Title
Social Experience and Physiology: Effects of Social Relationship Qualities on Allostatic load

Author
Brooks, Kathryn Pauline

Publication Date
2012

Peer reviewed|Thesis/dissertation

UNIVERSITY OF CALIFORNIA

Los Angeles

Social Experience and Physiology:

Effects of Social Relationship Qualities on Allostatic Load

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Psychology

by

Kathryn Pauline Brooks

2012

ABSTRACT OF THE DISSERTATION

Social Experience and Physiology:

Effects of Social Relationship Qualities on Allostatic Load

by

Kathryn Pauline Brooks

University of California, Los Angeles, 2012

Professor Christine Dunkel Schetter, Co-chair

Professor Theodore F. Robles, Co-chair

The aim of this dissertation is to better understand how the quality of social experience is related to allostatic load (AL), an index of cumulative dysregulation across physiological systems. More specifically, the project examines the effects of support and negativity from several sources on AL in a large community sample of middle-aged and older adults from the Midlife in the United States (MIDUS) study (N = 949, age 34-84). Results indicated that higher levels of negativity across the social network and lower levels of support from a spouse were each associated with higher AL, controlling for age and relevant demographic and health covariates. There was evidence that the effects of both network support and negativity varied by age, such that the association between social relationship quality and AL became weaker with age. This study is the first to demonstrate associations between social relationships and AL in a sample of adults

representing five decades of adulthood, rather than in a limited range of older adulthood. In addition, this study extends previous work by testing for independent effects of support and negativity from specific sources. Taken together, these findings provide support for theoretical formulations arguing that AL is a pathway linking the quality of social relationships with morbidity and mortality.

The dissertation of Kathryn Pauline Brooks is approved.

Shelley E. Taylor

Teresa E. Seeman

Thedore F. Robles, Committee Co-chair

Christine Dunkel Schetter, Committee Co-chair

University of California, Los Angeles

2012

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ACKNOWLEDGEMENTS

I wish to thank the members of my committee for their support and mentorship in the preparation of this dissertation.

VITA

Kathryn P. Brooks

EDUCATION

M.A., Psychology — 2008
University of California, Los Angeles, CA

B.A., Psychology, Magna cum laude — 2004
Carleton College, Northfield, MN

ACADEMIC EMPLOYMENT

Psychology Teacher — 2012-present
Lakeside Upper School, Seattle, Washington

Teaching Assistant — 2008- 2011
Department of Psychology, University of California, Los Angeles

Graduate Student Researcher — 2010
Department of Medicine, University of California, Los Angeles

Research Coordinator — 2004-2006
Department of Psychology, Stanford University, Stanford, CA

HONORS

UCLA Graduate Division Dissertation Year Fellowship	2011-2012
UCLA Psychology Dept. Shepherd Ivory Franz Distinguished Teaching Award	2011
UCLA NIMH Health Psychology Pre-Doctoral Fellowship	2009-2010
Summer Institute in Social Psychology Fellowship	2009
UCLA NSF Interdisciplinary Relationship Science Fellowship	2007-2008
NSF Graduate Research Fellowship Honorable Mention	2008
UCLA Graduate Division Summer Research Award	2007
UCLA Psychology Department Travel Award	2007
UCLA University Fellowship	2006-2007
Carleton College Distinction in the Psychology Major	2004
Carleton College Phi Beta Kappa Inductee	2004

PUBLICATIONS

Dunkel Schetter, C. & **Brooks, K. P.** (2009). The nature of social support. In Harry T. Reis & Susan Sprecher (Eds.), *Encyclopedia of Human Relationships.* Thousand Oaks, CA: Sage.

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Robles, T. F., **Brooks, K. P.,** Kane, H., & Dunkel Schetter, C. (in press). Attachment, skin deep? Relationships between adult attachment and skin barrier recovery.

Brooks, K. P., Gruenwald, T., Karlamanga, A., Hu, P., Koretz, B, & Seeman, T. E. (under review). Social relationships and allostatic load across the life-span.

Robles, T. F**., Brooks, K. P.,** & Kane, H. (under review). The matching hypothesis revisited: A research agenda for shifting social support research into automatic.

SELECTED CONFERENCE PRESENTATIONS

Brooks, K. P., & Seeman, T. E. (2011). Social relationships and allostatic load across the lifespan. Talk presented at the International Association for Relationships Research Mini-Conference on Health, Emotions, and Relationships, Tucson, AZ

Brooks, K. P., & Seeman, T. E. (2011). Relationship quality and allostatic load in middle-aged and older adults. Poster presented at the 69th Annual Meeting of the American Psychosomatic Society, San Antonio, TX.

Brooks, K. P, & Robles, T. F. (2010). Attachment security predicts cortisol responses to stressful and supportive interaction with a romantic partner. Talk presented at the 68th Annual Meeting of the American Psychosomatic Society, Portland, OR.

Brooks, K. P. & Robles, T. F. (2010). When couples fight, who suffers most? Gender differences in neuroendocrine responding to conflict with a romantic partner. Poster presented at the 11th Annual Meeting of the Society for Personality and Social Psychology, Las Vegas, NV.

Brooks, K. P. & Robles, T. (2008). Social support in romantic relationships: Effects on physiology and health. Talk presented at the International Association for Relationship Research Conference, Providence, RI.

Brooks, K. P. & Robles, T. (2008) Negative affect associated with blunted neuroendocrine responses to stress. Poster presented at the 9th Annual Meeting of the Society for Personality and Social Psychology, Albuquerque, NM.

Brooks, K., P., Mikels, J., Klest, B., Carstensen, L., & Freyd, J. (2007) Trauma exposure over the life-span: effects on emotion and health. Poster presented at the 8th Annual Meeting of the Society for Personality and Social Psychology, Memphis, TN.

Social Experience and Physiology:

Effects of Social Relationship Qualities on Allostatic Load

In the following thesis, Chapter 1 reviews the literature on social relationships, physiology, and health and lays out hypotheses that guide the research. Chapter 2 presents the methods of the study including an overview of the MIDUS study procedures, the measurement of support and negativity, and the operationalization of allostatic load. Chapter 3 contains results of tests of hypotheses, and Chapter 4 provides Discussion of these findings.

CHAPTER 1:

INTRODUCTION

Over the past thirty years, there has been tremendous interest in the link between social ties and physical health, and the consensus emerging from several lines of evidence is that the structure and quality of social relations predict rates of morbidity and mortality (see reviews by House, Landis, & Umberson, 1988; Cohen, 2004; Uchino, 2009; Taylor, 2007; Berkman, Glass, Brissette, & Seeman, 2000). Several large, community-based prospective studies demonstrate that individuals who are more socially integrated have lower mortality rates over time, controlling for baseline health status. For example, in a sample of 4,775 middle-aged and older adults from Alameda County, California, an index of the presence and extent of 4 types of social relationships predicted mortality over the subsequent 9 years (Berkman & Syme, 1979). Similarly, more frequent contact with family, friends, neighbors and coworkers predicted decreased risk of morality over 5 years in a sample of 17,433 Swedish adults aged 29-74 (Orth-Gomer & Johnson, 1987). Studies like these have established a link between the structural aspects of relationships and health, but there is also evidence that the *quality* of social relationships predicts health outcomes. Individuals who report more positive social functioning,

as evidenced by higher perceptions of available social support and higher ratings of marital satisfaction, show better physical health outcomes (see review by Uchino, 2009). For example, a recent meta-analysis on social relationships and mortality risk found that across 73 studies, higher perceptions of social support were associated with increased likelihood of survival (Holt-Lunstad, Smith, & Layton, 2010).

The primary aim of this research is to review and synthesize data linking qualitative aspects of social relationships with health-relevant physiological parameters. The review begins with a discussion of how qualitative aspects of relationships have been conceptualized and the suggestion that negative components of social ties have been underemphasized in the literature on relationships and health. Next, the concept of allostatic load (AL) is described and data linking relationship qualities with activity in allostatic systems are discussed briefly. Following that, large community studies on relationship qualities and AL are reviewed. These studies are most relevant to the proposed dissertation analyses, so they are reviewed in great detail. In the final section, conceptual and methodological limitations of existing research are highlighted and the aims and hypotheses of the current research are described.

The Light and Dark Sides of Relationships

This review is concerned with the qualitative aspects of relationships, which we refer to as *relationship qualities*. We use relationship qualities to refer to the non-structural characteristics and attributes of relationships. The word qualitative implies a degree of subjectivity, and thus when we discuss relationship qualities we are essentially referring to an individual's perception and subjective experience of a social relationship. This is not to be confused with *relationship quality,* a term which has been used by relationship scientists to

describe an individual's overall satisfaction with a relationship, studied most frequently in the context of marriage (Fincham & Beach, 2006).

The qualitative aspect of social relations that is most frequently studied in regards to physiology and health is *social support*, defined here as the perception or experience that one is loved and cared for by others, esteemed and valued, and part of a social network of mutual assistance and obligation (Wills, 1991). Social support can be conceptualized further in terms of *perceived support*, which refers to how much support is available if needed, and *enacted support*, which refers to how much support is actually provided (Dunkel Schetter & Brooks, 2009). In addition, support can serve informational, emotional, or instrumental functions. Perceived support is a more consistent predictor of health-related outcomes than enacted support (Cohen, 2003; Uchino, 2009), and has become the support measure of choice among researchers in this area. In fact, most studies purporting to measure social support as it relates to physiology, morbidity, mortality or other health-related outcomes are actually studies of perceived emotional support. In keeping with this tradition, when I use the term social support, I am referring to perceived emotional support, unless otherwise specified.

The literature on social support and health has been reviewed extensively elsewhere (Cohen, 2003; Uchino, 2009) and generally supports the notion that more or better quality social support is beneficial for health in terms of mortality, morbidity, and adjustment to illness. This work has led to the widespread notion that social ties promote health. However, relationships are not always positive and can involve conflict, criticism, and intrusiveness, referred to here collectively as *social negativity*. Over the past 25 years, researchers have highlighted the need to attend to the negative side of relationships to gain a more complete picture of how social ties influence well-being (Rook, 1984).

Conceptualizing the Negative Side of Social Relationships

Researchers across a variety of disciplines have long recognized that close relationships inherently involve conflict, miscommunication, and other negative processes (Canary, Cupach, & Messman, 1995; Gottman, 1994; Kelley et al., 1983; Pietromonaco, Greenwood, & Barrett, 2004; Sillars, 2009; Spitzberg & Cupach, 1988). By virtue of the fact that individuals have their own preferences, needs, goals, and motives, when two individuals are involved in a relationship their agendas will not always align. Indeed, with greater interdependence there is greater potential for interpersonal conflict (Braiker & Kelley, 1979). Although unpleasant, the occurrence of negative interactions does not indicate that a relationship is in jeopardy. Negative interactions can present opportunities for personal and relational growth, as successful resolution of conflict can increase intimacy and build trust (Canary & Cupach, 1988; Fincham & Beach, 1999). However, if negative interactions occur frequently or are not resolved constructively, they can be detrimental to the relationship and to the individuals involved (Gottman, 1994).

Research on negativity in social relationships began receiving increased attention in the 1980s, with the publication of Karen Rook's seminal paper on *problematic social ties* (1984). Rook argued that social relationships are not uniformly positive, and that negative social experiences may have greater impact than positive experiences, creating a *negativity effect*. This position drew from social exchange theory, which emphasized the dual nature of social ties (Homans, 1974; Thibaut & Kelley, 1959) and from evidence at the time that negative information is weighted more heavily than positive information (Hamilton & Zanna, 1972; Richey, McClelland, & Shimkunas, 1967).

Since then, dozens of terms have been used to describe the negative components of social interaction, often interchangeably and without explicit definition. A summary of commonly used

constructs from this literature is provided in Table 1. The majority of these terms has emerged from what can broadly be considered the social support literature, although the negative aspects of social relationships have been studied in other literatures as well, such as clinical and relationship science. There is a relatively large literature on conflict in laboratory settings, much of which has been conducted with married couples, but this literature is beyond the scope of this review and is reviewed elsewhere (Wright & Loving, in press).

