

Hypothesis Testing

Hypothesis 1.

The first hypothesis proposed that mothers' communication styles would be associated with emotional distress in their daughters. Specifically, negative maternal communication would correlate with increased symptoms of anxiety and depression in daughters, and positive communication would relate to fewer symptoms of psychological distress. This hypothesis was tested by calculating correlations of each of the IFIRS codes for mothers with psychological symptom scales from YSR/YASR and IES for daughters (see Table 14).

Table 14

Correlations Between Mothers' IFIRS Communication Codes and Daughters' Psychological Symptoms

Measures of Daughters' Psychological Symptoms											
Mothers' Codes											
Code	IES (total score)	IES (intrusion)	IES (Avoidance)	ASEBA anxiety/ depression	ASEBA somatic	ASEBA internal	ASEBA external	ASEBA total problems	ASEBA DSM depression	ASEBA DSM anxiety	ASEBA DSM somatic
1. Sadness (sd)	**.35***	**.32***	**.28***	.15	.06	.12	-.12	.03	.07	.12	.09
2. Anxiety (ax)	.22	.20	.16	.17	.14	.19	.07	.11	.18	.26	.09
3. Positive Mood (pm)	-.08	-.07	-.08	.03	.08	.02	.03	.05	.11	.17	.09
4. Hostility (hs)	.03	.10	-.05	-.13	-.03	-.09	.06	.03	-.03	-.02	.02
5. Denial (de)	-.09	-.18	.02	-.15	-.25	-.20	-.08	-.19	-.10	-.14	**-.26***
6. Warmth (wm)	.23	.21	.20	.07	.14	.14	-.04	.08	.02	.22	.13
7. Externalized negative (ex)	-.04	-.02	-.03	-.07	-.08	-.11	.07	-.06	-.07	-.05	-.11
8. Listener responsiveness (lr)	-.03	-.07	.02	.04	.16	.10	.04	.12	-.03	.22	.06
9. Communication (co)	.10	.12	.06	.19	.25	.24	.15	**.29***	.22	**.36****	.11
10. Avoidance (av)	-.04	-.01	-.05	-.05	-.18	-.11	.06	-.12	-.12	-.20	-.05
11. Lecture moralize (lm)	.17	.14	.17	**.33***	**.23+**	**.37****	**.30***	**.39****	**.38****	.22	.21
12. Whine/complain (wc)	.14	.08	.14	-.04	-.02	-.04	0	0	-.06	.16	.05
13. Prosocial (pr)	.15	.04	.20	.13	.14	.17	.04	.15	.05	**.30***	.07
14. Antisocial (an)	-.14	0	-.21	-.10	-.14	-.13	.06	-.08	-.02	-.17	-.07
15. Parental Influence (pi)	.15	.04	.20	.11	**.36****	**.27***	**.30***	**.35****	**.24+**	**.28***	**.32***
16. Child centered (cc)	.17	.14	.16	.08	**.27***	.20	.06	.13	.08	-.02	.20

+ p < .10, * p < .05, ** p < .01, *** p< .001 (remains significant after Bonferroni correction)

Results supported the first part of this hypothesis, that negative maternal communication and daughters' psychological symptoms would be associated, but did not support a relationship between positive maternal communication and daughters' symptoms. The most significant finding in regard to this hypothesis was that two particular maternal codes, lecture/moralize and parental influence, were associated with increased depression, somatization, internalizing, externalizing, total problems, and anxiety in daughters (see Table 10). Both of these codes describe mothers' tendencies to influence daughters' behavior, often in regard to breast cancer screening and awareness. Lecture/moralize and parental influence for mothers were related ($r = .30$, $p < .05$; see Table 5).

Another statistically significant relationship emerged between maternal sadness and daughters' tendency to experience avoidant behaviors and intrusive thoughts in regard to breast cancer, as measured by the IES (see Table 14). Although this relationship did not remain significant after Bonferroni correction, it is notable that the pattern emerged across both scales of the IES. This association may be caused by a third variable, mothers' personal breast cancer history. Mothers who had a history were rated as displaying more sadness by coders, and therefore it is possible that their daughters would experience more negative reminders of breast cancer, although the difference in IES scores in daughters with mothers with and without a history of breast cancer was non-significant.

Lastly, there were five unexpected findings from this set of analyses, none of which represented a pattern of coherent findings or remained significant after Bonferroni correction. The IFIRS code for maternal communication (measuring positive

communication behaviors) was positively correlated with daughters' total problems (r = .29, $p < .05$) and anxiety (r = .36, $p < .01$), and mothers' prosocial behavior was associated with increased anxiety in daughters (r = .30, $p < .05$). Additionally, mothers' denial was negatively associated with daughters' somatic symptoms (r = -.26, $p < .01$), while mothers' child-centered behavior was associated with increased somatic symptoms in daughters (r = .27, $p < .05$).

This first set of findings (maternal communication and prosocial behavior were associated with increased problems, anxiety in daughters) may be driven by the fact that mothers with a history of breast cancer were rated as showing better levels of communication and prosocial behavior, and therefore these daughters may be experiencing increased problems and anxiety as a result of their mothers' cancer history. The second set of findings (child-centeredness was associated with more somaticizing in daughters and denial was associated with less), may be explained by the tendency of parents to actually increase their child's propensity to engage in somatic complaints by attending to them (e.g., see Walker et al., 2006 for an example in children with chronic pain).

Hypothesis 2.

The second hypothesis proposed that mothers' communication style would be associated with daughters' coping style, such that negative maternal communication would be correlated with maladaptive coping (Disengagement), and positive maternal communication would correlate with more adaptive coping styles (Primary and Secondary Control).

The results, reported in Table 15, demonstrated findings similar to the first hypothesis, in that negative maternal communication was associated with maladaptive coping in daughters, but positive maternal communication was not associated with increased adaptive coping style in daughters. Specifically, mothers' tendency to engage in lecturing/moralizing was associated with increased Disengagement Coping in daughters ($r = .46$, $p < .001$). Negative maternal communication was additionally associated with decreased adaptive coping style in daughters (lecture/moralize and daughters' Secondary Control Coping: $r = -.38$, $p < .01$; parental influence and daughters' Secondary Control Coping: $r = -.33$, $p < .01$). Another result supporting this trend is that mothers' positive mood was associated with decreased Disengagement Coping in daughters ($r = -.35$, $p < .05$). However, positive mood was not associated with increased adaptive coping. In general, the most clinically significant finding from this hypothesis was that the maternal tendency to engage in lecturing behavior was associated with less adaptive coping styles in daughters.

