Hard-hearted doctors: the incremental validity of explicit and implicit-based methods in predicting cardiovascular disease in physicians

Nicholas John Katko

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A Dissertation

entitled

Hard-Hearted Doctors: The Incremental Validity of Explicit and Implicit-Based Methods in Predicting Cardiovascular Disease in Physicians

by

Nicholas John Katko

Submitted to the Graduate Faculty as partial fulfillment of the requirements for the

Doctor of Philosophy Degree in Psychology

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December 2010
An Abstract of

Hard-Hearted Doctors: The Incremental Validity of Explicit and Implicit-Based Methods in Predicting Cardiovascular Disease in Physicians

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The search for a coronary-prone personality profile is a popular and widely investigated topic. Regarding the constellation of personality characteristics and symptom behaviors, hostility is perhaps the most frequently studied construct. Most scientific investigations have assessed hostility through self-report methodology, requiring respondents to be consciously aware of their private internal states and/or behavioral expressions of hostility. This study attempted to assess the utility of using an integrative model of personality (Winter, John, Stewart, Klohn, & Duncan, 1998) for assessing both implicit and explicit hostility-related constructs to predict both premature cardiovascular disease (CVD) and premature coronary heart disease (CHD) using data from the Johns Hopkins Precursors Study. This dataset consists of medical students attending Johns Hopkins University from years 1948 to 1964 who have been studied annually as part of an ongoing prospective study of health and illness. Previously, a small, but positive relationship was found between self-reported hostility from the ‘Habits of Nervous Tension’ scale (HNT) and CVD within the Precursor sample (Chang, Ford, Meoni, Wang, & Klag, 2002). Using individually-administered baseline Rorschach
data (N= 415), it was believed that persons identifying hostile imagery in inkblots would also show similar patterns of pathogenic response that lead to early cardiovascular morbidity; that is, a positive relationship between Rorschach hostility and premature CVD and CHD would be found. By combining self-reported hostility-related measures and Rorschach hostility-related constructs according to an integrative model of personality, the measurement distortions inherent to each method may be reduced. Consequently, this should increase validity for predicting premature CVD and CHD. Empirical tests of the integrative model of personality revealed that explicit and implicit components of hostility interacted in the prediction of morbidity. In particular, the interaction pattern of high levels of explicit and high levels of implicit hostility significantly predicted the cumulative incidence of premature CVD. When adjusting for the effects of the baseline covariates, this interaction remained significant. Holding the effects of the covariates constant also produced a significant interaction for premature CHD. Explicit hostility and implicit hostility were not independent predictors of other CVD risk factors and relevant criterions assessed across the follow-up. The integrative model of hostility on the whole demonstrates potential value to areas of health psychology and preventive medicine.
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List of Abbreviations

A1…………… Primary Aggression
A2…………… Secondary Aggression
AG…………… Aggressive Movement
AgC………… Aggressive Content
AgC%-C…… Percentage of Aggressive Content centered
AgPast……… Aggressive Past
AgPast%-C…… Percentage Aggressive Past centered
AgPot……… Aggressive Potential
b……………… Regression coefficient
BMI………… Body Mass Index
CHD……… Coronary Heart Disease
Cl…………… Confidence Interval
CS…………… Comprehensive System
CVD………… Cardiovascular Disease
d………….. Cohen’s measure of effect size
DBP………… Diastolic Blood Pressure
df…………… Degree of freedom
F…………… Fisher’s F ratio
g…………… Hedge’s measure of effect size
H…………… Strong Hostility
HNT………… Habits of Nervous Tension
ICC………… Intraclass Correlation Coefficient
K…………… Number of Studies
M…………… Mean
MI…………… Myocardial Infarction
mm Hg…….. Unit of pressure
MOR………… Morbid
n……………. Number in a subsample
N……………. Total number in a sample
p……………. Probability
PCA……….. Principal Components Analysis
r…………… Pearson product-moment correlation
r b…………… Biserial Correlation
R………….. Multiple correlation; number of Rorschach responses
R^2………… Multiple correlation squared; measure of strength of relationship
SBP……… Systolic Blood Pressure
SD…………… Standard deviation
SE…………… Standard error (of measurement)
SES………… Socioeconomic Status
SM…………… Sado-Masochism
TABP……… Type A Behavior Pattern
Chapter 1

Introduction

Statement of the Problem

For nearly a century, epidemiological data have depicted an interesting trend in public health regarding the leading causes of mortality and morbidity in Western society. Non-communicable diseases such as cardiovascular disease (CVD), chronic obstructive pulmonary diseases, diabetes, and cancer have supplanted communicable diseases, such as small pox, tuberculosis, and polio, as inflicting the greatest number of disease-related deaths (Vollrath, 2006). It is worth mentioning that psychosocial factors have been identified in all causes of death, including unintentional injuries. The most promising associations however, are between non-communicable diseases whose onset is gradual, and psychosocial factors that are stably consistent over time, such as personality. Other psychosocial factors linked to physical health include social economic status (SES), occupational stress, and health compromising behaviors, such as smoking or alcohol abuse. Thus, understanding psychosocial factors is important since they are related to mortality and morbidity.

Health Psychology

Advances in medicine, physiology, and psychology have ushered in a new way of thinking about health and illness. Deemed the Biopsychosocial Model, this conceptualization broadly views health and illness as the cross-product of several different scientific phenomena. This includes the disciplines of genetics, biology, psychology (e.g., lifestyle, personality, stress, health attitudes), and social conditions (e.g., culture, social support). Clinical health psychologists are unique from other clinical
psychologists in that the former extend the study of human behavior by examining how biopsychosocial factors interact to influence health and illness. To the extent that these biopsychosocial factors negatively impact health and are amenable to change, they represent vital, relevant, and potentially accessible targets of study and intervention, thereby expanding the consumer-base of psychological research and practice. Such reasoning exemplifies the study of health psychology, whose purpose is to identify, understand, and minimize psychological risk factors of health.

Personality and health. By nature, the study of health psychology is a multidisciplinary enterprise that may involve investigators from several health-related disciplines and subdisciplines (Contrada & Guyl, 2001). Often this enterprise is symbiotic in nature. For instance, nosology, the branch of medicine that deals with the classification of diseases, has been aided by work in health psychology. Exploratory and theoretical research investigating assorted relationships between personality and mortality and/or morbidity have resulted in sophisticated models of disease. In these models, biological, psychological, and behavioral pathways to disease are outlined, and supported by data. In this way, one tenant of nosology, pathogenesis (i.e., the specific mechanisms by which agents engender physical disease), has benefited from studying personality. The converse can also be argued; nosology has aided personality research, in that, psychology researchers have been encouraged to dismantle multifaceted vague constructs (i.e., hostility), into separate, more narrowly defined components (cynicism vs. social avoidance). Not only does this seek to refine the construct, but it is helpful in parceling out the specific components that result in the most deleterious outcomes. Thus, one
broader benefit of health psychology has been greater reciprocity between the social and health sciences.

Type-A Behavior Pattern. The notion that characteristically hostile and tightly-wound persons are more susceptible to acquiring heart disease and atherosclerosis (Whiteman, 2006) is anything but innovative. Even so, the nature of the relation between psychological factors and coronary heart disease (CHD) is still a murky area for researchers (Booth-Kewley & Friedman, 1987). People have been “intuitively aware of the connection between the heart and emotional stress” (Brotman, Golden, & Wittstein, 2007, p. 1089) since antiquity, but it became empirical knowledge in the 1970’s. During that decade, Friedman and Rosenman (1974) were among the first researchers to investigate the coronary-prone personality. Deemed Type A behavior pattern (TABP), Friedman and Rosenman purported that persons showing the following constellation of attributes were at risk for CHD: hostility, high-achievement, impatience, and competitiveness. Implicit in the TABP, is the idea that certain psychological and behavioral factors frequently cluster together in persons with CHD, suggesting the possibility of a coronary-prone personality profile.

Hostility. After subsequent research failed to replicate the TABP, researchers began evaluating the correlated variables (Williams & Williams, 2006) to isolate the components of TABP (e.g., competitiveness, impatience) and evaluate them separately as possible contributors of CHD. From this line of research (Williams, Haney, Lee, Blumenthal & Kong, 1980), hostility emerged as the most lethal psychological factor in coronary atherosclerosis. Hostility rarely occurs in isolation, and has been correlated with other biopsychosocial factors (e.g., low SES, high cholesterol, hypertension, depression)
not recognized as part of the TABP (Williams & Williams, 2006). Considering this evidence, Williams and Williams (2006) contend that concurrent risk factors compound mortality and morbidity. A question that has yet to be answered is whether these psychosocial factors mediate the relationship between hostility and CVD. Another unanswered question is whether hostility can be thought of as a personality trait, that is, an individual’s distinctive patterns of thinking, emoting, and behaving (Funder, 2001).

Because hostility may be defined differently, these have been difficult questions to address. In summary, the principal component analysis (PCA) of TABP resulted in the abandonment of research and theory that examined high-achievement, impatience, and competitiveness in favor of studies investigating a single personality characteristic, hostility. Additionally, attention focused on studying other biological and psychosocial factors that were found to cluster with hostility and their relationship to CHD.

The assessment of hostility. Hostility is a multifaceted construct (Whiteman, 2006). It includes the following components “…a negative attitude towards others, a cynicism and mistrust of others’ motives (a belief that they will be hurtful) and an evaluation of others as mean, non-social and dishonest” (p. 16). Hostility is intricately related to other constructs, most notably, anger and aggression. Their interrelationships are briefly outlined here. Persons who possess underlying hostile beliefs are more prone to making negative attributions about their environment and thereby activating the hostile cognitions or attitude set that precipitates anger, an intense emotion accompanied by physiological arousal. As the intensity of anger grows, it becomes harder for the persons to prevent themselves from acting on negative action impulses, such as aggression (Donohue & Cavenagh, 2003). To summarize, hostility, anger, and aggression are
separate, yet related constructs. Hostility is manifest in beliefs, attitudes, or cognitions, while anger and aggression represent the emotional and behavioral expressions of hostility.

Having a conceptual framework for organizing the above constructs is vital for refining specific associations with CVD, particularly when meta-analytic reviews have reported effect sizes of differing magnitudes. Among hostility, anger, and aggression, Booth-Kewley and Friedman (1987) presented meta-analytic findings that hostility demonstrated the strongest relationship with CVD ($r = .16$); this combined effect size was computed across 12 studies. Efforts to isolate these related constructs are difficult, particularly because self-report measures of hostility inquire about feeling of anger and acts of aggression, but are not defined as such. Instead, they are often conceptualized as hostile connotations. Under this broader conceptualization, hostility is manifest in more than one level. It can be measured as an internal state of ‘neurotic’ hostility (e.g., thoughts and feelings) using self-report, through outwardly-directed behavior (e.g., insults or door-slamming) using observer ratings, or implicitly (i.e., automatic appraisals) using indirect, performance-based procedures.

In turn, the manner in which hostility is conceptualized and measured has important implications for research, particularly, when attempting to quantify the research findings. According to Whiteman (2006), the relationship strength between hostility and CHD varies as a function of both these issues. In line with this, different components of hostility have been linked to separate cardiac outcomes; outwardly expressed hostility was associated with MI, while privately experienced hostility was more commonly seen in angina patients (Whiteman, 2006). The methodological rigor of
studies is increased when both artifacts are systematically examined, providing more precise estimates of CHD morbidity and/or mortality.

Methods and measures for assessing hostility. As indicated, there are a variety of ways to assess hostility, anger, and aggression. Assessment measures may be broadly classified into three methods: self-report, behavioral ratings, and implicit-based techniques. Self-report, direct, or explicit methodology requires persons to make complex judgments as to the degree to which certain statements apply to them. Inherent in this method is the assumption that persons are both able and willing to report their internal psychological states. Traditional self-report formats include the prototypical paper-and-pencil style questionnaires, in which persons provide answers to direct questions (Cogswell, 2008). For self-report measures of hostility, this translates into persons rating the degree to which they experience hostile thoughts or feelings. Some time ago, Cook and Medley (1954) developed the Hostility Scale (Cook & Medley, 1954). This 50-item hostility self-report scale is derived from a set of Minnesota Multiphasic Personality Inventory (Hathaway & McKinley, 1943) items; nine of the original 50 Hostility Scale items were slightly altered in the revised Minnesota Multiphasic Personality Inventory (MMPI-2; Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989). It was believed that higher scores on this scale reflected a dislike and mistrust of others. A commonly held view of the Hostility Scale score is that it measures cynicism, including elements of social avoidance (Whiteman, 2006). Correlations with the Big Five personality trait of neuroticism have also been observed for the Cook-Medley scale, demonstrating partial concurrent validity with other ‘negative affect’ traits. By far, the Cook-Medley scale has been the most frequently used measure in CHD research. The popularity of this scale is
seen by its empirical associations with coronary artery disease, CHD events, peripheral artery disease, cardiovascular reactivity, hypertension, risk factor status, and premature mortality from all causes (Barefoot & Lipkus, 1994).

Interview methods are also available to assess hostility. While conducting the interview, examiners may ask persons to identify expressive behaviors, such as verbal aggression (name-e.g., calling) or aggression towards objects (e.g., punching the wall) or in the case of the TABP Structured Interview (Rosenman, 1978), examiners may also assess examinees for behavioral ratings of hostility. Rating criteria include speech stylistics (e.g., voice volume, speed of speaking, explosive words), motor activity (e.g., gesticulation, grimaces), and interpersonal style (e.g., hostility, verbal competitiveness). This versatility makes the Structured Interview unique among assessment techniques. The interview essentially represents a cross-method approach to measuring hostility, providing information from both self-report and observer ratings. The Structured Interview emphasizes global scores of hostility derived by synthesizing information across the two domains, rather than as discrete categories. For instance, Potential for Hostility (Dembroski & MacDougall, 1983) incorporates ratings for hostile content of answers, intensity of hostile responses, and hostile style of interaction with the interviewer (Dembroski & MacDougall, 1983). From a research standpoint, studies that make use of interview methods can provide especially valuable data about one’s hostility. The major limitation of conducting interviews is the considerable time that it takes to train persons to administer and score them.

The third and final category of personality methodology is implicit-based, performance, or indirect assessment. In contrast to those who support self-report methods
at the exclusion of others, proponents of implicit-based methods are more skeptical about peoples’ ability and willingness to provide accurate responses to direct queries regarding private psychological states. They contend that social desirability and unconscious processes conspire to obfuscate accurate self-reporting. The goal of implicit methodology is to circumnavigate these obstacles (i.e., social desirability, unconscious processes) by minimizing the salience of the targeted personality construct(s) as well as tapping cognitive processes that are relatively separate from introspection through a variety of procedures (i.e., responding to ambiguous stimuli, generating narratives to pictures, pairing object categories with evaluative descriptors). David McClelland wrote extensively about the different types of cognitive processing. He and others (McClelland, Koestner, & Weinberger, 1989) reported that self-report measures are filtered through cognitively elaborated constructs such as analytic thought and various concepts of the self and others. In comparison, implicit methods were purportedly mediated by syncretic cognition. McClelland et al. provide useful descriptions for distinguishing between these two different types of cognition. Whereas analytic cognition is “knowledge by description” (p. 698), that is, people are interpreting what they see or feel using linguistic concepts, syncretic cognition is “knowledge by acquaintance” (p. 698). In other words, people are automatically reacting or feeling, such as when recognizing a familiar face or experiencing sadness when listening to a song associated with a deceased loved one. The major criticisms pitted against implicit methods are that they lack reliability and predictive utility, particularly with regard to the Rorschach (Garb, 1999; Wood, Nezworski, & Stejskal, 1996), though these criticisms have been countered with good reliability (Meyer et al., 2002) and validity (Hiller, Rosenthal, Bornstein, Berry, &
Brunell-Neuleib, 1999). It is also worth noting here that the Implicit Association Test (Greenwald, McGhee, & Schwartz, 1998) has quickly garnered empirical support within the social cognition field (Cogswell, 2008).

The Rorschach is the earliest ancestor of the implicit-based assessment techniques; it has a long, rich, and polemic past within the assessment community. Rorschach-based assessment provides a unique source of information. The theoretical significance of the Rorschach, stems from the belief that it captures aspects of personality that are less accessible to introspection (i.e., characteristics that may operate outside of consciousness) and/or that are confounded by intentional response bias (Cogswell, 2008). The Rorschach provides one useful method for understanding aggression as a personality construct. Several aggression-related variables have been developed for the Rorschach and have been used to identify hostile and aggressive character traits and/or extant psychopathology. Rorschach aggression variables have been used in research to compare and differentiate among relevant traits, diagnostic groups, and individuals (Baity & Hilsenroth, 1999; Mihura & Nathan-Montano, 2001; Mihura, Nathan-Montano, & Alperin, 2003).

Thus, multiple measures and methods exist for assessing different expressions of hostility-related constructs, each accompanied by its own set of strengths and weaknesses. A few of the more common assessment tools include the Hostility Scale, the Structured Interview, and the Rorschach.

Meta-analytic findings. Effect sizes of small magnitude are consistently observed between hostility and CVD in addition to commonly associated risk factors. Booth-Kewley and Friedman (1987) reported the combined effect size (i.e., Pearson product-
moment correlation) for hostility and CHD to be $r = .17$, with a probability of $p < .0000001$; this finding is based on the results of only 9 studies. In comparison, a more recent meta-analytic review by Myrtek (2001) reported a smaller effect for hostility and CHD. Myrtek computed a population effect size as the weighted average of all correlations coefficients across 14 published studies; a very small effect was observed, with a population effect size of $R = .02, p < .01$. Rutledge and Hogan (2002) also found a small effect size for anger ($r = .08, 95\% \text{ CI}, .06 -.10$) in the prediction of hypertension.

Using Hedges’ $g$ (Hedges, 1981) as an effect size estimate, another meta-analysis (Bunde & Suls, 2006) showed associations between hostility, as measured by the Cook-Medley Hostility Scale and a number of CHD risk factors, including BMI ($g = .17, p < .01$), waist to hip ratio ($g = .25, p < .01$), SES ($g = -.28, p < .01$), alcohol consumption ($g = .11, p < .01$), and smoking ($g = .16, p < .01$). In sum, researchers are detecting small to very small effects for the relationship between hostility and CVD as well as relevant risk factors.

