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THE EFFECTS OF HUMOR ON CARDIOPULMONARY FUNCTIONING, PSYCHOLOGICAL WELL-BEING, AND HEALTH STATUS AMONG OLDER ADULTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
The Degree Doctor of Philosophy in the
Graduate School of The Ohio State University

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ABSTRACT

Previous research suggests that humor has beneficial effects on mood, health status, and pulmonary functioning among healthy adults. However, no previous studies have examined the effects of humor among individuals with chronic obstructive pulmonary disease (COPD), despite the fact that patients with COPD are at risk for impairments in emotional well-being, quality of life, pulmonary functioning, and health status. Two studies were conducted to evaluate the effect of humor among patients with COPD. Study 1 was an acute humor intervention in which participants viewed either a Humorous or Neutral video presentation. Participants were evaluated with pulmonary function tests, heart rate and blood pressure monitoring, and questionnaires assessing affect and state anxiety both before and after the video intervention. The sample included 22 participants (36% male) with a mean age of 67.8 (±8.8) years who exhibited severe airway obstruction [mean forced expiratory volume in 1 second/forced vital capacity ratio (FEV₁/FVC)=0.52(±.17)]. Results indicated that functional residual capacity increased in the Humor participants (mean change=0.9 liters, p<.05), but decreased among the Neutral participants (mean change=-0.2 liters, p<.02). In addition, Humor participants exhibited a trend toward increased residual volume. Disease severity predicted change in air trapping following the humor intervention, with increased air trapping exhibited by those
with less severe pulmonary disease. Study 2 examined the psychological and health benefits associated with a sense of humor and the use of humor as a coping style among individuals with COPD. The sample included 46 participants (41% male) with a mean age of 66.9(±9.9) who completed one comprehensive assessment of humor, depression, trait anxiety, affect, quality of life, and recent infectious illnesses. Correlational analyses revealed that a humorous coping style was associated with decreased depression ($r=-.47$, $p<.001$), diminished anxiety ($r=-.51$, $p<.001$), decreased negative affect ($r=-.32$, $p<.04$), improved positive affect ($r=.46$, $p<.01$), enhanced quality of life ($r=.57$, $p<.001$), and fewer days with an infectious illness ($r=-.34$, $p<.02$). Sense of humor was correlated with decreased anxiety ($r=-.39$, $p<.01$) and improved positive affect ($r=.35$, $p<.02$). These studies offer preliminary evidence that individuals with COPD may reap psychological and health benefits from having humorous personality attributes, particularly a humorous coping style. However, laughing aloud may cause acute decreases in pulmonary functioning by increasing the amount of trapped air in the lungs.
This effort is dedicated to my family.

Thanks for the endless love, laughter, support, and wisdom.
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Prior research indicates that exposure to humorous stimuli has been associated with improved psychological, cardiopulmonary, and immune functioning among healthy adults. Furthermore, sense of humor and use of humor as a coping strategy are positively associated with elevations in mood and immune functioning. These benefits of humor may be particularly pertinent for individuals with chronic obstructive pulmonary disease (COPD), who typically experience impairments in pulmonary, psychological, and immune functioning. This investigation consists of two studies that were conducted to determine the effects of humor exposure and a humorous personality style among older adults with COPD.

**Chronic Obstructive Pulmonary Disease**

COPD denotes a group of illnesses that affect the respiratory system. COPD is a largely irreversible disease characterized by chronic obstruction of airflow, breathing difficulties, and persistent ventilatory impairment (Cugell, 1988; Petty & Hodgkin, 1987). The clinical course of COPD is progressive in nature and may lead to significant shortness of breath, hypoxemia, oxygen dependence, and respiratory failure. Ultimately,

The typical COPD patient is 60 years old and male, although the ratio of males to females has declined over the years, possibly due to increased incidence of smoking among females (Cugell, 1988; Higgins, 1984). Cigarette smoking is a major contributing factor to COPD, as are occupational exposures, air pollution, and a genetic deficiency of alpha-1-antitrypsin (Idell & Cohen, 1987; Higgins).

Pathology of COPD

COPD is an umbrella term that incorporates emphysema and chronic bronchitis. The lungs of the COPD patient are marked by irreversible tissue damage resulting in hyperinflation of the lungs, reduced maximal expiratory flow rate, hypoxemia, and impaired diaphragmatic and chest wall functioning. Additionally, increased residual volume ("air-trapping") is observed due to premature airway closure and loss of lung elasticity (Cooper & Lefrak, 1996; Mahler et al., 1986a; Rogers, Sciurba, & Keenan, 1996).

Although emphysema and chronic bronchitis are each characterized by a specific and unique physiology, most patients with COPD exhibit symptoms of both emphysema and chronic bronchitis and thus may have received both diagnoses (Mahler et al., 1986a; Rabinowitz & Florian, 1992; Cugell, 1988). Emphysema is characterized by large air-filled spaces resulting from permanent damage to alveolar sacs and surrounding walls.
Lung alterations are caused by deterioration of lung elastin, the elastic fiber network of the lungs. The air-filled sacs and loss of elasticity lead to hyperinflation of the lungs and collapse of small airways due to a damaged supporting structure. Chronic bronchitis is characterized by hypersecretion of mucus in the respiratory tract, enlarged mucus glands, and inflammation of the airway lining (DiGiovanna, 1994; Cugell). These destructive changes result from damage to cells that line the trachea and bronchi. Bacterial growth in the airways is particularly common in chronic bronchitis and may contribute to excessive mucus production (Mahler et al.).

**Lung Functioning and the Diagnosis of COPD**

Pulmonary function tests, including lung volume and flow rate tests, are utilized to diagnose COPD and assess severity of airway obstruction. Lung volume testing provides a number of important measures of lung functioning. Total Lung Capacity (TLC) is the amount of gas contained in the lungs after maximal inspiration, indicating the maximal volume of gas that the lung can hold at a given time. However, TLC is not equivalent to the amount of gas expelled during expiration, because an amount of gas always remains in the lungs. Functional Residual Capacity (FRC) is the amount of air remaining in the lungs following a normal exhalation. FRC consists of two components - the volume of air that can be expelled when forced out of the lungs following a normal expiration (Expiratory Reserve Volume, ERV), and Residual Volume (RV), the amount of air that remains trapped in the lungs even after maximum exhalation. Therefore, there is always a measurable amount of air remaining in the lungs at any given time. Vital Capacity (VC) is the amount of gas forcibly exhaled after forced maximum inhalation (i.e., TLC less the RV). These subdivisions of lung volume are the same for all adults;
however, the volume of each subdivision will vary depending on the presence of pulmonary disease. Because the lungs of COPD patients lose elastic recoil and thus the ability to push air out of the lungs, COPD is characterized by elevations in RV, FRC, and therefore TLC (Ayers, Whipp, & Ziment, 1978). Figure 1 diagrams the capacities of the lung.

Flow rates indicate the severity of airway obstruction and are conducted via spirometry testing. COPD patients demonstrate a decreased expiratory flow rate and an increased time for expiration (Mahler et al., 1986a). Thus, one standard measure of flow rate is the forced expiratory volume in 1 second (FEV₁), which assesses the volume of air expelled from the lungs during the first second of maximum expiration. An FEV₁ of at least 80% of the predicted value (based on age, height, gender, and race) is indicative of normal pulmonary functioning, while an FEV₁ of 50% or less of the predicted value denotes severe airway obstruction (Mahler et al.). Another standard measure is the total amount of air expired, or forced vital capacity (FVC), which typically decreases as the trapped air (e.g., residual volume) increases. The FEV₁ is typically compared to the FVC and expressed as a percent, where a ratio of less than 70% indicates airflow obstruction (Mahler et al.). These two measures, FEV₁ and FVC, are assessed by measuring maximum expiration for as long as possible following maximum inspiration.

Lung functioning naturally declines with age, but the deterioration is experienced at an exponential rate in those with COPD. For example, healthy nonsmokers experience an average FEV₁ decline of 30 ml per year, while individuals with COPD experience a loss of approximately 75 to 80 ml per year (Mahler et al., 1986a, Mahler, Rosiello, & Loke, 1986b).

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Clinical Manifestations of COPD

Health Consequences. The medical consequences of COPD are vast, including an increased susceptibility to respiratory infections, routine use of medical care services, and complex medication regimens. Economic costs for COPD exceeded 30 billion dollars in 2000 (American Lung Association, 2001; Kaplan, Ries, & Atkins, 1985; Rabinowitz & Florian, 1992).

On average, individuals with COPD experience one to four acute exacerbations of the illness per year, characterized by increases in shortness of breath, cough, and/or sputum production (Cherniak, 1991). Although there is debate regarding the etiology of these acute episodes, many researchers believe that viruses and bacteria play a role (Cugell, 1988). Individuals with COPD are at increased risk of acquiring respiratory infections (Higgins, 1984; Levin & Levin, 1989). The presence of bacteria in the lower respiratory tract of non-hospitalized COPD patients is not uncommon, with one study documenting positive cultures in 25% of individuals with stable COPD and in 53% of persons with exacerbated COPD. The most commonly found bacteria were strands of the influenza and pneumonia viruses (Monso, Ruiz, Rosell, Manterola et al., 1995). Although respiratory infections are associated with increased morbidity and mortality in this population, lung functioning is not necessarily altered as a consequence (Higgins, 1984; Lowenberg, Orie, Sluiter, & de Vries, 1986).

COPD was a primary reason for over 17 million doctor visits in 1985, and over 900,000 hospital admissions in 1986 that totaled an excess of 5.5 million inpatient days (Higgins & Thom, 1989). COPD was the primary discharge diagnosis in nearly 700,000 hospital admissions and was the cause of death in more than 107,000 individuals in 1998,
a 126% increase in deaths since 1979 (American Lung Association, 2001).

Hospitalization for COPD may be an indicator of poor prognosis. In a population-based sample of COPD patients in Finland, 48% were deceased an average of 5.7 years after their first COPD-related hospitalization (Vilkman, Keistinen, Tuuponen, & Kivela, 1997). The 2,000 COPD patients included in the Finnish study had a total of more than 7,000 hospitalizations over six years, and COPD accounted for 30% of deaths, second only to coronary heart disease, while pneumonia and influenza were the third most common cause of death (Vilkman et al.). Petty (1987) conducted a 10-year follow-up of patients with COPD who had completed a pulmonary rehabilitation program. His data confirm that patients with advanced COPD typically die from pulmonary disorders. Of 143 participants followed, the cause of death was pulmonary-related in 110 individuals (77%), 105 of whom died of COPD or pneumonia.

**Physical Consequences.** Dyspnea, or shortness of breath, is typically the most prevalent and debilitating symptom of COPD, and the primary reason for which many individuals first seek medical attention (Kinsman, Yaroush, Fernandez, Dirks et al., 1983, Mahler et al., 1986a). In the early and intermediate stages of the disease, dyspnea may only be present during physical activity. However, as the disease gradually progresses, dyspnea can be triggered by atmospheric conditions, upper respiratory infections, and activities of daily living that require only minimal effort, such as bathing and dressing (Cugell, 1988; Levin & Levin, 1989).

Individuals with COPD tend to experience significant physical limitations and impairments in performance of daily activities. Significant impairments are experienced in areas of mobility, grooming, bathing, dressing, eating, sleeping, and recreational...
activities (Barstow, 1974; Leidy, 1995). McSweeny, Grant, Heaton, Adams, & Timms (1982) examined activities of daily living in COPD patients and a group of healthy older adults. Individuals with COPD reported a much higher percentage of impairment in numerous areas compared to the control participants, including areas of recreation and pastime, sleep and rest, home management, and ambulation. Employment was reported as the area of greatest impairment, although this was not significantly greater than the impairment reported by the healthy controls. On average, individuals with COPD experience between 12 and 68 days of restricted activity per year due to their condition (Higgins, 1984).

Individuals with COPD also demonstrate impairment in sexual functioning, with as many as 35% of participants reporting an inability to perform intercourse due to impotence or dyspnea (Fletcher & Martin, 1982; Rabinowitz & Florian, 1992), and others reporting reduced frequency of intercourse (Fletcher & Martin). The impairment in sexual functioning in this population is associated primarily with cardiopulmonary dysfunction and hypoxemia, rather than with psychological factors (Fletcher & Martin; McSweeny, 1988).

**Psychological Consequences.** Psychiatric symptoms and impairment in psychological functioning are frequently observed among individuals with COPD. Depression is the most commonly reported emotional consequence of the disease, reflected by a pessimistic outlook and feelings of hopelessness and worthlessness (Sandhu, 1986). In one study, 42% of participants with moderate to severe COPD reported a significant amount of depression, as indicated by a score of 15 or higher on the Beck Depression Inventory (Light, Merrill, Despars, Gordon et al., 1985). In another
study, 17 of 23 participants in a rehabilitation program for COPD were identified as having a “crippling degree of depression,” as indicated by clinical interviews (Agle, Baum, Chester, & Wendt, 1973; Agle & Baum, 1977). Reports of depression and depressive symptomatology have been documented consistently, with depression occurring in anywhere from 16% to 74% of patients with COPD (Yellowlees, 1987; Ries, Kaplan, Limberg, & Prewitt; 1995; Agle & Baum; Keele-Card, Foxall, & Barron, 1993; Isoaho, Keistinen, Laippala, & Kivela, 1995; Karajgi, Rifkin, Doddi, & Kolli, 1990). Although the rates of depression may vary across studies as a function of the measures and samples utilized, depression is a typical consequence of COPD. However, the incidence of depression may not be greater in COPD than in other chronically ill populations (Sandhu).

Anxiety is another emotional consequence of COPD, affecting as many as 96% of patients (Agle & Baum, 1977; Yellowlees, 1987; Karajgi et al., 1990). Anxiety is exhibited in accelerated speech, exaggerated movements, tachycardia, perspiration, and dyspnea (Dudley, Glaser, Jorgenson, & Logan, 1980b). In a study by Karajgi et al., clinical interviews were utilized to assess lifetime prevalence of various psychiatric disorders. Sixteen percent of the COPD patients met criteria for an anxiety disorder at some point in their lives, and 8% presented with symptoms consistent with panic disorder, indicating that the rate of panic disorder was 5.3 times higher in this COPD sample than in the general population. Furthermore, as many as 37% of COPD patients may experience at least one panic attack in their lives, as characterized by bouts of intense anxiety, physiological arousal, cognitive impairment, and an intense urge to flee the situation (Porzelius, Vest, & Nochomovits, 1992).

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The anxiety experienced by individuals with COPD has been described as a fear of dyspnea, suffocation, and death (Sandhu, 1986). When feelings of breathlessness trigger emotional arousal and anxiety, ventilatory demands on the body are increased, potentially leading to hypoxia or hypercapnia. This increased physiological arousal further exacerbates feelings of anxiety, which, in turn, lead to greater respiratory insufficiency, increased dyspnea, and eventually more severe anxiety symptoms. This dyspnea-anxiety spiral can be difficult to stop and may temporarily disable an individual with COPD (Emery & Lebowitz, 2000; Sandhu). Consequently, some COPD patients try to refrain from experiencing strong emotions, such as anger, depression, or joy, in order to avoid the associated physiological arousal and potential vicious cycle of arousal, dyspnea, and emotions (Dudley, Glaser, Jorgenson, & Logan, 1980a).

In conclusion, the pulmonary and psychological profiles of the COPD population indicate a chronically ill group of individuals who typically suffer from pulmonary, physical, psychological, and health complications. Research findings among healthy adults suggest that patients with COPD may reap particular benefit from humor, as humor has been implicated in alleviating depressed mood, reducing residual air trapped in the lungs, and improving health status.

Humor

The impact of humor on the human body has long been speculated to be positive and beneficial. In the early 1900's, Freud (1928) referred to humor as “the highest of the defense mechanisms” (p. 217), allowing individuals to detach themselves from disturbing situations and feel a sense of protection and invulnerability. He described humor and laughter as cathartic mechanisms that release pent-up frustrations and negative emotions
in a socially acceptable framework, allowing individuals to maintain psychic and emotional stability (Freud; Freud, 1905). The therapeutic and healing potential of humor has been described more recently in Norman Cousins' (1979) *Anatomy of an Illness*, a descriptive account of his recovery from a serious illness through daily doses of laughter and vitamin C. After being diagnosed with a life-threatening collagen disorder, Cousins viewed laughter-provoking films to stimulate positive emotions. Episodes of laughter were followed by hours of pain-free sleep and an eventual decline in and reversal of his inflammatory condition (Cousins). Throughout the past several decades, researchers have begun to investigate empirically the physiological, psychological, and health benefits of humor.

**Physiological Effects of Humor**

In the study of humor physiology, scientifically referred to as gelotology, researchers have documented the impact of humor on various systems of the human body. The concept of humor can be broken down into the stimulus (humor), the emotional response (mirth), and the behavioral response (smiles and laughter; Fry, 1992). Laughter and mirth, like other emotional responses, are believed to trigger activation of the sympathetic nervous system and produce predictable changes in the body (Averill, 1969; Fry, 1977; Leiber, 1986). Following a brief arousal phase characterized by increased heart rate and blood pressure, the body experiences the resolution phase in which physiological variables return to levels comparable to or below baseline functioning.

**Respiratory Effects of Laughter.** The most obvious physiological consequence of mirthful laughter occurs in the respiratory system, as laughter is predominantly a
respiratory event. During laughter, there is a marked disruption in and activation of the respiratory cycle (Fry, 1977; Averill, 1969; Lloyd, 1938). In a study examining the physiological responses to sadness and humor, Averill found that participants who underwent a brief humor induction experienced greater increases in respiratory rate and more respiratory irregularities than did participants in a sadness induction or control condition.