Table 15

Correlations Between Mothers' IFIRS Communication Codes and Daughters' Coping and Stress Responses

Daughters' Coping Style (Responses to Stress Questionnaire)					
Mothers' Codes					
Code	Primary Control Coping	Secondary Control Coping	Disengagement Coping	Involuntary Engagement	Involuntary Disengagement
1. Sadness (sd)	.17	.12	.01	.09	**-.46*** **
2. Anxiety (ax)	.09	.13	-.11	.11	**-.31***
3. Positive Mood (pm)	.23	.26	**-.35***	-.05	**-.25+**
4. Hostility (hs)	.01	-.02	-.04	.05	0
5. Denial (de)	.02	.05	-.19	.10	-.04
6. Warmth (wm)	.06	-.13	-.15	**.37****	-.13
7. Externalized negative (ex)	.04	.08	-.14	-.07	.04
8. Listener responsiveness (lr)	.10	-.02	-.12	.03	.01
9. Communication (co)	-.06	-.14	-.02	**.29***	-.02
10. Avoidance (av)	-.04	.13	-.03	-.13	.01
11. Lecture moralize (lm)	-.22	**-.38****	**.46*****	.19	.18
12. Whine/complain (wc)	0	.13	.01	-.04	-.15
13. Prosocial (pr)	.09	-.02	-.06	.08	-.10
14. Antisocial (an)	.05	.18	-.15	-.11	-.08
15. Parental Influence (pi)	-.08	**-.33***	.19	**.36***	.03
16. Child centered (cc)	-.08	-.16	-.05	.27	.07

+ p < .10, * p < .05, ** p < .01, *** p< .001 (remains significant after Bonferroni correction)

Hypothesis 3.

The third hypothesis proposed that positive maternal communication styles would be associated with increased knowledge about breast cancer in daughters, whereas negative communication styles would be associated with lower levels of knowledge. Correlational analyses did not support this hypothesis, in that there were no significant correlations between any of the IFIRS codes for mothers and daughters' scores on the Knowledge Questionnaire. Additional analyses demonstrated that mothers' breast cancer history did play a role in daughters' knowledge about breast cancer, such that daughters in dyads positive for maternal history had higher scores than daughters negative for maternal history (daughters in dyads with positive breast cancer history: mean = 60.5 %, sd = 15.7%, no breast cancer history: mean = 49.8%, sd = 16.9%; $t_{(1,49)} = -2.31$, $p < .05$; see Table 10). Thus, daughters in families with a history tended to be more knowledgeable about breast cancer than daughters in families without a history. Maternal communication style did not, however, have an association with daughters' knowledge about cancer.

Hypothesis 4.

The fourth hypothesis proposed that mothers' communication style would be associated with daughters' biological reactivity, such that negative maternal communication would correlate with increased stress reactivity, and positive communication would not be related to daughters' biological reactivity. As found in the results for the first three hypotheses, there was a significant relationship between negative maternal communication and daughters' stress response. However this relationship only

held for cortisol levels and did not occur for α-amylase. As hypothesized, positive maternal communication did not correlate with daughters' stress hormone levels.

Negative maternal communication, more specifically denial, externalized negative, and antisocial, was associated with higher cortisol levels in daughters (see Table 16). Although several of these correlations did not remain significant after Bonferroni correction, there was a clear pattern of a positive relationship between these three codes and daughters' cortisol across multiple time points of hormonal measurement.

Unexpectedly, maternal sadness was correlated with lower levels of daughters' cortisol at all time points with the exception of baseline (see Table 16). This may be indicative that maternal sadness induced an empathic, caretaking response in daughters, especially since mothers with a history of breast cancer were coded as exhibiting more sadness, and their daughters were coded as exhibiting more emotional caretaking.

Table 16

Correlations Between Mothers' IFIRS Communication Codes and Daughters' Biological Stress Measures

Measures of Daughters' Biological Stress Reactivity										
Mothers' Codes										
	Salivary Cortisol (ug/dL)					Salivary α-Amylase (U/mL)				
Code	baseline	Post-discussion	15 min post	30 min post	45 min post	baseline	Post-discussion	15 min post	30 min post	45 min post
1. Sadness (sd)	-.35	**-.36***	**-.45***	**-.41***	**-.38***	-.01	-.01	-.29	.04	-.13
2. Anxiety (ax)	-.25	-.23	-.20	-.15	-.22	.09	.07	-.02	-.04	-.06
3. Positive Mood (pm)	-.07	-.04	-.11	-.17	-.08	**.36***	**.35+**	**.33+**	.24	.28
4. Hostility (hs)	0	-.06	-.04	.22	-.06	-.06	-.10	-.08	-.01	-.12
5. Denial (de)	**.52****	**.52****	**.41***	.09	**.55*****	.14	.20	**.44***	**.32+**	.26
6. Warmth (wm)	-.31	-.30	-.17	-.17	-.31	.16	.15	.13	.07	.04
7. Externalized negative (ex)	**.33+**	.30	.27	**.37***	**.35+**	-.11	-.09	.10	-.26	-.14
8. Listener responsiveness (lr)	-.26	-.23	-.16	-.05	-.23	.21	.21	.14	.04	.11
9. Communication (co)	-.21	-.20	-.15	-.12	-.20	.17	.10	.07	-.07	.05
10. Avoidance (av)	.18	.17	.12	.09	.18	-.09	.05	.03	.07	.03
11. Lecture moralize (lm)	-.16	-.20	-.27	.02	-.20	-.03	-.09	-.02	-.09	0
12. Whine/complain (wc)	.11	.09	.01	-.05	.11	.02	.06	.23	.22	.14
13. Prosocial (pr)	-.28	-.27	-.20	-.10	-.28	.17	.12	-.03	-.17	-.03
14. Antisocial (an)	**.40***	**.40***	.30	.09	**.39***	-.21	-.11	.11	.03	-.12
15. Parental Influence (pi)	.01	.02	-.08	.06	.02	.15	.15	.28	.01	.20
16. Child centered (cc)	-.22	-.18	-.14	-.02	-.17	-.17	-.10	-.18	-.22	-.12

+ $p < .10$, * $p < .05$, ** $p < .01$, *** $p < .001$ (remains significant after Bonferroni correction)

In regard to daughters' α-amylase levels, results indicated a trend for a relationship between mothers' denial and daughters' higher cortisol levels (see Table 16). Additionally, there was an expected positive correlation between maternal positive mood and daughters' α-amylase levels. However, these correlations did not reach full statistical significance. Because no overall patterns emerged in regard to daughters' α-amylase levels, these results should be interpreted with caution.

Correlations were also computed between daughters' communication and daughters' hormone levels (see Table 17) and between mothers' communication and mothers' hormone levels (see Table 18). As seen in Table 17, patterns emerged indicating that higher levels of daughters' cortisol were associated with higher levels of daughters' externalized negative and whine/complain, and lower levels were correlated with increased sadness, communication and prosocial behavior. As seen in Table 18, there was a very strong correlation between mothers' whine/complain and higher levels of mothers' cortisol, and a weaker negative relationship between maternal positive mood and cortisol levels. Although an analysis of mothers' cortisol levels was not part of this dissertation and is discussed elsewhere, it is important for interpretive purposes to note that there was also a strong relationship between maternal cortisol levels at all five time points and scores on the Impact of Events Scale (correlations ranged from r = .36 to .51 across the five time points, all statistically significant).