Findings as a function of methodology. Current validity research has not clearly determined the extent to which these measures and/or methods of assessing hostility differentially predict CHD (Miller, Smith, Turner, Guijarro, & Hallet, 1996). Evidence does support behavioral ratings of hostility as being more closely related to CHD than self-report (Miller et al., 1996). The Potential for Hostility measure in particular has shown to be predictive of both CVD and CHD (Dembroski, MacDougall, Costa, & Grandits, 1989). Miller and colleagues (1996) reported a weighted mean $r$ of .18 for structured interview indicators of Potential for Hostility in a sample size ($K$) of four studies while self-report measures of experiential hostility produced a weighted mean $r$ of .08 ($K = 9$). Evidence linking Rorschach hostility or aggression to CHD is less
established than self-report, interview, or behavioral ratings. Cleveland and Johnson (1962) however found that MI patients evidenced more hostility in comparison to a group of tuberculosis patients, reporting a Biserial correlation $r_b$ of .41 with a sample size ($N$) of 50 participants.

The classification of CVD. Several diseases affecting various organ systems can be classified as CVD (Whiteman, 2006). Most research examining personality and CVD has focused primarily on diseases of the heart, or CHD. This consists of Myocardial Infarction (MI), angina, chronic ischemic heart disease, hypertensive heart disease, congestive heart failure, or other coronary disease that requires coronary bypass surgery or percutaneous coronary interventions (Chang et al., 2002). One key feature of all CVD is a narrowing of the arteries due to the formation and buildup of a fatty plaque, which is called atherosclerosis (Whiteman, 2006). This process can occur in the brain as cerebrovascular disease (i.e., stroke) or it can manifest in the leg as pain, as in the case of peripheral vascular disease (Whiteman, 2006). In conclusion, CVD is a diagnosis that may encompass one or more atherosclerotic conditions that may occur in one or more organs and/or areas throughout the body including the heart, brain, and legs.

Pathogenesis. How does a non-physical concept like personality adversely impact physical health (Whiteman, 2006)? The short answer to this question is through multiple pathways. Broadly speaking, the proposed risk pathways can be differentiated according to how one conceptualizes the environment. Such can be either understood as “The external environment that the person dwells within” and/or “The internal, bodily environment of the individual” (p. 25). Regarding the latter descriptor, hostility and CHD might point to an “inborn structural weakness” of the cardiovascular system from which
hostility and CHD are predisposed. In another capacity, hostility may chronically initiate a chain of intense taxing physiological responses, thereby accelerating atherosclerosis, or vascular damage. Excessive cardiovascular, neuroendocrine and sympathetic nervous system activation are a few of the physiological responses by which hostility may inflict cellular damage. In the other direction, reduced parasympathetic nervous system functioning has also been found in hostile persons; the parasympathetic nervous system is essential in restoring the internal environment to baseline levels after a physiological stress response. Further potential risk factors that co-occur with hostility include increased platelet activation, increased blood levels of inflammatory cytokines, and increased expression of metabolic disorders (Williams & Williams, 2006). It is also understood however, that hostility may affect blood pressure directly through vasoconstriction of the arteries.

Many have wondered how young adults with enviable fitness levels and ascetic dietary habits can also incur heart attacks. This has prompted researchers to explore an alternative explanation for why seemingly healthy persons who are prone to anger, hostility and mild to moderate depression are at risk for CVD. A substance known as C reactive protein may provide some answers. It has been implicated in the underlying plaque that materializes inside the arteries as they clog. Though people with the traditional risk factors show elevated levels of C-reactive protein, healthy persons who are prone to experience hostility, anger, and depressed mood, also exhibit elevated levels. Suarez (2004) conjectured that “Individuals with depressed symptoms may evaluate their social environment in a cynically hostile manner and thus respond with greater anger as a consequence of their negative affect state” (p. 688). In turn, the combination of hostility,
anger, and depressive symptoms stimulates production of the stress hormone norepinephrine. An excessive level of this hormone then activates the inflammatory arm of the immune system. Consequently, it further triggers genes to be expressed that are associated with chronic, low-grade inflammation that contain C-reactive protein (Suarez, 2004). In conclusion, evidence suggests that certain psychological attributes including anger, hostility, and depressive symptoms may indirectly affect immune functioning. Hostility may initiate the body’s internal stress response, thereby activating the gene expression of low-grade, chronic inflammation that is characteristic of C-reactive protein, the building blocks of artery clogging plaque.

With respect to the external environment, hostility may also operate in an “outside–in” fashion that leads to atherosclerosis (Williams & Williams, 2006). Hostile persons may purposefully or non-purposefully alienate themselves from others by virtue of off-putting behaviors (Williams & Williams, 2006). In this case, it is the isolation and increased stress that follows from an antagonistic interpersonal style, rather than the presence of hostility per say, that is pathogenic. Another potential disease pathway is through the health compromising behaviors linked to both hostility and CHD (Williams & Williams, 2006). Such health damaging behaviors include cigarette smoking, sedentary lifestyle, poor dieting, and social isolation. Health damaging behaviors are often understood as ‘self-medicating’ reactions to psychological stress. They plausibly exacerbate various domains of CVD risk including increased body mass index (BMI), increased 24-hour caloric intake, increased blood pressure, and increased cholesterol/high-density lipoprotein ratio (Williams & Williams, 2006). In addition, hostility may amplify the susceptibility to physical illness and disease by its negative
relationship with health vigilance. Examples of this include the failure to monitor physical symptoms, delayed decisions to seek medical consultation, and poor adherence to treatment regimens (Contrada & Guyll, 2006). Correlations between hostility and low health conscientiousness might alternatively be explained as reactions to physical illness, rather than the precipitants (Contrada & Guyll, 2006). To disentangle the specific directional relationship between these variables, more prospective studies in this area are needed. An alternative explanation for the relationship between hostility and CVD seems plausible, whereby health-damaging behaviors mediate this relationship. In summary, there is evidence to suggest that hostility may be both directly and indirectly involved in many different disruptive biological processes.

One may realize that each of the above hypotheses does not necessarily preclude the other. Consistent with this, a “transactional model” of disease has also been proposed for hostility (Whiteman, 2006). This recognizes the plausibility of both ideas; that is, the duality of external and internal environments in the contribution of atherosclerosis.

A physiological model of hostility. A detailed physiological model of the effects of hostility is offered by Williams (1994). His research model integrates work in behavioral medicine and molecular biology. The hypothesized physiological mechanisms involved in atherosclerosis are highlighted. Williams begins by stating that high cholesterol levels and high catecholamine reactivity are routinely found in hostile men. Taken together, Williams believes that these attributes are responsible for atherogenesis. His reasoning is as follows: Increased cholesterol concentrations are known to increase the beta adrenergic receptor. Cyclic adenosine monophosphate a second messenger of the beta adrenergic receptor, stimulates cellular functions. Additionally, increasing
intracellular cyclic adenosine monophosphate likely influences the molecules (i.e., oxidized-low-density lipoprotein) and processes that affect macrophage activation or atherosclerotic plaque formation. One way cyclic adenosine monophosphate is stimulated is through the catecholamine epinephrine, which is found to have greater concentrations in the blood during times of stress. To summarize this sequence of pathogenic events, high cholesterol levels and high catecholamine reactivity combine to increase beta adrenergic receptor activation. In return, one of its secondary messengers, cyclic adenosine monophosphate, increases in response to catecholamine stimulation during times of stress, thereby interrupting the molecular processes involved in macrophage activation that engenders atherosclerotic plaque formation.

Detailed physiological models such as these are complex; vastly different levels of analysis (i.e., molecular, behavioral) have to be synthesized into a larger unifying framework. Over time, these sophisticated models should simultaneously provide a more thorough and parsimonious explanation as to how hostility affects health.

Serotonin function and hostility. Origins regarding the development of hostility are proving to be a compelling and promising area of research. It has been postulated that “reduced brain serotonergic function resulting from the experience of relatively harsh and adverse circumstances in early childhood is one important factor contributing to the clustering of health damaging psychosocial and behavioral characteristics in lower SES groups” (Williams & Williams, 2006, p. 262). In other words, brain serotonergic functioning is viewed as the mediator variable for the observed clustering effects of psychosocial risk factors with biological (e.g., hostility, depression, low social support, job stress) and behavioral mechanisms (e.g., cigarette smoking, sedentary lifestyle,
hypertension, increased autonomic responding, increased platelet activation). The most impressive data though comes from behavioral science research with animals. Vervet monkeys (Raleigh, McGuire, Brammer, Pollack, & Yuwiler, 1991) were administered pharmacological treatment which either accentuated or diminished serotonin levels in the brain. Monkeys receiving the latter treatment demonstrated more aggressive behavior towards female monkeys, which subsequently lead to their lower social status in the group. In contrast, monkeys whose serotonin levels were artificially bolstered showed greater affiliative behavior towards the females, resulting in superior social standing within the group.

This trend is also seen when aggressive behavior is the primary target of investigation. Outwardly aggressive persons were discovered to have decreased levels of the serotonin metabolite 5-hydroxyindoleacetic acid in cerebrospinal fluid (Brown, Goodwin, Ballenger, Goyer, & Major, 1979). In a sample of normal participants (Roy, Adinoff, & Linnoila, 1988) low cerebrospinal fluid 5-hydroxyindoleacetic acid levels were linked to high scores on the Hostility and Direction of Hostility Questionnaire. An inverse relationship was also shown between assault and irritability scores on the Buss-Durkee Hostility Inventory and the pharmacological stimulation of serotonin function. According to William’s (1994) conclusion, it seems that serotonin function plays an integral role in the experience and expression of hostility.

Acute versus chronic stress. Given that atherosclerosis develops slowly over time, most research, including the above hypotheses are derived from a trait hostility perspective. If chronic stressors and the negative affective states (e.g., hostility, depression) that accompany them are indeed linked to atherosclerosis, than what about in
the case of acute stressors, such as major life changes and events? Strike and Steptoe (2005) have depicted how transient experiences of anger, stress, or physical exertion may increase the risk of triggering an immediate MI by twofold. Cardiovascular mortality (in addition to all-cause mortality), is greater in the months following the death of a spouse (Brotman et al., 2007). Additionally, in the weeks and months after the September 11th terrorist attacks in 2001 in New York, defibrillator firings in patients with ischaemic and non-ischaemic cardiomyopathies occurred two to three times more frequently than normal (Brotman et al., 2007). Because the number of arrhythmic events was distributed over several weeks subsequent to the day of the actual catastrophe, and in communities far removed from Ground Zero, it suggests that this event had widespread psychological reverberations (Brotman et al., 2007). Similar to the inhibition versus expression of anger/hostility, chronic versus acute stressors may result in separate types of cardiovascular outcomes. This presupposes more than one pathway from the stress response to CVD. Put another way, the nature and extent of the stressor affects cardiovascular risk differently. Acute stress is likely to trigger thrombotic, arrhythmic, or mechanical cardiovascular events, while chronic stress seems to accelerate the atherosclerotic process (Brotman et al., 2007). For patients with pre-existing coronary disease, “acute stressors might result in CVD events through increasing pressure at the site of a weak atherosclerotic plaque (with subsequent plaque rupture) or from regional myocardial ischaemia distal to a stenotic vessel leading to ventricular dysrhythmias” (p. 1091). Thus, although atherosclerotic coronary disease incurred by chronic stressors may facilitate this process, it may be the acute stressor that delivers “the final blow.”
Illuminating the various mechanisms by which chronic stress leads to cardiovascular morbidity is a convoluted process. As mentioned earlier, stress could potentiate CVD by increasing blood pressure, or indirectly through health damaging behaviors (i.e., smoking, sedentary lifestyle, medical non-compliance). Additionally, acute stress may trigger thrombotic, arrhythmic, or mechanical CHD events like MI. Of importance, it appears there is a “consistent relation between chronic emotional or psychosocial stress and coronary atherosclerosis (and atherosclerotic risk factors), and these relations persist after adjustment for confounding variables, including lifestyle variables” (p. 1092). This suggests that for some individuals, emotional and psychological stress may represent enough of a risk factor to promote CVD, in and of itself.

Emotional repression and suppression. The idea that inhibiting one’s anger can be maladaptive is a deep-rooted and commonly held belief. Its popularity is due, in part, to Sigmund Freud. It was Freud who introduced the hydraulic model of sexual and aggressive drives (Bushman, 2002). According to this model, when feelings of anger are repressed (i.e., the unconscious removal of emotions or cognitions), internal pressure builds. If the pressure is not released, psychological or physical problems can result, including hysteria or an explosion of rage (Bushman, 2002). Rather than keeping anger “bottled up inside” (p. 725) and building more internal pressure over time, anger should be intermittently released in small amounts, which subsequently relieves internal pressure. Importantly, Bushman has challenged the merit of the hydraulic model with his highly publicized research on catharsis. His findings have shown that venting anger by enacting aggression towards objects has been found to increase anger and aggressive
behavior rather than minimizing it (Bushman, 1999; 2002). For instance, angry participants (2002) who hit a punching bag and thought about the person who had angered them were more aggressive in blasting their rivals with loud, unpleasant noises (i.e., laboratory measure of aggressive behavior) during a competitive task, in comparison to participants who thought about becoming physically fit. Though these findings are intriguing, if not partially contradictory to the hydraulic model, they do not generalize to physical health and CHD, which is the present investigation’s outcome of interest.

Two psychological processes by which negative emotions are “bottled up” include repression and suppression. Psychoanalytic theory defines repression as an ego-defensive coping response whereby negative emotion and cognitions are reflexively removed from consciousness. Suppression, by comparison, refers to the effortful, conscious inhibition of negative emotion, and/or its behavioral displays (Contrada & Guyll, 2004). Another way to define repression and suppression is by the “individual’s coping response or orientation toward negative emotion” (p. 73). Like hostility and anger, clarifying their overlapping and conceptually distinct properties is challenging (Contrada & Guyll, 2004). One question has to do with the particular emotion that is being suppressed or repressed. Does it constitute: (a) Anger, (b) anxiety, or (c) a general negative emotion? The propensity of cardiac patients to underreport anger, in relation to observer ratings (i.e., spouse/friend) is greater than what has been observed for depression and anxiety (Ketterer et al., 1996). Repression and suppression may be considered as similar ego-defensive processes. Both represent coping mechanisms and/or a personal stance intended to distance oneself from negative affective experiences.
Research findings. There is considerable indirect evidence to support Freud’s idea that inhibiting anger is physically unhealthy. Anger suppression and essential hypertension have been linked as early as the 1930’s, when Alexander (1939) proposed the “now classic psychosomatic hypothesis” (Suls, Wan, & Costa, 1995, p. 444), which stated that the inhibition of hostility produces chronic tension and anxiety that results in hypertension. A series of meta-analyses conducted by Suls et al. (1995) investigated the relationship between self-reported anger and essential hypertension. Though overall the data showed a small, statistically significant effect, the most important relationship was observed between two anger measures, the Harburg Anger-In/Anger-Out (Harburg et al., 1973) and the Spielberger Anger Experience Anger-In scale (Spielberger et al., 1985), and resting blood pressure. Both self-report instruments measure feelings of annoyance and irritation (i.e., experience of anger) along with a general reluctance to express such feelings. As this research suggests, failure to express anger may also promote disease advancing physiologic responses.

Creating a suppression factor derived from a Denial scale, Social Desirability, and Inhibition scale, Zhang et al. (2005) found a significant interaction between hostility and suppression, particularly the combination of low hostility and high suppression predicted the onset of hypertension at 3-year follow-up for middle-aged men (i.e., 42-60 years). Moreover, this interaction remained significant even after controlling for systolic blood pressure (SBP), diastolic blood pressure (DBP), BMI, smoking behavior, and education levels at baseline. Put another way, “a one-standard deviation increase in the hostility score was associated with a 79% increase” (p. 450) in hypertension risk among a group of high suppressing middle-aged men. In this same sample, Kawachi, Sparrow, Spiro,
Pantel, and Weiss (1996) found statistically significant multivariate-adjusted relative
risks among men reporting the highest levels of anger, as measured by the MMPI-2
Anger Content Scale. These men were classified as having greater risk for developing
CHD.

Weinberger, Schwartz and Davidson (1979) introduced the term repressive
coping style after developing an indirect measurement strategy. To be identified as
having a repressive coping style, one must be low on self-reported trait anxiety, such as
the Bendig short form of the Taylor Manifest Anxiety Scale (MAS; Bendig, 1956) and
high on a veiled measure of defensiveness, like the Marlowe-Crowne Social Desirability
Scale (MC; Crowne & Marlowe, 1964). Several studies incorporating this method have
yielded results supporting high levels of autonomic reactivity in repressive coping in
relation to various laboratory stressors, including, electromyographic reactivity, blood
pressure, immunological responses and serum glucose levels (Jamner, Schwartz, &
Leigh, 1988; King, Taylor, Albright, & Haskell, 1990; Newton & Contrada, 1992;
Weinberger et al., 1979). Additionally, Phipps and Steele (2002) reported that a
repressive adaptive style in children was found among children diagnosed with cancer
and other serious chronic illness.

Researchers have applied this approach to assess the effects of anger suppression
or repression on CVD. Greater heart rate responses to a stress-provoking task were
evidenced by "repressors", i.e., participants with low trait anger scores and high
Marlowe-Crowne scores, than did “true” low anger participants, that is, low scorers on
both instruments (Siegman, Anderson, & Boyle, 1991). Interestingly, a different pattern
of scores was observed by Jamner, Shapiro, Goldstein, and Hug (1991). They identified
the term “defensive hostility” meaning that persons scoring high on hostility and defensiveness, showed greater DBP and SBP responses when two laboratory stressors were introduced.