Despite differences in terminology, the interpersonal constructs presented in Table 1 seem to refer to similar underlying phenomena, which we refer to in total as *social negativity.* Social negativity involves *behaviors which are directed at the recipient and are perceived as aversive or unwanted,* and does not simply refer to the presence of negative feelings about another person.

We propose that social negativity is a multidimensional construct composed of three distinguishable but overlapping aspects. A description of these proposed dimensions with prototypical items is presented in Table 2. The first proposed dimension is *conflict,* defined as behaviors which provoke conflict, particularly those involving the expression of anger such as "yelled at me," "lost his/her temper with me," and "argued with me." The second dimension is *insensitivity*, and involves behaviors which convey disregard for an individual's needs or wishes such "acted unsympathetic to my personal concerns" and "took advantage of me." The third proposed dimension is *interference*, defined as behaviors which interfere with an individual's ability to pursue goals such as "invaded my privacy," "interfered in my personal matters," and "made too many demands." The dimensions described here reflect our attempt to synthesize broadly across the literature, but there is still debate within the literature about the dimensional structure of negativity and more empirical work is needed.

Social negativity is conceptually and empirically separable from social support, as evidenced by the fact that positive and negative aspects of relationships consistently emerge as distinct factors (Okun & Keith, 1998). Although social support and negativity are not reciprocally organized, they tend to be negatively correlated, and this correlation is greatest when assessed within a specific relationship such as a marriage (Okun & Lockwood, 2003). The balance between negativity and positivity within a network is conceptually and empirically distinct from the negative and positive elements within a specific relationship, and may have different implications for health.

We have defined negativity as the presence of aversive behaviors, rather than the absence of desired behaviors, and in keeping with this definition we suggest that an absence of social support does not constitute social negativity. However, there are instances in which others refuse to provide the support we seek, despite being aware of our need, and this type of withholding may represent a form of negativity (Newsom et al., 2005). An individual's attributions for a provider's failure to provide support likely play a role in determining whether the behavior constitutes an instance of social negativity; attributing the failure to ignorance or lack of skill should not engender the same affective response as attributing the failure to cruelty or lack of caring.

As defined here, social negativity describes normative behaviors that occur in most relationships for most individuals. Although these behaviors are perceived as unwanted and can elicit negative affect, they occur in even the healthiest relationships. However, we would argue that the types of severe abuse, violence, and neglect studied in the context of social work and related fields are beyond the scope of social negativity due to their severity and often pathological nature.

Measuring Social Negativity. Social negativity measures vary in whether they assess negativity within a specific relationship, across a category of relationships (e.g., friends), or across the entire social network. To assess negativity across the social network, researchers explicitly ask participants to rate the quality of their network (e.g., "How often do people in your social network criticize you?"), but there is some evidence that when people are asked to rate their entire network in this manner, they underestimate the frequency of negative exchanges (Barrera, Chassin, & Rogosch, 1993). An alternative means of measuring negativity across the network is to aggregate relationship-specific reports (e.g., "How often does [Person X] criticize you?") into category-wide or network-wide measures (Campo et al., 2009).

Measures also vary in terms of whether they assess counts of the number of negative network members (e.g., Rook, 1984; Antonucci, Akiyama, & Lansford, 1998) or the frequency with which negative behaviors occur (e.g., Lepore, 1992). Frequency measures may ask participants to recall negative behaviors over a specific time period such as the past week (Abbey, Abramis, & Caplan, 1985; Lepore, 1992) or past month (Ruehlman & Karoly, 1991; Newsom et al., 2005), or to rate the frequency of negativity without reference to a time specific time period (Vinokur & van Ryn, 1993). Both count and frequency negativity measures are relatively subjective in that they place considerable emphasis on the respondent's construal of a target's actions and the respondent's subjective response to these actions. As described in Table 1, the majority of items used to measure negativity assess the respondent's construal of a target's actions, such as "made too many demands on you" (Schuster et al., 1990) or "forgot or ignored you" (Newsom et al., 2005). Fewer items explicitly assess the respondent's affective response to a target's behaviors, such as "made you feel unwanted" (Vinokur & van Ryn, 1993), "got on your nerves" (Abbey et al., 1985), or "provoked conflicts or feelings of anger" (Rook, 1984). In

some instances, negativity from a target can provoke negative behavior in the recipient, a phenomenon described as initiated negativity (Boerner, Reinhardt, Raykov, & Horowitz).

Dimensional structure. Whereas social support researchers have identified numerous functions of positive resources such as informational, instrumental, and emotional support (Dunkel Schetter & Brooks, 2009), the dimensional structure of social negativity has received far less attention. Using a measure they developed to assess negative interactions in a person's social network, Ruehlman and Karoly (1991) identified four factors, which they labeled hostility/impatience, interference, insensitivity, and ridicule. These factors were only moderately intercorrelated (*r*s ranging from .43 to .56), suggesting that negativity is not a unidimensional construct. Finch and colleagues (1999) later extracted three factors from a revised version of the same measure which they called insensitivity, interference/hindrance, and anger. Through a series of qualitative studies that included focus groups and card-sorting tasks, Newsom and colleagues (2005) developed a measure of negative social exchanges with four moderately intercorrelated (rs ranging from .35 - .56) factors: unsympathetic/insensitive behavior, failure to provide help, unwanted advice or intrusion, and rejection/neglect. Taken together, this work suggests that social negativity is a multidimensional construct composed of related but separable aspects.

Accounting for the Joint Contributions of Support and Negativity

In order to fully understand the effects of relationship qualities on physiology and health, it is essential to account for both the positive and negative elements of social ties, as well as how these factors interact. Social positivity and negativity consistently emerge as distinct – albeit often moderately correlated - factors, whether assessed at the network or dyadic level (Okun & Keith, 1998). For example, Finch, Okun, Barrera, Zautra, and Reich (1989) examined the factor

structure of positive and negative ties in a sample of older adults ($N = 246$) and found that the number of individuals listed as providers of emotional and instrumental support was not correlated with the number of individuals who were sources of negative experiences. The statistical independence of positive and negative domains of social experience confirms the theoretical assertion that negativity is not equivalent to the absence of support. It also implies that individuals can vary in the balance of positivity vs. negativity in their social networks. For example, some people may report networks characterized by high levels of support and high levels of negativity, while others may report moderate levels of support and low levels of negativity.

Importantly, the correlation between positive and negative dimensions of social functioning varies based on level of assessment, and network-wide or category-wide measures typically yield lower correlations than measures within a given relationship. In their meta-analysis of studies published between 1984-1999 (280 effect sizes), Okun and Lockwood (2003) report that the correlation between positive and negative aspects of relationships is greatest when assessed within the provider, especially when that provider is a spouse. For example, Okun & Keith found that frequency of positive exchanges was negatively correlated with the frequency of negative exchanges (*r*s ranged from -.23 to .43), when assessed within a specific relationship. However, Campo and colleagues (2009) reported a far more modest correlation between ratings of positivity and negativity, assessed across the network ($r = -.17$). The balance of negativity and positivity within a network is conceptually distinct from the negative and positive elements of a specific relationship, and may have different implications for health.

Relationship Quality and Allostatic Load: Pathways

One of the primary pathways by which social relationship qualities may influence health and disease involves the activation of stress-related physiological systems. Stressors elicit distinct patterns of autonomic nervous system (ANS), hypothalamic-pituitary-adrenocortical (HPA) axis, cardiovascular, immune, and metabolic activity which help the body adapt to the stressor and achieve physiological homeostasis. Over time these activations may contribute to wear and tear on systems involved (McEwen, 1998). Allostasis describes the process by which the body adapts to the ever-changing environment to achieve stability though change, and allostatic load (AL) refers to the cumulative cost of these adaptations (McEwen, 1998). Allostatic load is typically measured by obtaining measures of ANS, HPA, cardiovascular, immune, and metabolic function. For each system, individuals are designated at high risk if their score exceeds or falls below a certain threshold (depending on the parameter), and risk scores from each system are combined to create an overall measure of risk. For example, Seeman and colleagues computed AL scores as the sum of 10 parameters for which an individual was in the high risk quartile (Seeman, Singer, Rowe, Horwitz, & McEwen, 1997). In large community studies, AL is predictive of morbidity and mortality: higher AL scores predicted greater functional decline over the subsequent 7 years among older adults (Karlamangla, Singer, McEwen, Rowe, & Seeman, 2002), increased incidence of cardiovascular disease (Seeman, Singer, Rowe, Horwitz, & McEwen, 1997), and increased risk of mortality over 7 years (Seeman, McEwen, Rowe, & Singer, 2001), independent of socio-demographic characteristics and baseline health.

Social relationships may contribute to allostatic load directly, in that interpersonal stressors are accompanied by increased activity in allostatic systems (Kiecolt-Glaser et al., 1993; Kiecolt-Glaser et al., 1996). Details about relationship qualities and specific physiological

systems will be provided in the next section, but the basic idea is that relationships characterized by high levels of negativity should elicit more "hits" on allostatic systems. Social ties also serve an indirect or stress-buffering function, in that the physical presence or mental representation of a supportive tie can dampen physiological responses to stressors, both in the lab (Kirschbaum, Klauer, Filipp, & Hellhammer, 1995; Smith, Ruiz, & Uchino, 2004) and in daily life (Ditzen, Hoppmann, & Klumb, 2008). The stress-buffering effects of positive social interaction may be due in part to the release of neuropeptides like oxytocin and vasopressin (Carter, 1998; Taylor, Dickerson, & Klein, 2002; Uvnas-Moberg, 1997). Relationships may influence physiological responses to stress by altering perceptions of stress and of the availability of support (Sheldon Cohen & Wills, 1985). Individuals with more satisfying and positive social ties may perceive potentially stressful situations as less threatening and feel that they have more resources available to cope than individuals with less satisfying ties.

Relationship Qualities and AL-Relevant Physiology: Evidence

Stressors can occur in many life domains, and relationship stressors can exert particularly potent effects on health and wellbeing. Over time, the physiological activations that accompany relationship stressors may contribute to dysregulation in the baseline functioning of each of the systems that contribute to AL. In the next section, studies linking relationship qualities with baseline function in the systems which comprise AL are reviewed. As currently conceptualized, the parameters which are used to assess AL are all indices of baseline function, not stress reactivity (Seeman, McEwen, Rowe, & Singer, 2001), so data on stress reactivity will not be discussed here. The majority of these studies concern social support rather than social negativity, which reflects the bias of the field more generally. Rather than provide an exhaustive review, I describe the general pattern of findings in each area and highlight key studies.

Endocrine. The most commonly used endocrine measures in the relationships and health literature are the catecholamines, epinephrine (E) and norephinephrine (NE), and cortisol. All three hormones are released during stress and serve adaptive functions in that acute elevations help the body to deal with stressors, but repeated or prolonged elevations are harmful (Lovallo & Thomas, 2000; Sapolsky, Romero, & Munck, 2000). Previous operationalizations of AL have included urinary levels of E, NE, and cortisol, which indicate total production over the previous 12 hours, and higher levels indicate higher risk (Seeman & Chen, 2002; Seeman et al., 2004).

The majority of work on social ties and baseline endocrine function is concerned with cortisol. Cortisol is released in a diurnal pattern, whereby cortisol levels rise sharply upon waking and decline over the remainder of the day, and the most commonly used indices of baseline function are diurnal slope, total daily concentration (area under daily response curve), and overnight production.

There is evidence that individuals who report greater network-level support exhibit healthier patterns of baseline cortisol function, including lower mean daily concentrations (Heaney, Phillips, & Carroll, 2010; Turner-Cobb, Sephton, Koopman, Blake-Mortimer, & Spiegel, 2000), steeper diurnal decline (Abercrombie et al., 2004; Sjogren, Leanderson, & Kristenson, 2006), lower plasma levels (Wadhwa, Dunkel-Schetter, Chicz-DeMet, Porto, & Sandman, 1996), and lower overnight production as measured in urine (Seeman, Berkman, Blazer, & Rowe, 1994), though some studies report no association between support and one or more of these parameters (Smyth et al., 1997; Turner-Cobb, Sephton, Koopman, Blake-Mortimer, & Spiegel, 2000). These studies represent a range of populations including students (Heaney, Phillips, & Carroll, 2010), older adults (Seeman, Berkman, Blazer, & Rowe, 1994), pregnant women (Wadhwa, Dunkel-Schetter, Chicz-DeMet, Porto, & Sandman, 1996), and

cancer patients (Turner-Cobb, Sephton, Koopman, Blake-Mortimer, & Spiegel, 2000). Variability in sample composition, cortisol measurement, and support instruments presents a problem for synthesis and integration, but nonetheless the evidence linking stronger network-level support with more optimal HPA function is quite strong.