Table 17
Correlations Among Daughters' IFIRS Communication Codes and Biological Stress Measures

Measures of Daughters' Biological Stress Reactivity										
Daughters' Codes										
	Salivary Cortisol (ug/dL)					Salivary α-Amylase (U/mL)				
Code	baseline	Post-discussion	15 min post	30 min post	45 min post	baseline	Post-discussion	15 min post	30 min Post	45 min post
1. Sadness (sd)	**-.32+**	-.30	-.29	-.19	**-.33+**	-.13	-.11	**-.41***	-.10	-.10
2. Anxiety (ax)	-.12	-.17	-.20	.13	-.13	.14	.17	.14	.06	.21
3. Positive Mood (pm)	-.13	-.10	-.10	-.27	-.11	-.04	-.08	-.08	-.10	-.14
4. Hostility (hs)	-.02	-.07	-.05	**.37***	-.05	.20	.24	.28	.16	.15
5. Denial (de)	.10	.06	-.01	.03	.09	.16	.20	**.38***	.11	.15
6. Warmth (wm)	-.22	-.21	-.25	-.25	-.24	.01	-.05	-.05	-.15	-.19
7. Externalized negative (ex)	**.36***	**.32+**	**.32+**	**.42***	**.35***	-.04	-.01	.17	.01	-.03
8. Listener responsiveness (lr)	-.27	-.26	-.22	-.10	-.29	.11	-.06	-.28	-.20	-.11
9. Communication (co)	**-.42***	**-.39***	**-.33+**	-.25	**-.41***	.10	.05	-.25	-.12	-.02
10. Avoidance (av)	.21	.21	.11	.17	.24	-.20	-.13	.15	.02	-.06
11. Lecture moralize (lm)	-.13	-.12	.02	.01	-.12	.14	.26	0	.19	.10
12. Whine/complain (wc)	.18	.09	.20	**.63*****	.11	.12	.11	.17	.03	.03
13. Prosocial (pr)	**-.37***	**-.35+**	-.30	-.16	**-.36***	.10	.05	-.18	-.11	-.03
14. Antisocial (an)	.26	.25	.20	.24	.27	-.02	.06	.31	.13	.04
15. Emotional Caretaking (ec)	-.16	-.15	-.20	-.06	-.15	.10	.07	.16	.08	.09
16. Instrumental Caretaking (ic)	-.11	-.14	.02	.19	-.13	-.03	-.09	-.07	-.29	-.12

+ p < .10, * p < .05, ** p < .01, *** p< .001 (remains significant after Bonferroni correction)

Table 18
Correlations Among Mothers' IFIRS Communication Codes and Biological Stress Measures

Measures of Mothers' Biological Stress Reactivity										
Mothers' Codes										
	Salivary Cortisol (ug/dL)					Salivary α-Amylase (U/mL)				
Code	baseline	Post-discussion	15 min post	30 min post	45 min post	baseline	Post-discussion	15 min post	30 min post	45 min post
1. Sadness (sd)	.27	.25	.28	.22	.27	.08	-.04	.18	.09	.02
2. Anxiety (ax)	.18	.08	.04	.07	.08	.10	-.11	.01	.13	-.04
3. Positive Mood (pm)	**-.49****	**-.47****	**-.42***	**-.40***	**-.39***	.14	.18	.10	.16	.14
4. Hostility (hs)	.18	.19	.25	.18	.19	-.04	.22	.22	.24	.13
5. Denial (de)	-.07	-.02	-.06	-.13	-.16	-.24	-.19	-.06	-.03	-.17
6. Warmth (wm)	.13	.08	0	.15	.11	.11	.08	.04	.04	.03
7. Externalized negative (ex)	-.29	-.24	-.16	-.24	-.26	.17	.18	.27	.14	.30
8. Listener responsiveness (lr)	-.26	-.28	-.32	-.26	-.25	.26	0	-.09	-.09	-.06
9. Communication (co)	-.15	-.19	-.25	-.21	-.21	.25	.05	-.15	-.11	-.08
10. Avoidance (av)	.16	.15	.19	.16	.17	-.10	-.04	.13	.10	.08
11. Lecture moralize (lm)	-.09	-.11	-.05	-.11	-.10	-.07	.15	-.06	.04	.05
12. Whine/complain (wc)	**.65*****	**.68*****	**.75*****	**.67*****	**.70*****	-.04	.23	**.49****	**.37***	**.33**+
13. Prosocial (pr)	-.27	-.30	-.34	-.26	-.27	.30	.12	-.08	-.10	.01
14. Antisocial (an)	.11	.14	.19	.14	.14	-.11	.06	.25	.26	.16
15. Parental influence (pi)	-.19	-.22	-.19	-.26	-.25	.17	.07	.01	.03	.15
16. Child centered (cc)	-.18	-.20	-.23	-.20	-.19	.17	-.19	-.13	-.15	-.09

+ p < .10, * p < .05, ** p < .01, *** p< .001 (remains significant after Bonferroni correction)

Hypothesis 5.

A series of linear regression analyses were conducted to examine the relationships between the variables from hypotheses one through four (see Table 19). For the first regression equation, Daughters' Total Problems Scale from the YSR/YASR was chosen as the dependent variable, since it was the scale most strongly correlated with mothers' communication (see Table 14), and represented a total, broad measure of all psychological symptoms that daughters might have experienced. Mothers' observed lecture/moralize and parental influence behaviors were entered as the first step, and were chosen because of their consistent positive relationship with several measures of daughters' psychological symptoms (see Table 14). Lastly, daughters' coping style (e.g., Primary Control, Secondary Control, and Disengagement Coping) was entered as the second step. Daughters' coping style was entered as the second step to test the hypothesis that the relationship between mothers' communication and daughters' psychological symptoms is mediated by daughters' coping style. The full model was significant ($F_{(5,49)} = 6.50$, $p < .001$) and accounted for 36% of the variance in daughters' total problems on the YSR/YASR (adjusted R-squared). Both lecture/moralize and parental influence were found to be significant predictors of daughters' total problems (see Table 19), but lecture/moralize became non-significant when daughters' coping style was added to the model. Only daughters' Primary Control Coping was significant out of the three coping styles ($\beta = -.33$, $p = .02$).