Shedler, Mayman, and Manis (1993) discussed how limitations in self-report methodology can result in researchers spuriously assigning labels of “psychological health” to their participants. Believing that psychological defenses are alive and well in persons, Shedler et al. (1993) question the face-valid assumption of self-report data. In doing so, they speak to the inherent dangers of what is potentially an over-reliance on self-report methods in assessment. To combat limitations of self-reports, Shedler and colleagues comment on the importance of clinical judgment. Discerning between ‘true’ versus illusory psychological health is reportedly better left to clinical acumen, than are “objective” mental health scales. The authors identify another ‘danger’ lurking; defense mechanisms like denial have physiological costs. Of the persons who are deemed ‘psychologically well-adjusted’ on self-report mental health scales, Shedler et al. hypothesize that persons will fall into one of two subgroups. The first subgroup is psychologically healthy. By contrast, the second subgroup consists of “defensive deniers,” people who are psychologically distressed, but who maintain “an illusion of mental health through defensive denial of psychological distress” (p. 1117). Clinically, this latter subgroup presumably possesses underlying vulnerability, which is defended against by maintaining strong self-views of psychological health. Minimal awareness of personal needs, wishes, and feelings are negative outcomes that follow from denying one’s affective experience. Because finding suitable criterion measures to measure functioning in these broad domains is challenging, the authors instead selected two tests
of physiological function, blood pressure, and heart rate. According to their hypothesis, persons who engage in defensive denial should have a greater positive change in their autonomic activity after exposure to several laboratory stressors in comparison to persons who are genuinely psychologically healthy. Over time, the pronounced reactivity should also confer greater health costs.

Shedler et al. conducted three studies to test their hypotheses. Study 1 included a sample of 58 undergraduate university students who were classified into three groups. The first group was reported to be psychologically healthy, as indicated by a self-report measure and substantiated by a clinician, who based his or her evaluation on the participant’s first recollection using the Early Memory Test (Mayman, 1968). Classified as having illusory mental health, the second group was also psychologically healthy according to a self-report measure. But, by contrast, these persons were considered psychologically distressed by the clinician evaluating the Early Memory Test. The final group was deemed psychologically distressed both by the self-report measure as well as the clinician. Consistent with this, the authors found the second group (i.e., participants reporting psychological health on a self-report measure, but who were judged to be distressed by the clinician) had the greatest levels of coronary reactivity after being exposed to the laboratory stressors. An impressive bit of information is that the authors were able to replicate this finding in Study 2 and 3. Only the key differences of the other studies are briefly reported here. Study 2 reanalyzed the Study 1 data, however, a panel of undergraduate students interpreted the Early Memory Test and provided evaluations of mental health instead of a clinician. The purpose of this was to examine the robustness of subjective human judgment and the Early Memory Test as an assessment tool. Study 3
also used slightly different methods to test the same hypothesis as well as a larger sample of undergraduate students (\(N = 74\)) from a different university. Effect sizes of substantial magnitude (\(r = -.48, -.30, -.37\)) were found in each of the three studies respectively; these effects are considered medically significant.

Shedler et al.’s hypothesis was reportedly influenced, in part, by the research of Pennebaker and Susman (1988). This research shows that inhibiting thoughts and feelings is physiologically demanding. In the short term, it produces autonomic reactivity, which then becomes a problem later in one’s life (Pennebaker & Susman, 1988). Unnecessary physiological activity becomes a “cumulative stressor,” making persons more susceptible to a host of illnesses over time (Shedler et al., p. 1119). There is also support for the converse process; decreases in autonomic activity, changes in immune functioning, and reduced health care visits have been linked to addressing painful thoughts and emotions (Pennebaker, Kiecolt-Glaser, & Glaser, 1988).

For the present study however, the most relevant research comes from Friedman and Ulmer (1984). Among MI survivors who received psychotherapy, and those who received standard medical care, their results indicated that the psychotherapy group had nearly half the rate of second MI’s. One aforementioned theory is that the relation between psychological defenses and heart disease is mediated by autonomic reactivity. Shedler et al. (1993) state “Flux in heart rate and blood pressure appears to create turbulence and sheer stress in the coronary arteries, damaging the inner linings of the arteries (the endothelium) and setting in motion a process leading to atherosclerosis and, ultimately, to heart disease proper” (p. 1119). Thus, there is a substantial body of research
to support the notion that consciously or unconsciously holding onto anger and other negative emotions may adversely affect health.

Lastly, Gross and Levenson (1993; 1997) studied the physiological effects of emotional suppression by having participants view an evocative film (amusing or sad). Prior to the showing of these films, some participants were instructed to inhibit their expressive behavior in the course of viewing the film. Compared to those participants who did not receive these instructions, (i.e., the control group) ‘suppressing’ participants showed greater increases in somatic activity, heart rate, skin conductance, relative sympathetic activation, and relative respiratory activation (Gross & Levenson, 1997). The results of this study are partly in line with hydraulic theory, at least with respect to the suppression of intense emotions. According to the authors, it suggests that “both positive and negative emotions exacts a physiological cost, particularly when one keeps in mind that this sympathetic activation of the cardiovascular system occurs despite decreased metabolic demands caused by the decrement in manifest expressive behavior” (p. 101). Significant physiological activity from emotional suppression was observed when physical and expressive behaviors (e.g., smiling, crying, face touching) were consciously inhibited. Another essential finding was that participants’ emotional suppression did not provide relief from the subjective experience of that emotion. Also important, only amusement (i.e., happiness and pleasantness) and sadness were examined in this study, conveying uncertainty about whether these results generalize to other emotions. Nevertheless, the link is strong enough to suggest that it would be likely, or at least those emotions viewed as intense, such as anger.
It is important to point out that emotional repression and suppression are not invariably negative. Of course occasions exist when it is socially adaptive or necessary to restrain emotions and negative action impulses. Disciplining an insolent child in the midst of a religious service, or throwing coffee at a vulgar colleague is not appropriate behavior. Emotionally mature adults are judicious in reacting to anger provocations. When frustrated, they seek solutions, which sometimes include emotional expression. Ideal emotional regulation is illustrated by Gross and Levenson (1993) “…there is an optimal level of emotion regulation-somewhere between total strangulation and completely unfettered expression” (p. 96). When emotional suppression becomes a person’s default coping style for managing stress, it poses an obstacle for successful adjustment. Not only does suppression impair others’ ability to attend to one’s needs thereby compounding and/or prolonging subjective distress, but it also leads to widespread increases in sympathetic activation that negatively affect health. On the other hand, if a person “flies off the handle” after every inconvenience or mishap, or avenges every perceived personal slight, he/she is likely to have a lonely, discordant, and short life.

Implicit Versus Explicit Personality

Implicit personality. The differences between explicit and implicit methods of assessment were briefly highlighted. As attention in the psychological literature turns to examining each method’s strengths and weaknesses, a competitive analysis of their attributes often unfolds. Traditionally, the author’s preferred method of assessment (which is not always articulated but can typically be inferred) is lined up against the other method. Then, the author identifies instances where the method falls short and where it is
superior, tending toward the latter. Many authors use this hard-line approach to espouse their views and/or values while attempting to preserve some degree of neutrality. At other times, it is the reader who conducts his or her own version of the competitive analysis with the data. More often than not, by engaging in this practice the most important and interesting point of discussion is lost, which is that explicit and implicit methods should be seen as complimentary rather than as antithetical.

Implicit or performance-based tests such as the Rorschach, Thematic Apperception Test, or Implicit Association Test are often misunderstood as just another method of getting at the same personality constructs as self-report instruments (McClelland et al., 1989). Despite the pioneering work of McClelland and others, it may not be uncommon for a psychologist to speak about self-reported (i.e., explicit) and Thematic Apperception Test- or Rorschach-derived (i.e., implicit) characteristics like achievement interchangeably. Of course, the Rorschach and the Thematic Apperception Test do provide a means of assessing personality, as do their self-report instrument counterparts, but it involves divergent ways of thinking about personality.

Empirically unrelated but conceptually related to personality, self-report methods and performance-based methods are each understood to be valid measures (Winter et al., 1998). How can this be? McClelland’s insight was his ability to look beyond this seemingly paradoxical relationship. Prior to the advent of McClelland’s work, much of the assessment field devoted to human motives was divided into two camps (Winter et al.): (1) Those persons who primarily focused on classifying behavior as traits, as proposed by Gordon Allport (1937), and (2) those that adhered to a more process-analysis, or motive theory, as championed by Henry Murray (1938). Though
fundamentally different, the two personality theories were largely viewed as competing. Accordingly, self-report instruments, or questionnaires, were used to assess traits, while performance-based tests (i.e., Thematic Apperception Test, Rorschach) were used to assess motives. Thus, when McClelland, Atkinson, Clark, and Lowell (1953) demonstrated that measures of self-attributed motives and implicit motives seldom correlated with one another, each camp used the data to discount the validity of the rival theory (McClelland et al., 1989). But McClelland offered an elucidating alternative explanation that reconciled the findings; one that offered a positive and balanced view of each assessment approach (Winter et al.). Understanding traits and motives as two different kinds of behavior, McClelland recognized how both reflected domains of personality, rather than as mutually exclusive ideas.

Implicit personality represents the automatic processes that influence both our feelings and behavior. Two examples of these automatic processes include motives, and ego-defensive process that may or may not be subject to awareness. McClelland et al. (1989) describe motives as a fundamental goal or desire, “Motives refer to people’s wishes and desires—states of affairs that they would like to bring about (consciously or unconsciously)” (p. 231). In other instances motives are “states of affairs they would like to prevent” (p. 231). An example of this is would be an avoidance motive. McClelland believed that motives represented a type of emotional conditioning through the consistent, potent pairing of affective experiences with natural incentives. It was believed that these associations arose early in life, before the acquisition of language. There is evidence that viewing a romantic film can stimulate primitive brain areas to secrete dopamine among persons labeled “high” in an affiliation motive, which provides
compelling support for this idea (McClelland et al.). Additionally, McClelland reasoned that implicit motives would be most effective in predicting spontaneous behavior over time, since persons would naturally gravitate towards intrinsically rewarding experiences, irrespective of explicitly defined goals. Evidence also supports this view (McClelland et al.; Spangler, 1992). Thus, implicit personality is made up of both motives and defense mechanisms that are intrinsic, automatic, and involuntary, often operating outside conscious awareness.

Explicit personality. The converse of implicit personality is *explicit personality* “that part of the personality of which the person is aware. It consists primarily of self-ascribed dispositions to think, behave, or feel in ways that are available to introspection.” (Frost, Ko, & James., 2007, p. 1299). Traits (i.e., conscientiousness) are typically associated with explicit personality, but may also include motives. To contrast with the earlier example given of an implicit motive, McClelland et al. (1989) characterizes explicit motives as conscious, socially constructed beliefs about one’s capacity for pursuing self-identified goals. Since attitudes and values are likely communicated through the individual’s family and larger culture (i.e., society), it follows that explicit goals are acquired after language has developed, when “concepts of the self, others, and what is valuable is acquired” (p. 697). Regarding the influence of explicit motives on subsequent behavior, McClelland et al., state that explicit motives best predict specific responses to specific situations or behaviors. Explicit personality can be understood as a type of subjective narrative that has been constructed over time based on self-attributed thoughts, behaviors, and feelings.
An integrative typology. Building on McClelland’s research, Winter et al. (1998) proposed a unifying model of personality that integrates explicit methods with implicit-based methods to best understand and predict dynamic behavior. Under this model, Winter et al.’s channeling hypothesis asserts that self-beliefs about personality (explicit) influence the “channels” in which individuals express their implicit motives. For examples, imagine a child who possesses a strong implicit affiliation motive, and has a high tolerance for stimuli (i.e., trait). Further, this child may be encouraged by parents to socialize frequently (reinforcement) such that he is often described ‘the life of the party.’ In time, such descriptions will be ingrained in the child’s self-concept as “extraverted.”

To illustrate the dynamic nature of the channeling hypothesis, consider a variation on this example. Suppose the child in this next case also has a strong implicit motive for affiliation, but instead has a low threshold for external stimuli. Additionally, imagine the child is raised in a culture where children are discouraged from talking at home (reinforcement). This child may come to view oneself as “introverted” because they generally prefer more subdued environments than is typical of parties. Nevertheless, the child is compelled to express this implicit affiliation motive, and may find unique outlets for expressing such. For instance, the child may volunteer to visit with elderly persons at a retirement center. In the first example, the child’s implicit motives and explicit beliefs are congruent. By contrast, the second example depicts incongruence between the child’s implicit motives and explicit beliefs. Together, these examples depict how implicit and explicit dimensions of personality dynamically interact to channel behavior.
Self-Report Methods of Hostility and Aggression

The conceptualization of hostility has ramifications for the methods and operationalization of the construct (Barefoot & Lipkus, 1994). Traditionally, self-reports and interview-based methods have been the most popular techniques for the assessment of anger and hostility. Each method has its own set of strengths and weaknesses, an artifact of the different theoretical grounds on which these measurement strategies are based. Self-report methods by far represent the most straightforward, accessible, and face valid technique for assessing anger and hostility (Barefoot & Lipkus, 1994). Allport argued that the best way to know about people’s private internal states and experiences is simply to ask (White, 2006). This idea is intuitively appealing and practical, but overly simplistic. As indicated previously, self-report methods draw on a separate dimension of personality, providing only a partial manifestation of someone’s personality. Despite its intuitive, expedient, and cost-effective nature, self-report methods rest on three unstable assumptions; these are described below.

Item comprehension. The first assumption concerns item comprehension. It is also the most testable. Not all respondents may be able to understand the language or format required to provide an accurate, and/or a valid self-report. The Personality Assessment Inventory (Morey, 1991) is generally a ‘user-friendly’ self-report instrument; it requires a fifth-grade reading-level. Other instruments usually demand greater sophistication on the part of respondents. Keep in mind that most self-report instruments are constructed using college students. One relevant issue is that low socioeconomic status (SES) is correlated with hostility, and both constitute independent CHD risk factors. Since persons of low SES are also less likely to have completed higher education, item comprehension remains
a potential confound. Even though sophisticated, psychometrically rigorous instruments are available to assess personality they may not be accessible to all persons. To the degree that item comprehension is socially or culturally biased, the validity of self-report is suspect.

Level of self-awareness. The second assumption on which the validity of self-reports are based concerns the respondents level of self-awareness (Barefoot & Lipkus, 1994), or capacity for introspection. In assessment research, low agreement is traditionally observed between self- and informant- ratings of psychological problems and personality characteristics (Achenbach, McConaughy, & Howell, 1987; Achenbach, Krukowski, Dumenci, and Ivanova, 2005; Meyer et al., 2001). As any adult can tell you, “Do as I say, not as I do”, is a commonly uttered phrase in the presence of children. This reflects a discrepancy between ‘saying’ and ‘doing.’ Not surprisingly, researchers have questioned the degree of self awareness in respondents (Fenigstein, Scheier, & Buss, 1975).

Trait visibility (Tellegen, 1991), the extent to which the trait is evident in an observable and unequivocal manner, is one aspect by which self-reports of symptom behaviors can be corroborated in the laboratory. Consistent with this, Klonsky, Oltmanns, and Turkheimer (2002) found that self and informant agreement was higher for personality disordered adults exhibiting the more extraverted type of Cluster B personality disorders (e.g., Histrionic and Antisocial Personality Disorder) than the Cluster A personality disorders (e.g., Schizoid and Schizotypal Personality Disorder) and Cluster C personality disorders (e.g., Avoidant and Obsessive Compulsive Personality Disorders). Significantly larger correlations were also found for externalizing problems
when compared to other problems in a meta-analysis of adult research (Achenbach et al., 2005). For private affective states however, such external validation procedures are more challenging. Thus, there is a dearth of empirical evidence showing the accuracy of self-reported emotional experience, though it does not necessarily imply inaccuracy. Introspection still remains the most straightforward and practical approach for gaining access to a person’s thoughts, emotions, and behaviors. Nonetheless, this faculty likely varies greatly from one person to another and may even fluctuate within persons.

Self-deception and psychological defenses. To complicate matters, ego-defensive processes, which are separate from introspective tendencies, may also be operating to confound ratings (Barefoot & Lipkus, 1994). Frost et al. (2007) refer to defense mechanisms as unconscious self-protective processes that consist of mental operations that enable persons to keep disturbing or painful thoughts and emotions out of consciousness. It is not that individuals with defense mechanisms lack the general ability to introspect. In fact, such individuals may be quite skilled at introspection, so long as the attribute/domain does not conflict with their self-view. In line with this, Meyer (1996) adapted Tellegen’s (1991) idea of trait visibility to consider aspects of conscious accessibility. Personality characteristics may lie within conscious awareness, others within partial awareness, and still others beyond consciousness. The latter traits may be dynamically defended against, including hostility and anger, since these are negatively valued attributes (Barefoot & Lipkus, 1994). Indeed, many of the defense mechanisms in psychodynamic theory gather that “aggressive people are often not aware of the full extent of their powerful desire to inflict harm” (Frost et al., 2007). Furthermore, persons may even display characterlogical features diametrically opposed to the underlying trait.
For instance, an individual who is perceived as having narcissistic qualities may be warding off against painful feelings of inferiority. Obviously, personality traits with high conscious penetration (e.g., extraversion) present less of a challenge to measurement validity than those traits that remain outside of conscious awareness, including less socially desirable traits like hostility. In this way, self-deception represents a further obstacle to the validity of self-reports.

Wanting to be viewed favorably by others is consistent with cultural norms and cultural ideologies (Frost et al., 2007). Reviewing the literature on self-report biases, Paulhus and John (1998) identified a 2-factor model of social desirability, which they labeled as the Alpha and Gamma factors. The first factor, Alpha, seems to identify “heroes”, or a narcissistic quality, whereby a person feels the need to exaggerate one’s abilities (e.g., intelligence, attractiveness, athleticism). On self-report instruments, this is manifest in unrealistically favorable self-perceptions against negative feelings or beliefs about weakness, anxiousness, and jealousy, both publicly and privately. It was hypothesized that this reflects an implicit need for agency, which may have arisen from early childhood experiences. For instance, in a home environment in which attention and praise were contingent upon the child’s performance or success in certain domains. Agency is also considered to be a trait characteristic of masculinity.

Gamma appears to detect “saints,” or persons stated to “minimize their sins” (i.e., aggressiveness, hostility, greed, dominance, inconsiderateness). These persons deny socially deviant impulses and claim Christ-like attributes. Persons high on this dimension are likely to be unrealistically high on prosocial self-perceptions (i.e., agreeableness, patience). Similarly, this also reflects an implicit motive but for affiliation. The motive
may have developed from a home environment where politeness and conscientious behavior were differentially reinforced, at cost to the child’s individualism or assertiveness. Affiliation or communion has traditionally been viewed as a characteristic of femininity.

Alpha and gamma processes are primarily self-deceptive in nature, though they may also be accessible to consciousness. For instance, it is mentioned that these biases may lead to greater distortion in the context of public evaluations than when responses are completed anonymously and social evaluation is minimized. Self-reports of hostility and anger are particularly relevant for “saints.” If one’s behavior is deemed hostile or aggressive, then it treads over the line of social morals and adaptive behavior (i.e., civility, politeness, friendliness, and cooperation, James et al, 2005) and thereby disrupts the social order.