The respiratory nature of laughter is comprised of inspiration, expiration, and the interval pause, each of which can be modified with regard to magnitude, duration, frequency, sequence, and rhythmicity. With a multitude of possible variations and combinations of these components, the respiratory profile during laughter varies widely within and across individuals (Fry, 1977). Despite the vast number of possible respiratory profiles, investigators agree that expiration is a predominant characteristic of laughter (Fry; Lloyd, 1938; Fry, 1986). In a seminal study examining the respiratory components of laughter in nine males ranging in age from 25 to 55, Fry (1977) reported a general respiratory pattern characterized by a greater increase in expiration than inspiration.

Fry (1986; 1992; 1994) asserts that this predominance of expiration over inspiration results in greater elimination of the air that builds up over time in the lungs with normal breathing (e.g., FRC, ERV, and RV), although he has never provided empirical evidence of this. In the presence of decreased elasticity of the lungs, which increases with age, more air becomes trapped in the lungs. As this residual air remains in the lungs, its oxygen concentration decreases until it no longer contributes to the body's oxygen supply. Over time, residual air becomes built-up with carbon dioxide and water.
vapor. These metabolic waste products encourage the development of bacterial growth, increasing the potential for bronchial infections and pneumonia. Due to the expiratory nature of laughter, oxygen-depleted residual air can exit the body in exchange for air with greater oxygen concentration and less moisture. Thus, it would appear that laughter may reduce the risk of respiratory infections by eliminating a portion of residual air. Among patients with COPD, laughter would be of particular benefit due to the increased FRC and RV and elevated risk of respiratory infections exhibited within this population.

The expiratory component of laughter is also believed to aid the dislodging and extraction of trapped discharges such as mucus and phlegm. Laughter is known to alternate with coughing when there is significant phlegm in the respiratory tract. Although the act of laughter may be physically irritating to some individuals with a chronic pulmonary condition (Wooten, 1993), it has been suggested that laughter may have benefits for COPD patients. For example, Fry (1992) suggests that laughter, "by aiding ventilation and clearing mucus plugs, helps many patients with chronic respiratory conditions such as emphysema" (p. 1857). Fry (1986) reports that telling jokes to emphysema patients may instigate laughter and coughing, and ultimately clear the bronchial tract of mucus plugs.

**Cardiovascular Effects.** A pattern of elevated heart rate and blood pressure has been documented in several brief humor induction studies (Averill, 1969; Fry, 1986; Danzer, Dale, & Klions, 1990). Acceleration of the heart rate is proportional to the duration and intensity of laughter, and heart rate may be increased to a sustained 120 beats per minute during vigorous laughter (Fry, 1969; Wooten, 1993; Fry & Stoft, 1971). Diastolic and systolic blood pressures may undergo brief, sometimes large elevations
proportional to the intensity and duration of laughter. Following increases in cardiovascular activity, heart rate and blood pressure temporarily drop below pre-laughter levels (Leiber, 1986; Fry, 1986).

Cardiovascular reactivity during laughter is indicative of increased heart muscle activity. It has been suggested that cardiovascular reactivity associated with laughter is analogous to reactivity during exercise (Fry, 1994; Fry, 1986). Laughter contributes to increased circulation, resulting from increased pumping action of the heart and increased pressure into the arterial system (Fry, 1986). Although a single bout of laughter is not comparable to sustained vigorous exercise, laughter can be experienced numerous times throughout each day, and may have cumulative positive effects on cardiovascular function. However, despite increases in heart rate, ventilation, and energy expenditure during laughter, the level of peripheral oxygen saturation has not been found to change among healthy adults (Fry & Stoft, 1971). Although studies have reported a relationship of intensity and duration of laughter with cardiovascular arousal, humor induction studies have neither measured these parameters nor examined them as mechanisms of effect.

**Immune Functioning Effects.** Empirical investigations demonstrating a link between brief humor inductions and enhanced immune functioning have measured levels of secretory immunoglobulin-A (s-IgA) before and after exposure to humorous video material. The secretory component of the immune system is housed within fluids that cover the mucosal surfaces of the body and those that are at ports of entry of invading viruses into the body (i.e., saliva, nasal, and bronchial pathways). Immunoglobulin A (IgA) is the predominant class of antibody in this category. S-IgA is considered the body’s first line of defense against viral and bacterial infections, particularly those in the
upper respiratory tract (Tomasi, 1976). A meta-analysis of eight studies concluded that higher levels of s-IgA are related to a lower incidence of acute upper respiratory tract illnesses. Although the average effect size was small ($r=.25$), the relationship likely reflects the complex and multi-determined nature of illnesses (Jemmott & McClelland, 1989). This line of research has implications that are particularly relevant to individuals with COPD, who are at elevated risk of developing upper respiratory infections.

The first empirical investigation to demonstrate an association between humor and immune functioning used a brief humor induction protocol among 10 undergraduate students, ranging in age from 20 to 36 years (Dillon, Minchoff, & Baker, 1985). Participants viewed a humorous videotape and a non-humorous didactic videotape in counterbalanced order. Dillon et al. found that s-IgA levels increased subsequent to a 30-minute humorous presentation, but remained stable after viewing the 30-minute control video. Although the s-IgA enhancement was short-lived, lasting only several minutes, it demonstrated a link between humor exposure and immune functioning.

Lefcourt, Davidson-Katz, and Kueneman (1990) conducted three studies with university students in an attempt to replicate and clarify the findings reported by Dillon et al. (1985). The series of studies provided additional support for the idea that exposure to humorous stimuli enhances immune functioning. Levels of s-IgA increased above baseline following a 30-minute humorous presentation in both audiotape and videotape formats. Results of the studies further suggest that humorous personality attributes may moderate immune functioning enhancement following humor exposure. Specifically, those with a greater sense of humor (study 3) and those with greater use of humor as a coping style (study 1) exhibited greater elevations in s-IgA following the humor
presentation. However, this interaction was only evident in two of the three studies, and the personality attribute involved in the interaction varied, although sense of humor and humorous coping style were both measured in all three studies.

Humor-induced changes in s-IgA levels have been replicated in similar studies utilizing university students (Perera, Sabin, Nelson, & Lowe, 1998; Labott, Ahleman, Wolever, & Martin, 1990; McClelland & Cheriff, 1997) and school-age children (Lambert & Lambert, 1995). Mean s-IgA concentration rates and secretion rates have increased as much as 82% and 89%, respectively, following humorous exposure, while the same parameters increased only 6% and 9% following a neutral presentation (Perera et al.).

Although these studies suggest a relationship between humor and immune functioning, many did not employ adequate control measures or sound methodological procedures. Specifically, control groups were not utilized in at least three humor induction studies that reported significant results (Lefcourt et al., 1990). Additionally, no study to date has examined the role of laughter as a causal mechanism for change in levels of s-IgA. Laughter was measured in one study, although its role in predicting change in s-IgA was not reported (Labott et al., 1990).

**Musculoskeletal Effects.** The musculoskeletal effects of mirthful behaviors are experienced in numerous parts of the body. In one study, following a brief sadness induction, female undergraduates listened to either a humorous audiotape, a non-humorous audiotape, or no tape (Danzer et al., 1990). Those in the humorous condition demonstrated greater zygomatic muscle tension than those in the control conditions, indicating a greater frequency of smiling. According to researchers, the act of laughter
alone utilizes 15 facial muscles. Laughter affects several groups of muscles including those in the abdomen, diaphragm, and intercostals. During hearty laughter, muscle involvement can spread to the legs, arms, back, shoulders, and neck. Following the muscular contractions associated with laughter, the entire body experiences deep muscular relaxation, even those muscles that were not directly involved with the mirthful response. According to researchers, vigorous laughter can act as a conditioning exercise for individuals with minimal mobility, due to the involvement of numerous muscles (Fry, 1986; Fry, 1992; Leiber, 1986).

In summary, the physiological changes associated with humor and laughter affect the entire body and include central nervous system stimulation, musculoskeletal activation, and stimulation of the immune system. Fry (1994) claims that “the physiological response to perceiving and enjoying humor involves total body participation...we laugh with our whole physical being” (p. 114).

Psychological Effects of Humor Exposure

The association between humor and positive emotions has been well-documented. From personal anecdotes, such as those from Norman Cousins, to empirical investigations, humor exposure appears to increase positive mood. The typical research design in this area assesses the mood states of participants both before and after a brief humor exposure, or before and after a multi-week humor intervention.

Averill (1969) assessed psychological reactions to a humorous, sad, or neutral video presentation using adjective rating scales. Items on the rating scales consisted of two opposing adjectives on a 7-point scale, each of which were categorized under eight main orthogonal factors, including "unpleasant-pleasant" and "sad-mirthful." The mean
scores in each of the three conditions (humor, sadness, and control) were statistically different from each other on the dimension of "sad-mirthful," with those in the humor condition reporting the greatest levels of mirth (Averill).

Other researchers have examined the psychological effects of humor induction on positive and negative emotions independently, as opposed to placing them on opposite poles of the same continuum. Fifty undergraduate participants rated their feelings of happiness, sadness, anger, and distress before and after watching either a humorous or sad 35-minute film. After watching the humorous video, participants reported feeling more happy, less sad, less angry, and less distressed than they did before the film (Njus, Nitschke, & Bryant, 1996). Although there was no control group in this study, results suggest that humor exposure can alleviate depressed mood and enhance positive mood. Humor exposure also has been implicated in alleviating induced depression and anxiety. In a group of 38 female college students, depressed mood was successfully induced after exposure to 20 depressogenic slides. Subsequently, participants were randomly assigned to a condition in which they listened to a humorous audiotape, a non-humorous audiotape, or no tape. Only the humorous exposure was capable of lowering depressed mood back to baseline levels (Danzer et al., 1990). Using a similar design, White and Winzelberg (1992) asked participants to engage in a mental stressor before being randomized to humor exposure, relaxation, or a control group. Levels of anxiety decreased significantly from post-stressor to post-humor exposure.

White and Camarena (1989) did not find any psychological benefit to humor among university students who participated in a six-week laughter training program, compared to individuals randomized to relaxation training or a control group. The reason
for this lack of emotional improvement is unclear but may be based on the program content. A description of the training program described various “exercises” but did not indicate the degree to which participants experienced exposure to humorous stimuli.

The positive psychological impact of humor exposure has also been demonstrated in an elderly population. In a long-term health care facility, 13 residents participated in either a humorous or non-humorous multi-week program (Adams & McGuire, 1986). Age of the participants was not reported. The treatment consisted of one movie presentation a week, broken down across three days, for six weeks. Participants completed the Affect Balance Scale, a measure of both positive and negative emotions, at the outset and conclusion of the program. Although both of the groups experienced significant improvement in total affect over time, those in the humorous group had higher scores at the culmination of the program than those in the non-humorous group, indicating greater positive emotions. Additionally, there was a decrease in requests for pain medication made by all members of the humorous condition, but only by 50% of those in the non-humorous condition (Adams & McGuire).

A more recent study consisted of 86 residents (mean age = 80 years) from four long-term care facilities. Participants were assigned to a humorous, non-humorous, or control condition, the first two of which consisted of 12 movie presentations over 12 weeks. Those in the humor group reported a significantly greater change in positive affect compared to the change demonstrated by those in the control group. (McGuire, Boyd, & James, 1993).

In both younger and older adult populations, exposure to humorous stimuli appears to affect emotional and/or physiological functioning. However, empirical
investigations to date have not attempted to clarify whether these effects are in response to humor exposure or to the consequent laughter. In one attempt to differentiate the effects of laughter from humor exposure, Labott et al. (1990) instructed undergraduate research participants to refrain from laughing while viewing a humorous video presentation. Unfortunately, half of those participants were unable to refrain from laughter. A more effective approach would involve measuring laughter throughout the presentation to examine whether the level of laughter contributed to the observed effects.

Although researchers have not yet examined the effects of laughter independent from humor exposure, they have documented that individuals vary in the degree to which they respond to and use humor in their daily lives. Thus, humorous personality attributes may influence psychological well-being, physical health, and the impact of exposure to humorous stimuli.

**Humorous Personality Style**

Numerous studies have reported benefit to using humor as a coping strategy and to having a sense of humor. In the humor literature, a sense of humor has been defined in behavioral terms to reflect the frequency of laughter behaviors exhibited in a multitude of situations (Martin & Lefcourt, 1984). Sense of humor is typically measured by the Situational Humor Response Questionnaire (SHRQ), a self-report measure asking respondents to indicate the degree of laughter they would likely experience in 18 specific situations. Use of humor as a coping style has been measured by the Coping Humor Scale (CHS), a 7-item self-report measure. Both of these personality attributes, particularly a humorous coping style, have been associated with enhanced health status and psychological functioning in a number of research studies.
Use of Humor as a Coping Style, Sense of Humor, and Health Status. Several studies have demonstrated a relationship between humorous personality attributes and both improved immune functioning and health status among healthy young adults. In a relatively early study, Dillon et al. (1985) found that those who used humor as a coping strategy demonstrated higher levels of baseline s-IgA prior to a humor induction. The relationship between CHS scores and baseline s-IgA levels was strong, with a correlation coefficient greater than .70 in each of the different research conditions. Dillon & Totten (1989) reported a similar relationship between humor and health. Expectant mothers’ use of humor as a coping style was positively correlated with levels of s-IgA (r=.61).

McClelland & Cheriff (1997) documented an association between humorous personality attributes and baseline levels of s-IgA among university students. Other researchers, however, have failed to find an association between humor and s-IgA, even when using larger sample sizes (Lefcourt et al., 1990; Labott et al., 1990). Martin (2001) accounts for the discrepancy by pointing out that “immunity levels are likely to fluctuate considerably over time, so that levels obtained in a single assay may be too unreliable to expect significant correlations with a trait measure of humor” (p. 510).

One method of overcoming the low reliability of a single measurement of s-IgA, is to examine clinical indicators of immune functioning. Prior research studies have already established a link between s-IgA and upper respiratory infections (Jemmott & McClelland, 1989). Therefore, some researchers have examined the relationship between humorous personality attributes and risk of respiratory infections. Among 17 expectant mothers, use of humor as a coping strategy was associated with fewer upper respiratory infections at two months post-delivery in both the mothers (r=-.51) and the infants (r=-...
McClelland & Cheriff (1997) found that the association between sense of humor and respiratory infections in a university sample varied as a function of humorous personality style. Specifically, individuals who reported high levels of humor appreciation reaped greater health benefits than those who reported high levels of humor production, where the former experienced fewer and less severe colds than did those in the latter group.

Numerous other studies have examined the relationship between humorous personality attributes and physical health, when health was not limited to infectious illnesses. Carroll (1990) and Carroll and Shmidt (1992) found a significant negative association between sense of humor and health problems in studies of university students. The health inventory utilized in these studies was a 13-item measure assessing a variety of symptoms, including headaches, back pain, nausea, and colds. The measure relied on participants' subjective interpretation of health, including such questions as, "Are you always in poor health?" and "Are you repeatedly bothered by severe itching?" In a sample of 73 older adults (mean age = 69 years), humorous coping style was a significant predictor of perceived health, while age, gender, living arrangements, and socioeconomic status were not significant predictors (Simon, 1990). Simon used the Current Health Subscale to assess health, which also relies on participants' subjective perceptions of health. The measure included items such as, "I'm as healthy as anybody I know." Other researchers have failed to find a relationship between humorous personality measures and overall physical health (Anderson & Arnoult, 1989; Labott & Martin, 1990; Porterfield, 1987).
The inconsistent findings regarding humor and health are not surprising, given the various ways in which health has been defined and assessed in these studies. As a whole, the health measures utilized in these studies suffer from a number of methodological weaknesses that preclude establishing a relationship between humor and physical health. First, a number of the measures relied on subjective perception of health as opposed to objective health status. For example, Carroll (1990) and Carroll and Shmidt (1992) used a measure of whether or not the participant experiences a given symptom “often.” Additional personality characteristics may confound interpretation of results. For example, Martin (2001) notes that neuroticism and/or negative affect must be examined and statistically controlled when examining the relationship between humor and health, as they may account for much of the relationship. Unfortunately, only one study examined the role of neuroticism in the relationship between humor and health (Korotkov & Hannah, 1994) and found that a significant relationship between the two variables disappeared when neuroticism was statistically controlled.

Second, most of the measures used in these studies did not incorporate a time frame within which participants were to base their responses. This subjectivity introduces additional statistical error into the results. Third, a majority of the measures used in these studies assess numerous and varied physical symptoms. With the operationalization of physical health varying excessively across studies, the likelihood of accruing positive results dwindles. A logical first step in this line of research is to use a measure that solely assesses symptoms of an infectious illness, because humor has been associated with elevated levels of s-IgA and s-IgA has been empirically linked with decreased risk of respiratory infections and infectious illnesses.
Although preliminary investigations have documented a potential relationship between infectious illness and humorous personality attributes, particularly a humorous coping style, these associations have not been examined in a population at increased risk for respiratory infection. The present study examined the relationship between humorous personality and health status among individuals with COPD by using an objective measure that focused on symptoms of infectious illness. Furthermore, negative affect was examined to determine if neuroticism moderates such a relationship.

**Use of Humor as a Coping Style, Sense of Humor, and Psychological Functioning.** A humorous personality may also correspond with greater psychological well-being. Female university students with a humorous coping style reported fewer depressive symptoms than those who were less likely to use humor as a method of coping with stress. Although this association was not replicated in another sample of university students (Overholser, 1992), humorous personality style was a significant predictor of depressive symptoms in several other investigations (Porterfield 1987; Nezu, Nezu, & Blissett, 1988). Among non-institutionalized older adults, humorous coping style was a significant predictor of emotional functioning, accounting for 10% of the variance in scores on the Affect Balance Scale (Simon, 1990). Despite support for a main effects model, several researchers have demonstrated that sense of humor may moderate the relationship between life stress and depressed mood (Martin & Lefcourt, 1983; Lefcourt, & Davidson-Katz, 1991).