Data from the stress literature provide indirect evidence that chronic social negativity, as defined here, may contribute to basal cortisol dysregulation. In laboratory studies, the threat of negative evaluation from others reliably elicits acute elevations in cortisol (Dickerson & Kemeny, 2004), which suggests that individuals who frequently experience social stressors involving negative evaluation or rejection in daily life may exhibit chronic HPA activation. In a meta-analysis of studies on chronic stress and HPA function, Miller, Chen, and Zhou (2007) found that chronic social stress (defined as stimuli which could diminish a person's social standing or interrupt a major social role) was associated with elevated morning and afternoon/evening cortisol, suggesting that chronic social stress may activate the HPA axis during the daytime. These findings do not directly speak to the effects of social negativity as it has been defined here, but do highlight the idea that the chronic experience of distressing social interactions contributes to alterations in basal production of cortisol.

At the dyadic level, qualities of the marital relationship have been associated with baseline HPA function. Most of this work concerns marital satisfaction, which has traditionally been conceptualized as a global evaluation of the marriage which primarily reflects positive aspects of the relationship (Bradbury, Fincham, & Beach, 2000), and is therefore not a true measure of support or negativity. Higher levels of marital satisfaction have been associated with steeper diurnal cortisol decline (Adam & Gunnar, 2001; Saxbe, Repetti, & Nishina, 2008; Vedhara, Tuinstra, Miles, Sanderman, & Ranchor, 2006), although the effects are observed less

consistently among men. Another study found that marital-role concerns, but not marital-role rewards, was related to flatter diurnal decline (Barnett, Steptoe, & Gareis, 2005).

Fewer studies have investigated the association between social relationship qualities and catecholamines, but this evidence is consistent with the notion that more supportive and less negative relationships are associated with lower overall production of E and NE. For example, more frequent emotional support was related to lower 12 hour overnight urinary NE and E in a sample of older men, though the effects were not observed among women (Seeman, Berkman, Blazer, & Rowe, 1994).

Cardiovascular. There are several mechanisms through which social relationships can influence cardiovascular physiology. The autonomic nervous system has a direct influence on the heart, such that sympathetic activation causes the heart to work harder and is ultimately more taxing on the cardiovascular system as a whole, while parasympathetic activation can dampen cardiovascular activity (Brownley, Hurwitz, & Schneiderman, 2000). Over time, stress-related cardiovascular activation can damage the lining of arteries, which may lead to deposition of atherosceloric plaques. In addition, inflammatory processes have a detrimental effect on cardiovascular function, and can exacerbate accumulation of plaques or make those plaques unstable.

Previous measures of AL have used resting heart rate and systolic and diastolic blood pressure (SBP, DBP) as indices of tonic cardiovascular activity (Seeman & Chen, 2002; Seeman et al., 2004). SBP and DBP pressure readings reflect the force exerted by circulating blood on blood vessel walls, with SBP and DBP representing the maximum and minimum pressure, respectively, and provide indirect evidence of the degree of wear and tear which has been placed on the cardiovascular system. The results of correlational studies are generally consistent with

the idea that higher levels of support are associated with lower tonic blood pressure. A meta-analysis of 21 studies on social support and blood pressure found a small but reliable effect across studies (Uchino, Cacioppo, & Kiecolt-Glaser, 1996). Other positive aspects of relationships have been associated with blood pressure; for example, a longitudinal study of 103 married subjects with mild hypertension found that lower marital cohesion and satisfaction was associated with elevated ambulatory SBP and DBP (Baker et al., 2000).

Over time, elevated blood pressure and other wear and wear on the cardiovascular system can lead to cardiovascular heart disease (CHD). Relationship qualities have been associated with CHD risk factors among healthy individuals (see reviews by Kamarck, Peterman, & Raynor, 1998; Smith & Ruiz, 2002). For example, community women who reported frequent undermining from others in their social network and female students who reported frequent undermining coupled with infrequent support both exhibited elevated fibrinogen, a risk factor for CHD (Davis & Swan, 1999). Lower marital satisfaction at baseline predicted greater increases in left ventricular mass index, another CHD risk factor, over a three year period (Baker et al., 2000).

Even after a patient has been diagnosed with CHD, the qualities of his or her relationships continue to have an effect on symptom progression and severity (Smith & Ruiz, 2002). Higher marital satisfaction predicted increased survival in patients with congestive heart failure (Coyne et al., 2001) and lower marital stress predicted decreased risk of recurrent coronary events in patients with CHD (Orth-Gomer et al., 2000). The size of these effects is quite remarkable: in the Orth-Gomer and colleagues study (2000), marital stress was associated with a 2.9-fold increased risk of recurrent events among women who were married or cohabiting with a male partner.

Inflammatory. Inflammatory processes are those by which the innate immune system responds to infection and tissue damage, and include the recruitment of other immune mediators to the site of injury, the provision of a physical barrier to prevent spread of infection, and the repair of damaged tissue. While inflammation is critical as a short term response to infection, prolonged systemic inflammation can have detrimental effects and is increasingly implicated in the pathology of many diseases, including cardiovascular disease (Ross, 1999), cancer (Coussens & Werb, 2002), and diabetes (Wellen & Hotamisligil, 2005). Inflammatory markers are included in current conceptualizations of AL (Seeman & Chen, 2002; Seeman et al., 2004), such that higher levels of pro-inflammatory mediators and/or markers connote higher risk. Inflammatory markers typically used in psychosomatic research include interleukin-6 (IL-6, a proinflammatory cytokine) and C-Reactive Protein (CRP, an acute-phase protein which rises in response to inflammation), and are typically measured in plasma. In addition to measuring basal levels of these inflammatory markers, challenge tests such as the administration of lipopolysaccharide (LPS) can be used to measure the magnitude of the inflammatory response to stimulation.

The quality of social relationships has been associated with numerous markers of inflammation (for review, see Kiecolt-Glaser, Gouin, & Hantsoo, 2009). Higher levels of support have been associated with decreased inflammation: more positive social relations were associated with lower IL-6 in older women (Friedman et al., 2005), higher perceived intimacy in relationships was associated with lower plasma IL-6 in cancer patients (Lutgendorf, Anderson, Sorosky, Buller, & Lubaroff, 2000) and in a study of pregnant women, higher support during the third trimester was associated with lower CRP throughout pregnancy (Coussons-Read, Okun, & Nettles, 2007). Conversely, the presence of negativity has been associated with increased inflammation: higher levels of interpersonal stress were associated with greater LPS stimulated

IL-6 production in adolescents girls (Miller, Rohleder, & Cole, 2009) and rheumatoid arthritis patients (Davis et al., 2008), and higher levels of daily interpersonal stressors were associated with higher plasma CRP in adolescents (Fuligni et al., 2009). Just as in the endocrine and cardiovascular literatures, the measurement of support and/or negativity is inconsistent across studies, but the general pattern of findings suggests that higher levels of support and lower levels of negativity are associated with less systemic inflammation.

Metabolic. The metabolic system is involved in the breakdown, synthesis, and storage of substances which yield energy to support bodily processes. One particularly important metabolic process involves the regulation of blood glucose. Blood glucose levels are regulated by homeostatic mechanisms whereby as glucose levels rise, excess glucose is converted into storage, and as levels fall below a certain point, glucose is liberated from storage. Prolonged elevations of blood glucose indicate poor metabolic control and contribute to metabolic syndrome, a cluster of symptoms that is a risk factor for coronary artery disease, stroke, and Type 2 diabetes. Previous measures of AL (Seeman et al., 2004; Seeman, Singer, Ryff, Dienberg Love, & Levy-Storms, 2002) have included glycated hemoglobin (HbA1c) as an index of metabolic control, as HbA1c levels indicate plasma levels of glucose of the previous 2-3 months.

Research on social ties and metabolic control has tended to focus on the effects of diabetes-related support from family members on treatment adherence, and these studies generally find that individuals with more supportive family environments have better metabolic control (Burroughs, Harris, Pontious, & Santiago, 1997). Aside from this literature, relatively few studies have examined social relationship qualities and indices of metabolic function. Low satisfaction with the emotional and practical support provided by a close other over the previous

year was linked to elevated HbA1c among 234 British civil servants (Feldman & Steptoe, 2003). In a sample of adolescents with diabetes, higher scores on a two-item measure of negativity from friends was associated with higher HbA1C, but support from friends was not related to metabolic control (Helgeson, Reynolds, Escobar, Siminerio, & Becker, 2007). In another study of adolescents with diabetes, those reporting more peer conflict had higher HbA1c, and this effect was especially strong for girls (Helgeson, Lopez, & Kamarck, 2009). Over time, the effects of relationships on metabolic control may contribute to disease. For example, women who were dissatisfied with their marriages were more likely to develop metabolic syndrome a decade later, as compared to women who were moderately or highly satisfied (Troxel, Matthews, Gallo, & Kuller, 2005).

Relationship Qualities and AL: Evidence

The research summarized above indicates that individuals in higher quality relationships shower fewer signs of dysregulation across allostatic systems. Therefore, better relationship functioning, characterized by high support and low negativity, should be associated with lower AL. There is some evidence to support this hypothesis from large community studies. The methods and results of these studies are summarized in Table 1. Some of these studies also examined social structural variables (e.g., social network size) as predictors of AL, but those results are not discussed as this review is concerned with qualitative aspects of social ties.

Singer and Ryff (1999) used retrospective reports of the quality of relations with parents and concurrent reports of intimacy with a spouse to create measures of "relationship pathways." In a small sub-sample of older adults ($N = 84$) from the Wisconsin Longitudinal Study (WLS; a random sample of the high school graduating class of 1957 in Wisconsin), the researchers classified participants as on the negative pathway if the participant reported below-average

quality relations with both parents and/or below-average intimacy with a spouse. Participants were classified as on the positive pathway if they reported higher than average relations with at least one parent and at least one type of intimacy in adulthood. 56% of individuals on the negative relationship pathway (n = 41) had elevated AL scores, compared to only 28% of individuals on positive pathway (n = 43). Although this study did not assess the distinct contributions of positive and negative aspects of social functioning, these data support the idea that more supportive and/or less negative relationships are associated with lower AL.

Weinstein and colleagues (Weinstein, Goldman, Hedley, Yu-Hsuan, & Seeman, 2003) found that higher levels of perceived demands from others were associated with higher AL in a small sample of older Taiwanese adults (N = 101). Unfortunately, the study instruments did not assess other components of social negativity (i.e., conflict, negative evaluation) or social support, but the fact that a simple measure of perceived demands predicted AL in such a small sample is noteworthy.

Perhaps the best study to date on social relationship quality and AL used data from two community-based cohorts (Seeman, Singer, Ryff, Dienberg Love, & Levy-Storms, 2002). One cohort was drawn from the Wisconsin Longitudinal Study (WLS) and included individuals aged 58-59 (N = 106), and the second cohort was drawn from the MacArthur Studies of Successful Aging (MAC) and included individuals aged 70-79 (N = 765). The method of assessing support differed across the cohorts. In the WLS cohort, a summary index of relationship pathways was used, similar to that of Singer and Ryff (1999). In the MAC cohort, respondents rated the support provided by spouse, children, and close friends/family, and these items were used to compute measures of emotional and instrumental support, averaged across sources. The MAC cohort also rated how often their spouse, children, and friends/relatives "make too many

demands of you" or "are critical of what you do," and these two items were used to compute indices of demands/criticism. In both cohorts, AL was computed using a range of cardiovascular, hormonal, and metabolic parameters using a previously established algorithm.