Table 19

Regression Equations Predicting Daughters' Psychological and Biological Stress Responses from Maternal Communication and Daughters' Coping Style

Equation 1 – Daughters' Total Problems Scale from YSR/YASR			
	Adj. R^2 = .36	**$F_{(5,49)}$ = 6.50, p < .001**	
1.	Mothers' Lecture/Moralize	β = .34, p = .01	R^2 change = .27
	Mothers' Parental Influence	β = .30, p = .02	
2.	Mothers' Lecture/Moralize	β = .21, p = ns	R^2 change = .15
	Mothers' Parental Influence	β = .28, p = .03	
	Daughters' Primary Control Coping	β = -.33, p = .02	
	Daughters' Secondary Control Coping	β = -.07, p = ns	
	Daughters' Disengagement Coping	β = .09, p = ns	
Equation 2 – Daughters' Average Cortisol Level			
	Adj. R^2 = .31	**$F_{(7,25)}$ = 2.61, p < .05**	
1.	Mothers' Sadness	β = -.38, p = .03	R^2 change = .50
	Mothers' Denial	β = .37, p = .10	
	Mothers' Externalized Negative	β = .16, p = .ns	
	Mothers' Antisocial	β = .21, p = .ns	
2.	Mothers' Sadness	β = -.37, p = .05	R^2 change = 0
	Mothers' Denial	β = .37, p = .05	
	Mothers' Externalized Negative	β = .16, p = .ns	
	Mothers' Antisocial	β = .20, p = .ns	
	Daughters' Primary Control Coping	β = -.01, p = ns	
	Daughters' Secondary Control Coping	β = -.01, p = ns	
	Daughters' Disengagement Coping	β = -.03, p = ns	
Equation 3 – Daughters' Average Cortisol Level			
	Adj. R^2 = .33	**$F_{(2,32)}$ = 8.87, p = .001**	
1.	Mothers' Sadness	β = -.31, p = .04	R^2 change = .37
	Mothers' Denial	β = .50, p < .01	

Regression analyses were not conducted in regard to the third hypothesis, that mothers' communication would be related to daughters' knowledge about breast cancer, as there were no significant relationships between communication and knowledge in correlational analyses.

In order to examine relationships from the fourth hypothesis, that mothers' communication would be associated with daughters' biological stress responses, two regression analyses were conducted. First, daughters' average cortisol level was chosen as the variable to be predicted, since it provided a measure of daughters' stress biology collapsed across time. In step one, mothers' sadness, denial, externalized negative, and antisocial were entered because of their significant relationship to daughters' cortisol levels (see Table 16). Daughters' coping style was entered in step two to eventually test for mediation between maternal communication and daughters' biological stress responses. The model was significant ($F_{(7,25)} = 2.61$, $p < .05$) and accounted for 31% of the variance (adjusted R-squared, see Table 19). However, only mothers' sadness and denial were found to be significant predictors, which did not change after daughters' coping style was added to the model. Because of these results, a third regression analysis was then conducted using only maternal sadness and denial to predict daughters' average cortisol. The model was significant ($F_{(2,32)} = 8.87$, $p = .001$) and accounted for 33% of the variance (adjusted R-squared, see Table 19).

Mediation

Upon examining the results from regression analyses, it appeared that daughters' Primary Control Coping could serve as a mediator between maternal communication (lecture/moralize and parental influence) and daughters' Total Problems Scale from the YSR/YASR. However, the predictors did not meet Baron and Kenny's requirements to test for mediation (Baron & Kenny, 1986), since maternal lecture/moralize and parental influence were not correlated with daughters' Primary Control Coping. Therefore, the

data did not support the hypothesis that daughters' coping style mediated the relationship between mothers' communication and either daughters' psychological symptoms or daughters' biological stress reactivity.

Path Model

It was not appropriate to test the path model suggested in the Introduction for goodness of fit, since supporting pathways were not confirmed in the above analyses. Although several aspects of maternal communication were found to be related to both daughters' psychological and biological stress reactions, this relationship did not include daughters' coping style as a mediator. Therefore, the suggested path model could not be examined for goodness of fit.

CHAPTER IV

DISCUSSION

Previous research has shown that being at risk for breast cancer can potentially serve as a source of psychological stress in women, including women without a known familial history of the disease. Additionally, correlational research has demonstrated that being at higher risk for breast cancer (by virtue of family history) is associated with increased biological stress reactivity in response to laboratory stress that is not related to breast cancer. However, previous research has focused exclusively on adult women and has not examined the psychological and biological correlates of breast cancer risk in younger women or in the context of family relationships. In light of these findings, the current study examined mother-daughter communication about breast cancer risk during a structured, stressful interaction, and measured associated patterns of stress reactivity. The current study utilized a correlational design to examine whether a specific set of maternal behaviors observed during interactions with their daughters were associated with differential levels of psychological and biological stress outcomes in adolescent and young adult daughters.

This study extended findings in this area of research by employing several novel design aspects. Behaviors were measured through mothers' and daughters' self-reports, mothers' reports about their daughters, direct observations of interaction, clinical interviews, and biological sampling. Additionally, participants were recruited from two sites to increase the socioeconomic and racial diversity of the sample and increase cross-

cultural validity of findings. In order to test effects on two different physiological stress systems, both salivary cortisol and α-amylase were measured. Additionally, the study design utilized a direct observation paradigm, which, to our knowledge, is the first of its type in examining the effects of breast cancer risk on stress reactivity in mother-daughter dyads. Studies in this area typically employ a stress paradigm such as the Trier Social Stress Test, where participants are asked to give a speech to a committee and do serial subtraction, a source of stress that is unrelated to the stress of breast cancer risk. By asking participants to discuss a specific set of questions related to breast cancer risk, we were able to observe patterns of interaction between mothers and daughters regarding this topic.

Further, studies in this area often measure behavior in adult daughters or sisters of women with a history of breast cancer. The current study examined differences in dyads with and without a personal history, and extended the sampling range of daughters' age to include 11-30 years. By extending this age range, we were able to investigate the correlates of cancer risk among young women and adolescent girls who typically are not provided with any formal medical guidelines on how to handle cancer risk (by virtue of their age), but yet have often faced the stressors of it through family or community history, or through the media. Lastly, in addition to monitoring dyads throughout an emotional discussion and physiological recovery period, information was collected about participants' coping styles and knowledge about breast cancer. Many other studies in the literature have measured stress reactivity, but have failed to measure how women cope with this stress and how much they have learned about the disease.

Overarching findings of this study indicated that mothers and daughters do experience stress, both biologically and psychologically, in reference to breast cancer risk, regardless of whether they have a positive family history. Additionally, certain types of negative maternal communication were associated with higher levels of markers of stress in daughters. These heightened levels of stress occurred both in the form of psychological symptom reports and hormonal stress measurements. However, positive maternal communication, in contrast, was not related to daughters' experience of stress in our data. Lastly, there were few differences between dyads with and without a history of breast cancer, with the exception that families affected by the disease scored higher on a test of knowledge about breast cancer than families who were unaffected and affected mothers displayed higher levels of sad affect during interactions with their daughters.