In conclusion, Gamma is an understatement of personal shortcomings, and character weaknesses, while Alpha can be understood as an amplification of one’s ego-strengths, talents, and/or genetic endowment. Both biases are believed to be primarily self-deceptive in nature and maintained through psychological defenses. However, these types are also evident from deliberate impression management, which refers to when persons are consciously engaging in response distortion to achieve a desired level of psychological adjustment.

Deliberate impression management. Having self-awareness is necessary, but is not sufficient for accurate responding. Deliberate impression management also is a significant obstacle in the validity of self-report information. Zhang et al. (2005)
observed a highly significant negative correlation, $r = (627), = .65, p < .01$, between the Hostility Scale score and a composite social desirability scale from the MMPI-2.

Ketterer et al. (1998) examined the degree to which “denial” in self-report methodology diminishes the predictive values of emotional distress for cardiac events by devising a quantitative method that statistically adjusts for response biases (i.e., social desirability and ego defensive processes). In this procedure, self-ratings of emotional distress are subtracted from observer ratings (i.e., spouse/friend) of the targets’ emotional distress. Ketterer et al. observed that self-report biases were a major limiting factor in accurately testing the association between psychosocial risk factors with disease outcomes over a 5-year period. When examined separately, self-reported emotional distress failed to positively predict cardiac events, but did so if corrected by observer reports. Interestingly, self-reported denial of anger and anxiety at baseline were among the strongest correlates of cardiac events. Furthermore, overall self-reported emotional distress negatively predicted cardiac events.

Another study by Lumley et al. (2005) found similar evidence of response bias in self-reported negative emotion (i.e., depression and anxiety) among a sample of migraine patients. Negative-emotion reports by significant others were more strongly related to the patients’ migraine activity than were their own reports. Self- and other-reported negative emotion were moderately correlated with one another ($r = .40, p < .001$). Taken together, these two studies indicate that reports from significant others may be more accurate in predicting health status than patient self-report.

Validity indices. As indicated, reluctance to admit hostile and angry feelings is most common in evaluative test-taking situations (Barefoot & Lipkus, 1994). Endorsing
negative attributes can result in social rebuke, or other negative outcomes (e.g., in child custody litigation). There is a way to combat some of the problems of self-report methodology. Psychometricians have created validity indices to flag respondents who disproportionately endorse items in self-serving directions; this is done in order to account for this bias. Two examples include the Lie Scale and the Correction Scale on the MMPI-2. Both indices purportedly assess faking good (Meehl & Hathaway, 1946) or a defensive response style. Returning to Paulhus and John’s research (1998), the Lie Scale is more akin to “saints;” persons who deny anger and conscientiousness (Friedman, Lewak, Nichols, & Webb, 2001). The Correction Scale is a better measure of the tendency to minimize emotional distress and claim personal coping resources consistent with “heroes.”

A frequent criticism of these strategies is that they neglect to distinguish between respondents who are distorting in a social desirable direction (i.e., impression management) and respondents who believe their socially desirable response to be accurate (i.e., ego defensive processes). In the latter case, a person may harbor a strong motive to aggress and inflict harm on others, but this aspect of his/her personality may not be consciously accessible, since it conflicts with his/her desire to be seen as cooperative, harmonious, and peaceful. This person will likely disavow aggression on a self-report scale, and thereby portray an incomplete and inaccurate view of his/her actual behaviors. It is this group of respondents who are believed to be processing information in a self-deceptive fashion (Barefoot & Lipkus, 1994). Unfortunately, validity techniques are not yet sophisticated enough to reliably distinguish between the two forms of bias.
The Rorschach

Rorschach-based assessment provides a unique source of information for clinicians and researchers aspiring towards a more complete and refined understanding of personality. Historically, clinicians have recognized the Rorschach’s merit for use in applied practice (Meyer, 1999); it regularly emerges as one of the most widely-used psychological tests amongst surveyed clinicians (Camara, Nathan, & Puente, 1998). Exner’s (2003) Comprehensive System (CS) is the most popular means for administering, scoring, and interpreting the Rorschach. In general, the CS has shown good reliability and validity (Meyer et al., 2002; Viglione, 1999). Despite this evidence, the Rorschach is commonly viewed with skepticism, particularly for behavioral scientists and psychologists opposed to psychodynamic theory. Wood et al. (1996) and Garb (1999) contend that the Rorschach is an incredulous test; at best, psychometrically flawed. Despite the undue criticism (Wood et al., 1996), the Rorschach endures as a viable assessment method showing good reliability and reasonable validity data (e.g., Hiller et al., 1999; Meyer & Archer, 2001; Meyer et al., 2002; Parker, Hanson, & Hunsley, 1988).

Few would fault the layperson for questioning the Rorschach’s ability to describe and quantify relevant personality characteristics. The most commonly heard phrase of examinees is “How do you get anything out of this?” Indeed, according to Meyer (1996), ascertaining the core meaning associated with various inkblot features often owes more to clinical observation than it does to research data. Following the above, the Rorschach would be said to have low face validity, that is, the extent to which the measure, on a superficial level, seems to evaluate what it is intended to measure. Face validity is the least important aspect of validity.
In terms of assessment methods, the Rorschach is unique. Although inkblots have a somewhat rich history in art and certain subcultures, most people have never encountered such stimuli (Meyer, 1997). In relation to the familiar and undemanding task of having to choose among a finite set of responses (e.g., true/false, Likert Scales) on a self-report personality test, the Rorschach requires the examinee to sit down, interact with the examiner, examine each of 10 inkblots, formulate an unspecified number of responses, decide whether to disclose or censor the response, and then articulate response details (e.g., shading, dimensionality).

The Rorschach and CVD. The Rorschach has an extensive past in psychosomatic medicine (Bertrán, 1996). As interest grew in psychosomatic diseases, investigators began testing their hypotheses regarding the diseases’ psychogenic origins. Persons diagnosed with colostomy and illeostomy (Keltikangas-Jarvinen, Eija, & Moller, 1984), neurodermatoses (Schoenberg & Carr, 1963), chronic hemodialysis (De Nour, Schaltiel, & Czaczkes, 1968), and morbid obesity (Inhanus, Keltikangas-Jarcinwen, & Mustajoki, 1986), to name a few, were assessed with various personality measures, including the Rorschach. Several researchers believed that the existence of a psychosomatic profile on the Rorschach would substantiate their theories of a psychogenic basis to these nebulous physical diseases. When subsequent research failed to demonstrate consistent and convincing evidence of a psychosomatic Rorschach profile, the focus shifted to examining specific Rorschach variables for clues. In spite of the Rorschach’s impressive reign in the early psychosomatic literature, inconsistent findings and the passage of time have tarnished its contributions (Bertrán, 1996)
Of the psychosomatic diseases not mentioned above, CHD was perhaps the most widely-investigated. Bertrán (1996) reviewed the literature on this topic. She categorizes the Rorschach studies of CHD into two categories: (1): hypertensive patients at risk for cardiovascular events, and (2) patients who have already experienced a coronary occlusion or MI. By contrasting these patients with healthy and/or non-diseased control groups, researchers tried to identify Rorschach variables that would differentiate the two groups.

Booth (1946) compared between patients with hypertension, Parkinson’s disease, and chronic arthritis. He discovered hypertensive patients to have the following characteristics in common: The central axis of the card was seen as opened in the middle (animals, books, etc); a greater number of anatomical, water, fire, and specific animal contents; few integration responses; “and movement responses in which the actions are determined by convention and force in order to maintain a particular position” (p. 20).

Another study (Rausch de Traubenberg, Javal, & Rivenq, 1963) found that compared to patients with ‘other’ disorders (i.e., psychosomatic disorders and psychoneurotic disorders), neurotic and non-neurotic hypertensive patients provided statistically significantly fewer responses, a lower proportion of responses determined by Form alone and less instances when objects were identified as pairs on each side of the blot. Possible explanations for this finding include examinee defensiveness, difficulty coping with a complex task demand, and less cognitive flexibility (i.e., divergent thinking).

The type of hypertension (i.e., labile versus essential) was investigated by Kamienieka (1977). Labile hypertension refers to blood pressure that oscillates rapidly and consistently. Essential hypertension is high blood pressure without an identifiable
medical cause. It is considered to be an inherited condition and constitutes about 90 percent to 95 percent of persons diagnosed with high blood pressure (Interhealth, 2007). On average, the labile (M=22.6) and essential (20.6) groups gave fewer responses than did a control group (M=27.6). Kamieniecka also observed a lower percentage of anxious content among the hypertensive groups. A year later, Safar and colleagues (Safar, Kamieniecka, Levenson, Dimitriu, & Pauleau, 1978) discovered that hypertensive patients gave fewer responses, increased popular responses, more global responses, fewer detailed responses, increased Form answers, increased Color-Form response, decreased Whole Human content, increased Whole Animal content, and decreased scores on an anxiety index comprised of the number of instances when Anatomy, Sex, and Blood contents were identified. Descriptions of these variables are provided below.

To begin, Form represents one of the seven broad categories of determinants. In general, determinants are used to denote the features of the inkblot that are perceived to represent the object described by the examinee. It involves complex cognitive-perceptual processes and is believed to be influenced by the habits, personality, and/or the psychological state of the individual at the time of administration. The Form coding is used for responses based exclusively on the form features of the blot, which is one broad way that the stimulus field may be translated by the examinee. Another determinant category is Color-Form; it is used for answers based on the chromatic color features of the blot. The sequencing of Color preceding Form indicates that Form is of secondary importance to the color perception of the object. By and large, articulation of color suggests affective expression.
Content coding refers to the category in which the identified object belongs. Responses involving a whole human form are believed to reflect an interest in people. Another coding category involves a whole animal form, which often is considered an indication of simplicity. As stated above, an anxiety index used in one study was comprised of three content categories: Anatomy (responses in which body parts or structures are described), Sex (responses involving sex organs, or activity of a sexual nature), and Blood (responses of blood, either human or animal).

These studies were often exploratory in nature, riddled with contradictory findings, did not incorporate tests of significance, and used different Rorschach systems. However, one robust finding emerged: Patients with coronary heart disease gave a fewer number of responses (Bertrán, 1996). Again, a few possible explanations for this finding include examinee defensiveness, difficulty coping with a complex task demand, and less cognitive flexibility (i.e., divergent thinking).

Kemple (1945) investigated whether persons experiencing physical illness would show psychopathology to a similar degree as persons experiencing mental illness. He saw hospital patients as showing more neurotic attributes, and that the severity of disease was moderated by the number of defenses (i.e., fewer defenses resulted in greater disease severity). In particular, Kemple interpreted the Rorschach profiles of coronary occlusion patients to show aggression, ambition, and working tirelessly towards power and prestige. This reliance on external gains for satisfaction and security was related to their extratensive style and subsequently, their limited capacity for introverted experiences and creative thought. Emotions tended to be externalized, albeit rationalized, as in the case of aggression.
Using the Klopfer system (Klopfer, Ainsworth, Klopfer, & Holt, 1954) for scoring the Rorschach, Miles, Waldofoigel, and Cobb (1954) similarly found persons who suffered MI before the age of 41 to produce fewer responses in relation to a control group. Because time of administration ranged between 10 months and 23 years after the event, any proposed relationship was unstable. Additionally, it was also the case that the MI group was significantly less intelligent, which also covariates with the number of responses.

The following two studies are the most relevant for the present investigation. Cleveland and Johnson (1962) compared a group of male MI patients to two control groups; one consisted of patients about to undergo cardiac or pulmonary surgery, and the other of Tuberculosis patients. Half of the 10 Rorschach variables differed significantly from the control groups. Specifically, MI patients evidenced more hostile content in their protocols as measured by Elizur’s Hostility Scale (1949). They also exhibited more white space, penetration, death fantasies, and anxiety.

The CS was first used to study CHD by Exner, Thomas, Cohen, Ridgeway, and Cooper (1981). The Rorschach was administered to both MI patients and post-operative orthopedic patients one to two days prior to being discharged from the hospital. Among patients who suffered an MI, more Inanimate Movement and Shading responses were observed in their Rorschach protocols. As the name implies, the former variable is used to identify responses in which a non-living object is in a state of movement, or in an unnatural tension state. The latter variable is used for responses that are based, in part, on the light-dark features of the blot and do not signify either texture or dimension. Both are believed to indicate situational stress experienced by the examinee, in particular, the
inundation of “frustrating, and free floating impulses that are beyond his or her control” (Perry et al., 1995, p. 457). Interestingly, these differences were not found during a follow-up administration 3 to 4 months later. Given that these patients had experienced a potentially lethal event, and were at immediate risk for suffering a second MI, the presence of these variables presumably captures the fragility of the patient’s mental state after experiencing a potentially lethal event.

Tuset (1990) also used the Comprehensive System to examine personality characteristics of persons who would go on to develop a subsequent MI. All of the fifty participants in the study had experienced a MI before the age of 65. Each was interviewed and administered a Rorschach during their hospitalization. Medical tests and clinical diagnosis were both used to evaluate the extent and seriousness of MI, and its course of development at 3 months, 1 year, and 5 years. Again, it was found that participants generated fewer responses than the normative average. Other interpretations of the data suggested that participants exhibited minimal ideational capacity and restrained affective experience. When affect was expressed, it tended to be spontaneous and poorly moderated by cognitive processes. Interpersonal relationships were also shown little attention, and information was processed in a simplistic and concrete manner. Their vision of reality was stated to be ego-centric and skewed. In contrast to Exner et al.’s (1981) earlier study, Inanimate Movement and Shading were not elevated at hospitalization, nor did they evidence a similar pattern of decline 3 months after the MI, though Anatomy + X-Ray (i.e., coded when content refers to x-ray, skeletal, or organs) and the Depression Index were significantly lower than at baseline. Together, variables Anatomy and X-Ray are an index of bodily concern and anxiety related to the body.
With regard to ideational capacity and perceptual accuracy, Acklin and Alexander (1988) also documented findings that were contradictory to later work (Tuset, 1990). They performed a discriminant function analysis of Rorschach data collected from four psychosomatic samples. Development of a second MI was predicted by variables Human Movement and a measure of perceptual accuracy, where the greater the frequency of such variables, the worse the outcome. To code Human Movement, activity must be occurring that is limited to human behavior only, thus, “A bear playing poker”, or “A very happy tree” (Exner, 2001; p. 35) are scored, in addition to all types of human activity. This variable may be suggestive of intelligence, and also introversion.

Though important, these two studies lack a critical component of methodological rigor, namely, that no baseline-data were collected on these patients (Bertrán, 1996). All measurements, including the one immediately following the MI, is considered follow-up.

Rorschach assessment of hostility related constructs. The Rorschach provides a unique method for understanding aggression as a personality construct. The CS Aggressive Movement (AG) score, which is assigned for aggressive actions taking place in the present, is routinely applied in clinical practice as part of CS scoring procedures. Alternative, specialized scales that go beyond the aggression information provided by the CS have also been used in Rorschach assessment and research (e.g., Gacono & Meloy, 1994). The idea behind these scales is that certain types of aggressive imagery are not captured by AG criteria. Empirical evidence has also suggested the need to move beyond global measures of aggression/hostility and begin to discriminate among the various types (Crain & Smoke, 1981). One popular example is the extended aggression variables devised by Gacono and Meloy (1994), which have been supported by good reliability and
validity (Baity & Hilsenroth, 1999; Gacono, Bannatyne-Gacono, Meloy, & Baity, 2005). Other relevant aggression measures include those developed by Elizur (1949) and Holt (1954). Because of their longevity, they have accumulated an impressive body of research. Thus, there is evidence supporting the use of several different aggression measures in scoring Rorschach imagery (Gacono et al., 2005; Katko, Meyer, Mihura, & Bombel, 2009).

Aggressive Movement. The AG is included as a special score within the CS (Exner, 2003). It includes any response in which there is movement that is clearly aggressive and that occurs in the present (e.g., "its two bears fighting"). Meyer et al. (2002) found an average ICC reliability value of .90 across 219 protocols in regard to AG.

Extended Aggression Indices. In 1992, Meloy and Gacono expanded upon Exner’s AG coding by publishing a preliminary article outlining four categories to quantify aggressive responses: Aggressive Content (AgC), Aggressive Potential (AgPot), Aggressive Past (AgPast), and Sado-Masochism (SM). The first score, AgC, is coded if any of the content is “popularly perceived as predatory, dangerous, malevolent, injurious, or harmful” (p. 105). An example of AgC would include, “an arrow.” If the response signals an aggressive act is about to occur or is imminent it is coded for AgPot. An example of AgPot would include “Two little alien creatures… being threatened to have their catch taken away from them by crab-like creatures, real predators… they don’t know these crab creatures are going to lop their heads off” (p. 105). Responses that indicate an aggressive act has occurred or the object has been the target of aggression is scored Aggressive AgPast. Instances when AgPast would be coded include, “Looks like a
bug here that somebody used a drill press on” (p. 105). The subject scores the final variable, $SM$ when devalued, aggressive, or morbid content is accompanied by pleasurable affect by the subject. Laughing after a response such as “A lady dancing and she got her head blown off” would be scored $SM$” (p. 107). Because scoring this variable requires that an examiner record the examinee’s expressed affect during the response, and given that this information was not consistently recorded as part of the Precursors Rorschach administration, $SM$ will not be scored in the present study. Ultimately, these variables have been supported by good reliability (Baity & Hilsenroth, 1999; Gacono et al., 2005) and are considered by many to be a useful supplement to the Rorschach and the CS. Regarding interrater reliability, Gacono et al. (2005) combined the mean reliability values across six studies. The lowest observed mean kappa/ICC was .84 ($AgPast$), while the lowest mean percent agreement was .86 ($AgPot$).