The pattern of findings was consistent with the idea that more supportive and/or less negative social ties are associated with lower AL, but the pattern of effects varied based on the specific social variable in question and the statistical procedure. In the WLS cohort, individuals with more positive overall relationship histories had lower AL scores, but the individual parental and spouse items (e.g., mother caring, adult emotional/sexual intimacy) did not predict AL. In the MAC cohort, higher levels of emotional but not instrumental support were related to lower AL scores in men, but not women. However, when demands/criticism from each of the sources were examined separately, a more nuanced pattern of findings emerged. Demands/criticism from a spouse were related to higher AL scores for both men and women. In logistic regression analyses, individuals reporting high levels of criticism/demands from childen were three times more likely to have a high AL score, and men reporting higher criticism/demands from a spouse were more likley to have a high AL score. The Seeman and colleagues (2002) findings are consistent with the notion that more supportive and/or less negative relationships are associated with lower AL. More specifically, the MAC data suggest that the effects of negativity may be moderated by source, such that negativity from a spouse or children is more impactful than negativity from other sources. However, the negativity measure was only two items and did not assess conflict, a key component of negativity (Finch, Okun, Pool, & Ruehlman, 1999; Ruehlman & Karoly, 1991). The WLS findings can perhaps be interpreted as evidence that higher levels of support are related to lower AL, but the relationship pathways measure was not a

true measure of social support, as it contains retrospective reports of childhood social functioning.

Seeman and colleagues (Seeman et al., 2004) analyzed data from a large sample of Taiwanese adults from the Social Environment and Biomarkers of Aging Study (SEBAS). The sample was largely rural and uneducated, and included near elderly (age 54-70, $N = 531$) and elderly (age 71+, $N = 419$) adults. Measures of social functioning included a measure of the number of social ties and several measures of relationship quality: perceived emotional support, criticism from others, and excessive demands from others (available for elderly participants only). Perceived emotional support was measured with 4 items, and criticism from others measured with 1 item which differed slightly at each time point (either "whether family, relatives, or friends sometimes or very often critical of what respondent does" or "whether people close to the respondent complain about or find fault with things respondent does"). Among the elderly participants, excessive demands from others were measured by asking "how much they felt that their spouse/children/others make too many demands on them." The measure of AL was limited in that it did not include all systems (e.g., markers of inflammation, PNS).

Results indicated that social relationship quality did not consistently predict AL. In linear regression analyses which included only age and sex as covariates, near elderly participants who reported criticism at one or more time points had higher AL, but this finding did not remain significant in a full multivariate model which included demographic and health factors. Contrary to expectation, low emotional support at any time point predicted lower AL among near elderly women, but when criterion for "low" was adjusted, this was no longer significant.

Although this study found that relationship quality was not related to AL when a full set of covariates was added, the authors acknowledge that the findings should be interpreted in light

of the cultural context. The structure and meaning of Taiwanese social relations differs from the US, in that Taiwanese tend to be more interdependent and hold greater respect for the elderly, two factors which could alter the meaning of social relationship quality measures. The extent to which Western conceptions of social support and negativity translate to an elderly, largely rural and uneducated Taiwanese sample is not clear. This study is also limited by an incomplete measure of AL.

Unresolved Questions

Taken together, the small set of studies reviewed above are somewhat consistent with the idea that more supportive and/or less negative relationships are associated with lower AL. However, a number of important questions regarding the associations between relationship qualities and AL remain unanswered.

Do support and negativity exert independent effects on AL? Only two of the studies assess positive and negative aspects of social ties as independent factors (Seeman et al., 2002; 2004), and all of the studies used limited indicators of negativity -- often a single item assessing only one component of negativity. It is necessary to account for support and negativity as distinct dimensions in analyses and to properly measure negativity in order to test whether support and negativity exert independent effects on AL. In addition, it is useful for theory building to distinguish between perceived and enacted measures of support, as they represent different constructs with different implications for health (Dunkel Schetter & Bennett, 1990; Uchino, 2009).

The psychological well-being literature indicates that support and negativity are distinct predictors of psychological well-being (Finch, Okun, Barrera, Zautra, & et al., 1989), and support and negativity may operate similarly as predictors of AL. As described earlier, social

life involves both positive and negative processes, often occurring within the same relationship. To fully understand the qualities of a relationship, it is not possible to reduce it to a single dimension (e.g., satisfaction), although this is often the approach. Just as affective scientists now recognize positive and negative affect as independent dimensions (Diener & Emmons, 1984) with distinct effects on physiology and health (Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002; Pressman & Cohen, 2005; Ryff et al., 2006), it is plausible that the positive and negative components of social relationships have distinct physiological consequences.

In addition, no study to date has explicitly tested whether support or negativity is a stronger predictor of AL. In the mental health literature, many researchers have observed a negativity effect whereby negativity is a stronger predictor of indices like distress, depressive symptoms, and satisfaction with life (Finch, Okun, Pool, & Ruehlman, 1999). For example, Rook found that the number of negative ties predicted lower well-being in older adults, but there were no effects of positive ties (1994). Similarly, in a daily diary study with older adults, Rook (2001) found that negative exchanges were more potent predictors of well-being than positive exchanges, and that changes in negative exchanges over a 1 year period predicted changes in depression, while changes in positive exchanges did not. Rook has argued that the negativity effect reflects the greater salience of negative exchanges, as compared to positive exchanges. Negative exchanges occur less frequently than positive exchanges, which may render them more upsetting and surprising when they do occur (Rook, 2001). Rook has also highlighted negative biases in human cognition and the idea that negative events have a greater psychological impact than positive events (Taylor, 1991). On a physiological level, negativity may be more predictive of AL than support because the majority of the components of AL are stress responsive systems activated by the detection of threatening information.

Alternatively, there are several reasons why support could exert a stronger effect on AL than negativity. Some studies in the psychological well-being literature find positivity effects. For example, Uchino, Holt-Lunstad, Smith, and Bloor (2004) found that the number of supportive ties was a stronger predictor of psychological distress than the number of negative ties. In addition, supportive exchanges occur more often than negative exchanges, and could thus account for a greater percentage of the variance in physiology based on frequency alone. Finally and speculatively, ratings of support may be more closely tied to underlying psychobiological or dispositional traits (Lakey & Scoboria, 2005), which could inflate the association between perceived support and AL. The occurrence of negativity, on the other hand, may be less reflective of underlying qualities of the individual. Although certain individuals are more likely to elicit interpersonal stressors (Hammen, 2006), negativity measures may nonetheless be less stable than perceived support measures because they explicitly assess the behavior of others.

Social Support by Social Negativity Interactions. Another hypothesis which has not been tested to date concerns the interaction of support and negativity, both at the network level and within specific relationships. At the network level (i.e., averaged across sources), support from certain relationships may buffer individuals from the deleterious effects of social negativity in other relationships. In the psychological well-being literature, this phenomenon has been described as cross-domain buffering, and there is evidence that support from one relationship can buffer individuals from the harmful effects of negativity in another relationship. In a sample of college students who rated their relationships with roommates and friends, Lepore found that conflict from friends or a roommate predicted increases in distress over time, but support from the other source attenuated the effects of conflict on distress (1992). Cross-domain buffering

effects may be reflected in physiology as well. That is, network-level measures of support and negativity may interact such that higher levels of support reduce the effect of negativity on AL.

At the dyadic level, support and negativity may interact differently. Reporting high levels of support and negativity within a relationship is very different from reporting high levels of support and negativity across relationships. The term *ambivalence* has been used to describe relationships which involve moderate to high levels of both support and strain (Uchino, Holt-Lunstad, Smith, & Bloor, 2004). According to Uchino and colleagues (2001), relationships can be classified in two dimensional space based on the extent to which they are sources of positivity and negativity, and ambivalent ties represent those individuals who fall in the high positivity/high negativity corner.

Ambivalent ties may actually be more detrimental for psychological and physical health than strictly negative ties. One reason for this is that the occurrence of negative behaviors in an otherwise positive relationship may cast a shadow on the entire relationship. DeLongis, Capreol, Holtzman, O'Brien, and Campbell (2004) suggest that the "proximal interpersonal context" influences the impact of negative and positive behaviors, such that when positive and negative interactions occur close together in time, they influence and provide a context for the other. When a tie exhibits a negative behavior, this could color subsequent interactions such that the individual interprets subsequent neutral or positive behaviors more negatively. In addition, interactions with ambivalent ties may be more unpredictable than interactions with aversive ties, and unpredictability renders situations more stressful (Miller, 1981; Seligman, Maier, & Solomon, 1971). In the context of an aversive relationship, whether with a grumpy co-worker or an unpleasant aunt, negative exchanges are expected and thus may not be as upsetting as when they occur as they might be in an otherwise supportive relationship. Finally, the negativity that

occurs within an otherwise supportive relationship may be especially stressful because the relationship is valued. It is easier to brush off an insult from an annoying co-worker than an insult from a spouse whom you love and with whom you have shared many positive experiences. The salience of the tie renders insult from the spouse distressing, and this should be reflected on a physiological level.

There is evidence that relationships characterized by high levels of both support and negativity may have more deleterious effects on physiology than other types of relationships. In one study, participants exhibited higher systolic blood pressure (SBP) when discussing negative events in the laboratory with an ambivalent friend than with supportive friend (Holt-Lunstad, Uchino, Smith, & Hicks, 2007). In an innovative experience sampling study, the researchers gave participants ambulatory blood pressure (BP) monitors and asked them to take a BP reading 5 minutes into each social interaction (Holt-Lunstad, Uchino, Smith, Olson-Cerny, & Nealey-Moore, 2003). Interactions with ambivalent ties were associated with higher SBP than interactions with aversive or supportive members. Although interactions with familial ties were associated with greater SBP than interactions with friends, co-workers, and other types of ties, controlling for familial classification did not change the ambivalence finding. If interactions with ambivalent ties are stressful, then having a network composed of many ambivalent ties may take a toll on cardiovascular function over time. Consistent with this prediction, Uchino and colleagues (2001) found that individuals with a relatively high number of ambivalent ties had greater heart rate and shorter pre-ejection period reactivity during a lab stressor, as a function of age. The authors interpret these findings as evidence that ambivalent relationships may take a toll on sympathetic control of the heart over time. More recently, Uchino and colleagues reported that individuals with a higher number of ambivalent ties had shorter telomeres, a marker of

cellular aging (in press). In addition, ambivalence towards parents and friends in particular were related to shorter telomeres. Taken together, this emerging evidence suggests that ambivalent relationships are more harmful for physiology than other relationships. The extent to which ambivalence is related to AL has not been tested to date.

Cumulative exposure. The cornerstone of the AL framework is that wear and tear on physiological systems accrues over time. To better understand how relationship qualities influence physiology, it useful to obtain repeated observations of social functioning and to test whether changes in the quality of social experience over time are reflected in AL. The failure to adopt a longitudinal perspective and account for issues of stability characterizes the study of social support and negativity more generally, in which "issues of persistence and chronicity are rarely examined empirically" (Newsom, Mahan, Rook, & Krause, 2008, p. 84). If AL represents the cumulative product of exposure to stressors over time, then changes in social experience over time may be related to AL such that increases in negativity or decreases in support may be related to higher AL.

Potential moderators: Age. In order to understand the effects of relationship quality on AL, it is essential to account for age, in part because age and AL are highly correlated (i.e., individuals accrue AL over the life-span). However, as Gruenewald and Kemeny recently noted (2007), few studies have examined whether the effects of social ties on physiology change over the life-span. As individuals grow older, the quality of their social ties may begin to assume a larger importance for physiology due to heightened physical vulnerability; as individuals age, physiological systems are less able to "bounce back" after stressors.

In addition, changes in the structure and function of social relationships over the life-span may render older adults more psychologically sensitive to the quality of social relations. As

people age, their social networks tend to become smaller (Antonucci, 2001). This reduction may reflect a motivated effort to "prune" peripheral and problematic ties, so as to focus on close, meaningful ties (Lang & Carstensen, 1994). According to socioemotional selectivity theory, aging is accompanied by greater awareness of the brevity of life, which shifts attention towards pursuing emotionally meaningful goals, such as maintaining important relationships (Carstensen, Isaacowitz, & Charles, 1999). As a result of this motivational shift, older adults may prioritize their closest relationships and reduce contact with more peripheral ties. This shift in social motivation may help explain findings that older adults tend to be more satisfied with their social networks (Luong, Charles, & Fingerman, 2011), and that reports of social support increase over time (Gurung, Taylor, & Seeman, 2003). If older adults place greater emphasis on close social ties than younger adults, these highly salient relationships should assume a greater impact on psychological functioning, which may in turn have consequences for physiology.