The findings are now considered in more detail in relation to each of the study hypotheses.

Hypothesis 1: Mothers' Communication and Daughters' Emotional Distress

The first hypothesis, that maternal communication about breast cancer risk would relate to daughters' psychological distress, was tested through correlational analyses and partial support was demonstrated. The data demonstrated that two types of maternal communication about breast cancer, lecture/moralize and parental influence, were associated with a range of psychological symptoms in daughters, including somatic complaints, depression, and anxiety. Behaviors coded as lecture/moralize included long monologues with no opportunity for daughter to speak or react, acting as an undisputed expert, and criticizing daughters' behavior with a moralizing tone. Behaviors reflective of

parental influence included attempts to regulate daughters' behavior or opinions in an authoritative manner as opposed to in the format of a open dialogue. Interestingly, mothers did not differ in their levels of lecture/moralize and parental influence based on a personal history of breast cancer. Therefore, a tendency to want to influence daughters' behaviors in regard to breast cancer (often in a lecturing manner) did not depend on mother having been affected by the disease. Additionally, daughters' experience of psychological symptoms was not related to maternal history of breast cancer.

These results suggest that maternal communication in the form of lecturing about breast cancer, rather than a mother's personal history of the disease, may be associated with increased psychological distress in adolescent and young adult daughters. Although the relationship between maternal communication about breast cancer and distress in daughters has not been previously examined to our knowledge, these data are in line with more general findings about mother/daughter communication. For example, negative maternal communication about financial issues and other family members during divorce has been linked to increased psychological symptoms in adolescent daughters (Koerner, Jacobs, & Raymond, 2000). Additionally, maternal dissatisfaction with their daughters, as mediated by lack of maternal warmth, is associated with increased self-criticism in adolescent daughters aged 12-15 (Thompson & Zuroff, 1999). In a review of behavioral genetics findings regarding adolescent depression, Pike and Plomin (1996) found that adolescents who were exposed to maternal negativity were more likely to be depressed than siblings exposed to less negativity. Thus, the findings are not surprising in that negative maternal communication is associated with poorer psychological outcomes in

daughters, both in the context of the greater mother/daughter relationship as a whole and more narrowly in regard to discussion about breast cancer.

The finding that maternal lecturing *about breast cancer* is associated with increased psychological symptoms in daughters may reflect a particular challenge for mothers and daughters in relation to this important health concern. For example, mothers likely serve as the primary source of information about breast cancer for young adolescent daughters. Mothers may be responsible for providing information, explaining the importance of breast self-exam, discussing family history, and serving as a confidant for daughters' worries and feelings about the disease. However, the current findings suggest that if these discussions are carried out in a negative manner (i.e., maternal lecturing), it is possible that daughters will experience increased distress and may be less able to process the information about breast cancer that mothers are trying to communicate.

The second part of this hypothesis, that positive maternal communication about breast cancer will be associated with decreased psychological distress in daughters, was not supported. This was surprising, based on other research findings that positive interactions between mothers and daughters are associated a better relationship quality and decreased psychological symptoms in daughters more generally (e.g., Eisenberg & McNally, 1993). The lack of a relationship between positive communication and decreased psychological distress in daughters may be due to restriction in variance in this sample. Specifically, mothers self-selected to volunteer and participate in this study, and most dyads reported that they had a close relationship with one another. Further, the mean scores for observed positive maternal communication were higher than those for

negative maternal communication. Therefore, this sample may have been limited to mothers who engaged in higher levels of positive communication than the average population. Restricting variance in positive maternal communication would have decreased the likelihood of finding a relationship between positive communication and decreased symptoms in daughters.

Finally, an unexpected finding emerged from testing this hypothesis, as maternal sadness was associated with increased scores for daughters on the Impact of Events Scale (IES) and its scales measuring intrusive thoughts and avoidance in regard to breast cancer. This finding may be related to a third variable, that mothers who had a history of breast cancer were rated as demonstrating more sadness than mothers without a history. Therefore, certain daughters may have exhibited greater levels of intrusive thoughts and avoidance because they were in dyads positive for a family history. Daughters' scores on the IES did not significantly differ in dyads positive versus negative for family history, however, this effect may have been too small to detect with the current sample size and somewhat low statistical power. The correlation between observed maternal sadness and daughters' intrusive thoughts and avoidance does, however, parallel the literature on children of depressed mothers, in that maternal depression has been associated with increased psychological symptoms in adolescents (Goodman & Gotlib, 1999; Pilowsky et al., 2006).

Hypothesis 2: Mothers' Communication and Daughters' Coping

Results for the second hypothesis, that maternal communication about breast cancer would relate to daughters' coping styles, followed a similar pattern to that found

in the first hypothesis. Maternal behaviors reflecting lecture/moralize were correlated with an increased level of Disengagement Coping in daughters, and both lecture/moralize and parental influence were associated with decreased Secondary Control Coping in daughters. Disengagement Coping (avoidance, denial, wishful thinking) has been shown to correlate with higher psychological distress whereas Secondary Control Coping (acceptance, distraction, cognitive restructuring, positive thinking) has been associated with lower distress, especially in survivors of breast cancer (e.g., Compas et al., 2006). Therefore, these findings signify that certain types of negative maternal communication (lecture/moralize and parental influence) are associated with less adaptive coping styles in daughters. Aside from one finding that maternal positive mood was associated less Disengagement Coping in daughters (which did not remain statistically significant after Bonferroni correction), there was no support for the hypothesis that positive maternal communication related to more adaptive coping styles in daughters. Thus, as found in the first hypothesis, only negative communication was related to daughters' coping style.

This finding, as in hypothesis one, also reflects a pattern found in mother/daughter relationships in general. Other studies have shown that maternal negative communication relates to poorer coping strategies in offspring (e.g., see Hamilton, Hammen, Minasian, & Jones, 1993, for an example in depressed mothers). Therefore, it is not surprising that this effect would extend to communication about breast cancer. Additionally, it may be the case that mothers who communicate negatively about breast cancer also communicate negatively about other topics, or have a general negative communication style. Therefore, the present findings could reflect general relationship patterns that also extend to this particular realm of communication.

These findings do, however, highlight problems specific to the area of communication about breast cancer. The association between maternal lecturing and Disengagement Coping in daughters suggests that mothers who tend to lecture about breast cancer have daughters who to tend to disengage when emotionally difficult information is presented to them. This is a pernicious pairing, in that these daughters may not receive and process health information that is vital to them. They will disengage from their mothers who serve as a main source of information about the disease, and will be more likely to engage in avoidance behaviors when learning about family history, monitoring for breast cancer symptoms, and other important health related behaviors. Essentially, maternal tendencies to lecture and moralize about breast cancer could leave daughters more vulnerable to the disease by virtue of a related tendency for daughters to disengage from warning signs and health information. However, the current findings are based on cross-sectional data and the direction of the association between maternal communication and daughters' coping cannot be determined. It is possible, for example, that mothers increase their lecturing and moralizing in response to daughters who cope by avoiding and disengaging from information and emotions related their risk of breast cancer. Future research is needed to detect the relationship between maternal lecturing and daughters' health behaviors, and then between daughters' health behaviors and risk for breast cancer.