Elizur Hostility Scale. The instructions for scoring the Elizur Hostility Scale were first outlined in Elizur (1949), as part of a larger theoretical framework for scoring Rorschach imagery. Termed the Rorschach Content Test, the broader measure contains a parallel set of instructions for scoring anxiety content. Elizur’s instructions are reported to be the most widely-used system for scoring hostility (Goldfried, Stricker, & Weiner, 1971). There are several other hostility scales that were based at least in part on Elizur's work (see Katko et al., 2009), including the hostility score that is formally incorporated into scoring the Holtzman Inkblot Test (Holtzman, 1961), as well as the Rorschach Hostility System (Murstein, 1956). As previously mentioned, Cleveland and Johnson (1962) used the Elizur Hostility Scale to measure hostile content in the Rorschach protocols of male MI patients and two control groups (i.e., one undergoing cardiac or
pulmonary surgery and the other being treated for Tuberculosis). They observed that MI patients evidenced more hostile content in their protocols as measured by Elizur’s Hostility Scale (1949). An meta-analytic review by Katko et al. (2009) found reliability values of substantial magnitude for the Elizur Scoring Systems both at the summary-score level \((r = .91; N = 1,279)\) as well as in subsamples \((n)\) at the response-level for exact agreement \((kappa = .89, n = 600, percent agreement = .94, n = 10,353)\).

Three levels of hostility exist within Elizur’s original scoring. Responses that evidence direct expression of hostility are scored Strong Hostility \((H)\) and assigned a value of 2. They include clear-cut instances of hatred, dislike, criticism and derogation. Responses that are less direct and vague that contain hostility to a smaller degree are scored Lesser Hostility \((h)\) and assigned a value of 1. The third level of the scale pertains to those responses that are neutral and cannot be scored for hostility, which are assigned a value of 0. After a protocol has been scored all hostile response points are tabulated into a summary score representing the total hostility of the subject.

Primary and Secondary Aggression variables. Holt’s Primary \((A1);\) Holt, 2005) and Secondary Aggression variable \((A2)\) are contained within a larger organization known as the pripro system, which is short for Primary Process scoring system. Primary and Secondary Process has its roots in psychodynamic theory. Freud was interested in categorizing an individual’s thinking as more id or ego driven. Thoughts that were whimsical, illogical and unrealistic were categorized as Primary Process. Alternatively, thinking that was more pragmatic, grounded and logical was labeled as Secondary Process. In the pripro system, responses that evidence aggressive Primary Process drives are scored Level 1; responses that reflect aggressive Secondary Processes are scored
Level 2. These categories are not thought of as discrete points. They are better understood as positions that depict qualitative differences in drive expression (Holt, 1966).

Reliability evidence (Katko et al., 2009) at the summary-score level reliability ($r = .84; N = 226$) and response-level for exact agreement ($kappa = .73, n = 3,361, \%A = .89, n = 1,943$) were also good.

The array of aggression-related measures in the Rorschach literature has likely fostered “confusion, redundancy, or inconsistencies” in research and clinical practice (Baity & Hilsenroth, 1999, p. 97). On the surface, conceptual and empirical overlap among these different approaches to scoring aggression is evident. Research suggests however, that aggression variables from the Exner, Gacono and Meloy, and Holt scoring systems form two distinct types of aggressive responses in factor analyses (Baity & Hilsenroth, 1999; Liebman, Porcerelli, & Abell, 2005). Factor I can be conceptualized as a propensity to describe the consequences of intense, primitive and blatant forms of aggressive activity (defined by the $A1$ score, $AgPast$, and CS Morbid variable ($MOR$)).

The $MOR$ score refers to objects identified as “dead, destroyed, ruined, spoiled, damaged, injured, or broken” (Baity & Hilsenroth, 1999, p. 106), in addition to objects for which dysphoric features are ascribed. By contrast, the Factor II can be conceptualized as a propensity to identify aggressive instruments and frightening or dangerous people and animals (defined by $AgC$, $A2$, and to a lesser extent $AG$). What is not clear is the extent to which Elizur’s hostility construct contributes unique or shared variance with the existing factor analytic research.

Empirical research that correlates multiple Rorschach aggression and/or hostility variables with self-reports of aggression is limited. Mihura et al. (2003) showed
significant and positive associations between self-reported aggression and the Rorschach aggression variables $AgC$, $AgPast$, and $AgPot$, but not $AG$, among a sample of undergraduate students. Two other studies demonstrated that one or more aggression variables were significant predictors of behavioral aggression both in adult (Baity & Hilsenroth, 2002) and adjudicated adolescent samples (Liebman et al., 2005). In each of these studies, a rating scale of aggressive behavior was used to code the level of violence reported in participants’ intake reports.

Also unclear, is the extent to which Rorschach scores of aggressive imagery are manifest through implicit processes and are not redundant with self-report measures of aggression related constructs. If research suggests that the self-report methods and Rorschach-based methods do indeed measure different components of aggression-related personality constructs then it would be most appropriate to incorporate an integrative typology in the assessment when aggression relates to the assessment question (Bing et al., 2007), in particular, one that combines Rorschach and self-report measures. This is because persons who express more latent (i.e., self-deception) forms of aggression, or who purposefully disavow aggression for social desirability (i.e. impression management) are unlikely to be identified using traditional self-report methods alone. Conversely, but in the same way, persons who do not harbor an implicit aggression motive, but perceive themselves as behaving aggressively, are unlikely to be identified by only using Rorschach-based assessment (e.g., Bing et al., 2007).

Precursors Study. Presently in its sixth decade of operation, the Johns Hopkins Precursors Study continues to amass an impressive amount of data from its aging cohort. From this extensive database, clues to solving important scientific mysteries (e.g.,
etiology of cancer, heart disease) may await discovery. Launching this colossal project was physician and visionary Caroline Bedell Thomas. In 1946, Thomas began collecting medical and psychosocial information from first-year medical students attending Hopkins Medical School. For the next 18-years, Thomas obtained baseline data from 1,337 medical students, who volunteered their time, and their physical comfort (e.g., when administered the cold pressor test) for the benefit of society. Several dozen investigators have made use of the some 6,000 variables collected at baseline to examine a variety of relevant topics in medicine, psychology, and public health. A few of the Precursors Study’s most substantial contributions include knowledge that cholesterol levels at age 22 are a good predictor of future health, while blood pressure levels at this age are not (The Johns Hopkins University, 1999).

Hypertension and coronary heart disease are popular topics of research in the Precursors Study. Thomas and Greenstreet (1973) examined psychobiological predictors of disease. Among the participants diagnosed with hypertension at ‘mid-life’ (i.e., 30-55 years), they observed increased blood pressure (resting DBP and SBP), increased heart rate, increased relative body weight (i.e., height divided by the cubed root of weight), and greater alcohol frequency at baseline, relative to a normal group, and other negative outcome groups (i.e., suicide, mental illness, coronary occlusion, tumor). A coronary occlusion group demonstrated the lowest SBP, with greatest SBP rise on the cold pressor test. During this test, individuals immerse their hand in cold water for two or more minutes in order to dramatically increase blood pressure. This group also showed increased cholesterol level, gave the fewest number of Rorschach responses, and smoked the most cigarettes daily. Though the fewest number of Rorschach responses seems
consistent with other research (Bertrán, 1996), the mean ($M = 34.29$) for the medical students in that study was in line with the normative average for adults ($M = 32.65$).

Another ‘midlife’ Precursors Study investigation of physician health was conducted 7-years later. Thomas, Santora, and Shaffer (1980) found mean alcohol consumption to be significantly greater in the CHD group, in comparison to other disordered groups and a healthy group. This difference was found only at the 20-year follow-up, when participants were 45 years or older, and not at baseline, nor at the 10-year follow-up. The authors mentioned that a long-term causal relationship between mean alcohol consumption and CHD was implausible; they did not attempt to offer any further interpretations. Nevertheless, a link between alcohol use and CHD was observed. It was also found that the hypertension group had smoked cigarettes for several more years, and to a greater extent (i.e., 20 or more cigarettes daily), than had the control group. The CHD group had also smoked for more total years than had their controls. There was also a positive significant difference in mean coffee consumption for the hypertension group, but only at the 10-year follow-up.

Research Questions

The link between Rorschach hostility related constructs and CHD (Cleveland & Johnson, 1962; Defourny et al., 1972) is at best tenuous. Nevertheless, the literature on repressive coping styles (Weinberger et al., 1979) and illusory mental health (Shedler et al., 1993) suggests that indirect methods are available for detecting persons that are suppressing or repressing negative feelings that presumably result in chronically elevated physiological responding and serious physical illness, but who may appear psychologically healthy, and/or non-aggressive on self-report scales. Furthermore,
Rorschach research (Baity & Hilsenroth, 1999; Liebman et al., 2005) has taken some initial steps towards disentangling the jumble of aggression measures. The current study builds on these ideas, and sets out to examine whether implementing an integrative model of personality in the assessment of hostility/anger/aggression that combines explicit and implicit measures, can most effectively predict premature CVD and CHD in the Precursors sample of male physicians followed over several decades. Even though the Rorschach and HNT assessed constructs are rather global and are conceptually better understood as measuring hostility-related constructs, for simplicity sake, they will be more narrowly referred to as assessing hostility.

Integrative models of personality have been promising in industrial-organizational research (Bing et al., 2007; Frost et al., 2007), but research is still in its infancy. Associations between self-reported anger reactions to stress and increased risk of premature CVD and CHD have already been identified in the Precursors sample (Chang et al., 2002). This should reduce uncertainty about the ability of this investigation to detect a positive effect, despite not having any direct evidence linking the integrative assessment model of implicit and explicit hostility-related constructs to CVD and CHD.

As mentioned, the factor analytic research of Rorschach aggression variables (Baity & Hilsenroth, 1999; Liebman et al., 2005) has identified a 2-factor model of aggression. For instance, persons who score high on Rorschach aggression Factor II (Baity & Hilsenroth, 1999), may channel their aggression in more directly confrontational ways, either by competition, challenging a peer, lashing out at others when angered, or using physical or verbal intimidation to seek a specific end or outcome. This may arise from their view of a cutthroat world, in which success of goals and/or
satiating one’s needs are achievable by “any means necessary.” Alternatively, for persons high in Rorschach aggression Factor I (Baity & Hilsenroth, 1999), they may implicitly perceive their environment as dangerous evaluating others as malevolent, punishing, and their environment as unpredictable. Consequently, these persons may have low self-efficacy, perceived themselves as victims, and exude a despondent attitude about the future. In comparison, Rorschach aggression Factor I is likely capturing expressions of a distinctly different construct. One that is suggestive of a depressogenic attributional style, but nevertheless, one that would plausibly be associated with CVD and CHD.
Before presenting hypotheses, an integrative model of hostility is presented. To better conceptualize the integrative typologies, it is helpful to refer to Figure 1. In the upper-right of Quadrant II are persons high in both explicit (self-reported) and implicit (Rorschach-assessed) hostility, reflecting a congruency between assessment methods.

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### Figure 1. Integrative Model of Hostility

*Note.* Figure is partially drawn from James and Mazorelle (2002) and Frost et al. (2007)
These persons describe themselves as hostile, and because implicit components are in place, persons may be inclined to construe situations as threatening and/or view others as mean, non-social, and dishonest. Consequently, they should be less inhibited in showing hostility towards others, or in monitoring their temper, resulting in interpersonal combativeness or the use of intimidation tactics. Individuals in this group should experience prolonged autonomic arousal due to explicit and implicit components in place.

Quadrant III in the lower-left also reflects a congruency of explicit and implicit personality. In this case however, it is typified by the absence of explicit or implicit hostility-related constructs. Individuals in this Quadrant view themselves as non-aggressive, affable, agreeable, helpful, and not overburdened or purposefully frustrated in ways that promote negative or aggressive behavior. Instead, they are likely to act in prosocial ways that deescalate or inhibit conflict. These individuals should have the least physiological reactivity within the sample because of the absence of explicit and implicit components.

By contrast, the other two quadrants depict incongruities between explicit and implicit personality. In the upper-left, Quadrant I contains individuals who view themselves as non-aggressive, hostile, or irritable, but nonetheless have Rorschach-assessed implicit hostility-related characteristics. To maintain this self-view, such people may engage in subtle, passive-aggressive ways that are not clearly identifiable as aggressive or hostile when agitated. Due to the incongruence between explicit and implicit hostility-related constructs, these persons are most similar to individuals with a repressive coping style (Weinberger et al., 1979), and should be characterized by having the highest autonomic reactivity, and associations with premature CVD and CHD.
Lastly, are the persons who are represented by the lower-right Quadrant (IV). This includes individuals who may describe themselves as irritable, angry, hostile, emotionally volatile, or coping poorly with stress, but are not predisposed to perceiving interpersonal slights, or environmental obstacles. Rather, these individuals may “act tough” or “pissed off” in a demonstrative fashion (e.g., bravado, attention seeking). Such behavior may produce autonomic arousal, though to a lesser degree than persons who possess the implicit component.

Hypotheses

1. Persons defined by Quadrant I (high Rorschach-assessed hostility but low self-reported hostility) will experience the greatest physiological demands due to an incongruence in their implicit and explicit hostility, thereby making them more inclined towards repressing or suppressing negative emotions. It is believed that they have a propensity for implicitly perceiving unjust situations, or towards experiencing frustration, aggression, and hostility, but because it is inconsistent with their self view, they are unlikely to engage in overt acts of hostility or anger. Instead, they may be seen by others as passive aggressive, and most inclined to repress or suppress their hostility-related proclivities.

Drawing from Gross and Levenson (1993), emotional inhibition is viewed as an active, effortful event during which “inhibitory processes are recruited and then pitted against ongoing emotional responses.” It is this counterpoising of attempts to inhibit expression against strong impulses to express that the physiological impact of emotional suppression is cultivated. This leads to the prediction that participants who inhibit ongoing hostile/anger-expressive
behavior should show greater signs of physiological activation than persons who do not engage in emotional inhibition. This group will show a positive relationship with the covariates assessed at baseline, midlife, and late-life. It should be mostly closely associated with the development of premature CVD and CHD.

2. Persons defined by Quadrant II (high Rorschach-assessed hostility and high self-reported hostility) will also exert physiological effort, since they too have a propensity for perceiving unjust, threatening, or frustrating situations. Because it is consistent with their self view, they are less inhibited in expressing hostility or anger. Though expressed hostility too has been linked to greater physiological reactivity, it is not hypothesized to be as damaging as repressive coping. Absent consistently active and effortful inhibitory processes, it seems that persons who carry out impulses to express hostility-related behaviors should be less physiologically compromised than persons defined by Quadrant I. Nonetheless, this subtype will be positively correlated with baseline covariates and predictive of midlife and late-life criterion variables as well as premature CVD and CHD.

3. Persons defined by Quadrant IV (low Rorschach-assessed hostility but high self-reported hostility) may actively express their anger and hostility, since it is consistent with their self view. However, because they do not have an implicit propensity for perceiving unjust, threatening, or frustrating situations, they are less likely to experience negative affect. Nevertheless, they may have increased physiological activity by feigning hostile, or demonstrative
behaviors, and so this subtype will also be positively correlated with baseline covariates, and it should be a significant predictor of criterion variables and morbidity, though both to a lesser degree than the above Quadrants.

4. Persons defined by Quadrant III (low Rorschach-assessed hostility and low self-reported hostility), are unlikely to express anger and hostility, since it is inconsistent with their self view. They also do not have an automatic propensity for perceiving unjust, threatening, or frustrating situations, and should have the least physiological reactivity. This subtype will be not be correlated with the baseline covariates, nor should this typology significantly predict criterion variables and morbidity.
Chapter 2

Method

Participants

Participants were medical students attending Johns Hopkins University from years 1946-1964. Not included in this original sample of 1,337 members of the graduating classes of 1948 to 1964, were those who did not sufficiently complete questions about anger reactions to stress in medical school \((n = 133)\), those who were diagnosed with CVD prior to graduating \((n = 2)\), and finally, those who died during medical school, or were not able to be reached for follow \((n = 26)\). Additionally, not all Rorschach protocols at baseline were administered individually (Beck, 1945); a group format (Harrower & Steiner, 1951) was also used. Beck administration produces more responses and more variability in the number of responses \((R)\) than is currently observed with CS guidelines, with \(R\) in this sample ranging from 8 to 156 \((M = 34.2, SD = 20.2)\). To contend with this variability, as well as the fact that inquiry was less complete than current standards, only protocols with an adequate number of responses (i.e., \(R \geq 18\) were retained. In addition, only the first five responses to any card were used. After making these adjustments, both the individual and group administrations were analyzed for statistical differences using the Beck scores that had been assigned to the protocols. It was found that the group administration produced results that deviated substantially from the individual administration, with moderate to large differences (Cohen's \(d > .60\)) indicting more form-dominant color, more diffuse shading, more blends, fewer pure form responses, fewer popular responses, and worse perceptual accuracy scores. Subsequently,
it was decided to only retain the 453 remaining individually administered Rorschach profiles. In addition, the small portion of women in the sample was excluded. Of the cases that remained, one did not have a CVD survival score recorded for it, so it too was excluded. In the end, this left 415 men whose data were included in the analyses. However, the final n for the main analyses (i.e., Cox regression) was 376; cases not containing both explicit and implicit data were dropped. Average age of participants at baseline was 25 years. Participants were followed up for 2 to 59 years after graduation. Thirty-seven men developed premature CVD (i.e., before age 55-years). Of these, 23 were diagnosed with premature CHD. Additionally, 137 men developed CVD after the age of 55. With regard to ethnicity, this sample is almost completely homogenous and 411 of the 415 men to be studied are European American.

As mentioned earlier, meta-analytic effect size estimates for self-reported hostility and CVD have ranged in magnitude from small to very small. With regard to prospective studies, Booth-Kewley and Friedman (1987) found a combined effect size of $r = .14$ across 3 studies, while Miller et al. (1996) reported a weighted mean $r = .08$ across 9 studies. With 376 participants in the main analyses for this study and alpha set at .05 in a two-tailed test, there was 80% power to detect an $r = .14$ and 50% power to detect an $r = .10$. Thus, the ability to detect a very small effect size (should a relationship exist) was compromised.

Procedure

The two independent predictor variables for the present study, Rorschach aggression-summary scores (i.e., implicit) and self-reported anger (i.e., explicit), were
scored on an ordinal scale. Information collected on implicit and explicit measures were obtained at baseline. Follow-up data concerning CVD and CHD outcomes in relation to the explicit measure have been published although data are not specifically available for the implicit measure. The former consisted of self-reports of anger reactions to stress, as measured by the Habits of Nervous Tension (HNT) questionnaire (see explicit measure description below). To measure implicit hostility, a constellation of Rorschach variables were chosen from various scoring systems: \textit{AG}, \textit{A1}, \textit{A2}, \textit{AgPot}, \textit{AgPast}, \textit{AgC}, \textit{H}, and \textit{h} (Elizur, 1949; Exner, 2003; Gacono & Meloy, 1994; Holt, 2005). These variables were used to score hostile and aggressive imagery in Rorschach responses.