In addition to voluntary changes in social network composition, older adults must contend with the loss of ties to death and disability. Older adults must find ways to substitute or compensate for lost ties, a potentially difficult task in the face of age-related reductions in health and mobility. The task of repairing and maintaining a threatened social network, especially as instrumental support needs increase due to illness or frailty, may render older adults more dependent on the quality of existing relationships.

There is evidence that older adults are in fact more vulnerable to the deleterious consequences of social negativity on mental health, as compared to younger adults. In a review of studies published between 1878-1996 (59 papers) on positive/negative exchanges and depressive symptoms, Okun and Keith (1998) reported that 41% of studies found a negativity effect, but this percentage was much higher among studies conducted with older adults (88%).

Potential moderators: Relationship type. The effect of relationship qualities on AL may be particularly strong in the context of marriage. Marital quality is consistently a stronger predictor of health outcomes than the quality of relationships with other family members, friend, or acquaintances (Robles & Kiecolt-Glaser, 2003). Although it has been studied less extensively than social support, a number of researchers have argued that social negativity should similarly be most impactful when it occurs in the context of close relationships, particularly marital relationships (Coyne & DeLongis, 1986). Spouses fulfill more of our support needs and are more closely intertwined with our self concepts. We care about obtaining their approval and we may spend more time with them than with other family or friends. In addition, spouses may be able to "push our buttons" and provoke conflict in ways that casual acquaintances do not. Therefore, the quality of the relationship with spouse/partner should have a stronger effect on AL than the quality of relationships with friends and other family members.

Study Overview

The overarching aim of this dissertation is to understand how the positive and negative components of social experience influence AL over time in a large sample of middle aged and older adults from the Midlife in the United States (MIDUS) study. More specifically, this study examines (a) whether reports of social support and social negativity are associated with AL, (b) whether there are interactive effects of support and social negativity on AL, and (c) whether changes in support and negativity over time are related to AL. In addition, this study examines age and relationship type as moderators of the effects of relationship quality on AL. The MIDUS data set includes well-designed and validated measures of positive and negative aspects of social functioning, repeated assessments of social functioning over a ten-year period, and extensive measures of all the components of AL.

Hypotheses

Conceptual models of hypotheses are presented in Figures 1-4, and the complete set of hypotheses is listed in Tables 2-3.

The first question of interest addresses how the quality of social experience is associated with AL in middle and older aged adults in this sample. Two hypotheses concern the main effects of support: Hypothesis 1ai states that higher levels of *network* support (i.e., support averaged across friends, family, and spouse) will be associated with lower AL, and Hypothesis 1aii states that among married individuals, higher levels of *spouse* support will be associated with lower AL. Two parallel hypotheses concern the main effects of negativity on AL: Hypothesis 1bi states that higher levels of *network* negativity will be associated with higher AL, and Hypothesis 1bii states that among married individuals, higher levels of *spouse* negativity will be associated with higher AL. Two hypotheses concern the relative magnitude of the effects of support and negativity on AL. These hypotheses are based on the idea that allostatic systems are stress-responsive systems that should be more responsive to negative stimuli than to positive, as well as evidence of "negativity effects" on psychological outcomes. Hypothesis 1ci states that Levels of *network* negativity will have a stronger effect on AL that levels of *network* support, and Hypothesis 1cii states that among married individuals, levels of *spouse* negativity will have a stronger effect on AL than levels of *spouse* support. Finally, two hypotheses concern the interactive effects of support and negativity on AL. Based on evidence that higher levels of network support can buffer individuals from the deleterious effects of negativity on psychological well-being, Hypothesis 1di states that *network* support and *network* negativity will interact such that higher levels of *network* support will reduce the effects of *network* negativity on AL. The second hypothesis is more counterintuitive, and is based on evidence that

ambivalent relationships characterized by moderate to high levels of positivity and negativity seem to be more detrimental for psychological and physical well-being than other types of relationships. Hypothesis 1dii states that among married individuals, there will be a significant interaction of *spouse* support and *spouse* negativity such that high levels of support will exacerbate the effects of negativity on AL.

The second question of interest addresses how changes in support and negativity over a ten-year period are related to AL. Two hypotheses concern the effects of changes in support on AL: Hypothesis 2ai states that Wave 2 *network* support will predict AL, controlling for Wave 1 *network* support, and Hypothesis 2aii states that Wave 2 *spouse* support will predict AL, controlling for Wave 1 *spouse* support. Two parallel hypotheses concern the effects of changes in negativity on AL: Hypothesis 2bi states that Wave 2 *network* negativity will predict AL, controlling for Wave 1, and Hypothesis 2bii states that Wave 2 *spouse* negativity will predict AL, controlling for Wave 1.

In addition to the two primary questions described above, a third question addresses whether the effects of social experience on AL change with age. Two hypotheses concern whether the main effects of support on AL vary by age: Hypothesis 3ai states that the effect of *network* support on AL will increase with age, and Hypothesis 3aii states that among married individuals, the effect of *spouse* support on AL will increase with age. Two parallel hypotheses concern whether the main effects of negativity on AL vary by age: Hypothesis 3bi states that the effect of *network* negativity on AL will increase with age, and Hypothesis 3bii states that among married individuals, the effect of *spouse* negativity on AL will increase with age.

The final question of interest concerns whether the effects of support and negativity on AL vary by source. Based on evidence that marital relationships have a particularly strong effect

on psychological and physical health outcomes, two hypotheses compare the effects of support and negativity from a spouse and other sources: Hypothesis4a states that among married individuals, *spouse* support will have a stronger effect on AL than support *from friends and family,* and Hypothesis 4b states that among married individuals, *spouse* negativity will have a stronger effect on AL than negativity *from friends and family*. An additional hypothesis concerns whether the relative magnitude of the effects of support and negativity varies by source, and Hypothesis 4c states that the relative effects of support and negativity will be moderated by source, such that the levels of negativity will have a stronger effect on AL than levels of support at both the *network* and *spouse* level, but this effect will be stronger at the *spouse* level.

CHAPTER 2:

METHODS

Procedure

This study uses data from the study of Mid-life in the US (MIDUS), a longitudinal study of health and aging in the United States conducted by the John D. and Catherine T. MacArthur Foundation Research Network on Successful Midlife Development.

MIDUS 1. The first wave of the MIDUS study was conducted mainly between 1995-1996, and collected survey data from 7,108 participants (age 24-74, 48% male). The sample was not technically nationally representative in that it unintentionally under-sampled those at the extreme ends of the socioeconomic distribution (i.e., very rich or very poor), but it did capture the majority of the SES distribution. The sample was composed of four subsamples: (1) individuals selected through random digit dialing (RDD; n = 3,487), (2) individuals oversampled from 5 urban areas (n = 757), (3) siblings of individuals from the RDD sample (n = 950), and (4) an RDD sample of adult twins (n = 1,914). All participants were non-institutionalized, English-speaking adults aged 25-74 living in the U.S. Respondents were invited to complete a 30-minute phone interview and 2 self-administered questionnaires, each approximately 45 minutes in length. Response rates varied between 70-70% for the phone interview (depending on the sub-sample), and 81-92% for the questionnaire.

MIDUS II. The second wave of MIDUS data were collected between 2004-2006 and every attempt was made to recruit all of the original respondents. Of the 7,108 original participants, 4,963 were successfully contacted and invited to complete a 30 minute phone interview. The average interval between waves was approximately nine years (range = 7.8-10.4 yrs), and the longitudinal response rate across all sub-samples, adjusted for mortality, was 75%.

In addition, 81% of the phone interview participants completed two self-administered questionnaires which they received by mail.

Biomarker Project. MIDUS II participants who had completed both the phone interview and self-administered questionnaire were invited to complete an assessment of a variety of biological indicators of physiology and health. This project was one of 5 projects comprising the MIDUS II "Integrative Pathways to Health and Illness," which was designed to investigate the long-term consequences of psychosocial and behavioral factors for health and illness. Eligible participants were assigned one of 3 data collection sites, based on their place of residence, and data were collected during a 24-hour stay at one of 3 General Clinical Research Centers (GCRCs). The protocol included a physical exam, 12 hour urine sample and fasting blood draw, which are discussed in greater detail below. Medical history and medication use were also assessed at this time.

Sample

This project analyzes data from those participants with complete data from MIDUS I, MIDUS II, and the MIDUS II biomarker project ($N = 949$). Participants in this sample were 34 to 84 years of age, with an average age of 55.26 ($SD = 11.78$), and the majority were white, married (72%), and in good health (90.5% rated their own health as good, very good, or excellent).

Measures

Social support and negativity. At each wave, support and negativity were measured from three sources – spouse/partner, family (except spouse/partner), and friends – using a self-administered questionnaire. The questionnaires were based on previous work by Schuster and colleagues (Schuster, Kessler, & Seltine, 1990) who found that support and negativity (which they referred to as "positive and negative exchanges") predicted depressed mood in a sample of

1,755 non-Black married adults (aged 18-65 yrs). Walen and Lachman (2000) analyzed the support and negativity measures from Wave 1 of the MIDUS survey and found that both support and negativity predicted psychological well-being and self-reported health problems. Specifically, higher levels of negativity from a spouse or family were associated with lower positive mood, higher negative mood, and more health problems. Higher levels of support from spouse, family, or friends was associated with higher life satisfaction, greater positive mood, and lower negative mood, but did not predict health problems.

The complete support and negativity measures are presented in Appendices A-C. Similar items were used for each source, with the addition of two items in the spouse measure. Scores represent mean response on a Likert-type scale of 1 to 4, with items reverse-coded such that higher scores indicate higher standing on that scale. Scores were computed for each variable by calculating the mean of the values of the items in each scale. Items were reverse-coded so that high scores reflect higher standing on the scale. The scales were computed for cases that have valid values for at least one item on the particular scale. Scores were not calculated for cases with no valid items on the scales.

Social support was measured with items that measure perceived availability of emotional support. For each source, respondents indicated how much the source "really cares about you" and "understands the way you feel about things, how much they could "rely on [source] for help if you have a serious problem, and how much they could "open up to [source] if you need to talk about your worries." For spouse/partner, respondents also rated how often he/she "appreciates you" and how much "you can relax and be yourself around him or her." Items were rated on 4-point scales (1 = *A lot*, 2 = *Some*, 3 = *A little*, 4 = *Not at all*), and the measures were internally consistent (Cronbach's alpha = .87, .79, and .79 for spouse/partner, family, and friend scales).

Social negativity was measured from each source by asking respondents to indicate how often each source "makes too many demands on you," "criticizes you," "lets you down when you are counting on [him or her]," and "gets on your nerves." For spouse/partner, respondents also rated how often he/she "argues with you" and "makes you feel tense." Items were rated on 4-point scales (1 = *Often*, 2 = *Sometimes*, 3 = *Rarely*, 4 = *Never*), and the measure was internally consistent (Cronbach's alpha = .90, .84, and .88 for spouse/partner, family, and friend scales).

Spouse ambivalence. Spouse ambivalence was assessed two ways. First, we computed the interaction between continuous measures of support and negativity, under the assumption that high levels of support and negativity would represent ambivalence. Second, we created a categorical variable, based on the approach taken by Uchino and colleagues (2004; Campo et al., 2009). An individual's relationship with his or her spouse was considered "ambivalent" if the individual rated his or her spouse as providing more than "some" support (i.e., spouse support rating greater than "2") and experiencing negativity more than "sometimes" (i.e, spouse negativity rating greater than "2"). This method of computing ambivalence was adapted from the Social Relationships Index (Campo et al., 2009), in which participants are asked to rate how helpful or upsetting specific sources are when the participant needs emotional, informational, and tangible support. A source is then categorized as ambivalent if the participant rates that person as being at least a little helpful and a little upsetting (i.e, a "2" or higher for both "helpful" and "upsetting," where 1 = *not at all* and 6 = *extremely*). Of the 660 participants in our sample who were married at both time points, 378 were categorized as ambivalent towards their spouses at M1.