**The Current Investigation**

Among healthy individuals, exposure to humorous stimuli has been associated with elevated mood, enhanced immune functioning, and alterations in cardiopulmonary
functioning. Furthermore, the use of humor as a coping style and the ability to exhibit laughter in a variety of situations may also be associated with improved psychological functioning and health status. Although numerous studies have found beneficial effects of humor, most participants in past research studies have been healthy young adults. Preliminary studies suggest that a multi-week humor intervention may have psychological and health benefits among healthy older adults, but no investigation to date has examined the impact of humor exposure and humorous personality attributes among chronically ill older adults.

Two studies were conducted to examine psychological, cardiopulmonary, and health effects of humor exposure and a humorous personality style among persons with COPD. Individuals with COPD exhibit increased residual air volume and are at an increased risk for developing upper respiratory infections and exhibiting symptoms of depression and anxiety. The pulmonary, psychological, and health benefits of humor demonstrated among healthy adults would have important clinical value in improving quality of life among patients with COPD at low cost.

The humor exposure literature has methodological weaknesses that have led to inconsistent results across studies. The current investigation attempted to address weaknesses of past studies. First, duration and intensity of laughter was measured during the humor exposure to assess the extent to which laughter is associated with change in physiological functioning. Second, participants in the humor exposure study were given a choice of humorous material to view in order to maximize the potential benefits of humor, as the perception of humor varies across individuals. Third, a manipulation check was used to confirm that the induction was humorous. Finally, health status among
participants was assessed by employing an objective measure that focused only on infectious illnesses, as humor has been associated in previous research with immune parameters related to respiratory and infectious illnesses.

In the present investigation, Study 1 consisted of a humor induction to examine the psychological and physiological effects of humor exposure among patients with COPD. It was hypothesized that participants would experience emotional and pulmonary benefit from the humor induction, as illustrated in Figure 2. Specifically:

1. The Humor condition would be associated with increased pulmonary functioning, as reflected by a reduced amount of air trapped in the lungs following expiration (e.g., decreases in FRC, RV, and ERV). This hypothesis is consistent with Fry's assertion that laughter can decrease the amount of air trapped in the lungs and therefore improve pulmonary functioning.

2. Heart rate and blood pressure were expected to increase during the video presentation among those viewing the humorous film, reflecting central nervous system responsiveness.

3. The Humor condition would be associated with increased positive mood and decreased negative mood, as well as decreased anxiety.

4. Changes in cardiopulmonary functioning observed in the Humor condition would be a function of the amount of laughter exhibited during the video presentation, with greater duration of laughter predicting a greater increase in heart rate and blood pressure during the humor induction and a greater decrease in trapped air in the lungs following the humor induction.
Study 2 examined the relationship between humorous personality attributes (a humorous coping style and a sense of humor) with quality of life, emotional functioning, and health status among individuals with COPD. Individuals who report a greater use of humor in their lives were expected to indicate greater psychological well-being and better health, as summarized in Figure 3. Specific hypotheses were as follows:

(1) Use of humor as a coping style and a greater sense of humor were expected to be associated with increased quality of life and decreased levels of depression and anxiety.

(2) Use of humor as a coping style and a greater sense of humor were expected to be associated with fewer and less severe episodes of infectious illness during the previous four weeks.
CHAPTER 2

METHOD OF STUDY 1

The Cardiopulmonary Humor Exposure Experimental Research Study (C.H.E.E.R.S.) consisted of a brief humor induction for COPD patients, who were randomly assigned to view either a 30-minute humorous video presentation or a 30-minute neutral video presentation. Pulmonary and psychological functioning were assessed before and after the video presentation. Cardiovascular functioning was monitored before, during, and after humor exposure. The study utilized a between-groups, repeated measures design.

Participants

Participants included 22 older adults who were recruited via advertisements and flyers posted throughout the central Ohio community. Specifically, flyers were distributed at several local hospitals, pulmonary rehabilitation facilities, pharmacies, doctor's offices, and community health fairs. Participants also were recruited through informational mailings sent out by the Central Ohio Breathing Association and several local churches and assisted living facilities. A local television news station, newspaper, and radio talk show each featured a story about the research study, which served as
additional means of recruitment. Criteria for inclusion in the study included (1) a diagnosis of COPD for at least six months, and (2) no prior history of pulmonary surgery.

Participants ranged in age from 51 to 82 (mean=67.8±8.8) and were mostly female [8 males (36%), 14 females (64%)]. Seventeen (77.3%) of the 22 participants reported a diagnosis of emphysema, 9 (40.9%) reported a diagnosis of chronic bronchitis, and 7 (31.8%) reported a diagnosis of chronic asthma. Participants had their pulmonary condition for an average of 10.6(±8.8) years. Participants presented with severe airway obstruction, as indicated by a mean FEV₁% predicted of 45.6(±15.8), a mean FVC% predicted of 70.2(±21.8), and a FEV₁/FVC ratio of 0.52(±0.17). Six participants were receiving supplemental oxygen therapy on a daily basis, 5 of whom received supplemental oxygen during their participation in the study. Additional demographic information and baseline pulmonary function values of the sample are summarized in Table 1.

Procedure

C.H.E.E.R.S. was conducted in the Pulmonary Clinical Research Laboratory in the Division of Pulmonary and Critical Care Medicine located in the Dorothy M. Davis Heart and Lung Research Institute at the Ohio State University Medical Center. The laboratory was a small room equipped with a reclining armchair for the participant, a television and VCR, a mounted camcorder, and equipment for pulmonary function assessment. Participants took part in the study individually, and each was asked not to use any pulmonary inhalers for 60 minutes prior to the start of the protocol.

The order in which pulmonary functioning and mood were measured following the video presentation was expected to create confounding effects. Specifically, if
pulmonary functioning was assessed first, followed by measures of emotional functioning, responses to the latter would likely be confounded by the perceived difficulty of the pulmonary function tests. Furthermore, if the order was reversed, the acute effects of the intervention on pulmonary functioning could dissipate during the time taken to complete measures of emotional functioning. Therefore, to capture the acute effects of humor exposure on both pulmonary functioning and mood, the humor induction was divided into two brief humor exposure episodes. Specifically, the first humor exposure episode examined the acute effects of humor on mood and cardiovascular functioning; the second humor exposure episode examined the acute effects of humor on pulmonary functioning. The study therefore consisted of three phases (baseline, intervention, and recovery), which occurred in the following order: baseline, intervention-part 1, recovery_cardiac_and_mood, intervention-part 2, and recovery_pulmonary. Figure 4 summarizes the research protocol and timeline.

**Baseline.** The purpose of the baseline phase was to measure cardiopulmonary functioning, mood, oxygen saturation, and dyspnea at rest. Following consent to the investigational procedure, each participant underwent standard helium-induced lung volume and spirometry testing. Next, paper and pencil measures were completed to assess current mood and current dyspnea severity. While completing all questionnaires, heart rate and blood pressure were measured every two minutes with an automated device (Dinamap, Tampa, Florida). The blood pressure cuff was placed on the participant’s non-dominant arm. Baseline measures of heart rate and blood pressure were obtained by
calculating the mean of each parameter during the baseline phase, which lasted approximately 60 minutes. Baseline oxygen saturation was obtained via a pulse oximeter finger-cusp upon completion of the paper and pencil measures.

**Intervention-Part 1.** Each participant was randomly assigned to an intervention condition (Humor or Neutral) via a random numbers chart. The intervention consisted of a 30-minute video presentation that was shown in two 15-minute segments (intervention-part 1 and intervention-part 2). The presentation was divided into two 15-minute segments to capture the acute effects of humor exposure on cardiovascular and emotional functioning (the effects of which were measured immediately after intervention-part 1) and pulmonary functioning (measured immediately following intervention-part 2). Participants were given a choice of three videotape presentations to maximize the potential beneficial impact of the Humor condition (Rotton & Shats, 1996). Those randomized to the Humor condition chose a presentation from the following selections: The Best of Abbott and Costello Live, Bill Cosby, Himself, or America’s Funniest Home Videos. These videos had been rated appropriate and humorous, with the expected impact on mood and laughter, in pilot testing with pulmonary rehabilitation patients. Participants randomized to the Neutral condition selected an informational presentation from the following selection: Information Superhighway: Understanding and Using the Internet, Plumbing, Home Repairs, or Woodworking Projects.

Each video presentation was shown on a 19” television screen that was situated approximately 6 feet from the participant. The lights in the room were turned off during the viewing, although a lamp provided background lighting. No research personnel were present in the room during the video presentation. A camcorder was used throughout
intervention-part 1 to record participants’ behavioral responses to the video presentation. Heart rate and blood pressure were monitored every two minutes throughout intervention-part 1. The mean of each cardiovascular parameter was used as a measure of cardiovascular functioning during the intervention phase.

**Recovery**<sub>cardiac and mood</sub>. The recovery<sub>cardiac and mood</sub> phase measured changes in mood and cardiovascular functioning in response to the video presentation. Recovery measures of mood and cardiovascular functioning occurred immediately after intervention-part 1. Participants completed questionnaires assessing current mood, current dyspnea severity, self-ratings of frequency of laughter behaviors exhibited during the presentation, and a manipulation check to rate the degree to which the film was perceived as humorous. Each participant also completed information about personal demographics and health history at this time. Heart rate and blood pressure were measured every two minutes during this phase, and a mean rating for each parameter was calculated during the first 10 minutes post-viewing (recovery<sub>cardiac-1</sub>) and from 10-22 minutes post-viewing (recovery<sub>cardiac-2</sub>). The recovery<sub>cardiac</sub> phase was broken down into acute recovery (recovery<sub>cardiac-1</sub>) and delayed recovery (recovery<sub>cardiac-2</sub>) based on previous findings that changes in cardiovascular functioning following humor exposure may follow a non-linear trend, consisting of immediate increases followed by delayed decreases (Leiber, 1986; Fry, 1986). Blood oxygen saturation levels were also measured immediately following intervention-part 1 (recovery<sub>oxygen</sub>).

**Intervention-Part 2.** Each participant viewed the latter 15-minute segment of the videotape in the same room as the first segment. No research personnel were present in the room during the video presentation. A camcorder was used throughout intervention-
part 2 to record participants’ behavioral responses to the video presentation. The purpose of intervention-part 2 was to examine the effects of the humor intervention on pulmonary functioning, the assessment of which was conducted immediately following this segment of the intervention.

Recovery_{pulmonary}. The effects of humor exposure on pulmonary functioning were assessed immediately following intervention-part 2. Participants underwent a second round of spirometry and lung volume tests at this time. Following completion of the study, which lasted approximately three hours, participants received $25 and a report summarizing their cardiopulmonary functioning.

Thus, the study consisted of three phases (baseline, intervention, and recovery). Baseline measures consisted of those administered during the baseline phase of the study. Intervention measures consisted of those measurements taken during intervention-part 1 only (cardiovascular functioning) or during both intervention-part 1 and intervention-part 2 (laughter). Recovery variables consisted of those variables measured following intervention-part 1 (recovery_{cardiac and mood} and recovery_{oxygen}) as well as those measured following intervention-part 2 (recovery_{pulmonary}).

Measures

Manipulation Check

Each respondent answered a one item rating to assess the effectiveness of the humor intervention. The item read, “On a scale from 1 to 5, how funny did you find the video presentation?” Response choices range from (1) “not at all funny” to (5) “very funny.”
Self-Ratings of Laughter Behaviors

Four items asked the respondent to rate the frequency of smiling and laughter behaviors exhibited during the video presentation. Each item asks “How often did you <smile> during the video presentation?” Responses range from (1) “not at all” to (5) “continuously.” One item addressed each of the following behaviors: “smiling,” “chuckling (internal or quiet laughter),” “mild or moderate laughter,” and “uncontrollable (or hearty) laughter.” These items were based on those used by Labott et al. (1990).

Observer-Ratings of Laughter Behaviors

Two trained research assistants independently viewed the video recording of each participant to rate the frequency of smiling and laughter behaviors exhibited during the intervention phase. Recordings of each participant from intervention-part 1 and intervention-part 2 were combined into a 30-minute recording. Each research assistant completed the same four items as described in the above section. Two additional items rated the degree to which each participant coughed and used purse-lipped breathing, on a scale ranging from (1) “not at all” to (5) “continuously.” Each research assistant also recorded the number of seconds of laughter exhibited by each participant during the 30-minute intervention period, to be used as an objective measure of duration of laughter.

Pulmonary Functioning

Pulmonary function tests, including spirometry and flow volume loops, were conducted by a trained research assistant using a body plethysmograph machine (Sensor Medics Vmax Series/6200 Autobox DL). This system features a 1000 liter cabin with rapid thermal calibration and an adjustable slide-out chair. The machine was calibrated prior to each use to insure optimum quality of test results. Spirometry and lung volume
tests were conducted during the baseline and recovery phases to determine gas exchange and lung functioning. Pulmonary function measures that were assessed included FEV₁, FVC, FRC, RV, ERV, TLC, and VC. Following the American Thoracic Society (1994) guidelines, the participant repeated up to four trials of both flow volume loop and spirometry testing until scores on the two best trials were within acceptable limits of each other.

**Cardiovascular Functioning**

An automated blood pressure monitor (Dinamap, Tampa, Florida) recorded heart rate and blood pressure every two minutes during the baseline, intervention-part 1 (first 15-minute video segment), and recovery cardiac phases. The blood pressure cuff was placed on the participant's non-dominant arm, and the participant kept the arm still throughout the study. A mean rating for heart rate, diastolic blood pressure, and systolic blood pressure was calculated for each of 4 phases: baseline, intervention-part 1, recovery cardiac-1 (first 10 minutes post-viewing), and recovery cardiac-2 (10-22 minutes post-viewing).

**Dyspnea**

Dyspnea severity was assessed using the Numeric Rating Scale (NRS), which has been shown to be a valid measure of present dyspnea in a sample of patients with COPD (Gift & Narsavage, 1998). The NRS is a one-item self-report measure of current dyspnea. The directions read, "On a scale from 0 to 10, indicate how much shortness of breath you are having right now, with 0 = no shortness of breath, and 10 = shortness of breath as bad as can be." The NRS has demonstrated adequate validity, correlating highly with the Visual Analog Dyspnea Scale. It has also been shown to effectively detect change in dyspnea severity before and after ambulation. (Gift & Narsavage).
Positive and Negative Affect

Emotional state was measured via the Positive and Negative Affectivity Scales (PANAS, Watson, Clark, & Tellegen, 1988). Negative affect, or neuroticism, depicts a variety of negative moods including anxiety, sadness, guilt, hostility, and self-dissatisfaction. In contrast, positive affect, or extraversion, subsumes a number of positive mood states including joy, energy, enthusiasm, interest, and affiliation. The PANAS is a 20-item measure that assesses negative affect (PANAS-N, 10 items) and positive affect (PANAS-P, 10 items). Mood descriptors (such as “excited,” “upset,” and “inspired”) are rated on a 5-point likert scale, ranging from (1) “very slightly or not at all” to (5) “extremely,” to assess the presence of the emotional state. The instructional set for the PANAS can be varied to reflect state or trait emotions. In the present study, participants responded to the PANAS items based on how they were feeling at the present moment.

State Anxiety

Current levels of anxiety were measured with the state subscale of the State-Trait Anxiety Inventory (STAI-X1, Spielberger, 1985). The state subscale consists of 20 items assessing current feelings on a 4-point likert scale, with response options ranging from (1) "not at all" to (4) "very much." Items include statements such as “I feel upset” and “I am presently worrying over possible misfortunes.” The instruction set asks respondents to indicate how they are feeling at the present moment.

Data Analysis

The primary mode of data analysis was a 2x2 (Group x Time) repeated measures analysis of variance (ANOVA) with group assignment (Humor vs. Neutral) as the
between subjects variable and time (baseline vs. recovery) as the within subjects variable. A 2 x 2 repeated measures ANOVA was conducted for each of the following variables: pulmonary functioning (FRC, ERV, and RV), mood (PANAS-P, PANAS-N, and STAI-X1), and dyspnea. The pulmonary functioning measurements at recovery were those assessed during the recovery pulmonary phase. The mood and dyspnea measurements at recovery were those assessed during the recovery cardiac and mood phase.

To assess the effects of the humor intervention on cardiovascular functioning, analysis consisted of 2x4 (Group x Time) repeated measures ANOVA with group assignment (Humor vs. Neutral) as the between subjects variable and time (baseline, intervention-part 1, recovery cardiac-1, and recovery cardiac-2) as the within subjects variable. A 2x4 repeated measures ANOVA was conducted for each of three measures of cardiovascular functioning: heart rate, systolic blood pressure, and diastolic blood pressure.

For variables only assessed once during the study (e.g., demographic data, laughter behaviors, and manipulation check), t-tests were used to evaluate differences between the two groups.