Hypothesis 3: Mothers' Communication and Daughters' Breast Cancer Knowledge

The current findings did not support the third hypothesis that mothers' communication style would be correlated with daughters' knowledge about breast cancer.

As mentioned above, there was instead a relationship found between maternal breast cancer history and knowledge about the disease in both mothers and daughters, whereby mothers and daughters in families affected by breast cancer were more accurate in their knowledge about the disease and its treatment. This finding may reflect a straightforward process in that women who have been affected by the disease have likely received more information and education about breast cancer than unaffected women. However, it is noteworthy that daughters' knowledge about breast cancer does not appear to be related to their mothers' style of communication, at least as measured in the current study.

Prior research (Lukwago et al., 2003) has shown that many other factors may affect knowledge about breast cancer, including age, education, income, and time-orientation (e.g., I need to think about my future versus not worried about the future). The findings from the current study indicate that women, and especially unaffected women, would benefit from additional education about the disease. This is evidenced particularly by unaffected women's scores on the Knowledge Questionnaire, on which mothers were correct on 60% of the items and daughters were correct on only 50%. This suggests that these women were unable to correctly answer approximately one-half of the basic questions about the disease, despite the fact that the questions were derived from publicly available sources (National Cancer Institute, American Cancer Society websites).

Also disturbing is the finding that daughters whose mothers did have a history of breast cancer (thereby greatly increasing their own chances of developing the disease) scored an average of 60% correct responses on the questionnaire (their mothers scored 78% on average). These daughters, who have on average a 25% chance of developing

breast cancer, also failed to correctly answer almost half of the questions on this questionnaire. Unfortunately, the relatively low knowledge scores for these participants reflect those found in several other studies (e.g., Pavic et al., 2007; Stager, 1993; Wellisch, Gritz, Schain, Wang, & Siau, 1991).

Studies have also shown that women are typically unsatisfied with their current knowledge level in regard to breast cancer, and desire more information about the disease (e.g., Rapport et al., 2006). Future research should focus on a way to bridge this gap between the desire for more education and information dissemination. Several such trials are already underway for a variety of health topics, including cardiovascular disease, diabetes, and breast cancer (Beranova & Sykes, 2007; Hopp, Hogan, Woodbridge, & Lowery, 2007; Rapport et al., 2006, respectively). Many of these studies are examining the use of technology (web-based or telephone interventions) to meet patients' information needs. The findings from this hypothesis support a need for such research studies.

Hypothesis 4: Mothers' Communication and Daughters' Biological Stress Responses

The fourth hypothesis examined the relationship between maternal communication and daughters' levels of stress hormones. Specifically, negative maternal communication was hypothesized to correlate with increased levels of salivary cortisol and α-amylase in daughters, while positive maternal communication was expected to be associated with decreased levels of the stress hormones. (The relationship between mothers' communication and her own stress hormones was not considered here, and is addressed in other analyses from this project).

Support for this hypothesis was mixed. Interpretations concerning α-amylase are not warranted because there were no consistent patterns in the correlational data, and most of the correlations did not remain significant after Bonferroni correction. In contrast, a very different picture emerged for the salivary cortisol data, such that there were patterns of consistent correlations that remained significant after adjustment for error and were more suitable for interpretation.

Daughters' salivary cortisol levels were not related to maternal breast cancer history or recruitment site. Daughters' cortisol levels fell linearly across time from baseline to 45 minutes after the interaction. This pattern follows the expected change in cortisol due to diurnal rhythms in an average person; levels are typically highest just after waking and then decrease slowly throughout the day. Lowest levels are found in the late afternoon and early evening, when cortisol levels bottom out and almost form a plateau.

From our data, it would appear that the daughters' biological stress responses, at least as measured by salivary cortisol, did not change in response to the discussion with their mothers about breast cancer. Although this was an unexpected finding, it is understandable in the context of a recent meta-analysis examining studies of laboratory stressors and changes in cortisol levels (Dickerson & Kemeny, 2004). These authors found that (a) motivated performance tasks with the elements of (b) uncontrollability and (c) social evaluative threat had the largest and most consistent effects on cortisol levels. A prototypic example of this type of task is the Trier Social Stress Test (Kirschbaum et al., 1993), in which participants are asked to prepare a speech (active, motivated performance task) for an audience of confederates (social evaluative threat) and then are told to conduct a serial subtraction task out loud while being harassed by confederates

(uncontrollability). The mother-daughter interaction task used in the current study, in contrast, had none of these elements. The task was an open-ended discussion format in which the participants were informed of what would occur and were left alone in the room during the discussion. The presence of the video camera could have been considered a social evaluative threat, but anecdotal observations suggest that most of the dyads appeared to ignore or habituate to its presence during the interactions, as confirmed by the coders while viewing the tapes. Thus, our interaction task most likely did not possess the qualities that were expected to elicit strong cortisol responses.

Despite the lack of changes in cortisol levels over the course of the observed mother-daughter interaction, there were several significant associations between maternal communication and daughters' cortisol levels, including baseline levels of cortisol. This suggests an association between mothers' and daughters' interpersonal interactions and daughters' ambient levels of cortisol, perhaps even in anticipation of the laboratory interaction task; that is, daughters' levels of this important stress hormone may be related to their general style of interactions with their mothers, rather than changing in response to this particular interaction. For instance, maternal denial in regard to breast cancer during the observed interaction was associated with increased cortisol levels in daughters across four of the five time points. This may reflect a relationship between maternal denial about breast cancer and daughters' cortisol in general, but not as changing across time from baseline to the end of recovery because of this stressful discussion.

Four maternal emotional and behavioral codes were found to relate to salivary cortisol levels in daughters. Specifically, denial, externalized negative, and antisocial were positively correlated with daughters' cortisol, whereas maternal sadness was

negatively associated with daughters' cortisol. Although this was the first study to our knowledge to measure cortisol in relation to mother-daughter communication about breast cancer, these findings parallel related research on communication and stress physiology. For instance, studies of marital conflict demonstrated that hostile communications during a laboratory interaction (much like the task used in the current study) were associated with partners' increases in cortisol (Kiecolt-Glaser et al., 1997) and autonomic arousal (Levenson, Carstensen, & Gottman, 1994).