Allostatic load. Consistent with previous work (Seeman, Rowe, McEwen, & Singer, 2001) the measure of allostatic load was designed to summarize activity across multiple

physiological systems. Sympathethic activity was assessed with 12-hour overnight urinary epinephrine and norepinephrine samples, which provided integrated indices of SNS activity. Parasympathetic activity was assessed with several indicators of baseline heart rate variability (HRV): standard deviation of the interbeat interval (SDRR), root mean square differences of successive beat-to-beat intervals (RMSSD), high frequency heart rate variability (HFHRV), and low frequency heart rate variability (LFHRV). HPA axis function was assessed with 12-hour overnight urinary cortisol, an integrated measure of HPA activity, and serum dehydroepiandrosterone sulfate (DHEA-S), a functional HPA axis antagonist. Inflammation was measured with a series of inflammatory markers: serum IL6, a proinflammatory cytokine; fibrinogen, a marker of inflammation that is a key factor in hemostasis; C-Reactive Protein (CRP), an acute-phase protein that increases in response to inflammation; endothelial leukocyte adhesion modecule-1 (E-Selectin), a cytokine-activated cell adhesion molecule that plays an important role in inflammation; and human soluble intercellular adhesion modecule-1 (sICAM-1), a cytokine-activated cell adhesion molecule. Cardiovascular activity was measured with pulse, SBP, and DBP. Metabolic processes were divided into two subscales. The metabolic-glucose scale used glycosylated hemoglobin (Hb_{A1c}), an integrated measure of glucose metabolism over several days, and the metabolic-lipids scale included body mass index (BMI), waist/hip ratio (WHR), serum triglycerides, and serum low-density and high-density lipoprotein cholesterol (LDL, HDL).

Data were collected during a 24-hour stay at one of 3 General Clinical Research Centers (GCRCs). Participants were assigned a data collection site based on the region in which they lived (West Coast, Midwest, East Coast). After arriving at the GCRC in the late afternoon, participants completed a self-administered questionnaire which included questions about medical

history and health behaviors. Participants then received a physical exam, during which vital signs and waist and hip measures were obtained. The next morning, twelve-hour overnight (7:00 pm – 7:00 am) urine samples and fasting blood samples were collected before breakfast.

Blood and urine samples were frozen in a -60 to -80 freezer and shipped on dry ice to the MIDUS Biocore Lab (University of Wisconsin, Madison, WI). Samples were assayed by the following labs: Meriter Labs (GML; Madison, WI; $Hb_{A1c,}$ triglycerides, HDL, LDL), Associated Regional & University Pathologists (ARUP) Laboratory (Salt Lake City, UT; DHEA-S), Laboratory for Clinical Biochemistry Research (University of Vermont, Burlington, VT; ICAM, E-Selectin, fibrinogen, CRP), Mayo Medical Laboratory (Rochester, MN; epinephrine, norepinephrine, cortisol), and the MIDUS Biocore Laboratory (IL-6).

Participants were given a risk score for each indicator, where 0 = *low risk* and 1 = *high risk.* High risk was defined as the bottom quartile for the parasympathetic indicators, DHEA-S, and HDL. For the remaining indicators, high risk was defined as the top quartile. The average number of high-risk indicators for each of the seven systems was computed, and these average risk scores were summed to obtain a overall AL score.

Covariates. Selection of covariates for inclusion in the current analyses was based on prior evidence suggesting that they could be potential confounders (i.e., that they have been related to both social relationship quality and allostatic load). Socio-demographics included *age* (in years), *gender* (coded 1 for male, 2 for female), *race* (White vs. Non-White), and *education*, which was assessed based on a 5-category, degree-based measure ranging from "less than high school" to "graduate school or more" and was treated as an ordinal variable in analyses. Health behaviors included current *smoking status* (0 = never, 1 = past, 2 = current), *drinking status* over the previous month (dummy coded variable indicating abstainer, light/moderate, or heavy), and

mean hours per week of *physical exercise* (weighted average of light, moderate, and vigorous exercise). Health status was assessed based on self-reports of *major chronic conditions* (e.g., heart disease, stroke, hypertension, and diabetes) conditions, as well as based on self-reports of *functional status*, measured as whether the individual had any impairments in basic activities of daily living.

CHAPTER 3:

RESULTS

Data Analytic Plan

SPSS (Version 15.0) was used for all analyses. After obtaining descriptive statistics and examining correlations among key variables, we tested hypotheses using generalized estimating equations in order to account for the fact that a subset of the sample were pairs of twins (n = 158 twin pairs). Generalized estimating equations permit the specification of an exchangeable correlation matrix, which can account for clustering by family membership. For each hypothesis, we first tested a model with only age included as a covariate. If the social experience variable in question was a significant predictor of AL in this initial model, we added additional covariates in steps (i.e., demographics, health status, health behaviors). Hypotheses about support and negativity from a spouse were tested using only data from married individuals (n = 660). With the exception of hypotheses addressing change over time, all support and negativity measures were taken from Wave 1. All variables were centered prior to creating interaction terms.

For a separate manuscript, we ran a similar set of analyses using the average of M1 and M2 social variables as predictors of AL (Brooks et al., under review). The rationale for computing average scores was to obtain a better estimate of social experience over the 10 year period than could be obtained using one time point alone. The analyses in that manuscript differed somewhat from the dissertation analyses reported here, in that they included frequency of social contact from friends and family as predictors of AL, explicitly compared friend and family (whereas the dissertation analyses combined friends and family), and included depressive

and anxious symptoms as covariates in the final models[1]. Analyses from that manuscript are referenced here as appropriate, and are described as "M1/M2" social variables, to indicate that they reflect the average of M1 and M2.

Descriptive Results

Table 4 provides demographic information and descriptive statistics. Overall, the sample was largely White and relatively highly educated, with over 50% reporting at least some college. Participants in this sample were 34 to 84 years of age (at the second wave of data collection), with an average age of 55.07 (*SD* = 11.68) at M2, and the majority were married at both time points (70%).

Older age was associated with higher levels of support and lower levels of negativity from all sources (all *p*s < .05, *r*s between -0.25 and 0.13), with the exception that friend support was not related to age at either time point, and spouse strain was not related to age at M1. Despite those exceptions, this pattern of findings is consistent with previous evidence that older adults tend to be more satisfied with the quality of their social relationships (Gurung, Taylor, & Seeman, 2003).

Women reported higher levels of family, friend, and network support at both M1 and M2, while men reported higher levels of spouse support at both time points (all *p*s < .05). This pattern is similar to findings from a large sample of Australian twins, in which men reported higher perceived support from spouse and women reported higher perceived support from siblings, children, relatives, and friends (Coventry, Gillespie, Heath, & Martin, 2004). More generally, the literature on gender differences in social support is inconsistent, with some studies reporting higher average levels among women (Turner & Marino, 1994; Coventry, Gillespie,

[1] Interestingly, depressive and anxious symptoms at M2 did not predict AL, and did not substantially alter the findings for support and negativity.

Heath, & Martin, 2004) and others reporting no difference (Furukawa, Harai, Hirai, Kitamura, & Takahashi, 1999).

Women reported higher levels of family and network negativity at both times points (all *p*s < .05), and marginally higher levels of spouse and friend negativity at M1. The literature on gender difference in social negativity is inconclusive, with some but not all studies finding higher reports of negativity among women (Newsom et al., 2008; Beals & Rook, 2006).

White participants reported higher levels of support (F (1, 947) = 5.24, $p < .05$) and lower levels of negativity (F 1, 947) = 4.45, $p < .05$) than non-white participants. This finding is based on a small, ethnically and racially heterogeneous sample of non-white participants (6.6% of the total sample, of which approximately 32% were African American, 47% multiracial, and 21% "other") so it should be interpreted with caution. Relatively few studies have addressed racial or ethnic differences in social support and negativity and the findings of these studies are inconsistent (e.g., Thorpe et al., 2012; Rees, Karter, & Young, 2010).

Preliminary Correlational Results

Consistent with previous work (Okun & Lockwood, 2003; Campo, 2009) higher levels of support were associated with lower levels of negativity (r = -0.35, $p < .001$). This moderate negative correlation is consistent with the theoretical premise that support and strain are separable and conceptually distinct (Brooks & Dunkel Schetter, 2011; Okun & Keith, 1998).

Older age was associated with higher AL (r = 0.38, $p < .001$), consistent with previous research (Seeman et al., 1997; Karlamangla et al., 2002). The concept of AL is based on the premise that individuals accrue wear and tear on physiological systems over the life-span, and thus there should be a positive association between age and AL, as observed here.

Mean AL scores varied by educational attainment such that higher levels of education were associated with lower AL (r = -0.20, p < .001). This finding is consistent with a sizeable body of evidence linking lower standing on socioeconomic markers like educational attainment with greater physiological dysregulation and poorer health (Adler et al., 2004; Seeman, Epel, Gruenewald, Karlamangla, & McEwen, 2010).

AL did not vary by sex, consistent with previous large population based studies (Seeman et al., 2002). AL also did not vary by race, which may be due in part to the small number of non-whites in the sample, as some previous studies have documented differences in AL by race (Geronimus, Hicken, Keene, & Bound, 2006).

Tests of Primary Hypotheses

H 1ai) Higher levels of network support will be associated with lower AL.

This hypothesis was not supported by analyses. As shown in Table 5, the association between network support and AL was not significant, and did not become significant with the addition of covariates. In our supplemental analyses, M1/M2 average support was associated with lower AL when first added to the model (unstandardized B = -0.05, p < .001), but was not significant with the addition of covariates (Brooks et al., under review).

H 1aii) Among married individuals, higher levels of spouse support will be associated with lower AL.

This hypothesis was supported by data analyses. As shown in Table 5, higher levels of spouse support were significantly associated with lower AL (B = -0.20, p < .01), and this association remained significant with the addition of all covariates (B = -0.17, p < .05). Similarly, higher levels of M1/M2 spouse support were associated with lower AL, controlling for all covariates (B = -0.18, p < .05), (Brooks et al., under review).

H 1bi) Higher levels of network negativity will be associated with higher AL.

This hypothesis was supported by tests performed. As shown in Table 5, higher levels of network-wide negativity were associated with higher AL (B= 0.25, $p < .01$) and this association remained significant with the addition of covariates, although the magnitude of the coefficient was reduced (B = 0.17, $p < .05$). Similarly, M1/M2 network negativity was marginally associated with higher AL (B = 0.17, $p < .10$), (Brooks et al., under review).

H 1bii) Among married individuals, higher levels of spouse negativity will be associated with higher AL.

There was marginal support for this hypothesis in analyses. As shown in Table 5, higher levels of spouse negativity were associated with higher AL in the baseline model (B = 0.15, $p < .05$) and in a model with demographics (B = 0.16, $p < .05$) but the association was rendered marginal with the addition of health status. The results were stronger when M1/M2 spouse negativity (i.e., averaged across M1 and M2) was entered as a predictor. Higher M1/M2 spouse negativity was associated with higher AL, controlling for all covariates (B = 0.14, $p < .05$; Brooks et al., under review).

H 1ci) Levels of network negativity will have a stronger effect on AL than levels of network support.

This hypothesis was supported by tests conducted. As shown in Table 5, when network support and negativity were both entered as predictors, higher levels of negativity were associated with higher AL (B = 0.27, $p < .01$), but support was not related to AL (B = 0.05, $p > .10$). The positive association between negativity and AL remained significant with the addition of all covariates (B = 0.20, $p < .05$).

H 1cii) Among married individuals, levels of spouse negativity will have a stronger effect on AL than levels of spouse support.

This hypothesis was not supported. As shown in Table 5, when spouse support and negativity were both entered as predictors, neither social variable was associated significantly with AL. When health status was added to the model, there was a marginal negative association between spouse support and AL, but this was rendered non-significant with the addition of health behaviors. There was no association between spouse negativity and AL. These results may be due in part to the negative correlation between spouse support and negativity (r = -0.65, p < .001).

H 1di) There will be a significant interaction of network support and network negativity such that higher levels of support will reduce the effects of negativity on AL.

This hypothesis was not supported. As shown in Table 5, the interaction between network-wide support and negativity was not significant.

H 1dii) Among married individuals, there will be a significant interaction of spouse support and spouse negativity such that high levels of support will exacerbate the effects of negativity on AL.