The secondary mode of analysis included hierarchical regression analysis to evaluate the extent to which duration of laughter exhibited during the humor induction contributed to change in cardiopulmonary functioning. For the regression analyses, the dependent variable was pulmonary functioning at recovery or cardiovascular functioning during the treatment intervention.
CHAPTER 3

RESULTS OF STUDY 1

Forty-three individuals responded to recruitment efforts. However, 9 did not have a diagnosis of obstructive pulmonary disease, 6 became ill and/or were hospitalized prior to participation, 1 was unable to participate due to schedule conflicts, and 3 did not attend their scheduled appointment. Of the 24 remaining participants, one was excluded following completion of the study due to absence of obstructive pulmonary disease (FEV₁ % predicted=104, FVC % predicted=90), and another was excluded due to mechanical error in conducting pulmonary function testing. Therefore, 22 participants comprised the final sample of Study 1. The 12 participants randomized to the Humor condition did not differ from the 10 participants randomized to the Neutral condition with regard to demographic characteristics, baseline cardiopulmonary functioning, oxygen saturation, dyspnea, or mood. Tables 1-4 summarize demographic characteristics, baseline functioning, and functioning at recovery in both groups.

Video Presentation

Among the 12 Humor participants, 75% (n=9) selected to view Bill Cosby, Himself. 17% (n=2) viewed America's Funniest Home Videos, and 8% (n=1) viewed The Best of Abbott and Costello Live. Among those in the Neutral condition, 60% (n=6)
viewed Information Superhighway: Understanding and Using the Internet. 20% (n=2) viewed Plumbing, Home Repairs, and 20% (n=2) viewed Woodworking Projects. As expected, the Humor presentations were rated as funnier (mean=4.4±1.00) than the Neutral presentations (mean=1.3±.48, p<.001).

Self-Ratings of Laughter Behaviors

Self-ratings of laughter behaviors indicated that those in the Humor condition demonstrated a greater frequency of all behaviors than did those in the Neutral condition: smiling (humor=3.7±.78 vs. neutral=1.7±.48, p<.001), chuckling (humor=3.3±.87 vs. neutral=1.1±.32, p<.001), moderate laughter (humor=3.5±.90 vs. neutral=1.0±.00, p<.001), and hearty laughter (humor=2.6±1.16 vs. neutral=1.0±.00, p<.001).

Observer-Ratings of Laughter Behaviors

Observer-ratings of the number of seconds of laughter exhibited throughout the presentation demonstrated adequate reliability (r=.87), as did ratings of the 4 laughter behaviors (rs=.89-.94). Humor participants laughed an average of 195.4 (±136.6) seconds throughout the presentation, compared to an average of 1.0(±1.6) second of laughter exhibited by the Neutral participants (p<.001). Observer ratings of laughter behaviors revealed a pattern similar to the self-ratings, with laughter behaviors exhibited more frequently during the Humor video presentation than during the Neutral presentation: smiling (humor=3.6±1.03 vs. neutral=1.4±.41, p<.001), chuckling (humor =3.0±.74 vs. neutral =1.1±.21, p<.001), moderate laughter (humor =2.5±.89 vs. neutral =1.0±.00, p<.001), and hearty laughter (humor =1.9±1.19 vs. neutral =1.0±.00, p<.03). Observer ratings also indicate that those in the Humor condition exhibited greater use of pursed-lip breathing throughout the presentation compared with those in the Neutral.
condition (humor=1.7±.72 vs. neutral=1.1±.21, p<.03), and also tended to cough more frequently than did the Neutral participants, although this latter trend did not reach statistical significance (humor=10.7±17.1 vs. neutral=1.3±2.5; p<.09). Self-ratings and observer ratings of laughter behaviors were highly correlated (rs=.73-.90). Results of the laughter responses exhibited by the two groups are summarized in Table 5.

Pulmonary Functioning

Two of the 22 participants had incomplete pulmonary function data at recovery due to equipment malfunction (e.g., oxygen leak in Autobox); therefore several of the analyses reported include only 20 participants (11 Humor, 9 Neutral). Effects of the humor intervention on pulmonary functioning were analyzed utilizing 2x2 repeated measures ANOVA, with treatment condition (Humor vs. Neutral) as the between subjects factor and time (baseline and recovery) as the within subjects factor. A separate analysis was conducted for each of the following 3 dependent variables: FRC, RV, and ERV.

Functional Residual Capacity. Analyses were conducted to determine if the humor intervention affected the amount of air remaining in the lungs following a normal expiration. Consistent with the pathology of obstructive airway disease, participants exhibited elevated levels of FRC at baseline (mean=4.5±1.6 liters). Mean baseline FRC did not differ between Humor participants (mean=4.9±1.9; n=12) and Neutral participants (mean=4.4±1.9; n=10; p=ns). Repeated measures ANOVA revealed a significant Group x Time interaction for FRC [F(1,19)=6.33, p=.02]. Testing of simple effects revealed that the change in FRC across time was statistically significant for both
groups. As shown in Table 2, Humor participants displayed an average increase in FRC of 0.89(±1.32) liters following the intervention (p=.04), while Neutral participants exhibited a mean decline of 0.24(±0.24) liters (p=.02).

**Residual Volume.** A change in FRC across time suggests that participants should have experienced changes in RV and/or ERV, as FRC is the summation of these two parameters. As would be expected among COPD patients, participants exhibited substantial amounts of air trapped in the lungs, as indicated by an average baseline RV of 3.6(±1.2) liters. Mean RV at baseline was 3.9(±1.3) among Humor participants (n=11) and 3.3(±1.0) among Neutral participants (n=9; p=ns). Repeated measures ANOVA revealed a Group x Time interaction approaching statistical significance [F(1,18)=3.76, p<.07]. Although there was no significant change in RV across time for either group, there was a trend for RV to increase across time among Humor participants [mean change=0.62(±1.16) liters, p<.11]. At recovery, RV was significantly higher among Humor participants (mean=4.55±1.59) than among Neutral participants (mean=3.08±0.95; p<.03), as shown in Table 2.

**Expiratory Reserve Volume.** Humor and Neutral participants did not differ significantly with regard to ERV at baseline [Humor (n=11): mean=0.64±0.48; Neutral (n=9): mean=0.66±0.55] or recovery (Humor: mean=0.77±0.55; Neutral: mean=0.60±0.55). Neither group experienced a significant change in ERV across time. Repeated measures ANOVA revealed no significant Group x Time interaction for ERV [F(1,18)=1.84; p=ns], suggesting that the humor intervention did not affect ERV.

**Acute Changes in Pulmonary Functioning.** Because the impact of humor on pulmonary functioning has never been examined empirically, the rapidity and longevity
of any potential changes in pulmonary functioning secondary to humor are also unknown. To rule out whether changes in hypothesized pulmonary functioning parameters are immediate and/or short-lived, another set of 2x2 (Group x Time) repeated measures ANOVAs was conducted with the result from the first trial ($F_{FT}$) of pulmonary function testing at recovery (as opposed to the result calculated over a series of trials) as the dependent variable. These analyses were conducted primarily to determine whether acute changes in RV or ERV may have existed briefly in the moments immediately following the humor exposure.

The effects of humor exposure on FRC proved to be immediate, as indicated by a significant Group x Time interaction for $FRC_{FT}$ [$F(1,18)=9.84; p<.01$]. Functional residual capacity increased among Humor participants from a mean of 4.9 ($\pm$2.0) liters at baseline to a mean of 5.8 ($\pm$2.2) liters at the first trial of recovery ($p<.04$). Neutral participants measured a mean of 3.9 ($\pm$1.0) liters at baseline and a mean of 3.5 ($\pm$1.2) liters at the first trial of recovery ($p<.03$). The two groups differed in FRC at the first trial of recovery ($p=.01$).

Analyses of RV$_{FT}$ indicate a significant Group x Time interaction [$F(1,17)=5.82; p<.03$]. Humor participants exhibited a trend of increased RV across time, where RV went from an average of 4.0 ($\pm$1.4) liters at baseline to an average of 4.8 ($\pm$1.7) liters at the first trial of recovery ($p=.07$). Humor participants exhibited a greater volume of RV at the first trial of recovery compared with Neutral participants ($p=.01$).

The humor exposure did not appear to affect ERV at the first trial of recovery. Analyses indicate no significant Group x Time interaction [$F(1,18)=0.35; p=ns$].

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**Other Measures of Pulmonary Functioning.** Disease severity, as measured by FEV₁/FVC, was not affected by the humor intervention, as indicated by the absence of a significant Group x Time interaction \([F(1,20)=0.02; p=ns]\).

Changes in VC indicate that the humor intervention affected the volume of air that could be exhaled after maximum inspiration. Repeated measures ANOVA revealed a Group x Time interaction that was approaching statistical significance \([F(1,18)=3.83; p<0.07]\). Neutral participants experienced a significant change in VC across time, increasing from a mean of 2.45\((\pm 0.9)\) liters at baseline to 2.54\((\pm 0.9)\) liters at recovery (mean change=0.10\((\pm 0.13)\) liters; \(p=.04\)), as shown in Table 2. Vital capacity among Humor participants remained stable across time; the mean at baseline was 2.32\((\pm 0.8)\) liters and the mean at recovery was 2.27\((\pm 0.7)\) liters.

Repeated measures ANOVA revealed no Group x Time interaction for TLC \([F(1,18)=3.07; p=ns]\), indicating that the humor intervention did not affect the total amount of air contained in the lungs following maximum inspiration.

The humor intervention did not appear to alter FEV₁ or FEV₁% predicted, as illustrated by no significant Group x Time interactions for those variables \([F(1,20)=0.45; p=ns; F(1,20)=0.23; p=ns\), respectively\].

Analyses indicate that FVC and FVC% predicted were not influenced by the humor exposure. No significant Group x Time interaction emerged for either parameter \([F(1,20)=1.17; p=ns; F(1,20)=1.04; p=ns\), respectively\].

**Laughter as a Predictor of Change in Pulmonary Functioning**

Hierarchical regression analyses were employed to test the hypothesis that laughter predicts change in pulmonary functioning following humor exposure. Thus, the
following analyses were limited to the Humor participants. A hierarchical regression was performed for each of the pulmonary parameters hypothesized to be affected by humor exposure and laughter (FRC, RV, and ERV). For each pulmonary regression equation, the dependent variable was pulmonary functioning at recovery (FRC\textsubscript{Recovery}, RV\textsubscript{Recovery}, or ERV\textsubscript{Recovery}). Pulmonary functioning at baseline was entered as a covariate in Step 1 of each equation (FRC\textsubscript{Baseline}, RV\textsubscript{Baseline}, or ERV\textsubscript{Baseline}). Laughter was entered in Step 2 of each equation to assess impact on change in functioning. A set of analyses was performed for each of three measures of laughter. The objective measure of laughter consisted of the average of the two independent raters’ observations of the number of seconds of laughter exhibited by each participant during the 30-minute video presentation. A second set of analyses was conducted for the observer ratings of laughter behaviors exhibited throughout the presentation (i.e., the sum of the average of two independent observer ratings of the presence of chuckling, moderate laughter, and hearty laughter). A final set of analyses was conducted for self-ratings of laughter exhibited during the video presentation (i.e., the sum of participant responses to questions assessing presence of chuckling, moderate laughter, and hearty laughter). These analyses are considered preliminary, as the sample size limits the power for performing a 2-step hierarchical regression analysis.

**Seconds of laughter as a predictor of change in pulmonary functioning.** As shown in Table 6, seconds of laughter exhibited during the humor exposure did not have a direct effect in predicting change in FRC or RV following humor exposure. Laughter accounted for a non-significant 2% of the variance in FRC at recovery (t=0.82, p=ns), above and beyond the 67% of variance accounted for by baseline FRC. As shown in
Table 7, baseline RV predicted half the variance in RV at recovery ($r^2=.49, p<.02$). Laughter did not further contribute to RV at recovery ($t=0.62, r^2=.02, p=ns$). Analysis of ERV indicated that laughter predicted change in functioning over time, as shown in Table 8. Laughter accounted for an additional 12% of the variance in ERV at recovery ($t=2.36, p<.05$), above and beyond the 70% of variance accounted for by baseline ERV. The direction of the relationship between laughter and change in ERV was positive, indicating that greater frequency of laughter predicted increased air trapping.

**Observer-ratings of laughter as a predictor of change in pulmonary functioning.**

A similar pattern of findings emerges when the measure of laughter consists of observer-ratings of the presence of laughter exhibited during the humor exposure. Observer-ratings of laughter did not predict change in FRC or RV. Laughter did not contribute to FRC at recovery ($t=0.09, r^2<.00, p=ns$) above and beyond the 67% of variance accounted for by baseline FRC. Laughter did not account for additional variance in RV at recovery ($t=-0.11, r^2<.00, p=ns$) above and beyond the 49% of variance accounted for by baseline RV. As shown in Table 9, observer-ratings of laughter accounted for an additional 11% of the variance in ERV at recovery, above and beyond the 70% of variance accounted for by baseline ERV, a trend approaching statistical significance ($t=2.17, p=.06$).

**Self-ratings of laughter as a predictor of change in pulmonary functioning.** Self-ratings of laughter exhibited during the humor presentation did not predict change in FRC or RV, but were a significant predictor of change in ERV. Laughter did not contribute to the variance of FRC at recovery ($t=0.89, r^2=.03, p=ns$) above and beyond the 67% of variance accounted for by baseline FRC. Self-ratings of laughter did not account for additional variance in RV at recovery ($t=-0.07, r^2<.00, p=ns$) above and beyond the 49%
of variance accounted for by baseline RV. As shown in Table 10, self-ratings of laughter accounted for an additional 15% of the variance in ERV at recovery, above and beyond the 70% of variance accounted for by baseline ERV ($t=2.91, p<.02$).

**Disease Severity as a Predictor of Change in Pulmonary Functioning**

A post-hoc series of hierarchical regression analyses was performed to examine the extent to which disease severity predicted change in pulmonary functioning following humor induction. These analyses were performed to examine the mechanisms underlying the increased air trapping exhibited by Humor participants following humor exposure. Two sets of hierarchical regression analyses were conducted to examine whether disease severity predicted change in FRC or RV. For each regression model, pulmonary functioning at recovery was the dependent variable ($FRC_{Recovery}$ or $RV_{Recovery}$). The same pulmonary functioning parameter at baseline was entered as the independent variable in Step 1 ($FRC_{Baseline}$ or $RV_{Baseline}$). Disease severity at baseline ($FEV_1/FVC$) was entered as the independent variable in Step 2. These analyses included the Humor participants only and are considered preliminary due to the limited sample size. Results are summarized in Tables 11-12.

**FRC.** As summarized in Table 11, FRC at baseline accounted for 67% of the variance in FRC at recovery ($p<.001$). Disease severity accounted for an additional 20% of the variance in FRC at recovery ($t=3.75, p<.01$), indicating that disease severity was associated with change in FRC following humor exposure. The direction of the relationship indicates that less severe disease was associated with larger increase in FRC.

**RV.** Disease severity also was a significant predictor of RV at recovery ($t=6.84, t^2=.44, p<.001$), after statistically controlling for baseline RV ($t^2=.49, p<.001$). The
direction of this relationship indicates that greater increase in RV was associated with less severe disease. Results are summarized in Table 12.

**Cardiovascular Functioning**

One participant was unable to tolerate the dinamap blood pressure cuff and her cardiovascular data were unavailable. Therefore, analyses for heart rate and blood pressure include 21 participants (12 humor, 9 Neutral). The effects of the humor intervention on cardiovascular functioning were analyzed utilizing 2x4 repeated measures ANOVA, with treatment condition (Humor vs. Neutral) as the between subjects factor and time (baseline, intervention, recovery cardiac-1, recovery cardiac-2) as the within subjects factor. A separate set of analyses was conducted for each of the following dependent variables: heart rate, systolic blood pressure, and diastolic blood pressure.

**Heart Rate.** The Group x Time interaction for heart rate was not significant \( F(3,17)=0.88; p=ns \). The two groups did not differ from each other with regard to heart rate during baseline, intervention, recovery cardiac-1, or recovery cardiac-2.

**Blood Pressure.** There was no significant Group x Time interaction for systolic or diastolic blood pressure, indicating that the humor intervention did not have a significant impact on blood pressure [systolic: \( F(3,17)=0.68, p=ns \); diastolic: \( F(3,17)=0.89, p=ns \)]. The groups were similar with regard to blood pressure at baseline, intervention, recovery cardiac-1, and recovery cardiac-2.

**Oxygen Saturation**

Effects of the humor intervention on blood oxygen saturation levels were examined via a 2x2 repeated measures ANOVA, where treatment condition (Humor vs. Neutral) was the between subjects factor, and time (baseline vs. recovery) was the within
subjects factor. Oxygen saturation levels did not vary as a function of the humor intervention, as indicated by no significant Group x Time interaction \([F(1,20)=0.02; p=ns]\). However, on average, participants in both groups exhibited improved oxygen saturation levels following the video presentation [time main effect: \(F(1,20)=6.07; p<.02\)].

Statistical analyses for oxygen saturation were repeated excluding the 5 subjects who were using supplemental oxygen during participation, in order to minimize any confounding effects. These analyses, which included 9 Humor participants and 8 Neutral participants, revealed similar results. In a repeated measures ANOVA that examined treatment effects from baseline to recovery, no significant Group x Time interaction emerged \([F(1,15)=0.08; p=ns]\). A main effect for time emerged, indicating that blood oxygen levels increased from baseline to recovery among those breathing room air only \([F(1,15)=5.48; p<.04]\). The groups were comparable to each other at both timepoints.

**Dyspnea**

Changes in dyspnea from baseline to recovery were analyzed using a 2x2 (Group x Time) repeated measures ANOVA, with treatment condition (Humor vs. Neutral) as the between subjects factor and time (baseline and recovery) as the within subjects factor. The analysis revealed no significant Group x Time interaction, and no significant simple main effect for group or time. Dyspnea severity did not change during the course of the intervention for either group.

**Emotional Functioning**

Effects of the humor intervention on emotional functioning and mood were analyzed utilizing 2x2 repeated measures ANOVA, with treatment condition (Humor vs.
Neutral) as the between subjects factor and time (baseline and recovery) as the within subjects factor. A separate analysis was conducted for each of the following 3 dependent variables: positive affect, negative affect, and state anxiety.