Denial, externalized negative, and antisocial, the three negative maternal codes that related to daughters' stress physiology, are closely related aspects of negative communication. In fact, both maternal denial and externalized negative were correlated with maternal antisocial communication ($r = .27$, $p < .05$, $r = .31$, $p < .05$ respectively). The definition of denial as outlined in the IFIRS manual included the participant's tendency to deny the existence of a problem or to take responsibility for a problem. The mothers in this study typically exhibited denial as a refusal to address their daughters' questions and worries about breast cancer. A common example would be a daughter's comment such as the following: "Mom, I'm really worried about you…I wish you would get a mammogram," and a mother's reply: "You worry too much. I'm really not at risk for the disease." Externalized negative, defined by hostility toward things or people outside the interaction, was often typified by a similar negativity on mothers' part. For example, the statement, "It's your father's fault that I don't exercise. He asks me to do too many other things that take up my time," would be coded as externalized negative. Antisocial behavior was defined as immature, self-centered, or obnoxious actions, and is also a composite code consisting of denial, externalized negative, and several other

negative codes. A common example would be a mother's comment to her daughter that "you really need to shape up. If you don't stop doing stupid things and take care of your body, you are going to get sick." All three of these codes exemplify behavior that it is critical, uncaring, and unresponsive to daughter's feelings.

It is possible that these maternal behaviors were perceived by daughters as a social evaluative threat as outlined by Dickerson and Kemeny (2004). As opposed to the social evaluative threat of the Trier Social Stress Test, in which participants make a spontaneous speech to a group of unsympathetic confederates, these daughters may have felt that their personal feelings and beliefs about breast cancer were negatively evaluated by their mothers. Daughters whose mothers consistently communicate in this manner may be exposed to this source of stress on an ongoing basis, including prior to the interaction. Therefore, it is possible that a chronic social evaluative stressor, in the form of negative maternal communication, was responsible for the meaningful variations in cortisol found in these daughters.

Another possibility is one of reverse causality, in that the women's stress physiology may have influenced their communication during the interaction. For instance, mothers and daughters with higher levels of ambient cortisol may experience more stress on a general level throughout their daily lives. It is possible that they participated in the study while influenced by this greater level of stress and therefore displayed more negative communication. For instance, a mother-daughter pair who fights frequently and has a chaotic living situation at home could theoretically have increased physiological stress reactivity. This pair may have been quicker to exhibit higher levels of negative behavior, such as whining/complaining and lecturing than another dyad under

less stress. Therefore, the relationship between negative maternal communication and stress reactivity could be unidirectional in either way or even bidirectional.

Another interesting finding was that an affective code for behavior, maternal sadness, related in the opposite direction as negative maternal behavioral codes to daughters' cortisol levels. That is, maternal sadness was negatively correlated with daughters' cortisol at all time points with the exception of baseline, such that higher levels of mothers' sadness were related to lower levels of daughters' cortisol during the interaction task. One possible reason for this finding is that mothers with a history of breast cancer displayed significantly higher levels of sadness than unaffected mothers. It is feasible that discussing mothers' struggle with the disease elicited an empathic response from daughters. This effect was observed on the videotapes, as many of the daughters with affected mothers attempted to comfort them when sadness was displayed during the interaction. Daughters in affected dyads were rated as showing higher levels of emotional caretaking of mothers than in unaffected dyads.

According to gender-based theories on stress, this type of interaction would elicit the production of oxytocin and not cortisol in daughters in response to their mothers' sadness. Oxytocin, often considered the "mothering" hormone due to its release during breast-feeding, has been shown to be released in women at times when social support is elicited (Taylor, 2005). According to this theory, our social interaction stress paradigm would not have activated the HPA axis (and therefore cortisol levels) but instead the hormone oxytocin and other, more gender-specific stress responses. Oxytocin levels were not measured in this study, but these data suggest that it may be important to measure hormonal correlates of empathic responses in mothers and daughters communicating

about breast cancer. Oxytocin would be an excellent candidate for this correlate, given prior findings of its release during "tend and befriend" behaviors in women (Taylor, 2005).

Aside from this gender-based theory of stress, it is also that possible that maternal sadness and related caretaking behaviors from daughters were a form of emotional expression. In the literature on emotion suppression, emotional expression is considered an adaptive form of coping, while active efforts to suppress emotion have detrimental effects on psychological outcome (Gortner, Rude, & Pennebaker, 2006; Richards & Gross, 1999). It is important to note that sadness may not be a psychological symptom or reflection of stress as in clinical depression, but instead a healthy expression of a significant emotion. Since these mothers were not clinically depressed, it is possible that sadness was perceived positively as a sign of emotional connectedness by daughters both psychologically and biologically.

Yet another consideration in interpreting daughters' biological stress reactions is daughters' own communication behaviors. Daughters' behavior codes for externalized negative and whine/complain were correlated with increased cortisol, and the codes communication and prosocial were correlated with decreased cortisol. These are consistent with an overall pattern in which positive behaviors were associated with decreased cortisol and negative behaviors with increased cortisol. It is most likely the case that several factors were associated with daughters' cortisol levels, including both maternal communication and daughters' own communication patterns.

Communication styles for mothers and daughters may be linked in a complex manner, such that there are bidirectional and individual influences on each. For example,

daughters may adapt to or emulate their mothers' mode of communicating with others. This was evidenced by the fact that several behaviors (positive mood, hostility, warmth/supportiveness, externalized negative, and avoidance) were positively correlated for mothers and daughters. Similarly, communication styles may change during the course of interaction if one member exhibits certain behaviors toward the other. Since the IFIRS coding system is a macro-coding system, the tapes were viewed in their entirety and then coded for average levels of behavioral displays across the interaction. A micro-coding system, in contrast, is used to analyze each phrase or behavior that a participant exhibits, and then the reaction of the other participant is analyzed. Therefore, behavior is coded within each behavioral sequence. A micro-coding system would allow for a more fine-tuned analysis of the process through which mothers' communication relates to daughters' stress physiology. It would have been possible using such a system to examine daughters' psychological and behavioral reactions to each comment made by mothers. Our research group opted for a macro-coding system such as the IFIRS to examine overall patterns of behaviors during an interaction and how these might relate to various outcome measures.

Given this use of a macro-coding system, our results indicate that negative maternal communication, as well as daughters' own negative communication, was associated with increases in salivary cortisol. Maternal sadness, which may have elicited an empathic response from daughters, was associated with a decrease in daughters' cortisol levels. The use of a micro-coding system could allow for a more detailed hypothesis about causal factors in these relationships.

Finally, as predicted in the fourth hypothesis, positive maternal communication was not related to daughters' stress hormone levels. This hypothesis suggests that positive communication would not elicit a biological stress response in daughters, and therefore would not be associated with any changes in stress hormone levels. Our data indicate, however, that future studies should examine the relationship between positive maternal communication and oxytocin levels in both mothers themselves and in their daughters in order to capture a biological picture of empathic responses.