The results testing this hypothesis were mixed. As shown in Table 5, the interaction between spouse support and negativity was not significant, but the categorical measure of ambivalence was associated with higher AL. Spouse ambivalence (where 0 = *not ambivalent* and 1 = *ambivalent*) was a marginal predictor of higher AL when first added to the model, and became significant with the addition of demographics. Therefore, although the hypothesis as stated was not supported, our data provided support for the concept underlying the hypothesis.

H 2ai) Wave 2 network support will predict AL, controlling for Wave 1 network support.

This hypothesis was not supported. As shown in Table 6, when network support from M1 and M2 were entered in steps to the model, neither was a significant predictor of AL, and these results did not change with the addition of covariates.

H 2aii) Wave 2 spouse support will predict AL, controlling for Wave 1 spouse support.

This hypothesis was not supported. As shown in Table 6, higher levels of M1 spouse support were associated with lower AL, but this association became marginal when M2 spouse support was added to the model. When health behaviors were added to the model, the association between M1 spouse support and AL was not significant.

H 2bi) Wave 2 network-wide negativity will predict AL, controlling for Wave 1.

This hypothesis was not supported. As shown in Table 6, when M1 and M2 network negativity were entered as predictors in steps, higher levels of M1 negativity were associated with higher AL, and there was no association between M2 negativity and AL. The positive association between negativity and AL became marginal when health status was added to the model.

H 2bii) Wave 2 spouse negativity will predict greater AL, controlling for Wave 1.

This hypothesis was not supported. As shown in Table 6, when M1 spouse negativity was first entered in the model, it was positively (not inversely) associated with AL. However, when M2 spouse negativity was added to the model in a second step, neither M1 nor M2 spouse negativity was associated significantly with AL. When demographic covariates were added to the model, there was a marginal positive association between M1 spouse negativity and AL, but this association was rendered marginal with the addition of health status.

Secondary Hypotheses

H 3ai) The effect of network support on AL will increase with age.

This hypothesis was not supported by analyses. As shown in Table 7, network-level support interacted with age, although the main effect of support was not significant. Similar results were found for M1/M2 network support. To better understand the nature of the interaction, we plotted the predicted values of AL at varying levels of M1 network support and age. As shown in Figure 5, the pattern of predicted values suggested that among younger adults, higher support was associated with lower AL, but that among older adults the association was reversed such that higher support was associated with higher AL. In order to test these predictions, we split the sample into groups by age (34-49, 50-64, 65+) and tested Model 1 (i.e., support and age as predictors). Among those 34-49, higher support was associated with lower AL (unstandardized B = -0.35, $p < .001$). The associations between support and AL were not significant in either of the older groups, but both coefficients were positive (50-64, B = 0.10; 65+, B = 0.19).

H 3aii) Among married individuals, the effect of spouse support on AL will increase with age.

This hypothesis was not supported either. As shown in Table 7, there was no evidence that the effects of spouse support interacted with age, as the interaction term was not significant. Similar results were found using M1/M2 spouse support.

H 3bi) The effect of network negativity on AL will increase with age.

This hypothesis was not supported. There was evidence that the effects of network-level negativity varied as a function of age, but not in the predicted direction; the direction of the interaction term was negative. The interaction between network negativity and age was marginal in all models tested. The effects of M1/M2 network negativity interacted with age in a similar fashion (interaction B = -0.01, $p < .10$), (Brooks et al., under review).

In order to better understand the nature of the interaction between M1 network negativity and age, we plotted the predicted values of AL by age and network negativity. As shown in Figure 6, the pattern of predicted values suggested that among younger adults there was a positive association between negativity and AL, but there was little relationship among older adults. When we tested the association between network negativity and AL by age group, the results confirmed this interpretation: among those 34-49, there was a strong positive association between network negativity and AL ($B = 0.48$, $p < .001$), but among those 50-64 and 65+, negativity was not a significant predictor. However, these results should be interpreted with caution because coefficient associated with negativity was not significant in the final model, and the interaction term was marginal.

H 3bii) Among married individuals, the effect of spouse negativity on AL will increase with age.

As shown in Table 7, there was no evidence that the effects of spouse negativity on AL varied with age. Higher levels of spouse negativity were associated with higher AL (although the association became marginal when health status was added to the model), but the interaction term was not significant. Results were similar for M1/M2 spouse negativity. Therefore, this hypothesis was not supported.

H 4a) Among married individuals, spouse support will have a stronger effect on AL than support from friends and family.

This hypothesis was supported. As shown in Table 8, when spouse and family/friend support were both entered as predictors, spouse support was associated with lower AL, but there was no association between friend/family support and AL. These associations remained significant with the addition of covariates.

H 4b) Among married individuals, spouse negativity will have a stronger effect on AL than negativity from friends and family.

Results did not support this hypothesis. As shown in Table 8, when spouse and friend/family negativity were first entered into the model, higher friend/family negativity was associated with higher AL but there was no association between spouse negativity and AL. The effect of friend/family negativity remained when demographic variables were added to the model, but was not significant when health status was added.

H 4c) The relative effects of support and negativity will be moderated by source, such that levels of negativity will have a stronger effect on AL than levels of support at both the network and spouse level, but this effect will be stronger at the spouse level.

This hypothesis was not supported. As shown in Table 8, when support and negativity from spouse and family/friends were all entered as predictors of AL, higher spouse support was associated with lower AL and higher family/friend negativity was associated with higher AL. Contrary to our expectations, higher family/friend support was marginally associated with higher AL. In the final model, higher spouse negativity was marginally associated with lower AL and higher family/friend support was associated with *higher* AL. Thus, when all four variables were included in one model we did not see evidence of a negativity effect, and we did not see evidence that a negativity effect was stronger for spouse as compared to family/friends.

This hypothesis was not explicitly tested in the M1/M2 analyses, but we did test a model that model included contact, support, and negativity from family, friends, and spouse. Consistent with our dissertation predictions, M1/M2 spouse support was marginally associated with lower AL, while support from other sources was not related to AL. Inconsistent with prediction, M1/M2 spouse negativity was not a stronger predictor than family or friend negativity. (In fact,

strongest evidence was for family negativity; higher family negativity related to higher AL in initial model with no demographic or health covariates). Also inconsistent with prediction, M1/M2 negativity was not a stronger predictor than support when considered by source.

Supplemental Analyses: Gender Interactions

Tests were conducted to examine possible gender interactions in the main effects of support (at both the network and spouse level) by adding a gender interaction term to each model. None of the gender interaction terms were significant (all *ps* > .05), indicating that the main effects of support and negativity were not moderated by gender.

CHAPTER 4:

DISCUSSION

The aim of this dissertation was to examine the associations between positive and negative aspects of social ties and AL. Several key themes emerged from the results. First, the relative importance of support and negativity varied based on the type of relationship being assessed. At the social network level, negativity mattered more than support, but the reverse was true at the spouse level. Second, individuals whose spouse relationships were characterized by ambivalence (i.e., moderate to high levels of both support and negativity) had higher AL. Third, the association between relationship quality and AL varied with age, such that the effects of both support and negativity were stronger among younger adults. The theoretical implications of these key findings are discussed in greater detail below.

Of the twelve primary hypotheses tested, only three hypotheses were supported and there was marginal support for two others. Two supported hypotheses concerned the main effects of support and negativity, and one concerned the relative magnitude of the effects of support and negativity. Those receiving marginal support were the primary hypotheses concerning the main effects of negativity, and the interaction of spouse support and negativity. The remaining seven primary hypotheses were not supported by results. Notably, there was no support for any hypotheses concerning the interactions of network support and negativity or changes in social experience over time. Of the seven secondary hypotheses, one hypothesis about the relative importance of spouse support as compared to other sources was supported. The remaining six secondary hypotheses were not supported, and these hypotheses concerned age interactions and comparisons between spouse and other sources. These results are discussed below, and the theoretical

Main Effects of Support and Negativity

One of the most interesting sets of findings to emerge from this dissertation concerns the relative importance of social support and social negativity in predicting AL. Based on evidence that social negativity is a stronger predictor of psychological well-being than positive aspects of relationships (Finch et al., 1999; Rook, 1994, 2001; Newsom et al., 2003), we predicted that negativity would be a stronger predictor of AL. We found evidence of such a "negativity effect" at the network level, but the reverse was true at the spouse level. These findings suggest that the effects of support and negativity on AL vary based on whether they are occurring in the context of a marriage or across the entire social network. They add to an evolving understanding of the dual aspects of our relationships and the ways in which different categories of relationships influence health differently over the lifespan.

Negativity Matters More Than Support at the Network Level.

At the social network level, higher reports of negativity were associated with higher AL independent of age and other covariates. This finding is consistent with other studies reporting a positive association between negative aspects of social ties and AL (Weinstein et al., 2003; Seeman et al., 2002), and suggests that a social network characterized by high levels of social negativity may contribute to wear-and-tear on allostatic systems over time. The present study adds to the literature by demonstrating an association between AL and social negativity in a sample of middle aged and older men and women. Importantly, this study used a multi-item measure that tapped multiple dimensions of social negativity, whereas previous studies relied on 1-2 items as indicators of negativity.

Contrary to prediction, network support was not related to AL. This finding is inconsistent with the broader base of evidence liking positive social functioning with more

optimal physiological well-being (Cohen, 2003; Uchino, 2009; Holt-Lunstad, Smith, & Layton, 2010). However, it is worth noting that the evidence to date linking social support and AL is minimal and mixed. Although higher levels of network emotional support were associated with lower AL among men in the MacArthur cohort, the same measure did not predict AL among women (Seeman et al., 2002). Singer and Ryff (1999) and Seeman and colleagues (2002) both reported that more positive relationship functioning was associated with lower AL among adults in the Wisconsin Longitudinal Study, but their measures combined positive and negative aspects of relationships, and are not proper analogues to the support measure used here. Thus, this is a first test of this precise premise in some senses.

Our failure to detect an association between network support and AL may be due to the presence of an age interaction, whereby the association between support and AL became weaker with age. Among the youngest adults in our study (aged 34-49), higher network support was associated with lower AL, as predicted. However, among older adults (50-84) the direction of the association appeared to reverse. The pattern of predicted values suggested that support may in fact be associated with higher AL among the oldest adults in our study. If network support is more predictive of physiology among younger and middle aged adults, this could explain why previous studies have yielded inconsistent results: these studies have been conducted exclusively among adults over the age of 50.

Support Matters More Than Negativity at the Spouse Level

At the spouse level, we found evidence that support was more predictive of physiology than negativity. As predicted, higher levels of spouse support were associated with lower AL, independent of age and other covariates. This finding is consistent with a handful of studies linking positive aspects of relationships with lower AL (Seeman et al., 2002; Singer & Ryff,

1999), and with evidence that marriage has a potent effect on physiology and health (Robles and Kiecolt Glaser, 2003). More generally, this finding suggests that individuals who experience relatively high levels of social support in their marriages may incur less stress-related wear-and-tear on physiological systems over time, as compared to individuals experiencing less support from their spouse. This is a particularly important finding because it reaffirms and extends our understanding of the benefits of support through potential physiological mechanisms, and highlights AL as one of those mechanisms.

There was marginal evidence that higher levels of spouse negativity were associated with higher AL. Spouse negativity was associated with higher AL when first entered as a predictor, but the association was marginal when health status was added to the model. However, when spouse negativity was averaged across the two measurement occasions (i.e., M1 and M2), it was associated with higher AL, and remained significant with the addition of all covariates.

When we tested the relative contributions of spouse support and negativity by entering them as predictors in the same model, neither variable predicted AL. This may be due to the negative correlation between spouse support and negativity. One conclusion that can be drawn from these findings is that spouse support matters more than spouse negativity, but that they do tend to be negatively correlated. Although negativity and support are conceptually distinct, it may be less important to separate them when examining the effects of a specific relationship on AL, as opposed to examining the social network more broadly.