As mentioned previously, research (Baity & Hilsenroth, 1999; Liebman et al., 2005) indicates that aggression variables from the Exner, Gacono and Meloy, and Holt scoring systems form two distinct types of aggressive responses in factor analyses. However, what is not certain is the extent to which Elizur’s two hostility content scores of \textit{H} and \textit{h} fit into this factor analytic research. To address this research question, 225 Rorschach protocols were randomly selected and scored for aggressive-related imagery using the following variables: \textit{AG}, \textit{MOR}, \textit{A1}, \textit{A2}, \textit{AgPast}, \textit{AgC}, \textit{H}, \textit{h} (Elizur, 1949; Exner, 2003; Gacono & Meloy, 1994; Holt, 2005). To determine the degree of confidence in the author’s scoring, 20 protocols were randomly selected and independently scored by three independent coders. Four of the variables were scored by G.B. (\textit{A1}, \textit{A2}, \textit{H}, \textit{h}), three by G.M. (\textit{AG}, \textit{MOR}, \textit{AgPast}) and two by J.M. (\textit{AgC}, \textit{AgPot}). Interrater reliability was evaluated by calculating the exact agreement intraclass correlation (ICC) for a single rater under a one-way random effects model. Cicchetti’s (1994) rule of thumb for interpreting
ICC is applicable here: values greater than .74 are considered to indicate excellent reliability, values ranging from .60 to .74 are considered good, values below .40 to .59 are considered fair, and values below .40 are considered poor. A minimal reliability standard of .60 was adopted.

Data for all variables were entered into a PCA in order to ascertain the most comprehensive, empirically refined aggression indexes. Variables not contributing any unique variance were discarded. Based on the results, a decision was subsequently made to score the most non-redundant variables in the remaining sample of protocols.

As in the case of the Rorschach aggression variables, an ample pool of possible covariates was available for examination in this study. Several were omitted from the outset based on logical grounds. For instance, DBP and SBP are highly interrelated. If each were included in a multiple regression model, the subsequent results likely would have been confounded by problems of multicollinearity. For this reason, it was decided to omit DBP rather than SBP as a predictor variable since the latter has demonstrated stronger associations with CVD in the medical literature (He & Whelton, 1999). However, DBP was retained as a criterion variable at midlife.

All covariates were measure at baseline and will be defined generally according to an earlier Precursors Study investigation of CVD (Chang et al., 2002). A subset of covariate variables were also measured at various times during follow-up. BMI was defined as weight in kilometers divided by the square of height in meters according to a dimensional scale. Cholesterol (i.e., hyperlipidemia) was assessed by levels of serum cholesterol on a dimensional scale. Smoking, or Number of Cigarettes, was measured on
an ordinal scale based on the number of cigarettes smoked daily. The categories were as follows: None = 0, 1-10 = 1, 11-19 = 2, 20-39 = 3, and 40+ = 4. An ordinal scale was also devised for measuring the frequency of alcohol use, Alcohol Usage. The variable was classified as follows: None (non-drinkers) = 0, non-regular drinker = 1, regular drinker = 2. Readings for resting SBP, and heart rate were assessed on a dimensional scale. Activated blood pressure was assessed according to the response of SBP (SBP Response) to a standardized cold pressor test. Similarly, activated heart rate (Active Heart Rate) was measured via the heart rate response to a Master’s two step exercise test.

Traditionally, hypertension is examined by dichotomizing the data into hypertensive and non-hypertensive groups, where a reading of 160/105 pressure units (mm Hg) or greater, or alternatively, 140/90 mm Hg on at least 2 readings 1 week or more apart, constitutes a hypertensive coding. Though these cut-points are routinely applied in medical research, and may be meaningful in some instances, in reality, blood pressure exerts a moderating influence on health. In other words, the greater the blood pressure reading, the greater the health risk. Following this logic, blood pressure readings were assessed on a dimensional scale. This allowed the analyses to retain statistical power and sensitivity.

Parental premature CVD was defined as paternal development of morbidity before the age of 55 years (Father Premature CVD), or maternal morbidity before age 65 years (Maternal Premature CVD). Accordingly, the same two cut-offs (i.e., age 55 years and age 65 years) was used to define premature CVD and CHD for participants.
A new hypothetical covariate, parental occupation, was included in the present study. This decision was influenced by the negative associations that are commonly found between low SES and CHD (Williams & Williams, 2006), a natural byproduct of the increased institutional obstacles, pressures, and (most importantly) stress that disenfranchised individuals encounter every day. Database records regarding family of origin income were not immediately available for study. In its absence, obtainable data on parental occupation was believed to represent an incomplete, if not indirect measure of SES. Paternal (Paternal Occupation) and maternal occupation (Maternal Occupation) were categorized and coded according to an ordinal scale as follows: Laborer/housewife = 0, farmer = 1, clerical = 2, operative = 3, craftsman= 4, service worker = 5, sales worker = 6, manager = 7, physician or professional = 8. Importantly, these covariates are distinct in the sense that they represent non-selected influences of heredity and circumstance respectively, rather than personal life-style choice. Further, the impact these variables exerted on health were plausibly active since birth.

Both hostility measures were used to predict various midlife and late-life criterion variables. For the former, summary variables for BMI, SBP, and DBP were created by aggregating scores across two different, 10-year age spans (i.e., 30-39 years and 40-49 years) to create the following variables: DBP: 30-49-year-old; SBP: 30-49-year-old; and BMI: 30-49-year-old. Additionally, smoking was assessed at the 20-year follow-up (Number of Cigarettes: 20-year follow-up) using the same ordinal scale that was used to at baseline based on the number of cigarettes smoked daily (i.e., none = 0, 1-10 = 1, 11-19 = 2, 20-39 = 3, and 40+ = 4). A summary alcohol variable, Alcohol Total, was also
created. It was assessed on a dimensional scale quantifying the total number of alcohol drinks consumed per week in each of the following years: 1978 (Alcohol Consumption: 1978), 1986 (Alcohol Consumption: 1986), 1989 (Alcohol Consumption: 1989), 1997 (Alcohol Consumption: 1997), and 2003 (Alcohol Consumption: 2003). All were pooled to form a single summary variable. Late-life criterions were limited to BMI, DBP, and SBP assessed in the 50-59-year-old range (BMI: 50-59-year-old; DBP: 50-59-year-old; SBP: 50-59-year-old).

CVD was defined as follows: CHD–MI, sudden death, chronic ischemic heart disease, and other coronary disease that required coronary bypass surgery or percutaneous coronary interventions; (non-CHD) hypertensive heart disease; congestive heart failure; cerebrovascular disease; atherosclerosis; aortic aneurysm; peripheral vascular disease; and arterial embolization. For CVD and CHD diagnosed, it had to have been assessed by an inventory checklist of medical conditions, or alternatively, through medical records submitted by participants or their medical providers. Throughout follow-up, information on treatment was assessed; a committee of 5 physicians assigned diagnoses after reviewing all the treatment information.

Explicit measure. As mentioned previously, the Precursors Study required participants to report their reactions to stress. This information was obtained by means of the HNT. Devised by Thomas and psychiatrist Barbara Betz, the HNT is a questionnaire/checklist of 25 items, each of which is intended to represent individual responses to stress when under pressure (Graves & Thomas, 1981). Respondents are prefaced with the following question: *Whenever you find yourself in situations of undue*
pressure or stress, how do you usually react? Instructions then inform the respondent to underline all items/reactions that are indicative of their behavior. To score the HNT, all of the endorsed items are simply tabulated for the entire checklist. After completing this portion of the survey, respondents are then asked: Briefly describe your chief reactions to pressure or stress and the situations in which they most occur. Examples are included next to the question in parentheses such as, competitions, examinations, and family situations. Consistent with previous research using the HNT as a predictor of CHD/CVD (Chang et al., 2002), at this time, only the endorsed items were used. Median age of the sample at the time of HNT administration was 22 years.

Researchers at Johns Hopkins University performed the most recent Precursors Study (Chang et al., 2002) to use the HNT in examining CVD. Participants were 1055 men who had been followed up for 32 to 48 years ($M = 43$) after graduation. The authors’ aim was to ascertain whether anger responses to stress, as measured by the HNT, were associated with risk of premature and total CVD. Anger was defined as the number of endorsed anger reactions on the HNT, which consisted of 3 items: (1) “expressed or concealed anger,” (2) “irritability,” and (3) “gripe sessions.” Validity for this anger index was determined by its positive correlations with the Multidimensional Anger Inventory questionnaire, which was completed by 700 Precursors participants in 1988 (Chang et al.). Specifically, anger at baseline as measured by the HNT was significantly correlated about 40 years later with the following factor derived scaled scores on the Multidimensional Anger Inventory: Anger-In, Anger-Arousal, Hostile Outlook, Range of Anger-Eliciting Situations, and total Anger. Correlation coefficients ranged from .10 ($p =$
.007; Hostile Outlook) to .18 (p < .001; total Anger). Thus, the HNT Anger index seems to assess both affective (i.e., irritability) and behavioral components (i.e., gripe sessions) consistent with the earlier definitions of anger and aggression.

Data Analyses

To help organize the array of variable information, it is summarized below in Table 1.

Table 1

Summary of Variable Information

<table>
<thead>
<tr>
<th>Variable Type</th>
<th>Baseline Predictors</th>
<th>Baseline Covariates</th>
<th>Midlife Criterion</th>
<th>Late-life Criterion/Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensional</td>
<td>HNT AgC AgPast</td>
<td>BMI Cholesterol SBP</td>
<td>BMI: 30-49-year-old</td>
<td>BMI: 50-59-year-old</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SBP Response Heart Rate</td>
<td>DBP: 30-49-year-old</td>
<td>DBP: 50-59-year-old</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Active Heart Rate Alcohol Usage</td>
<td>SBP: 30-49-year-old</td>
<td>SBP: 50-59-year-old</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number of Cigarettes Father Occupation</td>
<td>Alcohol Total</td>
<td>Number of Cigarettes: 20-year follow up</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mother Occupation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dichotomous</td>
<td>Father Premature CVD Mother Premature CVD</td>
<td></td>
<td>Premature CVD</td>
<td>Premature CHD</td>
</tr>
</tbody>
</table>

Data were initially organized and screened for data entry error by generating a table with minimum and maximum scores, standard deviations (SD), means (M), and values for skew and kurtosis. Outlier analysis with DfBeta helped determine whether any extreme scores or values existed that would disproportionately influence the Cox regression results. Collinearity diagnostics were conducted to check for multicollinearity among the main predictors. By verifying the absence it was possible to show that Cox regression and hierarchical multiple linear regression models were free of these problems.
Moreover, the predictors in the Cox models were tested to see if they satisfied the assumption of proportional hazards.

Next, Pearson product-moment correlations were calculated between the explicit (HNT-hostility) and implicit (Rorschach hostility) personality variables. This calculation helped ascertain whether each assessment method measured “a different, if not, independent, component of personality” that is consistent with research (Frost et al., 2007, p. 1310). Thus, the correlation was expected to be near zero. Next, Pearson product-moment correlations were calculated to examine the relationships between the hostility measures (i.e., predictors) with each of the covariates. Statistical differences between the correlations obtained for implicit and explicit hostility were tested according to methods outlined by Meng, Rosenthal, and Rubin (1992).

The primary analyses concerned tests of the integrative model’s predictions regarding premature CVD and CHD. Because both are dichotomous dependent variables, hierarchical Cox regression was used rather than a hierarchical multiple linear regression model. It was also desirable because it has procedures available to test for the possible effects of covariates, independent variables, or predictor variables using the Cox proportional hazards model. The advantage of this procedure is that it can handle any number of covariates, treat continuous predictor data as continuous, and provide an estimate of magnitude of the difference in outcome based on differences on the predictor(s) (Norman & Streiner, 2000). Therefore, it was possible to examine several dimensional prognostic variables at once, such as the interaction of Rorschach-assessed aggression with self-reported anger while controlling for Alcohol usage, SBP, or any
other covariate. Separate analyses were run to examine the main effects for each proposed implicit predictor of hostility (i.e., AgC and AgPast). The number of HNT items (i.e., explicit), entered into a regression equation first, followed by the AgC or AgPast scores. In the third step, an interaction term was added to the model as the cross products of the centered independent variables. This procedure ensures that the data are modeled at a meaningful place among the data points. By setting the mean of the predictors to zero, the coefficients in a regression model determine the regression slope when the other values are held constant at their mean (i.e., at a value of zero).

Cox regression models were also constructed that adjusted for the effects of the baseline covariates using backward stepwise regression procedures. This particular strategy was implemented to avoid creating an excessively complex model, like having several covariates and a comparatively small dataset, in which case there is the possibility of “overfitting” the data. A backward stepwise regression procedure was used for the covariate-adjusted models. These regression equations differed from the previous ones in that it there were two blocks, beginning with forced entry of covariates and backward removal of non-significant contributors of baseline covariates on Block 1. With all non-significant predictors of morbidity removed from the model in an iterative process, the explicit, implicit, and interaction term predictors were added on Block 2.

Clinical Implications

Integrative models of personality are proving to be an exciting area of research within industrial-organizational settings (Bing et al., 2007; Frost et al., 2007). Applying integrative models of personality to other fields of psychology may also be fruitful. Two
such fields include health psychology and/or preventive medicine. It was hoped that the integrative models would benefit both healthcare providers and patients by improving the clinical accuracy at which CVD and CHD morbidity risks are measured in relatively healthy adults so that a wider range of responsive treatments can be offered earlier.
Chapter 3
Results

Principal Component Analysis

A PCA was conducted on the nine Rorschach aggression and hostility variables 
\((AG, MOR, A1, A2, AgC, AgPast, AgPot, H, h)\) that, on the basis of prior research, we 
believed would be most relevant to the hostility-related constructs. The PCA yielded a 
two-component model that was largely in keeping with past findings (Baity & Hilsenroth, 
1999; Liebman et al., 2005) consisting of the “aggression at objects” (Baity & Hilsenroth, 
1999, p. 104) and “aggressive objects” (p. 105) factors of aggression.

The Rorschach protocols of 225 males were drawn from the Precursor’s study and 
scored on all variables. Parallel analysis (PA) was used to determine the correct number 
of components to retain. In this procedure, components or factors are retained so long as 
the observed eigenvalues (EVs) are greater than the mean EVs of parallel components 
which are derived from random data having the same sample size and number of 
variables (Glorfeld, 1995; Hayton, Allen, & Scarpello, 2004). Rather than using the mean 
of the randomly generated EVs, the 95th percentile of each EV was used, as it has been 
recommended as a more stringent and accurate criterion for factor retention (Goldfried et 
al., 1971; Hayton et al., 2004). In this study, EV’s were generated from 100 randomly 
permutated datasets.

In a two-component solution, the components accounted for 58% of the total 
variance. An oblique rotation was performed with the first and second components. The 
correlation between the components was small \((r = .27)\) so an orthogonal–varimax
rotation was used to simplify interpretation of the results. Component 1 accounted for 31% of the total variance after rotation and was defined by $A2, AgC$, and $h$. This dimension reflects the production of responses containing hostile behavior, weapons, and aggressive instruments. Component 2 accounted for 27% of the variance after rotation and it was defined by $H, AgPast, MOR$, and $A1$; indicating damaged, harmed, or spoiled objects. These results suggest that the Elizur hostility variables share variance with the existing factor analytic research rather than contributing unique variance. Further details about the methods, procedures, and results of this study are described by Katko, Meyer, Mihura, and Bombel (in press). Based on the information provided in Figure 2, a decision was made to retain $AgC$ and $AgPast$ and apply these scores to the remaining sample of Rorschach protocols, as both consistently showed the best pattern of convergent and discriminant factorial validity. Each was separately utilized as the predictor variable for the implicit measure in the final analyses.
Figure 2. Components Plot of Aggression Variables in Three Samples (N = 225)

Interrater Reliability

As reported earlier, the sample for the final analyses was limited to males (N = 415) whose records contained Rorschach data and survival scores for CVD; the study author scored all protocols for AgC and AgPast. To compute interrater reliability, 20 protocols were originally randomly selected and independently scored for AgC and AgPast by J.M. and G.M., respectively, as part of the preliminary study (i.e., PCA). Using Cicchetti's (1994) benchmarks and the exact agreement ICC for a single rater
under a one-way random effects model, interrater reliability was excellent ($ICC > .74$) for each variable ($AgC = .91, AgPast = .76$).

Descriptive Statistics

Table 2 presents descriptive data for all predictor, covariate, criterion, and construction variables obtained at baseline and during the follow-up period. Nine percent ($n = 37$) of the participants in our samples acquired premature CVD with a mean age of onset of 48.43 ($SD = 6.53$). Within this group, 62% ($n = 23$) specifically developed premature CHD, with a mean age of onset of 48.74 ($SD = 4.86$). The average time to the onset of premature CVD and CHD from baseline assessment was 23.46 and 23.48 years, respectively. Cases not containing both explicit and implicit data were omitted from the main analyses, leaving a final $n$ of 376.