Hypothesis 5: Path Analysis and Mediational Model

Regression equations demonstrated that maternal parental influence and daughters' Primary Control Coping predicted 36% of the variance in daughters' Total Problems Scale from the YSR/YASR. Additionally, maternal sadness and denial predicted 33% of the variance in daughters' average cortisol levels. These results indicate that certain types of maternal behavior accounted for a large portion of the variance in daughters' psychological and biological stress reactions.

However, since the patterns of association in the data did not meet basic requirements for testing mediation and a path model (Baron & Kenny, 1986), the fifth hypothesis could not be fully examined. Therefore, it would be overly speculative to hypothesize about the causal relationship between the variables examined in this study.

Limitations

In addition to several strengths, the current study also had several limitations that need to be addressed in future research. A major limitation of this study design was the

use of two separate 15-minute interactions. One discussion focused on a current concern or issue in the relationships between these mothers and daughters (identified by a research assistant from a questionnaire completed by the participants) and the other discussion focused on breast cancer risk. The order in which the discussions occurred was counterbalanced across dyads. This format was chosen based on prior trials by this research group using an interaction paradigm. In previous studies using this paradigm it was thought that the dyads needed a "warm-up" before discussing the difficult topic of breast cancer risk (Dausch et al., 2001). The assumption was made that dyads would engage in a manner that was more reflective of their natural conversation style about breast cancer (e.g., not influenced by the camera and artificial atmosphere) if another topic was presented first. Therefore, the physiological recovery period, clinical interviews, and questionnaires filled out after the interaction were influenced by both discussion tasks. Additionally, approximately half of the dyads engaged in the breast cancer topic having already discussed another stressful issue. This may have colored their interaction style during the breast cancer task. In fact, several of the families who had the issue task first remained visibly upset about the discussion during the breast cancer task, and occasionally revisited the topic during the second task. The opposite also occurred, in that dyads who had the breast cancer discussion first occasionally continued it during the second discussion. In future studies it may not be advisable to use the two-discussion format. From viewing the interaction tapes, it appears that mothers and daughters did not in fact need a warm-up period before discussing breast cancer.

This limitation likely had the greatest effect on interpretations concerning the daughters' stress hormone levels, which were influenced by both discussion tasks. The

majority of the questionnaires used to assess psychological stress and symptoms were completed by daughters prior to attending to attending the laboratory session, having received them in the mail about a week prior. Therefore, neither of the discussions would have influenced daughters' answers on the self-report questionnaires. The clinical interviews administered by research assistants after the physiological recovery period were not used in analyses for this manuscript. Given this limitation, it is interesting that correlations were still significant between communication about breast cancer and several of the outcome measures. These relationships may have been even stronger without the complication of the added discussion.

Another limitation was the relatively small sample size and low power to reliably detect correlations that are small in magnitude. There were many trends in the data that could not be interpreted, or correlations that lost significance after Bonferroni correction. A larger sample size would have allowed for more power to detect effects.

A third limitation is that the mothers and daughters who volunteered for this study were generally enthusiastic about breast cancer research and were self-selected to place more importance on the topic. This likely lowered the representativeness of our sample and differentiated these women from the general population. We tried to dampen this effect by recruiting at medical clinics in addition to breast cancer awareness events and support groups. This allowed access to women who may have been less motivated about the topic than women who regularly attend breast cancer awareness events. However, there was still a clear and noticeable effect of self-selection for participation. Our sample likely did not include women who are highly avoidant of the topic of breast cancer, since they would not have elected to participate in the study. It would be important for future

studies to capture this population, since it is the women who are most avoidant that may suffer the greatest health consequences (Epping-Jordan et al., 1994).

In the same vein, most of the participants reported that they had a good relationship with their daughter or mother. Our participants therefore represented mothers and daughters who had close relationships and would be willing to participate in this study together. This may not be representative of the closeness of mother-daughter relationships in the general population.

Lastly, this study design did not employ a control or comparison group or task to examine the relationship between mother-daughter communication and psychological and biological outcomes. All dyads discussed the same set of questions about breast cancer, and all participants completed the same laboratory interaction. It would have been useful to compare data from our participants to other mother-daughter pairs who engaged in a non-stressful discussion topic, and also in a non-breast cancer related stressor. This would have allowed us to analyze whether this particular topic had an effect on the dyads, and not just the participation in a stressful, laboratory-based task.

Implications for Future Research

The results from this study indicate that certain types of maternal communication about breast cancer have an association to daughters' coping style and psychological and biological reactions to stress. Five primarily negative maternal communication styles, lecture/moralize, parental influence, denial, externalized negative, and antisocial, were found to relate to increased levels of psychological symptoms and cortisol levels in adolescent and young adult daughters. Additionally, maternal sadness was found to relate

to increased intrusive thoughts about breast cancer and decreased cortisol levels in daughters.

Future research should examine the pathways through which maternal communication about breast cancer affects daughters' psychological and biological outcomes, and whether daughters' coping style plays a role in this relationship.

Additionally, although our data indicated that there is a relationship between negative maternal communication style about breast cancer and daughters' stress reactivity, a similar relationship between positive communication and increased psychological well-being in daughters was not demonstrated. Future studies should focus on the benefits of positive communication about breast cancer between mothers and daughters, instead using measures of positive outcomes (e.g., quality of life questionnaires, measures of happiness and life satisfaction). For example, one study found that communicating about one's experience with breast cancer was associated with greater posttraumatic growth, including better relationships with others and increased appreciation of life (Cordova, Cunningham, Carlson, & Andrykowski, 2001). Our tendency to focus on negative outcomes may have prevented us from demonstrating the benefits of positive maternal communication.

Lastly, our data suggest that two types of intervention studies are warranted. First, an intervention should be tested to teach mothers how to communicate about breast cancer with their adolescent and young adult daughters. This intervention should focus on decreasing negative communication styles such as lecturing, denying feelings, and self-centered behaviors towards daughters. This could result in daughters having less stress in regard to breast cancer risk and possibly in improved health outcomes for daughters in

the long-run. Second, more research should be conducted on how to increase knowledge about breast cancer in all women. This research could begin by focusing on higher risk populations, and especially in daughters of affected mothers. However, since only 25% of breast cancer patients have a relative with the disease, increased knowledge is a necessity for all women.

Common medical standards dictate that women do not need to begin screening for breast cancer until after age 40 for average risk or 30 for high risk. However, this provides younger daughters with little outlet for coping with the stressors of breast cancer risk. They are not educated about warning signs, often not taught about breast self-exam, and are not provided with a platform to discuss family history, worries about the disease, and fears for their own and their mothers' futures. Our data indicate that breast cancer is an important topic for mothers and daughters, even in families unaffected by breast cancer. As exposure to information about the disease continues to rise as a result of the media and breast cancer awareness organizations, researchers should be aware that this epidemic also affects young daughters, many of whom worry about the possibility of the disease affecting their own families.

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