### Positive and Negative Affect
Analyses revealed a Group x Time interaction for positive affect, PANAS-P, that was approaching statistical significance \([F(1,20)=4.00, p<.06]\). Because the Group x Time interaction was marginally significant, simple main effects were examined. Simple main effects revealed a trend where positive affect was maintained throughout the intervention among those in the Humor condition, but not among those in the Neutral condition. Participants in the Neutral condition exhibited a non-significant decrease in positive affect across time (mean change=-3.3±7.3; \(p=.19\)); participants in the Humor condition reported positive affect similar at baseline and recovery (mean change=1.3±3.0; \(p=ns\)). T-tests indicate that the two groups differed significantly with regard to PANAS-P scores at recovery (Humor: mean=38.7±6.7; Neutral: mean=29.6±7.1, \(p<.01\)), but not at baseline (Humor: mean=37.3±6.3; Neutral: mean=32.8±7.2, \(p=ns\)).

The repeated measures ANOVA for negative affect (PANAS-N) revealed no Group x Time interaction \([F(1,20)=0.13, p=ns]\).

### Anxiety
Participants exhibited a moderate degree of anxiety at baseline, as demonstrated by scores on the STAI-X1 (mean=27.2±7.2). The humor intervention did not affect levels of state anxiety, as reflected by the absence of a Group x Time interaction \([F(1,20)=0.03; p=ns]\).
CHAPTER 4

DISCUSSION OF STUDY 1

The present study was conducted to examine the acute emotional and cardiopulmonary effects of a brief humor induction among individuals with COPD. Humor exposure was expected to elevate mood, increase central nervous system arousal, and improve pulmonary functioning. Results of this study do not support the experimental hypotheses. The humor induction had little impact on mood and had no impact on cardiovascular functioning. Furthermore, the humor induction led to diminished pulmonary functioning, as demonstrated by increased FRC and a trend toward increased RV following humor exposure.

The sample for this study is typical of the COPD population with regard to demographic variables and pulmonary functioning, except that it was predominantly female (64%). The humorous stimuli used in the present study were successful at inducing humor, as reflected in both self-ratings and observer-ratings. Humor participants exhibited greater frequency of smiling and laughing throughout the presentation in comparison to Neutral participants.

With regard to emotional functioning, positive affect was reported higher at recovery among Humor participants than among Neutral participants. However, neither
group experienced statistical change in positive affect across time. Furthermore, the pattern of results suggests that positive affect was maintained across time among Humor participants, but decreased across time among Neutral participants. The humor induction had no impact on negative affect or anxiety.

The negative findings regarding emotional functioning are surprising given the robust associations reported in the literature between humor exposure and mood. However, the acute humor induction studies reported in the literature consist of samples comprised of healthy, young adults. Given the research design and methodology of the current study, no speculations can be made as to whether these null findings are reflective of an older age group or of a COPD population. However, long-term humor intervention studies with older adults have reported enhanced emotional functioning across time, suggesting that older adults' mood is receptive to humor exposure (Adams & McGuire, 1986, McGuire et al., 1993). Thus, it is possible that the null findings for emotional functioning that emerged in the present investigation are unique to COPD patients.

Although participants did not report increased shortness of breath following the humor exposure, breathing may have become more labored in response to laughter, as indicated by increased use of pursed-lip breathing among Humor participants and greater frequency of coughing, compared with the Neutral participants. Decreased pulmonary functioning following the humor exposure further substantiates the hypothesis that any benefit in mood resulting from humor exposure may have been diminished by the negative pulmonary changes associated with laughter. Qualitative information regarding the subjective experience of laughter was not available for these participants, but would have been useful in determining whether laughter was perceived as aversive and whether
laughter thus may have hindered emotional benefit from humor exposure. A healthy control group would be necessary to test these hypotheses and examine whether the pattern of emotional functioning found in this study is unique to older adults with COPD.

An alternative explanation is that the measures of psychological functioning used in the present study are not appropriate for capturing acute changes over a brief timespan in this sample. Previous studies documenting acute changes in mood following humor exposure have not employed the PANAS, but have relied on the Affect Balance Scale and/or non-validated questions to assess mood. Future studies should include a wider range of psychological measures to increase the likelihood that one or more are sensitive to detecting change over a brief time period.

Cardiovascular functioning did not change as a function of humor exposure in the current study. This was surprising given that prior studies have found sharp increases in cardiovascular parameters during laughter (Averill, 1969; Fry, 1986; Danzer et al., 1990). One possible explanation is that heart rate and blood pressure were not measured frequently enough to capture these acute changes in cardiovascular functioning. The present investigation measured cardiovascular parameters every two minutes. Researchers who have reported positive results in the past have measured these parameters either every minute or continuously (Averill, 1969; Danzer et al., 1990). An alternative explanation is that individuals with COPD may laugh less frequently and/or less vigorously than healthy adults in order to prevent physiological arousal, due to the potential of exacerbating COPD symptoms (Emery & Lebowitz, 2000). Research has not examined the threshold of laughter necessary to produce changes in cardiovascular functioning. Although objective and subjective indices assessing the frequency and
severity of laughter behaviors were employed in the current investigation, most past studies have not done so. Therefore, it is not possible to compare the frequency or severity of laughter among COPD patients with healthy participants from other studies. A healthy control group in the current study would have made such a comparison possible. Future investigations should monitor and report laughter behaviors regularly. Not only are these parameters important for interpreting results, but they can further elucidate mechanisms of effect when findings are significant.

The pulmonary changes that occurred in this sample suggest that exposure to humorous stimuli had negative acute effects on pulmonary functioning among individuals with COPD, as indicated by increased amounts of air trapped in the lungs following the humor induction. Specifically, the humor induction had a significant impact on FRC and RV, as demonstrated by higher levels of FRC and RV among Humor participants at recovery, in comparison to Neutral participants. Most noteworthy, FRC increased significantly by 15% among Humor participants, indicating that a greater volume of air remained in the lungs following a normal expiration subsequent to the humor induction. Among the Neutral participants, FRC significantly decreased by 5% across time. A similar trend emerged for RV, where Humor participants exhibited a 16% increase across time, a trend that was approaching statistical significance; Neutral participants exhibited a non-significant decrease of 6%. The humor induction had no impact on ERV. This pattern of results indicates that, following humor exposure, Humor participants exhibited greater volumes of air trapped in the lungs following normal and maximal expiration, in
comparison to the Neutral participants. Humor participants and Neutral participants did not differ from each other at recovery with regard to disease severity, FEV₁, FVC, VC, or TLC, nor were any differences in these parameters expected.

These findings are not consistent with Fry's (1977) assertion that residual volume decreases during laughter as a result of the predominantly expiratory nature of the behavior, which he documented in his empirical examination of respiratory alterations during laughter among healthy adults. However, findings from the current investigation are consistent with the pathology of COPD, which is characterized by increases in FRC, RV, and TLC. Elevations in these pulmonary measures reflect a loss of elastic recoil and thus hyperinflation of the lungs, both of which interfere with the ability to expel air from the lungs. Hence, at rest, individuals with COPD have greater volumes of air trapped in the lungs following expiration (FRC, RV), and can hold a greater volume of air in the lungs when full (TLC). The pathology of the disease suggests that FRC should increase following laughter, because laughter is associated with increased inspiration and expiration (Fry). Although an increased volume of air is entering the lungs during laughter, individuals with COPD will continue to have difficulty expelling the air. Therefore, it is quite possible that FRC and RV would increase following laughter as more air enters the lungs and becomes trapped. Furthermore, the amount of laughter should predict the magnitude of pulmonary change.

This is the first investigation to examine empirically laughter as a causal mechanism of the physiological changes that follow exposure to humorous stimuli. The Humor and Neutral participants did not differ from each other with regard to pulmonary, demographic, or emotional measures at baseline, indicating that the presence of laughter
is the distinguishing variable between the groups, and should thus be considered a predictor of change in pulmonary functioning among the Humor participants. However, hierarchical regression analyses did not confirm that the changes in FRC and RV exhibited among participants were a function of the amount of laughter exhibited throughout the video presentation. Two explanations may account for these null findings. One possible explanation is that presence of laughter, and not amount of laughter, is predictive of pulmonary change among individuals with obstructive disease. Individuals with COPD tend to exhibit decreased inspiratory capacity (Ayers et al., 1978). With greater hyperinflation of the lungs, which occurs with disease progression, the diaphragm flattens and loses the ability to expand and contract with ease. Because contractions of the diaphragm typically allow air to be drawn into the lungs, hyperinflation and disease severity lead to decreased inspiratory capacity (Hodder, 2001). Therefore, the amount of air inspired during laughter may vary according to disease severity. Thus, the increase of trapped air following laughter will likely depend in part on inspiratory capacity, which cannot be assumed constant among individuals with COPD. Unfortunately, inspiratory capacity was not measured in this investigation.

A second alternative is that the amount of laughter does contribute to change in pulmonary functioning, but that the small number of Humor participants in the current study limited statistical power and hindered the ability to detect a true relationship. Correlational analyses between laughter and change scores in FRC and RV did not reach statistical significance (change in FRC: $r=.26$, change in RV: $r=.21$). However, the correlation coefficients suggest that, with greater statistical power, duration of laughter would contribute to change in functioning following humor exposure. Additional
evidence that duration of laughter may play a role in predicting change in functioning is based on findings that objective and subjective ratings of laughter were each significant contributors to change in ERV following humor exposure, despite ERV not changing significantly among Humor participants across time. Measures of laughter accounted for an additional 11%-15% of the variance in ERV at recovery after statistically controlling for baseline ERV. The direction of these relationships indicates that greater amount of laughter is associated with greater increase in trapped air following humor exposure.

Because the pulmonary changes exhibited post-intervention were consistent with disease-related changes in COPD, and because duration of laughter was not found to predict changes in FRC or RV, disease severity also was thought to influence the pulmonary changes exhibited following humor exposure. After controlling for baseline levels of functioning, which accounted for 67% and 49% of the variance in FRC and RV at recovery, respectively, disease severity accounted for an additional 20% and 44% of the variance, respectively. The direction of these findings suggested that greater air trapping was associated with less severe disease. This pattern of findings supports the hypothesis that diminished inspiratory capacity associated with disease progression may limit air trapping following laughter among those with more advanced disease. These results suggest that disease severity may moderate the relationship between laughter and changes in air trapping, where duration of laughter would predict increased air trapping only among those with less severe disease and thus less impaired inspiratory capacity.

The small sample size in the current study did not allow for the examination of this hypothesis, which should be explored in future studies.
Although the changes in pulmonary functioning that emerged following humor exposure appear somewhat consistent with the pathology of COPD, there is reason to interpret the pulmonary changes that emerged in this study with caution. Numerous sources of short-term intra-individual variability during pulmonary function testing exist, including body posture, head position, patient effort, circadian rhythms, and computer and hardware technicalities [American Thoracic Society (ATS), 1991]. Although actions were taken to reduce sources of error, all pulmonary testing for this study was conducted by a trained research assistant and not by a pulmonary technician. Therefore, the pattern of pulmonary results that emerged in this study should be considered preliminary and must be interpreted with caution, until future research provides replication.

Given that sources of error for pulmonary testing are great, the ATS (1991) set parameters for the minimum percent change in pulmonary functioning required for that change to be considered practical. For individuals with COPD, within-day changes in FVC should be 11% or greater to be considered significant, and changes in FEV₁ should be at least 13% to be considered significant (ATS). Unfortunately, recommendations have not been established for other pulmonary parameters, further complicating interpretation of the pulmonary changes reported in this study. However, it appears that the humor exposure had genuine effects on pulmonary functioning among the Humor participants, whose decline in pulmonary functioning was 16% for RV and 18% for FRC. The improvements noted among Neutral participants, although statistically significant, may reflect error, as the percent of change was less than 6% for both FRC and RV.
This study offers preliminary evidence that exposure to humorous stimuli may have a negative impact on pulmonary functioning among individuals with moderate to severe COPD, as indicated by an increased volume of air trapped in the lungs between breaths. This pattern appears to be in part a function of disease severity, with air trapping increasing among those with less advanced disease. Although duration of laughter did not predict degree of change in pulmonary functioning following humor exposure, the presence of laughter is thought to be responsible for pulmonary deterioration. It is unclear whether this pattern of results is unique to humor induction or rather reflects the consequences of emotional arousal. Future investigations can address this issue by including treatment conditions that target multiple emotional states that may have a negative impact on individuals with COPD, including anger, sadness, or joy, in addition to humor. An additional limitation is that the current investigation only addresses the acute effects of humor exposure. The longevity of the pulmonary changes that may occur immediately following humor exposure is unknown, as are any potential cumulative effects of laughter or humor exposure.

A final limitation to note is the small sample size employed in the current study. Experimental hypotheses were tested utilizing a sample of 22 participants. With a limited sample size, there is a smaller probability of detecting true relationships that may exist among variables. A larger sample size would allow for greater opportunity to identify various effects of humor exposure and validate the pattern of findings that emerged in this investigation.
CHAPTER 5

METHOD OF STUDY 2

Study 2 examined whether humorous personality attributes (specifically, the use of humor as a coping style and a sense of humor) predict psychological functioning and health status among individuals with COPD. Individuals who report a greater use of humor in their lives were expected to reap psychological and physical benefits.

Participants

Participants in this study included 46 older adults with a history of COPD. They were recruited to participate via flyers circulated throughout the central Ohio community, in the same manner participants for Study 1 were recruited. In order to be eligible to participate, individuals must have been diagnosed with COPD for at least six months. Participants ranged in age from 38 to 82 (mean=66.89±9.94 years); Forty-one percent were male (n=19) and 59% female (n=27). Eighty-seven percent of the sample was Caucasian (n=40), 11% was African American (n=5), and 2% percent was Hispanic (n=1). Participants had been diagnosed with COPD for an average of 10.50(±8.42) years. Twenty-two of the participants in Study 2 also participated in Study 1. Additional demographic information is listed in Table 13.
Procedure

Participants completed numerous paper and pencil measures to assess sense of
humor, use of humor as a coping style, mood, quality of life, and demographic and health
history information. The questionnaire packet required approximately 1.5 hours to
complete. For the subset of individuals who participated in both Study 1 and Study 2,
questionnaires were completed at the Dorothy M. Davis Heart and Lung Research
Institute at the Ohio State University Medical Center during the baseline phase of Study
1. For the remaining 24 participants, the questionnaire packet was completed at home
and returned via mail. Each participant also took part in a brief structured interview
(Health Review) to determine the number of infectious illnesses experienced in the
previous four weeks. This interview was either conducted in person (for those who also
participated in Study 1) or over the telephone (for those who participated only in Study
2). Participants received $15 upon completion.

Measures

Humor as a Coping Style

The Coping Humor Scale (CHS; Martin & Lefcourt, 1983) measures the degree to
which an individual uses humor to cope with stress. Responses to statements on this 7-
item measure are made on a 4-point likert scale, with options ranging from (1) “strongly
disagree,” to (4) “strongly agree.” Two items are keyed in the negative direction. Higher
scores on the CHS are indicative of greater use of humor as a coping strategy.

The CHS demonstrates adequate internal consistency, test-retest reliability, and
concurrent validity (Martin & Lefcourt, 1983; Overholser, 1992; Martin, 1996). Martin
reviews use of the CHS and reports that internal consistency of the measure is increased
when item 4 is left out. Item 4 reads “I must admit that my life would probably be easier if I had more of a sense of humor.” Martin reports that inconsistent interpretation of the item lowers reliability, and he encourages that this item be removed. Therefore, the CHS used in the present investigation only included the remaining 6 items.

**Sense of Humor**

The Situational Humor Response Questionnaire (SHRQ; Martin & Lefcourt, 1984) is a quantitative measure of sense of humor. The SHRQ is based on a behavioral definition of sense of humor and assesses the frequency of smiles, laughter, and other mirthful behaviors in a variety of situations. The measure consists of 21 items, 18 situational items and three generalized self-report items. The former items describe a particular event or situation, followed by 5 Guttman-type response options ranging from responses such as (1) "I would not have been particularly amused" to (5) "I would have laughed heartily." An example of a situational item is as follows: "If you were shopping by yourself in a distant city and you unexpectedly saw an acquaintance, how would you have responded or how would you respond?" Directions for the situational items instruct participants to recall the occurrence of that situation and their subsequent reaction, or to imagine that situation happening. The three general self-report items ask participants to rate their overall amusement in a variety of situations, the degree to which their amusement varies from situation to situation, and the desirability of choosing friends who are easily amused. Because the situational items in the SHRQ were derived for use with university students, Martin (1996) emphasizes the importance of modifying items
according to the sample studied. The situational items used in this study were modified for relevance in a chronically ill older sample. The modified version used for this study is depicted in Table 14.

The SHRQ demonstrates adequate reliability and validity. Measures of internal consistency have ranged from .70 to .83 across samples, with a four-week test-retest reliability of .70. Internal consistency for the modified version of the SHRQ used in the current study was adequate (Cronbach’s alpha=.80). The SHRQ has been correlated with the frequency and duration of observed laughter during an interview, peer ratings of the participant’s sense of humor, and responses while performing an impromptu humor routine. The SHRQ has been positively correlated with the vigor subscale of the Profile of Moods States, but not with total mood disturbance (Martin & Lefcourt, 1984). The CHS and SHRQ are moderately correlated (rs range from .3 to .4; Martin, 1996).