Table 2

**Descriptive Statistics for Study Variables**

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>$n$</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Skew</th>
<th>Kurtosis</th>
<th>Minimum/Maximum</th>
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</thead>
<tbody>
<tr>
<td>HNT</td>
<td>376</td>
<td>.45</td>
<td>.71</td>
<td>1.52</td>
<td>1.66</td>
<td>0/3</td>
</tr>
<tr>
<td>AgC</td>
<td>415</td>
<td>4.62</td>
<td>2.38</td>
<td>2.38</td>
<td>.58</td>
<td>0/14</td>
</tr>
<tr>
<td>AgPast</td>
<td>415</td>
<td>.43</td>
<td>.80</td>
<td>2.39</td>
<td>6.96</td>
<td>0/5</td>
</tr>
<tr>
<td><strong>Baseline Covariate Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBP</td>
<td>412</td>
<td>124.55</td>
<td>13.03</td>
<td>.421</td>
<td>.120</td>
<td>90/170</td>
</tr>
<tr>
<td>SBP Response$^c$</td>
<td>404</td>
<td>118.11</td>
<td>12.01</td>
<td>.33</td>
<td>.82</td>
<td>80/170</td>
</tr>
<tr>
<td>Alcohol Usage$^d$</td>
<td>376</td>
<td>.91</td>
<td>.43</td>
<td>-.51</td>
<td>2.12</td>
<td>0/2</td>
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<tr>
<td>Cholesterol</td>
<td>330</td>
<td>193.02</td>
<td>29.38</td>
<td>.61</td>
<td>1.44</td>
<td>121.78/314.58</td>
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<tr>
<td>Heart Rate</td>
<td>402</td>
<td>76.82</td>
<td>9.84</td>
<td>.61</td>
<td>.87</td>
<td>48/108</td>
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<tr>
<td>Active Heart Rate$^e$</td>
<td>397</td>
<td>103</td>
<td>23.15</td>
<td>.36</td>
<td>-.16</td>
<td>48/187</td>
</tr>
<tr>
<td>BMI</td>
<td>415</td>
<td>22.92</td>
<td>2.39</td>
<td>.61</td>
<td>1.42</td>
<td>15.61/33.94</td>
</tr>
<tr>
<td>Number of Cigarettes$^f$</td>
<td>392</td>
<td>1.06</td>
<td>1.24</td>
<td>.75</td>
<td>-.89</td>
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</tr>
<tr>
<td>Father Occupation$^g$</td>
<td>404</td>
<td>6.82</td>
<td>1.88</td>
<td>-.202</td>
<td>3.05</td>
<td>1/8</td>
</tr>
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<td>Mother Occupation$^g$</td>
<td>395</td>
<td>1.30</td>
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<td>1.82</td>
<td>1.50</td>
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<tr>
<td>Father CVD $&lt; 55^h$</td>
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<td>.09</td>
<td>.28</td>
<td>2.95</td>
<td>6.72</td>
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<tr>
<td>Mother CVD $&lt; 65^h$</td>
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<td>.11</td>
<td>.31</td>
<td>2.49</td>
<td>4.2</td>
<td>0/1</td>
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</tbody>
</table>

Midlife Criterion Variable
<table>
<thead>
<tr>
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<th>20-year follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI: 30-49-year-old</strong></td>
<td>406</td>
</tr>
<tr>
<td><strong>DBP: 30-49-year-old</strong></td>
<td>403</td>
</tr>
<tr>
<td><strong>SBP: 30-49-year-old</strong></td>
<td>403</td>
</tr>
<tr>
<td>Alcohol Total</td>
<td>364</td>
</tr>
<tr>
<td>Number of Cigarettes</td>
<td>368</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>20-year follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI: 50-59-year-old</strong></td>
<td>359</td>
</tr>
<tr>
<td><strong>DBP: 50-59-year-old</strong></td>
<td>356</td>
</tr>
<tr>
<td><strong>SBP: 50-59-year-old</strong></td>
<td>356</td>
</tr>
</tbody>
</table>

**Late-life Criterion Variable**

<table>
<thead>
<tr>
<th></th>
<th>20-year follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CVD by Age 55</strong></td>
<td>37</td>
</tr>
<tr>
<td>Age when CVD first detected</td>
<td>-</td>
</tr>
<tr>
<td>Time from Assessment to CVD</td>
<td>-</td>
</tr>
<tr>
<td><strong>CHD by Age 55</strong></td>
<td>23</td>
</tr>
<tr>
<td>Age when CHD first detected</td>
<td>-</td>
</tr>
<tr>
<td>Time from Assessment to CHD</td>
<td>-</td>
</tr>
</tbody>
</table>

**Note.** n refers to the number of cases who provided data on that variable.

a Administered at baseline. b Aggregate variable. c Response of SBP to a cold pressor test. d Ordinal Scale (0 = ‘None’; 1 = ‘Non-Regular’; 2 = ‘Regular’). e Master’s two-step exercise test-ECG. f Ordinal Scale (0 = ‘Non-Drinker’; 1 = ‘1-10’; 2 = ‘11-19’; 3 = ‘20-39’; 4 = ‘40+’). g Ordinal Scale (0 = ‘Laborer/Housewife’; 1 = ‘Farmer’; 2 = ‘Clerical’; 3 = ‘Operative’; 4 = ‘Craftsman’; 5 = ‘Service Worker’; 6 = ‘Sales Worker’; 7 = ‘Manager’; 8 = ‘Physician or Professional’). h Dichotomous Scale (0 = ‘No’; 1 = ‘Yes’). i Number of alcohol drinks consumed per week for years: 1978; 1986; 1989; 1993; 1997; and 2003.

**Diagnostics**

Univariate data such as the skew, kurtosis, maximum and minimum values were used to identify potentially erroneous entered values for all variables in this study. Next, DfBeta values were computed and evaluated for all cases the key predictors (i.e., HNT, AgC). This statistic measures the degree to which a given case for a given covariate will affect the regression coefficient. Higher values denote greater changes in the regression coefficient if the case is removed from the dataset. None of the DfBeta values was sufficiently large that it warranted exclusion of a particular case.

Multicollinearity is a condition in which two or more predictors are highly correlated in a multiple regression model. It is problematic because it signifies that at least one of the predictors is failing to account for any unique variance in the dependent variable and is thereby redundant. To measure how much variance in a predictor is
unique and not explained by others, Tolerance statistics are used. Like correlations, values can range from 0.0 to 1.0. Higher values indicate less commonality among the predictors while lower values indicate more overlap. To generate collinearity diagnostics a linear regression model with forced entry of all predictors and potential baseline covariates was run to compute and examine the respective Tolerance values, Variance Inflation Factors, and Variance Proportions (in this analysis the criterion was immaterial; the focus was on the association among the predictors; Garson, 2010). Multicollinearity was not a notable issue, with Tolerance values ranging from .27 to .96, and Variance Inflation Factors ranging from 1.038 to 3.719, which are within normal limits. However, the Variance Proportions indicated that there were several pairs of variables that shared large Variance Proportions (i.e., > .50) and that corresponded to large condition indices (i.e., > 30). In these instances there was obvious conceptual overlap between the two variables (e.g., parental occupation and parental education), and decisions were made to retain the less redundant one. In the end, 12 covariates remained for testing alongside the predictor variables.

A fundamental assumption of the Cox regression is that the ratio of hazards for any two cases is the same across all time periods. Put another way, if Person A is twice as likely to acquire premature CVD as Person B at the 5-year follow up given some difference in covariate value/scores, then their relative morbidity risks (i.e., 2 to 1) from that point remains unchanged. A popular procedure for testing the assumption of proportional hazards is the log minus log plot. However, this method is not recommended for models with multiple covariates or when a covariate is continuous (Garson, 2010).
Instead, Harrell’s rho was used to test for the proportional hazards assumption. This statistical test is based on the Schoenfeld residual for a particular covariate and the rank of survival time (Box-Steffensmeier & Jones, 2004). Results for all three predictor variables were non-significant.

Associations Between Main Predictor Variables

The HNT did not significantly correlate with either AgC, \( r(374) = -0.023, p = 0.654 \), or AgPast, \( r(374) = -0.011, p = 0.824 \). The very small and non-significant relationships observed between the explicit and implicit assessment methods are in line with research findings reviewed earlier. A small and highly significant correlation was observed between AgC and AgPast, \( r(413) = -0.201, p < 0.0001 \), suggesting some overlap in the type of imagery captured by these scores. However, it does not signify that the addition of a second implicit measure is redundant.

Associations Between Main Predictors and Baseline Covariates

Only three of the covariates correlated significantly with the predictor variables. The BMI was related to both the explicit, \( r(374) = 0.152, p < 0.01 \), as well as the implicit measure (AgPast), \( r(413) = -1.15, p < 0.05 \). A test for differences between the dependent correlations (Meng et al., 1992) was significant \( (p < 0.01) \). The negative correlation is noteworthy in that it suggests that greater AgPast scores are associated with lower percentages of body fat which is inconsistent with research (Nabi et al., 2008). Another unexpected finding was the negative correlation observed between SBP and AgC, \( r(410) = -1.13, p < 0.05 \). However, Alcohol Usage was positively related to AgC, \( r(374) = 0.115, p < 0.05 \), which is in line with empirical findings concerning the clustering effects of
hostility and health damaging behaviors. Lastly, Father Occupation was negatively correlated with AgPast, \( r(402) = -112, \ p < .05 \). A conceptual link here with hostility is not as evident in comparison to other covariates. However, exposure to adverse psychosocial stressors early in life, such as economic hardships due to a caregiver’s low work wages, represents a theoretical underpinning for the development of hostility (Williams & Williams, 2006).

Primary Tests of the Integrative Model

For the primary research question, hierarchical Cox regression models tested for the possible effects of the integrative model on CVD and CHD morbidity over time. Separate analyses were performed for AgC and AgPast to examine each aggression component individually and reduce multicollinearity. A decision was made to control for the potential confounding effects of variability in \( R \) for all regression analyses. After dividing by \( R \), the mean was subtracted from each predictor to create centered variables. The resulting decimal values were then multiplied by 100 to obtain percentages that would facilitate interpretation of all subsequent results. For all hierarchical Cox regression models, individual regression coefficients reflect the association between each predictor and the likelihood of acquiring premature CVD or CHD over the follow-up period, with corresponding odds ratios indicating the percentage difference in morbidity risk per unit difference in the predictor score. Results for AgC percent centered (AgC%-C) will be presented first with Time to premature CVD event as the dependent variable in the regression model followed by the CHD-prediction model. This same format will be
used to report the results for AgPast percent centered (AgPast%-C). Parallel analyses will then be repeated using models that adjust for the influence of covariates.

Table 3 provides results from the Cox regression analyses examining the ability of the integrative model to predict time to premature CVD and CHD. Cases not containing both explicit and implicit data were dropped from all regression analyses. The final n was 376; 34 of these individuals developed premature CVD while 21 acquired premature CHD. In all models the magnitude of the regression coefficients and their significance did not change notably from one block to the next so for simplicity the text focuses on the coefficients from the final block with all variables entered.

### Table 3

**Cox Regression Predicting Morbidity Status as a Function of the Centered Explicit and Implicit Predictors**

<table>
<thead>
<tr>
<th>Event</th>
<th>CVD (n = 34 / 376)</th>
<th>CHD (n = 21 / 376)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predictor</td>
<td>Hazard ratio</td>
<td>95% CI</td>
</tr>
<tr>
<td>Block 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HNT-C</td>
<td>.188</td>
<td>1.207</td>
</tr>
<tr>
<td>Block 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HNT-C</td>
<td>.169</td>
<td>1.184</td>
</tr>
<tr>
<td>AgC%-C</td>
<td>-.074</td>
<td>.929</td>
</tr>
<tr>
<td>Block 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AgC%-C</td>
<td>-.081</td>
<td>.923</td>
</tr>
<tr>
<td>HNT-C*AgC%-C</td>
<td>.077</td>
<td>1.080</td>
</tr>
<tr>
<td>Block 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HNT-C</td>
<td>.188</td>
<td>1.207</td>
</tr>
<tr>
<td>Block 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HNT-C</td>
<td>.186</td>
<td>1.204</td>
</tr>
<tr>
<td>AgPast%-C</td>
<td>.048</td>
<td>1.049</td>
</tr>
</tbody>
</table>
The findings in the upper left quarter of Table 3 focus on AgC%-C predicting early CVD. The results demonstrate that both AgC%-C and the interaction term (i.e., HNT-Centered (HNT-C) X AgC%-C) share significant associations with premature CVD. First, for the simple effects, an increase in AgC%-C leads to a significant decrease in morbidity risk ($p < .01$). Although AgC was hypothesized to uniquely predict CVD morbidity independent of the HNT, the association was expected to be positive. The negative pattern suggests that higher AgC%-C scores may provide a protective effect against developing premature CVD. Using the exponentiation of the regression coefficient, such that the constant $2.717281$ or, $e$, is raised to the power of $b$, there is a small predicted decrease in CVD risk of $e^{-0.81} = -0.923$ for every one percent increase in AgC%-C. However, this simple effect cannot be readily interpreted given that there also is a significant interaction effect ($p < .05$), which indicates that the impact of AgC%-C on CVD changes as a function of HNT scores. The upper right quarter shows the relational patterns when Time to CHD was the outcome of interest. In this instance though there were no significant associations observed among the predictors, with HNT and the interaction term just exceeding conventional levels of significance (having $p$ values of .053 and .056, respectively).
The interaction for explicit and implicit aggression predicting premature CVD is presented in Figure 3. Figure 4 provides a plot of the near-significant results for predicting CHD. Both figures show regression surfaces that reveal a very similar pattern of associations. In each figure, there are three separate lines to indicate the slope of the regression surface for \(AgC\%-C\) values that are low \((-9.00,\) which is equal to about the 10\(^{th}\) percentile\), average \((0.00)\), and high \((+9.00,\) which is equal to about the 90\(^{th}\) percentile\). The horizontal axis provides reference points for HNT-C scores that are low \((-0.45,\) which is equal to a raw score of 0\) and high \((+2.0,\) which is equal to a raw score between 2 and 3\). In general, the left side of the figures indicate that for all levels of implicit hostility (i.e., all three lines) people with low explicit hostility have relatively low risks for early CVD or CHD (with predicted hazards from the full model between .001 and .003). The right side of both figures indicate that for people with high explicit hostility the risk for early CVD or CHD also remains relatively low for those with low or average implicit hostility (with predicted hazards between .0005 and .006) but it increases for those who have high levels of implicit hostility (with predicted hazards of .033 for CVD and .043 for CHD). Thus, the steepest slope in each figure suggests that when both high explicit and high implicit hostility are present the likelihood of developing premature CVD or CHD is notably higher than under all other circumstances.
Figure 3. Integrative Model for Premature CVD Morbidity
In separate analyses with \textit{AgPast\%}-%-Centered (\textit{AgPast\%}-C) on Block 2, no significant associations were found when predicting either CVD or CHD. The coefficients are presented in Table 3 and the results are graphed in Figures 5 and 6. For the latter, the vertical axes are set to be the same as in Figures 3 and 4 and the lines depicting low and high values for \textit{AgPast\%}-C are now set at -1.00 (which is equal to the 69.4\% of cases that have a value of zero) and +3.00 (which is equal to about the 90\textsuperscript{th} percentile), respectively.

\textbf{Figure 4.} Integrative Model for Premature CHD Morbidity
Figure 5. Integrative Model for Premature CVD Morbidity
Based on the above findings, a second hierarchical Cox regression model addressed whether the integrative model could be used to predict CVD and CHD morbidity after controlling for the contributions of the baseline covariates. By isolating the effects of the integrative model from the effects of other variables (e.g., Number of Cigarettes, AlcoholUsage) that affect participant’s cardiovascular health, it improves the estimate of the predictive validity coefficients. Additionally, if it was discovered that the integrative model did not significantly predict morbidity after adjustment for covariates,
then it would undermine its utility as a predictor variable that is meaningful to assess over and above the simple covariates.

A backward stepwise regression procedure was used for the covariate-adjusted models. Thus, the regression equations for these analyses differ from the previous ones in that it there are two blocks, beginning with forced entry and backwards removal of non-significant contributors of baseline covariates on Block 1. All of the baseline covariates that are not significant predictors of morbidity are then eliminated from the model in an iterative process before entry of the explicit, implicit, and interaction term predictors on Block 2. The final $n$ for the regression analyses was 267 with 25 of these individuals developing premature CVD while 15 acquired premature CHD. Table 4 summarizes the results of Block 2. The left side of the table shows that 2 of the 12 covariates, Number of Cigarettes, and Alcohol Usage, were both significant baseline predictors of premature CVD with hazards ratios of 2.035 ($p < .0001$) and .289 ($p < .05$), respectively. This indicates that there was a 204% increase in morbidity risk per each one point increase in the Number of Cigarettes score (e.g., 0 = ‘None’; 1 = ‘1-10’; 2 = ‘11-19’; 3 = ‘20-39’; 4 = ‘40+’). However, for Alcohol Usage the association with premature CVD was negative ($b = -1.242$) indicating a 29% (i.e., $e^{-1.242}$) decrease in morbidity risk per each one point increase in the Alcohol score (e.g., 0 = non-drinkers; 1 = non-regular drinkers; 2 = regular drinkers). Neither HNT-C ($p = .286$) or AgC%-%C ($p = .198$) were significant predictors. Interestingly, a negative regression coefficient ($b = -.422$) was observed for HNT-C in this model. Most importantly, however, the interaction term formed by the
A combination of explicit and implicit hostility predicted morbidity ($p < .01$) independent of the other predictors.

As can be seen from the right side of Table 4, Number of Cigarettes, and Alcohol Usage were also significant baseline predictors when Time to CHD was the outcome of interest with hazards ratios of 2.297 ($p < .001$), and .167 ($p < .05$), respectively. Like the previous analysis, Alcohol Usage was negatively associated with the predictor ($b = -1.791$). However, unlike the previous model, another significant baseline predictor was observed for Cholesterol ($p < .05$) with a hazards ratio of 1.021. Again, neither the HNT-C ($p = .348$) or AgC%-C ($p = .948$) were significant predictors of premature CHD, but the interaction term predicted morbidity ($p < .01$) independent of the other predictors.

Table 4

*Cox Regression Predicting Morbidity Status as a Function of the Centered Explicit and Implicit Predictors After Controlling for Baseline Covariates*

<table>
<thead>
<tr>
<th>Event</th>
<th>CVD ($n = 25 / 267$)</th>
<th>CHD ($n = 15 / 267$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predictor</td>
<td>Hazard $b$</td>
<td>Hazard $p$</td>
</tr>
<tr>
<td>Block 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td># of Cigarettes</td>
<td>0.711</td>
<td>2.035</td>
</tr>
<tr>
<td>Alcohol</td>
<td>-1.242</td>
<td>.289</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>HNT-C</td>
<td>-0.422</td>
<td>0.655</td>
</tr>
<tr>
<td>AgC%-C</td>
<td>-0.049</td>
<td>0.952</td>
</tr>
<tr>
<td>HNT-C AgC%-C</td>
<td>.163</td>
<td>1.177</td>
</tr>
</tbody>
</table>

*Note.* Statistical models computed separately for AgC. Results represent parameters only for Block 2. Values in column 2 reflect unstandardized regression coefficients, whereas values in column 3 are hazard ratios denoting percentage change in morbidity risk per unit increase of predictor. Morbidity status was coded as either 0 (healthy) or 1 (diseased).

The interaction for explicit and implicit aggression predicting CVD and CHD after adjusting for baseline covariates is presented in Figures 7 and 8. The horizontal axes
are set to be the same as in Figures 3 and 4, as are the lines depicting low (-9.00) and high (+9.00) values for AgC%-C. The left side of the figures indicate that for all levels of implicit hostility (i.e., all three lines) people with low explicit hostility have relatively low risks for early CVD or CHD (with predicted hazards from the full model between .0006 and .004). Consistent with earlier findings, the right side of both figures indicate that for people with high explicit hostility the risk for early CVD or CHD also remains relatively low for those with low or average implicit hostility (with predicted hazards between .00001 and .0008) but it increases notably for those who have high levels of implicit hostility (.02). As before, the steepest slope in each figure suggests that when both high explicit and high implicit hostility are present the likelihood of developing premature CVD or CHD is notably higher than under all other circumstances.
Figure 7. Integrative Model for Premature CVD Mortality After Controlling for Baseline Covariates
In conclusion, the hierarchical Cox regression analyses yielded convincing evidence for the efficacy of an integrative model to predict premature CVD and CHD. The interaction of HNT-C and AgC%-C was significant in the CVD-prediction model and in both models when controlling for the effects of baseline covariates. In particular, the combination of high explicit and high implicit hostility resulted in the greatest morbidity risk.
Tests of the Hypotheses

A Kaplan-Meier Analysis was initially proposed and considered in this study to determine whether the baseline hazard functions for premature CVD dropped at a faster rate for participants with different configurations of implicit and explicit hostility. However, it was impossible to dichotomize the HNT and the aggression scores into meaningful low and high categories because each was associated with very few events. This analysis was subsequently omitted given the problematic distribution of scores.

Test of the Integrative Model to Predict Midlife Criterions

I intended to conduct hierarchical multiple regression analyses to test for the possible effects of predictor variables on various midlife outcome variables. Theoretically, these outcome variables should mediate the positive relationship between hostility and CVD. But before doing so, Pearson correlations were first computed between each of the predictor variables and the various midlife criterions to identify statistically significant associations. Correlations ranged from -.09 to .07. None of these correlations were statistically significant. Consequently, no regression analysis was completed.

Test of the Integrative Model to Predict Late-Life Blood Pressure Scores

Consistent with the above analyses, it was anticipated that hierarchical multiple regression analyses would be run to predict a late-life criterion from the integrative model, specifically, BMI and blood pressure scores in the 50-59-year-old range. Pearson correlations were first computed between each of the predictor variables and the BMI: 50-59, DBP: 50-59, and SBP: 50-59 scores to determine if any of the associations were
sufficiently reliable (i.e., statistically significant) to support a multiple regression model.

As before, none of the associations were significant, so no regression analysis was completed.
Chapter 4

Discussion

Support was found for the repressive coping hypothesis and the integrative model of hostility. A multiplicative combination of implicit imagery and explicit self-attribution influenced by research on TABP (Friedman & Rosenman, 1974), the physiological effects of emotional suppression and repression (Gross & Levenson, 1993; Pennebaker & Susman, 1988; Shedler et al.;1993; Weinberger et al., 1979), as well as integrative models of personality (Bing et al., 2007; Frost et al., 2007; Winter et al., 1998), accounted for significant amounts of variance in the prediction of premature CVD and CHD and other relevant health criterion assessed at follow-up. The main findings are briefly outlined below.

Of initial interest is the preliminary PCA of the nine Rorschach variables related to aggression and hostility \((AG, MOR, A1, A2, AgC, AgPast, AgPot, H, h)\). The results from this analysis had important implications because they were used to inform the selection of the measure of implicit hostility. A two-component solution was identified that accounted for 58% of the total variance. Component 1 and 2 accounted for 31% and 17% (after rotation), respectively. The former was defined by \(A2, AgC,\) and \(h\) and reflected the production of responses containing hostile behavior, weapons, and aggressive instruments. In turn, \(H, AgPast, MOR,\) and \(A1\), demarcated the second component that was characterized by the production of responses containing damaged, harmed, or spoiled objects. These results buttress two previous studies (Baity & Hilsenroth, 1999; Liebman et al., 2005) that support a two-component/factor solution of
Rorschach aggression. The resulting component structure was analogous to previous research with the exception that this PCA included Elizur’s (1949) hostility scores of $H$, and $h$. Rather than contributing unique variance to the existing aggression indices, the results suggest that $H$ and $h$ share variance with those measures and help define a common set of two components. The best pattern of convergent and discriminant factorial validity were displayed by $AgC$ and $AgPast$. Accordingly, each was chosen to be separately used as measure of implicit hostility.

The low and non-significant correlations between $AgC$, $AgPast$, and the self-report of hostility (i.e., HNT) provided evidence that the two Rorschach aggression scores capture an implicit component of a personality trait that is distinct from the explicit component measured by self-report. This finding is consistent with past research demonstrating that self-report (i.e., MMPI-2) and the Rorschach do not measure the same component of personality (Archer & Krishnamurthy, 1993a, 1993b).

More important, the Cox regression analyses showed that implicit hostility, specifically $AgC$, and explicit hostility significantly interacted in the prediction of premature CVD and CHD. Figures 3, 4, 7, and 8 showed that the direction and magnitude of the regression slopes linking morbidity risks to the HNT are dependent on $AgC$. Put another way, the impact of explicit hostility on morbidity risks change as a function of whether a person is implicitly more or less hostile. The combination of high implicit hostility and high explicit hostility in particular appears to confer the greatest morbidity risks relative to persons with the other configurations of implicit and explicit hostility. This is contrary to the theoretical basis for the pattern of the interaction predicted. For
instance, it was believed that the combination of low explicit hostility and high implicit hostility would result in the greatest associations with premature CVD and CHD given these individuals propensity for suppressing emotions.

The Cox regression results also do not support an additive model in which the predictor variables are treated as main effects. Only one simple effect was observed for $AgC$ in the premature CVD prediction model. This is noteworthy in light of the small, but positive relationship found between the HNT and premature CVD and CHD within the Precursor sample by Chang et al. (2002). At the same time, this discrepancy may not be too surprising considering that their sample size ($N = 1055$) for this study was extensively larger than the present study’s. Following this, it could be said that $AgC$ emerged as a more reliable predictor than the HNT in these analyses; however, the incremental predictive validity of $AgC$ is so negligible that doing so would risk overemphasizing its importance. Further, the association between $AgC$ and premature CVD was negative and it was expected to be positive. Given that there was also a significant interaction effect between $AgC$ and $HNT$ no attempt will be made to explain this finding. Lastly, the fact that $AgPast$ fared less than $AgC$ in these analyses is not unexpected because the former was believed to assess an underlying depressive vulnerability rather than hostility.

In sum, the Cox regression analyses indicate that it is the multiplicative combination of the explicit and the implicit hostile traits that is the most efficacious in predicting premature CVD and CHD. This study, like several before it (Bing et al., 2007; Brunstein & Maier, 2005; Frost et al., 2007; James & Mazerolle, 2002; Winter et al.,

A secondary purpose of this study was to test the integrative model of hostility to predict various criteria during midlife (i.e., 30-49-year-old range) and late-life (50-59-year-old range) follow-up. None of the 24 correlations examined between the predictor variables and these criterion variables were significant. Thus, while the core constructs (i.e., CVD, CHD) could be predicted from the integrative model, associations with intermediary variables proved more elusive.

Limitations

A potential limitation of this study is that it was conducted with a homogenous sample. On important demographic variables including, gender, race, age, occupation, level of education, and socioeconomic class, participants were virtually indistinguishable. This limits the ability to extrapolate any of the findings reported here to other populations. The use of homogenous samples in research is not entirely disadvantageous. The main reason being that by minimizing variability in education or race for example it simultaneously reduces their capacity to induce measurement error and undermine the internal validity of an investigation.

Whether the association observed between the integrative model of hostility and CVD morbidity vary by gender or race remains an important but unanswered research question presently. Self-reported hostility also predicts CHD in women. In a longitudinal study of 97, 253 women conducted by Tindle et al. (2009), the most cynical, hostile women (top versus bottom quartile) as measured by the Hostility Scale, had higher rates
of CHD (56 versus 44). Women should feel less open to expressing their anger and frustrations through outwardly hostile means (e.g., verbal and physical aggression), if engagement in gender normative forms of behavior is the rule. Not surprisingly, there is plenty of data available to support this notion (Thomas, 1991; Maier et al., 2009) as well as women’s preference for more acquiescent anger coping strategies like, suppression or somatization (Haynes, Levine, Scotch, Feinleib, & Kannel, 1978). Another study (Linden et al., 2003) however found that women are not more likely to suppress their anger despite reporting less aggressive responses to angering situations than men; instead, women showed greater reliance on social-support seeking as a self-reported anger response. Research on gender differences in the response production of Rorschach aggression variables is lacking, but it is worth noting Liebman et al. (2005) did not find that adjudicated adolescent females produced significantly less aggressive responses in comparison to adolescent males. In any case, there is reason to suppose that if one were to extrapolate the findings of the integrative model of hostility to a sample of women, a smaller effect size would likely be observed for the interaction pattern of high explicit hostility and high implicit hostility.

With regard to ethnicity, Maier et al. (2009) reported that African-Americans showed greater expressive forms of hostility than European-Americans on self-report measures of assault, verbal expression of anger, and one measure of outward anger expression ($p < .05$). Asian-Americans reported less anger control than European-Americans ($p < .002$) in addition to greater resentment and cynical hostility ($p < .05$). Unfortunately, research on racial differences in the response production of Rorschach
aggression variables is even more wanting than it is for gender. However, to the extent that the results reported in Maier et al. (2009) are generalizable, there is reason to believe that the magnitude of the effect sizes observed for premature CVD and CHD should be equally, if not more pronounced if a subsequent study utilizing an integrative model of hostility was conducted with a more ethnically and culturally diverse sample.

Another limitation of this study was that the multivariate analyses in this study were not able to make maximal use of the entire data set \( (N = 415) \). Statistical software programs like, Statistical Package for the Social Sciences exclude from its analyses cases that have missing data on any of the variables (Patrician, 2002). Given that missing data is an inherent problem of longitudinal research (e.g., relocating, death, attrition), it inevitably undermined the power in this study. To address this problem, longitudinal imputation methods are available that use existing data to generate values approximate the “real” values. Such procedures may be considered for future applications of this study.

Conclusions

This study is unique in several respects. First, it extended the integrative model of personality to the prediction of a non-communicable disease. By showing this model to be viable, it demonstrated that implicit personality, in relation to the explicit personality, may provide a useful addition to the areas of health psychology and preventive medicine. Finally, it extended a programmatic effort to indirectly validate Rorschach aggression measures with behavioral or other relevant “real-world” criteria that do not depend on self-report. The validities reported here were impressive for such ephemeral phenomena.
With regard to the self-report measures, these data appear to be consistent with some research regarding related personality constructs as predictors of CHD however the validities reported herein are generally of lower magnitude. For instance, Kawachi et al. (1996) discovered that respondents who scored between 5 and 14 on the MMPI-2 Anger Content Scale had an increased risk of CHD (relative risk = 3.58, 95% CI = 1.08 to 11.9) over a 7-year follow-up period, in comparison to non-angry respondents. Explanations regarding this study’s findings and potential limitations are discussed below.

As mentioned above, previous research using integrative models of personality have traditionally been devised for the purposes of predicting a behavioral correlate of a personality trait assessed over a relatively short time frame, such as several weeks. For instance, Frost et al. (2007) hypothesized that different configurations of implicit and explicit aggression would in turn predict different behavioral manifestations of aggression such as, number of hard fouls (overt aggression), or obstructionism (passive aggression) for collegiate intramural basketball players over the course of a season. Thus, the present study diverged from others like it in that the integrative model was formulated with the goal of predicting a non-communicable disease that was modestly correlated with a personality trait over the lifespan. It was hypothesized that different configurations of implicit and explicit hostility would predict distinctive dispositional and psychophysiological sequelae of hostility, like impatience or high autonomic reactivity, that theoretically represented possible mechanisms of increased risk for CVD and CHD. Thus, the time interval between the administration of independent variables and the measurement of dependent variables in this study was substantially longer than in
previous research utilizing an integrative model. The longer time interval allows for other possible moderating and mediating variables (e.g., diet, exercise, medications) that were not assessed in this study to intervene and affect the outcome. In short, the long delay between baseline assessment and outcome was methodologically disadvantageous to observing a positive association between the integrative model of hostility and morbidity. Nonetheless, this study was still able to demonstrate a significant interaction effect.

Admittedly, explicit and implicit measures in this study have been used infrequently in CVD and CHD research. The HNT is a rather limited assessment tool for measuring hostility that has been circumscribed to Precursor Study investigations. At the same time, the three anger items have shown utility (Chang et al., 2002) in predicting premature CVD and CHD within the Precursor sample. Of the very few Rorschach studies that have examined links between personality characteristics and CHD, only one exploratory, cross-sectional study (Cleveland & Johnson, 1962) identified a significant relationship between MI patients and the production of responses with hostile content using Elizur’s Hostility Scale (1949). The fact that neither measure has also demonstrated significant validities with psychophysiological indicators of hostility or anger such as, skin conductance did not bolster the probability of finding a positive relationship with morbidity. As before, despite the dearth of positive research findings, this study was still able to demonstrate a significant interaction effect for morbidity.

Though the sample size ($n = 376$) for the main analyses would be considered ample in comparison to most other psychological studies, it was not ideal within the particular area of personality and health where small to very small effects are typically
observed. Effect size estimates for relationships between self-reported hostility and CHD and/or CHD risk factors in meta-analytic reviews of prospective studies have ranged from $r = .08 - .14$ (Booth-Kewley & Friedman, 1987; Miller et al., 1996). It was also the case that there were very few events/outcomes to predict within this subsample. Only 9% ($n = 34$) of the participants developed premature CVD and just 6% ($n = 21$) developed premature CHD. These low base rates operated as additional experimental challenges to this study.

Questions still remain about the construct validity of $AgC$ and $AgPast$. An ongoing challenge for validating these scores is in determining to what extent they may be used to predict real world aggressive behaviors, assess character pathology and traits, or simply reflect preoccupations with or fears of aggressive imagery (Baity & Hilsenroth, 2002). It may be the case that the two-component model of Rorschach aggressive imagery (Baity & Hilsenroth, 1999; Katko et al., 2010; Liebman et al., 2005) identified in research does not constitute an adequate measure of implicit hostility. In opposition to that potentiality, consider the Conditional Reasoning Test of Aggression (James, 1998). It has been incorporated in research testing integrative models of personality (Bing et al., 2007; Frost et al., 2007). In these studies, it has been utilized as the measure of implicit aggression to successfully predict dispositional correlates of aggressive personalities (Bing et al., 2007; Frost et al., 2007) in combination with explicit measures of aggression.

The Conditional Reasoning Test of Aggression is purported to measure dysfunctional unconscious biases in reasoning that are based on maladaptive belief structures (Bing et al, 2007). Two such examples include the potency bias and the hostile
attribution bias. The first involves a tendency to dichotomize thinking about social interactions in terms of dominance or submissiveness. In turn, this preoccupation with dominance leads to rationalizations that aggression is a formidable and courageous act that is valued and admired by others. Neglecting to act aggressively in contrast conveys weakness. The second bias concerns an underlying belief that others intend to inflict harm. The vigilant scanning of environmental threats produces unease and a sense of imminent danger that justifies the use of aggression for self-defense. Although not a direct one-to-one correspondence, these examples sound remarkably similar to Component One of Rorschach aggression identified in the preliminary study and described elsewhere (Baity & Hilsenroth, 1999; Katko et al., in press; Liebman et al., 2005). This bolsters the decision to conceptualize AgC as an implicit measure of hostility. Nonetheless, given the impressive empirical support reported for the Conditional Reasoning Test of Aggression (Bing et al., 2007; Frost et al., 2007) its efficacy may be worth exploring in future integrative models of personality to predict CVD and/or CHD or psychophysiological response characteristics associated with these diseases.

Overall, in this study, AgC appeared to work as a valid measure of implicit hostility. AgPast showed a very different pattern of correlates with the primary outcome measures, suggesting it may reflect more of an implicit identification with damaged, depressed, or vulnerable states. With respect to AgC, even though it was anticipated that low explicit hostility combined with high implicit hostility would have the most adverse impact on premature CVD and CHD, it turned out that it was the combination of high explicit and high implicit hostility that was most deleterious. If hostility truly is toxic for
the heart, then it is plausible that when unfettered expression (e.g., explicit) is crossed with a sturdy foundation of immediate, automatic hostile attributions (e.g., implicit) that the detrimental effects associated with either dimension are multiplied and morbidity risks consequently rise. A similar interactive pattern was reported by Perugini (2005) who examined an integrative model of smoking that combined explicit and implicit methods for assessing attitudes about smoking to predict this behavior. He commented that “when both systems (i.e., explicit and implicit) contribute synergistically to the activation of the same behavioral schemata, behavior is facilitated (p. 32).” Based on this idea, Perugini hypothesized that when explicit and the implicit attitudes are congruent, their joint influence on behavior will be strongest. This particular interaction pattern was supported. For instance, the combination of high explicit attitudes (i.e., positive thoughts/feelings smoking) and high implicit attitudes sharply and significantly increased the probability of smoking among participants.

The integrative model provides a more complete understanding of a multifaceted construct such as hostility by the distinction between explicit and implicit components illustrated here. Moreover, extensions to health psychology and preventive medicine show promise. The finding that the combination of high explicit hostility and high implicit hostility were associated with premature CVD and CHD morbidity might suggest that prevention and treatment efforts for hostility could be ameliorated and especially germane for persons with this particular configuration. If subsequent research replicates these results, psychotherapy could be a valuable intervention for persons evidencing the most deleterious combination of explicit and implicit hostility. As persons become more
aware of these separate dimensions of their personality, they can work towards modifying those behaviors (e.g., smoking, binge eating, aggressive outbursts) or conditions (e.g., marital discord) that exacerbate their morbidity risks while experimenting with new coping behaviors (e.g., exercise, mindfulness/meditation, conflict resolution strategies) to diffuse their hostility. The combination of enhanced cardiovascular health and greater psychological adjustment is certain to result in an advantageous interaction effect.
References


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