**Depression**

The Center for Epidemiological Studies – Depression Scale (CESD; Radloff, 1977) is a 20-item scale assessing symptoms of depression during the previous week. Sixteen of the items are keyed in a positive direction; the remaining four are keyed in a negative direction. Items such as “I felt that everything that I did was an effort” and “I enjoyed life” are responded to on a 4-point Likert scale, where response options range from (0) “rarely or none of the time (less than 1 day)” to (3) “most or all of the time (5 to 7 days).” Higher scores on the CESD are indicative of greater depressive symptomatology. Adequate internal consistency has been demonstrated with Cronbach’s alpha reported at .87. The CESD also demonstrates adequate construct validity (Radloff; Comstock & Helsing, 1976).
Anxiety

General levels of anxiety were measured via the trait subscale of the State-Trait Anxiety Inventory (STAI-X2, Spielberger, 1985). The trait subscale consists of 20 items, for each of which the respondent indicates general ratings on a 4-point likert scale, where response options range from (1) “almost never” to (4) “almost always.”

Positive and Negative Affect

The Positive and Negative Affectivity Scales (PANAS-P and PANAS-N; Watson, et al. 1988) were used to assess current levels of emotional functioning.

Quality of Life

Quality of life was measured via the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36; Ware & Sherbourne, 1992). This inventory taps 9 health-related dimensions including physical functioning, role functioning - physical, role functioning - emotional, social functioning, bodily pain, mental health, vitality, general health perceptions, and change in health. A raw score is calculated for each of the above scales and transformed into a scale score that converts the lowest possible score to zero and the highest possible score to 100. Reliability coefficients for the scales range from .78 to .93 and psychometric validity ranges from .67 to .82 across scales. The SF-36 has been validated on medical and psychiatric patient populations (McHorney, Ware, Lu, & Sherbourne, 1994; McHorney, Ware, & Sherbourne, 1993). A higher score on each of the scales is indicative of more optimal functioning. Two composite score are computed, one for Physical Functioning and the other for Mental Health.
Health Status

Symptoms of respiratory illness were measured by a structured interview based on the Health Review (Orts, Sheridan, Robinson-Whelen, Glaser et al., 1995). This measure is administered orally, with ratings made by the clinician. The Health Review assessed illness episodes that have occurred in the previous four weeks, focusing on number of episodes, length of each episode, necessary treatment, and specific symptoms of each. A checklist of 13 symptoms is reviewed for each reported illness episode, assessing the presence of symptoms such as “swollen lymph glands in neck” and “increase in cough lasting at least 24 hours.” The Health Review was utilized for this study because of its focus on respiratory infections. The current investigation focused on the number of illness episodes experienced in the previous month (ILLNESS-E) and the number of days the symptoms persisted during the previous month (ILLNESS-D). The Health Review demonstrates appropriate psychometric properties, with interview responses significantly correlated with physician diagnoses of illness (Orts et al.).

Data Analysis

The primary mode of data analysis for Study 2 was correlational analysis. For each of the humor attributes, CHS and SHRQ, a set of correlations was conducted. Four correlations evaluated the relationship between humor and psychological functioning, as measured by: CESD, PANAS-P, PANAS-N, and STAI-X2. Additional correlational analyses were conducted to examine the degree to which humorous attributes predict quality of life, as measured by the SF-36. Correlations were run for each of the two composite scores (mental health and physical functioning). Humor attributes were also correlated with the two health status variables: ILLNESS-E and ILLNESS-D. In
addition, the humor scales were correlated with pulmonary functioning variables (FEV₁/FVC, FEV₁% predicted, FRC, RV, and ERV) to examine the relationship between humor and disease severity.

The secondary mode of analysis included hierarchical regression analysis to evaluate the degree to which humorous attributes contributed to duration of infectious illness episodes experienced in the previous 4 weeks. For the regression analyses, the dependent variable was ILLNESS-D, the covariate was ILLNESS-E, and the predictor variable was the humorous attribute (CHS or SHRQ).
CHAPTER 6

RESULTS OF STUDY 2

Humorous Personality Style

CHS. Participants’ scores on the CHS indicate that they use humor to cope with stress. Out of a possible score of 24, the mean CHS score in this sample was 19.3(±3.4). Scores on the CHS were positively associated with years of education ($r=.29; p=.05$). A trend emerged suggesting that a humorous coping style was negatively correlated with the number of years since receiving a pulmonary diagnosis ($r=-.28, p=.06$). The CHS was not associated with any other demographic variable.

SHRQ. The mean SHRQ score in this sample was 56.6(±9.2), out of a possible score of 105. Individual scores ranged from 38 to 79. Scores on the SHRQ were negatively associated with years since receiving a pulmonary diagnosis, a trend approaching statistical significance ($r=-.27; p<.07$). The SHRQ was not associated with any other demographic variable. The two measures of humorous personality style were moderately correlated with each other ($r=.36, p<.02$).
Baseline Functioning of the Sample

Psychological and Physical Functioning

Participants indicated significant psychological distress and impaired quality of life. CESD scores indicate borderline levels of depression [mean=13.4(±8.4)], with 37% of the sample (n=17) scoring in the depressed range of 16 or above. STAI scores indicate that participants experienced symptoms of anxiety in their daily lives. The mean score for STAI-X2 (trait anxiety) was 36.9(±9.9). On measures of affect, participants reported a mean score of 31.6(±7.9) for PANAS-P and 12.5(±3.8) for PANAS-N, where possible scores range from 10 to 50. Psychological functioning was positively associated with level of education (CESD: $r=-.38, p<.01$; STAI-X2: $r=-.34, p<.02$; PANAS-N: $r=-.35, p<.02$). Psychological functioning was not associated with any other demographic variables.

Scores on the SF-36 reveal significant impairment in psychological and physical functioning. The mental health composite score (mean=51.7±10.3) and the physical functioning composite score (mean=30.9±10.9) were well below scores of 100 (i.e., maximal functioning). Participants reported greatest impairment on the subscales for role-physical (mean=31.7±34.7) and global health perceptions (mean=33.4±21.4). Lesser impairment in functioning was reported on subscales for social functioning [68.5(±28.8)], bodily pain [68.5(±28.6)], and mental health [77.0(±16.8)]. Mean scores for all of the SF-36 subscales are summarized in Table 15. Quality of life was significantly associated with level of education (mental health composite score: $r=.42, p<.01$; physical functioning composite score: $r=.32, p<.03$). A trend emerged between the physical
functioning composite score and the amount of time since receiving a diagnosis of COPD ($r = -.28, p < .06$), suggesting that a longer disease course is associated with diminished quality of life in the domain of physical functioning.

According to results of the Health Review, participants experienced an average of $0.50(±0.76)$ infectious illness episodes in the previous month (ILLNESS-E), with the number of episodes ranging from 0 to 3. Symptoms of infectious illness were experienced for a mean of $5.0(±9.0)$ days during the previous 4 weeks (ILLNESS-D), with 9% of participants experiencing symptoms for all 28 days.

**Relationship Between Psychological and Physical Functioning Measures**

Correlates of psychological and physical functioning variables are summarized in Tables 16-18. Nearly all of the physical and psychological indicators of quality of life were significantly intercorrelated in the expected directions. Table 16 depicts the correlational matrix of the SF-36 subscales and composite scores.

CESD scores were strongly correlated in the positive direction with scores on the STAI-X2 ($r = .69, p < .001$) and the PANAS-N ($r = .55, p < .001$), and negatively correlated with scores on the PANAS-P ($r = -.52, p < .001$). CESD scores were also correlated with the number of infectious illnesses experienced in the past month ($r = .35, p = .02$) and the number of days the symptoms persisted ($r = .30, p < .05$). The relationship between measures of psychological functioning and health status are summarized in Table 17. As illustrated in Table 18, depression scores were significantly correlated with all the subscales of the SF-36 in the negative direction ($rs$ range from -0.30 to -0.73, $ps < .05$).

Trait anxiety was correlated with a number of measures of psychological and physical functioning, including all of the subscales of the SF-36 ($rs$ range from -0.41 to -

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.84, ps < .01), with the exception of the physical functioning subscale. STAI-X2 scores were strong correlates of affect (PANAS-P: r = -.59, p < .001; PANAS-N: r = .82, p < .001) and moderate correlates of infectious illness (ILLNESS-E: r = .35, p < .02; ILLNESS-D: r = .30, p = .05).

**Humorous Personality and Psychological Functioning**

Correlational analyses were conducted to assess the degree to which sense of humor and use of humor as a coping style were associated with psychological functioning. Measures of psychological functioning include the CESD, STAI-X2, PANAS-P, and PANAS-N. As shown in Table 19, results indicate that humorous personality attributes, particularly the use of humor as a coping style, are associated with positive well-being.

**CHS.** Scores on the CHS were associated with psychological functioning. A humorous coping style was strongly correlated with CESD (r = -.47, p < .001), STAI-X2 (r = -.51, p < .001), and PANAS-P (r = .46, p < .01), and was moderately correlated with PANAS-N (r = -.32, p < .04). The direction of these relationships indicates that greater use of humor is associated with enhanced emotional functioning.

**SHRQ.** SHRQ scores were significantly correlated with trait anxiety, accounting for 15% of the variance in STAI-X2 scores (r = -.39, p < .01). Sense of humor also accounted for 12% of the variance in PANAS-P scores (r = .35, p < .02). Results indicate that SHRQ scores did not reliably predict CESD or PANAS-N scores.
Humorous Personality and Quality of Life

Correlational analyses were conducted to examine the degree to which humorous personality attributes predict quality of life, as measured by the mental health and physical functioning composite scores of the SF-36. Results of the analyses are summarized in Table 19.

CHS. CHS was strongly associated with the mental health composite score ($r = .57, p < .001$). Correlations between CHS and the subscales that comprise the mental health composite score were conducted to further examine the relationship. Moderate positive correlations existed between CHS scores and the following subscales: mental health ($r = .59, p < .001$), role – emotional ($r = .29, p < .05$), social functioning ($r = .42, p < .01$), and vitality ($r = .38, p = .01$). A humorous coping style did not correlate with the physical functioning composite score.

SHRQ. A sense of humor was not significantly related to quality of life in this sample. SHRQ scores were marginally associated with scores on the mental health composite score ($r = .26, p < .08$), indicating that a sense of humor is related to more optimal mental health. No other trends emerged.

Humorous Personality and Health Status

Analyses were conducted to examine the relationship between sense of humor and use of humor as a coping style with indicators of physical health. Correlational analyses were used to examine the association between each humorous personality attribute, CHS and SHRQ, with each of the two health-related variables: ILLNESS-E and ILLNESS-D.

CHS. CHS was associated with ILLNESS-D ($r = -.34, p < .03$), with higher levels of CHS associated with fewer sick days. Although Martin (2001) suggests that negative
affect can present bias in symptom reporting, PANAS-N was not correlated with ILLNESS-D ($r=.25$, $p=ns$), suggesting that negative affect did not have a direct influence on symptom reporting in this sample. CHS scores were not correlated with the number of illness episodes reported.

**SHRQ.** The SHRQ was not associated with the number of infectious illness episodes experienced in the previous month or the number of days sick with symptoms of an infectious illness.

**Humor as a predictor in the length of each illness episode.** Hierarchical regression analyses were conducted to test the degree to which humorous personality attributes influence the severity of illness episodes. For each of two hierarchical equations, the dependent variable was the number of days symptoms were experienced in the previous month. In step 1 of the model, the number of illness episodes experienced was entered into the equation. The humorous personality attribute (CHS or SHRQ) was entered in Step 2. The number of illness episodes accounted for 43% of the variance in the number of days symptoms persisted ($r^2=.43$, $p<.001$). A humorous coping style accounted for an additional 5% of the variance in the number of days symptoms persisted, a trend approaching statistical significance ($p<.07$). The final model accounted for almost half of the variance in the dependent variable [$F(2,41)=18.41$, Adjusted $R^2=.45$, $p<.001$]. Sense of humor accounted for a significant portion of the variance in the number of days symptoms persisted, above and beyond that accounted for by the number of illness episodes experienced ($r^2=.07$, $p=.02$). The entire model accounted for nearly half of the variance in days sick [$F(2,41)=20.21$, Adjusted $R^2=.47$, $p<.001$].
Humorous personality and disease severity. Data on pulmonary functioning were available for 22 of the participants who had taken part in Study 1. Correlational analyses were performed to examine the relationship between each humorous personality attribute (CHS and SHRQ) with each of the following pulmonary measures: FEV1%, FEV1/FVC, FRC, RV, and ERV. Analyses revealed a trend where higher scores on the SHRQ were associated with increased levels of ERV ($r=0.35; p<0.11$), suggesting that individuals who reported laughing with greater frequency in various situations tended to expire a greater volume of air from their lungs during maximum expiration. No other trends emerged.
CHAPTER 7

DISCUSSION OF STUDY 2

The present study was conducted to examine the degree to which humorous personality attributes predict physical, psychological, and health functioning among individuals with COPD. The primary hypotheses stated that a greater sense of humor and use of humor as a coping style would be associated with lower levels of depression and anxiety, greater quality of life, and fewer infectious illnesses. Results of Study 2 support experimental hypotheses, suggesting that humorous personality attributes, particularly the use of humor as a coping style, are related to benefits in emotional well-being and health status among individuals with COPD. Table 19 summarizes the relationships between humorous personality attributes and the various indices of functioning assessed.

Participants reported significant impairments in psychological functioning and quality of life. Specifically, 37% of the sample scored in the critical range on a standard measure of depression. Mental health and physical functioning were greatly impaired, as indicated by quality of life composite scores that were well below maximal functioning. Participants experienced symptoms of an infectious illness for an average of 5.02(±9.02) days in the previous four weeks. These indicators suggest that the sample included in this investigation was representative of the COPD population, as indicated by increased levels
of depression, diminished quality of life, and increased incidence of infectious illness. However, consistent with previous literature, not all participants in this study reported psychological distress or infectious illness. Humorous personality attributes were examined to determine the degree to which they account for the variance in emotional well-being and health status.

Participants who reported greater use of humor as a coping style and a greater sense of humor also reported better psychological functioning. Use of humor to cope was associated with decreased depression, lower levels of anxiety, greater positive affect, and diminished negative affect. Sense of humor also was associated with psychological functioning in the positive direction, as indicated by moderate correlations with anxiety and positive affect.

Humorous coping style was associated with mental health indices of quality of life, but not with physical functioning. Sense of humor was generally not associated with quality of life, although a trend emerged suggesting that a greater sense of humor was associated with enhanced mental health functioning.

With regard to health status, results offer some support for the hypothesis that humorous personality attributes are associated with clinical indicators of improved immune functioning, especially recent infectious illness. Although number of infectious illnesses experienced in the previous 4 weeks was not associated with sense of humor or a humorous coping style, humorous coping style was associated with the number of days for which the symptoms persisted ($r=-.34, p=.02$). This pattern of results is consistent with the finding that s-IgA is associated with severity of infectious illness in healthy young adults, but not with the incidence (McClelland & Cheriff, 1997).
was not correlated with the number of days symptoms persisted, and thus does not appear to be a contributing factor to the observed relationship. Results from this study provide clinically-relevant data among individuals with COPD, supporting the role of humor in predicting severity of illness.

Although the emerging relationship between a humorous coping style and severity of illness is consistent with previous research, the cause of this pattern of results cannot be explained by the current study. Two hypotheses may offer insight into reasons why humor predicted severity, but not frequency, of illness episodes. First, a restricted range of the number of infectious illnesses reported may have inhibited the likelihood of detecting significant results. Participants in the study experienced an average of 0.50(±0.76) infectious illness episodes in the four weeks prior to participation, with the number of episodes experienced ranging from 0 to 3. The 4-week interval used in the current study may not have been adequate to gather a wide enough range of responses necessary for detecting a true relationship. Some researchers in the past have addressed this issue by querying participants about the number of illnesses experienced over the course of the past year (McClelland & Cheriff, 1997). A weakness with this approach is that participants' memory and symptom-reporting biases are likely to confound responses with a long time span. An alternate method would be to assess health status each month for several months. Therefore, the number of illnesses over a larger time frame could be evaluated, while symptom-reporting biases minimized. This method has not been employed in studies examining humor and health.

Alternatively, the pattern of results in this study may reflect the possibility that biology or environment have a more central role in determining the onset of an infectious
illness in the COPD population, while personality factors may affect the severity and length of illness. The data suggested that humorous coping style and sense of humor predicted illness duration, after statistically controlling for number of episodes experienced. Psychological variables (depression, anxiety, affect) did not predict illness duration. Results thus offer preliminary support for the hypothesis that a humorous personality style affects the length of an infectious illness episode.

Although these findings indicate that humor is associated with enhanced emotional functioning and health status, the CHS is more strongly associated with overall functioning than is the SHRQ. In the present study, a humorous coping style predicted decreased depression, anxiety, and negative affect, improved quality of life and positive affect, and fewer sick days in the past month. Although a sense of humor predicted some indices of emotional functioning, it failed to predict depression, negative affect, health status, and quality of life. This pattern suggests that humorous coping may be a better predictor of functioning than sense of humor among older adults with COPD.

It is possible that the SHRQ does not portray an adequate conceptualization of sense of humor, particularly among individuals with COPD. The term humor refers to the acts of perceiving, expressing, and appreciating situations that are amusing, ironic, comical, or witty. The SHRQ taps only into the expressive realm of humor, as it assesses the degree to which the respondent would express laughter in a variety of situations. Unfortunately, even within this restricted definition of humor, the instruction set of the SHRQ does not specify that the behavioral response chosen by the respondent should reflect the perception of humor in that given situation. Specifically, an individual may smile or laugh in a given situation in response to anxiety or embarrassment, as opposed to
humor. Furthermore, the quantitative expressive approach to measuring sense of humor, as taken by the SHRQ, may not be appropriate for the COPD population. Researchers indicate that individuals with COPD may refrain from and/or minimize emotional expression in order to avoid subsequent physiological changes that can exacerbate shortness of breath (Emery & Lebowitz, 2000). Thus, the degree of laughter expression exhibited in a variety of situations may not adequately reflect the level of humor perceived in a given situation among individuals with COPD. To increase the validity of a measure of sense of humor, aspects of perception and appreciation of humor must also be incorporated, both of which would likely be more accurate at depicting sense of humor in the COPD population than would be the expression of laughter behaviors.

Findings from Study 2 must be interpreted with caution as the research design utilized has numerous limitations. The statistical approach used in this study was correlational, hence the causal direction of these relationships cannot be determined. Although previous research findings based on prospective data suggest that humorous personality attributes predict improved emotional functioning and health status across time (Nezu et al., 1988; McClelland & Cheriff, 1997; Porterfield, 1987), the current study cannot confirm the direction of these relationships. In fact, the current study suggested that humorous personality characteristics may be inversely related to the number of years since receiving a diagnosis of COPD. Thus, humorous attributes may be reduced with increased length of illness. Length of disease course in this sample was not associated with depression or anxiety, suggesting that the relationship between humorous personality attributes and length of time since diagnosis is likely independent of changes
that may occur in psychological functioning following diagnosis. Future research must include longitudinal data to empirically investigate the nature of these relationships among individuals with COPD.

Findings from this study indicate that the benefits of humorous personality attributes on psychological functioning, quality of life, and health status that have been reported among healthy young adults, are also applicable to a sample of chronically ill, older adults. Identification of protective or resilient characteristics in this population are imperative, as individuals with COPD are more susceptible to experiencing diminished emotional well-being, physical functioning, and health status. Findings from this investigation re-affirm the importance of personality factors in the emotional and physical health of individuals with COPD. Although preliminary data suggest that humorous attributes are lower in those who have had the disease longer, this finding also may suggest that humorous attributes are malleable and can change across time. Because disease severity is not malleable, the ultimate goal in this line of research is to determine ways in which to enhance or maintain a humorous personality style, with the hopes of increasing emotional functioning, quality of life, and health status among individuals with COPD.
CHAPTER 8

CONCLUSION

The current investigation was the first to examine the effects of humor on cardiopulmonary functioning, psychological well-being, and health status among a chronically ill, older adult sample. Findings suggest that humorous personality attributes, particularly a humorous coping style, are associated with enhanced psychological functioning and health status. The findings are promising for the COPD population, who are at increased risk for depression, diminished quality of life, and infectious illness. Although the course of COPD is progressive and irreversible in nature, a humorous personality style may offer protection and resilience from the negative psychosocial and health sequelae of the disease. Brief assessment of humorous personality attributes may prove to be an inexpensive and quick method of identifying pulmonary patients potentially at risk for emotional distress, so that appropriate intervention can be provided. Future research should address the direction of the relationship between humorous personality attributes and functioning among this population by examining prospective longitudinal data. Identification of techniques that can maintain or increase humorous personality attributes may be a positive supplement to the standard pulmonary care.
Despite the positive association of humorous personality attributes and overall functioning, laughter may have negative effects for individuals with COPD, as it leads to increased air trapped in the lungs. Although the sample employed in this study was small, results offer preliminary evidence that the presence of laughter may deteriorate pulmonary functioning by leading to acute increases in FRC. These results offer support for clinical anecdotes suggesting that laughter can be an irritant for individuals with COPD. Future research should examine the pulmonary effects of other emotional states that may also lead to acute changes in pulmonary functioning among this population. Future investigations should examine whether duration of laughter is a predictor of change in pulmonary functioning among those with less severe disease and thus less diminished inspiratory capacity.

The pattern of findings from these two studies re-emphasizes the notion that humor is multi-faceted, involving perception, appreciation, and behavioral expression. Measurement of only one such aspect of humor cannot begin to evaluate the relationship between humor and psychosocial, emotional, and health functioning among a particular population. As illustrated by the present findings, different facets of humor may vary in importance among chronically ill adults, particularly those with pulmonary deterioration. While overt expression of humor may not be beneficial for individuals with COPD, results indicate that an integration of humorous personality attributes into daily living can be beneficial. Thus, future research and assessment instruments should incorporate the measurement of various aspects of humor so that the associated benefits can be identified and elaborated.

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LIST OF REFERENCES


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and reliability across diverse patient groups. Medical Care, 32, 40-66.


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APPENDIX OF FIGURES
Note.
ERV = expiratory reserve volume
IRV = inspiratory reserve volume
FRC = functional residual capacity
RV = residual volume
TLC = total lung capacity
TV = tidal volume
VC = vital capacity

Figure 1. Lung Volumes
Figure 2. Hypotheses for Study 1
Figure 3. Hypotheses for Study 2
Figure 3

Note.
CHS = Coping Humor Scale
SHRQ = Situational Humor Response Questionnaire
CES-D = Center for Epidemiological Studies – Depression Scale
PANAS = Positive and Negative Affectivity Scales, P=positive, N=negative
STAI-X2 = State-Trait Anxiety Inventory, trait scale
SF-36 = Medical Outcomes Study, 36-Item Short-Form Health Survey
**Research Protocol and Timeline:**

<table>
<thead>
<tr>
<th>Baseline</th>
<th>Intervention: Part 1</th>
<th>Recoveryocardiac and mood</th>
<th>Intervention: Part 2</th>
<th>Recoverypulmonary</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Consent form</td>
<td>• The first 15 minutes of the video presentation is viewed</td>
<td>• Recoveryocardiac-1</td>
<td>• The second 15 minutes of the video presentation is viewed</td>
<td>• Pulmonary function testing</td>
</tr>
<tr>
<td>• Pulmonary function testing</td>
<td>• Cardiovascular functioning monitored throughout</td>
<td>• 0-10 minutes post-video</td>
<td>• Participant videotaped to assess laughter</td>
<td>• Payment made to participant</td>
</tr>
<tr>
<td>• Cardiovascular functioning monitored (&gt; 30 minutes)</td>
<td>• Participant videotaped to assess laughter</td>
<td>• Recoveryocardiac-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Questionnaires:</td>
<td></td>
<td>• 10-22 minutes post-video</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Positive and negative affect</td>
<td></td>
<td>• Heart rate and blood pressure monitored</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o State anxiety</td>
<td></td>
<td>• Oxygen saturation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Dyspnea</td>
<td></td>
<td>• Recoveryaffect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Oxygen saturation</td>
<td></td>
<td>• Positive and negative affect</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• State anxiety</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other questionnaires:</td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td>• Dyspnea</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Laughter behaviors</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Demographics</td>
<td></td>
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**Phases of the Study:**

<table>
<thead>
<tr>
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<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>All measures assessed during baseline</td>
<td>• Cardiovascular functioning assessed during intervention-part 1</td>
<td>• Cardiovascular functioning and mood assessed during recoveryocardiac and mood</td>
</tr>
<tr>
<td></td>
<td>• Laughter assessed during intervention-part 1 and intervention-part 2 combined</td>
<td>• Pulmonary functioning assessed during recoverypulmonary</td>
</tr>
</tbody>
</table>

**Figure 4.** Timeline and Research Protocol for Study 1
APPENDIX OF TABLES
<table>
<thead>
<tr>
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<th>Humor (N=12)</th>
<th>Neutral (N=10)</th>
</tr>
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<tr>
<td></td>
<td>N</td>
<td>%</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>4</td>
<td>33</td>
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<tr>
<td>Female</td>
<td>8</td>
<td>67</td>
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<td><strong>Race</strong></td>
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</tr>
<tr>
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<td>17</td>
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<tr>
<td><strong>Marital Status</strong></td>
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</tr>
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<td>10</td>
<td>83</td>
</tr>
<tr>
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<td>0</td>
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<tr>
<td>Unemployed on disability</td>
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<td>0</td>
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<td>$15,000-$29,999</td>
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<td>$30,000-$44,999</td>
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<td>$45,000-$59,999</td>
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<td>17</td>
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<tr>
<td>$60,000 or greater</td>
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<table>
<thead>
<tr>
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<th>M</th>
<th>SD</th>
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</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>68.8</td>
<td>8.1</td>
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<tr>
<td><strong>Years of Education</strong></td>
<td>14.7</td>
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<tr>
<td><strong>Years since Diagnosis</strong></td>
<td>8.5</td>
<td>7.3</td>
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</tr>
</tbody>
</table>

**Note.**

* M = Mean
* SD = Standard Deviation

**Table 1: Demographic Characteristics of Participants in Study 1**
<table>
<thead>
<tr>
<th>Measure</th>
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<th>NEUTRAL</th>
<th>NEUTRAL</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Baseline</td>
<td>Recovery</td>
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<tr>
<td>FEV₆%</td>
<td>12</td>
<td>42.4</td>
<td>40.6</td>
</tr>
<tr>
<td>M</td>
<td></td>
<td>17.2</td>
<td>16.4</td>
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<tr>
<td>SD</td>
<td></td>
<td>64.8</td>
<td>63.0</td>
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<tr>
<td>FVC%</td>
<td>12</td>
<td>19.3</td>
<td>20.1</td>
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<td>M</td>
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<td>SD</td>
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<td>FEV₁/FVC</td>
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<td>5.8*</td>
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<td>RV</td>
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<td>SD</td>
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<td>TLC</td>
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<td>1.6</td>
<td>1.8</td>
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<td>VC</td>
<td>10</td>
<td>2.32</td>
<td>2.27</td>
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<tr>
<td>M</td>
<td></td>
<td>0.8</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Note.  
M = mean  
SD = standard deviation  
FEV₆% = forced expiratory volume in 1 second, reported as a percentage of the predicted value  
FVC% = forced vital capacity, reported as a percentage of the predicted value  
FEV₁ = forced expiratory volume in 1 second  
FVC = forced vital capacity  
FRC = functional residual capacity  
RV = residual volume  
ERV = expiratory reserve volume  
TLC = total lung capacity  
VC = vital capacity  

*=p<.05, the p-values indicate within-group comparisons across time

Table 2: Pulmonary Functioning at Baseline and Recovery in Study 1

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<table>
<thead>
<tr>
<th>Measure</th>
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<th>Rec\textsubscript{cardiac-1}</th>
<th>Rec\textsubscript{cardiac-2}</th>
<th>N</th>
<th>Baseline</th>
<th>Intervention</th>
<th>Rec\textsubscript{cardiac-1}</th>
<th>Rec\textsubscript{cardiac-2}</th>
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<tr>
<td>HR</td>
<td>12</td>
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<td></td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
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<td>76.8</td>
<td>75.9</td>
<td>76.3</td>
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<tr>
<td>SD</td>
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<td>13.8</td>
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<td>9</td>
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<td></td>
<td></td>
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<tr>
<td>M</td>
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<td>133.8</td>
<td>130.8</td>
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<tr>
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<td>76.7</td>
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<td>12.7</td>
<td>13.2</td>
<td>10.2</td>
<td>10.2</td>
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<tr>
<td>O\textsuperscript{2} SAT</td>
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<td></td>
<td></td>
<td></td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td></td>
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<td>94.4</td>
<td>94.0</td>
<td>94.3</td>
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<td>1.8</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Note.
Rec\textsubscript{baseline-1} = Recovery\textsubscript{baseline-1} phase
Rec\textsubscript{baseline-2} = Recovery\textsubscript{baseline-2} phase
M = mean
SD = standard deviation
HR = heart rate
BP-S = systolic blood pressure
BP-D = diastolic blood pressure
O\textsuperscript{2} SAT = oxygen saturation levels

Table 3: Cardiac Functioning at Baseline, Intervention, Recovery\textsubscript{cardiac-1}, and Recovery\textsubscript{cardiac-2} in Study 1
<table>
<thead>
<tr>
<th>Measure</th>
<th>N</th>
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<th>Recovery</th>
<th>N</th>
<th>Baseline</th>
<th>Recovery</th>
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<td>2.1</td>
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<td>3.3</td>
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</table>

Note.
M = mean
SD = standard deviation
PANAS = Positive and Negative Affectivity Scales, P=positive, N=negative
STAI-X1 = State-Trait Anxiety Inventory, state scale
NRS = Numeric Rating Scale for dyspnea

Table 4: Psychological Functioning and Dyspnea at Baseline and Recovery in Study 1
<table>
<thead>
<tr>
<th>Measure</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>M</td>
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<tr>
<td>Manipulation Check</td>
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<td><strong>Self-ratings of laughter behaviors</strong></td>
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<tr>
<td>Smiling</td>
<td>12</td>
<td>3.7</td>
</tr>
<tr>
<td>Chuckling</td>
<td>12</td>
<td>3.3</td>
</tr>
<tr>
<td>Moderate laughter</td>
<td>12</td>
<td>3.5</td>
</tr>
<tr>
<td>Hearty laughter</td>
<td>12</td>
<td>2.6</td>
</tr>
<tr>
<td><strong>Observer-ratings of laughter behaviors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smiling</td>
<td>12</td>
<td>3.6</td>
</tr>
<tr>
<td>Chuckling</td>
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<td>2.5</td>
</tr>
<tr>
<td>Hearty laughter</td>
<td>12</td>
<td>1.9</td>
</tr>
<tr>
<td>Purse-lipped breathing</td>
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<td>1.7</td>
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<td>Coughing</td>
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<td>10.7</td>
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<tr>
<td><strong>Seconds of Laughter Exhibited</strong></td>
<td>12</td>
<td>195.42</td>
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Note.
M = mean
SD = standard deviation

+ = p < .10  * = p < .05  ** = p < .001, the p-values indicate between-group comparisons.

Table 5: Laughter Behaviors in Study 1

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Variables entered: FRC at baseline, seconds of laughter

**Final Model**

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable entered</th>
<th>β</th>
<th>F</th>
<th>p-value</th>
<th>$R^2$</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>FRC at baseline</td>
<td>1.010</td>
<td>19.98</td>
<td>.002</td>
<td>.67</td>
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<td>2</td>
<td>Laughter</td>
<td>.003</td>
<td>0.67</td>
<td>.43</td>
<td>.69</td>
</tr>
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</table>

Adjusted $R^2 = .62$

**Note.**
FRC = functional residual capacity
Laughter = the number of seconds of laughter exhibited while viewing the 30-minute video presentation, as calculated by the average of 2 independent raters' observations

**Table 6: Seconds of Laughter as a Predictor of FRC at Recovery**
Variables entered: RV at baseline, seconds of laughter

Final Model

1. RV at baseline \( \beta = .837, F = 8.01, p = .02, R^2 = .49 \)
2. Laughter \( \beta = .002, F = 0.38, p = .55, R^2 = .51 \)

Adjusted \( R^2 = .39 \)

Note.
RV = residual volume
Laughter = the number of seconds of laughter exhibited while viewing the 30-minute video presentation, as calculated by the average of 2 independent raters' observations

Table 7: Seconds of Laughter as a Predictor of RV at Recovery
Variables entered: ERV at baseline, seconds of laughter

**Final Model**

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable entered</th>
<th>$\beta$</th>
<th>$F$</th>
<th>p-value</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ERV at baseline</td>
<td>1.013</td>
<td>34.57</td>
<td>.001</td>
<td>.70</td>
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<tr>
<td>2</td>
<td>Laughter</td>
<td>.001</td>
<td>5.57</td>
<td>.05</td>
<td>.82</td>
</tr>
</tbody>
</table>

Adjusted $R^2 = .79$

**Note.**
ERV = expiratory reserve volume
Laughter = the number of seconds of laughter exhibited while viewing the 30-minute video presentation, as calculated by the average of 2 independent raters' observations

**Table 8: Seconds of Laughter as a Predictor of ERV at Recovery**
<table>
<thead>
<tr>
<th>Step</th>
<th>Variable entered</th>
<th>$\beta$</th>
<th>$F$</th>
<th>p-value</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>ERV at baseline</td>
<td>1.00</td>
<td>31.92</td>
<td>.001</td>
<td>.70</td>
</tr>
<tr>
<td>2</td>
<td>Laughter</td>
<td>0.08</td>
<td>4.71</td>
<td>.06</td>
<td>.81</td>
</tr>
</tbody>
</table>

Adjusted $R^2 = .76$

**Note.**  
ERV = expiratory reserve volume  
Laughter = the sum of the average of two independent raters’ observations of the presence of chuckling, moderate laughter, and hearty laughter

**Table 9: Observer-Ratings of Laughter as a Predictor of ERV at Recovery**
Step | Variable entered | $\beta$ | F | p-value | $R^2$
--- | --- | --- | --- | --- | ---
Variables entered: ERV at baseline, self-ratings of laughter

**Final Model**

1. ERV at baseline | .96 | 38.56 | .001 | .70
2. Laughter | 0.08 | 8.47 | .02 | .85

Adjusted $R^2 = .82$

*Note.*
ERV = expiratory reserve volume
Laughter = the sum of the participant’s rating of the presence of chuckling, moderate laughter, and hearty laughter

**Table 10: Self-Ratings of Laughter as a Predictor of ERV at Recovery**
Step  | Variable entered  | β    | F      | p-value | R²   
---    |------------------|------|--------|---------|------

Variables entered: FRC at baseline, FEV₁/FVC

**Final Model**

1. FRC at baseline  | 1.67 | 51.70  | .001   | .67  
2. FEV₁/FVC        | 8.32 | 14.06  | .01    | .87  

Adjusted $R² = .84$

**Note.**

FRC = functional residual capacity
FEV₁/FVC = ratio of forced expiratory volume in 1 second and forced vital capacity

**Table 11: Disease Severity as a Predictor of FRC at Recovery**
Variables entered: RV at baseline, FEV₁/FVC

Final Model

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable entered</th>
<th>β</th>
<th>F</th>
<th>p-value</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>.001</td>
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<td>2</td>
<td>FEV₁/FVC</td>
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<td>46.79</td>
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<td>.93</td>
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</table>

Adjusted $R^2 = .91$

**Note.**
RV = residual volume
FEV₁/FVC = ratio of forced expiratory volume in 1 second and forced vital capacity

Table 12: **Disease Severity as a Predictor of RV at Recovery**
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<th></th>
<th>N</th>
<th>%</th>
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<td>Gender</td>
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<tr>
<td>Female</td>
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<td>Race</td>
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<td>Hispanic</td>
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<td>2</td>
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<td>7</td>
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<tr>
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<td>56</td>
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<td>20</td>
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<tr>
<td>Widowed</td>
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<td>18</td>
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<tr>
<td>Work Status</td>
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<td></td>
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<tr>
<td>Employed</td>
<td>5</td>
<td>11</td>
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<tr>
<td>Retired</td>
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<td>65</td>
</tr>
<tr>
<td>Unemployed</td>
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<td>7</td>
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<tr>
<td>Unemployed on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>disability</td>
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<td>9</td>
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<tr>
<td>Homemaker</td>
<td>4</td>
<td>9</td>
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<td>Family Income</td>
<td></td>
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<tr>
<td>&lt; $15,000 a year</td>
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<td>30</td>
</tr>
<tr>
<td>$15,000-$29,999</td>
<td>11</td>
<td>25</td>
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<td>$30,000-$44,999</td>
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<td>16</td>
</tr>
<tr>
<td>$45,000-$59,999</td>
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<td>16</td>
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<tr>
<td>$60,000 or greater</td>
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<td>13</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
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</thead>
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<td>Age</td>
<td>66.9</td>
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<tr>
<td>Years of Education</td>
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<tr>
<td>Years since Diagnosis</td>
<td>10.5</td>
<td>8.4</td>
</tr>
</tbody>
</table>

Note.
M = Mean
SD = Standard Deviation

Table 13: Demographic Characteristics of Participants in Study 2 (N=46)
Humor and laughter mean different things to different people. Each of us has conceptions of what kind of situations are funny, notions of the appropriateness of humor in various situations, and a sense of the importance of humor in our lives. In this questionnaire, you will find descriptions of a number of situations in which you may have found yourself from time to time. For each question, please take a moment to recall a time when you were actually in such a situation. If you cannot remember such an experience, try to imagine yourself in such a situation, filling in the details in ways that reflect your own experience. Then choose the item that best describes the way you have responded or would respond in such a situation. There are no right or wrong answers.

1. If you were at a doctor’s appointment in a neighboring town and you unexpectedly saw an old acquaintance, how have you responded or how would you respond?
   1. I would probably not have bothered to speak to the person.
   2. I would have talked to the person but wouldn’t have shown much humor.
   3. I would have found something to smile about in talking with him or her.
   4. I would have found something to laugh about with the person.
   5. I would have laughed heartily with the person.

2. If you were awakened from a deep sleep by the ringing of the telephone, and it was an old friend who was just passing through town and had decided to call and say hello...
   1. I wouldn’t have been particularly amused.
   2. I would have felt somewhat amused but would not have laughed.
   3. I would have been able to laugh at something funny my friend said.
   4. I would have been able to laugh and say something funny to my friend.
   5. I would have laughed heartily with my friends.

3. You had accidentally hurt yourself and had to spend a few days in bed. During that time in bed, how would you have responded?
   1. I would not have found anything particularly amusing.
   2. I would have smiled occasionally.
   3. I would have smiled a lot and laughed from time to time.
   4. I would have found quite a lot to laugh about.
   5. I would have laughed heartily much of the time.

4. When you have been engaged in some physical activity and you and your friends find yourselves to be completely exhausted...
   1. I wouldn’t have found it particularly amusing.
   2. I would have been amused, but wouldn’t have shown it outwardly.
   3. I would have smiled.
   4. I would have laughed.
   5. I would have laughed heartily.

(Continued)

Table 14: Modified Version of the SHRO Used in Study 2

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Table 14 (Continued)

5. If you arrived at a social gathering and found that someone else was wearing a piece of clothing identical to yours...
   1. I wouldn't have found it particularly amusing.
   2. I would have been amused, but wouldn't have shown it outwardly.
   3. I would have smiled.
   4. I would have laughed.
   5. I would have laughed heartily.

6. If a friend gave you a puzzle to solve and you found, much to your friend's surprise, that you were able to solve it very quickly...
   1. I wouldn't have found it particularly amusing.
   2. I would have been amused, but wouldn't have shown it outwardly.
   3. I would have smiled.
   4. I would have laughed.
   5. I would have laughed heartily.

7. On days when you've had no responsibilities or plans, and you've decided to do something you really enjoy with your friends or family, to what extent would you have responded with humor during that day?
   1. The activity would not have involved much smiling or laughter.
   2. I would have been smiling from time to time, but not really laughed aloud.
   3. I would have smiled frequently and laughed from time to time.
   4. I would have laughed aloud quite frequently.
   5. I would have laughed heartily much of the time.

8. You were traveling in your car during the winter and suddenly the car spun around on an ice patch and came to rest facing the wrong direction. You were relieved that no one was hurt and that there was no damage done to the car...
   1. I wouldn't have found it particularly amusing.
   2. I would have been amused, but wouldn't have shown it outwardly.
   3. I would have smiled.
   4. I would have laughed.
   5. I would have laughed heartily.

9. If you were watching a movie or television program with some friends or family and you found one scene particularly funny, but no one else appeared to find it humorous, how would you have most likely reacted?
   1. I would have concluded that I misunderstood or that it really wasn't funny.
   2. I would have "smiled to myself," but wouldn't have shown visible amusement.
   3. I would have smiled visibly.
   4. I would have laughed aloud.
   5. I would have laughed heartily.

(Continued)
Table 14

10. If you were having a romantic evening alone with someone you cared about...
   1. I would have tended to be quite serious in my conversation.
   2. I'd have smile occasionally, but wouldn't have laughed aloud much.
   3. I'd have smiled frequently and laughed aloud from time to time.
   4. I'd have laughed aloud quite frequently.
   5. I'd have laughed heartily much of the time.

11. If you unexpectedly performed poorly on an exercise test and later that evening you were telling a family member about it...
   1. I would not have been amused.
   2. I would have been amused, but wouldn't have shown it outwardly.
   3. I would have been able to smile.
   4. I would have been able to laugh.
   5. I would have laughed heartily.

12. You thought you recognized a friend in a crowded restaurant. You attracted the person's attention and walked over to him or her, but when you got there you discovered you made a mistake and the person was a total stranger...
   1. I wouldn't have found it particularly amusing.
   2. I would have been amused, but wouldn't have shown it outwardly.
   3. I would have smiled.
   4. I would have laughed.
   5. I would have laughed heartily.

13. If you were eating in a restaurant with some friends or family and the waiter accidentally spilled a drink of water on someone you were eating with...
   1. I wouldn't have found it particularly amusing.
   2. I would have been amused, but wouldn't have shown it outwardly.
   3. I would have smiled.
   4. I would have laughed.
   5. I would have laughed heartily.

14. If you were crossing a street at a crosswalk and an impatient driver, who had to stop for you, honked the horn...
   1. I wouldn't have found it particularly amusing.
   2. I would have been amused, but wouldn't have shown it outwardly.
   3. I would have smiled.
   4. I would have laughed.
   5. I would have laughed heartily.

15. If there had been an electrical outage while at the doctor's office and you spent several hours waiting for them to sort out the problem...
   1. I wouldn't have found it particularly amusing.
   2. I would have been amused, but wouldn't have shown it.
   3. I would have smiled a lot.
   4. I would have laughed a lot.
   5. I would have laughed heartily.

(Continued)
Table 14

16. If an employer announced that only a handful of workers would be receiving a holiday bonus this year, and then announced that you were one of the select few to receive the bonus...
   1. I wouldn't have found it particularly amusing.
   2. I would have been amused, but wouldn't have shown it outwardly.
   3. I would have smiled.
   4. I would have laughed.
   5. I would have laughed heartily.

17. In the distant past, if a girlfriend or boyfriend decided to break up with you because she or he had found someone else, and a few days later you were telling a good friend about it...
   1. I wouldn't have found any humor in the situation.
   2. I would have been amused, but wouldn't have shown it outwardly.
   3. I would have been able to smile.
   4. I would have been able to laugh.
   5. I would have laughed quite a lot.

18. If you unexpectedly received a very good test result from a doctor and later that evening you were telling someone about it...
   1. I would not have been particularly amused.
   2. I would have been amused, but wouldn't have shown it.
   3. I would have smiled.
   4. I would have laughed.
   5. I would have laughed heartily.

19. In choosing your friends, how desirable do you feel it is for them to be easily amused and able to laugh in a wide variety of situations?
   1. It is the most important characteristic I look for in a friend.
   2. Very desirable, but not the most important characteristic.
   3. Quite desirable.
   4. Neither desirable nor undesirable.
   5. Not very desirable.

20. How would you rate yourself in terms of your likelihood of being amused and of laughing in a wide variety of situations?
   1. It is my most outstanding characteristic.
   2. Above average.
   3. About average.
   4. Less than average.
   5. Very little.

(Continued)
Table 14

21. How much do you vary from one situation to another on the extent to which you laugh or otherwise respond with humor (i.e., how much does it depend on who you are with, where you are, how you feel, etc.)?

1. Not at all.
2. Not very much.
3. To some extent.
4. Quite a lot.
5. Very much so.

Note.
SHRQ = Situational Humor Response Questionnaire
<table>
<thead>
<tr>
<th>Measure</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHS*</td>
<td>19.3</td>
<td>3.4</td>
</tr>
<tr>
<td>SHRQ*</td>
<td>56.6</td>
<td>9.2</td>
</tr>
<tr>
<td>CES-D</td>
<td>13.4</td>
<td>8.4</td>
</tr>
<tr>
<td>STAI-X2</td>
<td>36.9</td>
<td>9.9</td>
</tr>
<tr>
<td>PANAS-P*</td>
<td>31.6</td>
<td>7.9</td>
</tr>
<tr>
<td>PANAS-N</td>
<td>12.5</td>
<td>3.8</td>
</tr>
<tr>
<td>SF-36 Composite Scores</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mental Health Composite Score*</td>
<td>51.7</td>
<td>10.3</td>
</tr>
<tr>
<td>Physical Functioning Composite Score*</td>
<td>30.9</td>
<td>10.9</td>
</tr>
<tr>
<td>SF-36 subscales, transformed scores</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bodily Pain*</td>
<td>68.5</td>
<td>28.5</td>
</tr>
<tr>
<td>Global Health Perceptions*</td>
<td>33.4</td>
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<td>Mental Health*</td>
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<td>16.7</td>
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<td>Physical Functioning*</td>
<td>36.2</td>
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<td>Role Functioning – Emotional*</td>
<td>61.6</td>
<td>40.3</td>
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<td>Role Functioning – Physical*</td>
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<td>Vitality*</td>
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<td>0.76</td>
</tr>
<tr>
<td>ILLNESS-D</td>
<td>5.0</td>
<td>9.0</td>
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</tbody>
</table>

**Note.**

M = Mean  
SD = Standard Deviation  
CHS = Coping Humor Scale  
SHRQ = Situational Humor Response Questionnaire  
CES-D = Center for Epidemiological Studies – Depression Scale

(Continued)
Table 15 (Continued)

PANAS = Positive and Negative Affectivity Scales, P=positive, N=negative
STAI-X2 = State-Trait Anxiety Inventory, trait scale
SF-36 = Medical Outcomes Study, 36-Item Short Form Health Survey
ILLNESS-E = Number of infectious illnesses experienced in the previous 4 weeks
ILLNESS-D = Number of days sick with an infectious illness in the previous 4 weeks

* = higher scores on these measures indicate more optimal functioning
<table>
<thead>
<tr>
<th></th>
<th>BP</th>
<th>GHP</th>
<th>MH</th>
<th>PF</th>
<th>RE</th>
<th>RP</th>
<th>SF</th>
<th>V</th>
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<th>PCS</th>
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<tbody>
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<td>---</td>
<td>.42**</td>
<td>.52***</td>
<td>.27+</td>
<td>.40**</td>
<td>.44**</td>
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<td>.36*</td>
<td>.39**</td>
<td>.55***</td>
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<td>.07</td>
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<td>.55***</td>
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<td>.81***</td>
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<td>.60***</td>
<td>.37*</td>
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<tr>
<td>V</td>
<td>---</td>
<td>.39*</td>
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<tr>
<td>MCS</td>
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</tr>
<tr>
<td>PCS</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
SF-36 = Medical Outcomes Study, 36-Item Short Form Health Survey
BP = Bodily pain subscale of the SF-36
GHP = Global health perceptions subscale of the SF-36

(Table 16: Correlational Matrix of SF-36 Subscales and Composite Scores in Study 2 (N=46))
<table>
<thead>
<tr>
<th>Table 16</th>
</tr>
</thead>
<tbody>
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<td>MH = Mental health subscale of the SF-36</td>
</tr>
<tr>
<td>PF = Physical functioning subscale of the SF-36</td>
</tr>
<tr>
<td>RE = Role functioning - emotional subscale of the SF-36</td>
</tr>
<tr>
<td>RP = Role functioning - physical subscale of the SF-36</td>
</tr>
<tr>
<td>SF = Social functioning subscale of the SF-36</td>
</tr>
<tr>
<td>V = Vitality subscale of the SF-36</td>
</tr>
<tr>
<td>MCS = Mental health composite score of the SF-36</td>
</tr>
<tr>
<td>PCS = Physical functioning composite score of the SF-36</td>
</tr>
</tbody>
</table>

+ = p<.07  * = p<.05  ** = p<.01  *** = p<.001

(Continued)
<table>
<thead>
<tr>
<th></th>
<th>CHS</th>
<th>SHRQ</th>
<th>CESD</th>
<th>STAI-X2</th>
<th>PANAS-P</th>
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<th>ILL-D</th>
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<tr>
<td>CHS</td>
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</table>

Note:
CHS = Coping Humor Scale
SHRQ = Situational Humor Response Questionnaire
CES-D = Center for Epidemiological Studies Depression Scale
PANAS = Positive and Negative Affectivity Scales, P = positive, N = negative
STAI-X2 = State-Trait Anxiety Inventory, trait scale

Table 17: Correlational Matrix of Psychological Function Measures and Illness History in Study 2 (N=46)
Table 17 (Continued)

| H1.NSS-S | number of infectious illnesses experienced in the previous 4 weeks |
| H1.NESS-D | number of days sick with an infectious illness in the previous 4 weeks |

+ = p<.08  * = p<.05  ** = p<.01  *** = p<.001
<table>
<thead>
<tr>
<th></th>
<th>BP</th>
<th>GHP</th>
<th>MH</th>
<th>PF</th>
<th>RE</th>
<th>RP</th>
<th>SF</th>
<th>V</th>
<th>MCS</th>
<th>PCS</th>
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<td>-.22</td>
<td>-.31*</td>
<td>-.24</td>
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<td>-.30*</td>
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</tbody>
</table>

Note: CHIS = Coping Humor Scale

Table 18: Correlational Analyses of Quality of Life, Psychological Functioning, and Illness History in Study 2 (N=46)
Table 18

SHRQ = Situational Humor Response Questionnaire
CES-D = Center for Epidemiological Studies - Depression Scale
STAI-X2 = State-Trait Anxiety Inventory, trait scale
PANAS = Positive and Negative Affectivity Scales, P=positive, N=negative
ILLNESS-E = number of infectious illnesses experienced in the previous 4 weeks
ILLNESS-D = number of days sick with an infectious illness in the previous 4 weeks
SF-36 = Medical Outcomes Study, 36-Item Short Form Health Survey
BP = bodily pain subscale of the SF-36
GHP = global health perceptions subscale of the SF-36
MH = mental health subscale of the SF-36
PF = physical functioning subscale of the SF-36
RE = role functioning - emotional subscale of the SF-36
RP = role functioning - physical subscale of the SF-36
SF = social functioning subscale of the SF-36
V = vitality subscale of the SF-36
MCS = mental health composite score of the SF-36
PCS = physical functioning composite score of the SF-36

* = p < .05  ** = p < .01  *** = p < .001
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<thead>
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<th>CHS</th>
<th>SHRO</th>
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<td>SF</td>
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<td>V</td>
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<td><strong>Physical Health</strong></td>
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<td>-.34*</td>
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</tbody>
</table>

**Note.**
CHS = Coping Humor Scale
SHRQ = Situational Humor Response Questionnaire
CES-D = Center for Epidemiological Studies – Depression Scale
STAI-X2 = State-Trait Anxiety Inventory, trait scale
PANAS = Positive and Negative Affectivity Scales, P=positive, N=negative
SF-36 = Medical Outcomes Study, 36-Item Short Form Health Survey
MH = mental health subscale of the SF-36, reported as transformed scores
RE = role functioning - emotional subscale of the SF-36, reported as transformed scores

(Continued)
Table 19 (Continued)

| SF = social functioning subscale of the SF-36, reported as transformed scores |
| V = vitality subscale of the SF-36, reported as transformed scores |
| ILLNESS-E = number of infectious illnesses experienced in the previous 4 weeks |
| ILLNESS-D = number of days sick with an infectious illness in the previous 4 weeks |

+ = $p < .10$  *= $p < .05$  ** = $p < .01$  *** = $p < .001$