Interactions of Support and Negativity

At the spouse level, we predicted that high levels of spouse support would exacerbate the effects of spouse negativity on AL. This hypothesis was based on evidence that ambivalent relationships are more detrimental for psychological and physical well-being than other types of

relationships (Uchino et al., 2004). Although the interaction between spouse support and spouse negativity was not significant, when we categorized participants as ambivalent using a method adapted from previous work (Campo et al., 2009), spouse ambivalence was associated with higher AL. This finding is consistent with evidence that ambivalent relationships are more harmful for physiology than other types of relationships (Holt-Lunstad et al., 2003, 2007; Uchino et al., 2001, in press). Our findings suggest that spouse relationships characterized by moderate to high levels of both support and negativity may especially harmful for physiology. Our findings also suggest that testing the statistical interaction between positive and negative aspects of relationships may not capture the construct of ambivalence, as defined by Uchino and colleagues.

At the network level, we expected support and negativity to interact quite differently. Based on evidence that higher levels of network support can buffer individuals from the deleterious effects of negativity on psychological well-being (Lepore, 1992), we expected that higher levels of network support would reduce the effects of network negativity on AL. There was no evidence of an interaction between network support and network negativity. However, there is a potential methodological explanation for this finding. This hypothesis was based on the idea of cross-domain buffering, in which support from one source can buffer individuals from the harmful consequences of negativity from a *different* source (Lepore, 1992). However, because our network measure combined multiple sources, it may have obscured cross-relationship interaction effects. In order to determine whether network support can reduce the harmful effects of network negativity, it may be necessary to test specific relationships. Future studies may be able to test this hypothesis more precisely.

Age Interactions

We expected that older age would magnify the effects of social relationship quality on AL due to age-related increases in physiological vulnerability and changes in the structure and function of social networks. If older adults have smaller networks and place relatively greater emphasis on those ties (Carstensen et al., 1999), then the association between social relationship quality and AL could become stronger as people age. The results did not support this hypothesis; rather, the associations between social relationships and AL became weaker with age or did not vary at all.

Among those 34 to 49 years of age, higher levels of network support were associated with lower AL, consistent with our argument that support would serve a protective function. Although the association between network support and AL was not significant among those 50 years or older, the pattern of values suggested that higher levels of support were associated with *higher rather than lower* AL. If this pattern is reliable, it may have interesting implications. Among older adults, reports of network social support could be confounded with need for support, such that age-related increases in illness or disability would be accompanied by elevations in AL and would elicit greater levels of support. Similar effects have been reported previously in the support literature (Wortman & Dunkel Schetter, 1979; Revenson, Wollman, & Felton, 1983).

There was some evidence that the positive association between network negativity and AL became weaker with age, which was opposite to prediction. These results should be interpreted with caution because the interaction term was marginal across all models. If in fact the association between negativity and AL becomes weaker with age, this would be consistent with the idea that the effects of social relationships on AL are less discernible in older age due to age-related physiological dysregulation.

We found no evidence of age interactions at the spouse level. These findings suggest that spouse support and negativity continue to influence physiology as people age. More generally, these findings highlight the central importance of marital quality for health.

Changes in Support and Negativity Over Time

The concept of AL is based on the premise that wear-and-tear accrues on physiological systems over time, such that repeated or prolonged exposure should be related to greater AL. Extending this thinking to the context of social relationships and AL, individuals who experience consistently high levels of social negativity over time should accrue greater physiological wear and tear than individuals who experience high levels of social negativity in bouts or specific periods of time but not chronically. Thus, we expected that Wave 2 social variables (support and negativity, at both the network and spouse level) would predict AL, controlling for Wave 1.

Contrary to our hypotheses, none of the Wave 2 social variables were associated with AL after controlling for social variables at Wave 1. The most obvious explanation for this finding is that there was relatively little change in ratings of social relationship quality between Waves 1 and 2 (network support change, *M(SD)* = 0.04 (0.41); network negativity change, *M(SD)* = -0.07 (0.38), and changes were of similar magnitude for support and negativity from specific sources)[2]. It is worth noting that this relative stability in network level ratings does not preclude the possibility that the quality of specific relationships changes over time. Between waves, a participant could reference slightly different groups of people in their "family" and "friend" ratings. For example, if the participant experienced increased negativity from a specific friend between Waves 1 and 2, the participant could have reduced or eliminated contact with that friend, and thus the problematic friend would not be referenced in the Wave 2 "friend" ratings.

[2] Some individuals reported up to approximately a 2 unit increase or decrease in support, and approximately a 1.5 unit increase or decrease in negativity. However, only 112 and 81 participants changed by more than 1 unit on their network level ratings of support or negativity, respectively.

Likewise, there may have been changes in marital quality that were not captured by our analyses, as our models only included participants who were married or partnered at both time points: participants who divorced or were widowed between Waves 1 and Wave 2 were not included in the spouse/partner analyses. Therefore, the use of network measures that summarize over relationships appears to be ill advised for testing questions such as these and more extensive relationship specific approaches are recommended.

Despite this problem, the relative stability of negativity and support ratings over time suggests that on average, participants did not perceive themselves to experience dramatic changes in the quality of their social networks. Any changes that occurred between the two measurement occasions were not sufficient to predict additional variance in AL. If relationship quality is relatively stable over time, then an assessment at any one time point could be a relatively valid snapshot or marker of relationship quality over the previous decade. In addition, the history that is represented as the shared variance between Waves 1 and 2 could account for much more of the variance in AL than changes over a ten-year period.

Moderation By Source

The final set of hypotheses addressed whether the effects of support and negativity on AL vary by source. Based on evidence that marital relationships have a particularly strong effect on psychological and physical health outcomes, we expected that spouse support and negativity would be more closely associated with AL than network support and negativity, respectively. The results provided some support for these hypotheses. Spouse support was in fact a stronger predictor of AL than friend/family support, but there was little difference between spouse and friend/family negativity. Spouses then appear more powerful than other network members with respect to the potency of the effects of their support on AL over time.

Finally, we tested whether the relative magnitude of the effects of support and negativity varied by source. We expected that at both the network and spouse level, negativity would have a stronger effect on AL than levels of support, and even more so at the spouse level. However, an interesting and unexpected pattern of findings emerged with all variables in the model. Neither source of negativity was associated with AL, higher spouse support was marginally associated with lower AL (consistent with previous analyses), and higher levels of family/friend support were associated with *higher* AL. Given that this association did not emerge in previous analyses, it should be interpreted with caution, but it suggests that family and friend support may play a different role in health than spouse support. Speculatively, family and friend support may be confounded with need for assistance while spouse support is not. More studies comparing sources of support and AL are needed to understand how and why different sources of support influence physiology.

Limitations

This study has several limitations in addition to those noted above. Although the sample is diverse in respect to age, gender, and socioeconomic status, it is not technically nationally representative. In particular, the MIDUS data do not permit us to test whether the associations among social relationship qualities and AL observed here extend to non-White Americans, and future research should better examine possible racial/ethnic differences.

An additional limitation of this study is the fact that AL was measured at only one time point, which precluded our ability to control for AL at baseline or to examine potential influences of prior AL on social processes assessed at MIDUS 1 and 2. Future work ought to employ repeated assessments of AL over time to test whether social relationship qualities predict

changes in AL over time and how AL may relate to dynamics of reported social contact, support and negativity.

Conclusion

In summary, the strongest support for hypotheses was in relation to the main effects of support and negativity from specific sources: spouse support and network negativity emerged as the strongest predictors of AL. In addition, there was support for hypotheses about the relative importance of spouse relationship quality as compared to other relationships, and about ambivalence within the spouse relationship. Taken together, these findings highlight the importance of treating positive and negative aspects of relationships as independent, and of examining specific sources.

This is the first study to examine the associations among qualitative aspects of social relationships and AL in a sample spanning a large portion of adulthood. Importantly, the age range in the MIDUS sample allowed us to test for age differences in the effects of social experience on AL. Whereas previous work has focused on the positive aspects of social relationships, this study extends previous work by comparing positive and negative aspects of relationships, using conceptually and empirically validated measures, and by comparing specific sources of support and negativity. An additional strength of this study is the measurement of AL, which is the most comprehensive to date, including assessment of multiple indicators of autonomic, endocrine, cardiovascular, metabolic and immune system activity (Gruenewald et al., 2012).

The findings of this study are consistent with previous evidence that the quality of social relationships is related to health-relevant physiology, and our study documents the persistence of associations from young adults through middle and older ages. Our findings also indicate that

the positive and negative aspects of social ties have independent associations with physiology, and that these associations vary based on the type of relationship and based on age. More generally, these findings are consistent with the idea that AL is a pathway linking the structure and function of social relationships with morbidity and mortality.

Table 1

Studies of Relationship Qualities and AL: Sample and Measurement Summary

Study	Sample	Support Variable(s)	Negativity Variable(s)
Singer et al., 1999 WLS	Older Americans adults (*N* = 84, age 58-59) from Wisconsin Longitudinal Study (WLS; random sample of high school graduating class of 1957 in WI)	Participants categorized into positive vs. negative relationship pathway, determined by (1) retrospectively rated quality of relations with mother and father in childhood (warmth, caring), and (2) intimacy with spousal (emotional + sexual, intellectual + recreational)	
Seeman et al., 2002 WLS	Middle aged American adults (*N* = 106, age 58-59) from the WLS	Same as above.	
Seeman et al., 2002 MAC	Older American adults (*N* = 765; age 70-79) from MacArthur Studies of Successful Aging (MAC)	Network-level and source-specific enacted emotional and instrumental support (spouse, children, and close friends/family averaged and examined separately)	Network-level and source-specific demands/criticism (spouse, children, and close friends/family averaged and examined separately)
Seeman et al., 2004 SEBAS (AL doesn't include all systems, e.g. markers of inflammation, PNS)	Middle aged (*N* = 531; age 54-70) and older (*N* = 41; age 71+) Taiwanese adults from Social Environment and Biomarkers of Aging Study (SEBAS).	Network-level perceived emotional support	Network-level criticism from others; older cohort also asked network-level demands
Weinstein et al., 2003	Older Taiwanese adults (*N* = 101; age 65-80+) from pilot study	n/a	Network-level demands (i.e., extent to which others place demands on respondent)
Gersten, 2008 SEBAS (AL limited to neuroendocrine markers)	Middle-aged and older Taiwanese adults (*N* = 880; age 54-90) from SEBAS	n/a	Occurrence (yes/no) of two family related stressors: "Familial tension/conflict" and "family's marital situation"

Table 2

Primary Hypotheses

1ai)	Higher levels of *network* support at will be associated with lower AL.
1aii)	Among married individuals, higher levels of support *from a spouse* will be associated with lower AL.
1bi)	Higher levels of *network* negativity will be associated with higher AL.
1bii)	Among married individuals, higher levels of negativity *from a spouse* will be associated with higher AL.
1ci)	Levels of *network* negativity will have a stronger effect on AL that levels of *network* support.
1cii)	Among married individuals, levels of negativity *from a spouse* will have a stronger effect on AL than levels of support *from a spouse*.
1di)	There will be a significant interaction of *network* support and negativity such that higher levels of support will reduce the effects of negativity on AL.
1dii)	Among married individuals, there will be a significant interaction of *spouse* support and negativity such that high levels of support will exacerbate the effects of negativity on AL.
2ai)	Wave 2 *network* support will predict AL, controlling for Wave 1 *network* support.
2aii)	Wave 2 support *from a spouse* will predict AL, controlling for Wave 1 support *from a spouse*.
2bi)	Wave 2 *network* negativity will predict AL, controlling for Wave 1.
2bii)	Wave 2 *spouse* negativity will predict AL, controlling for Wave 1.

Table 3

Secondary Hypotheses

3ai)	The effect of *network-level* support on AL will increase with age.
3aii)	Among married individuals, the effect of support *from a spouse* on AL will increase with age.
3bi)	The effect of *network-level* negativity on AL will increase with age.
3bii)	Among married individuals, the effect of negativity *from a spouse* on AL will increase with age.
4a)	Among married individuals, support *from a spouse* will have a stronger effect on AL than support *from friends and family*.
4b)	Among married individuals, negativity *from a spouse* will have a stronger effect on AL than negativity *from friends and family*.
4c)	The relative effects of support and negativity will be moderated by source, such that the levels of negativity will have a stronger effect on AL than levels of support at both the network and spouse level, but this effect will be stronger at the spouse level.

Table 4

Descriptive Statistics (N = 949)

Variable	*M* (*SD*)	*Range*
Demographics (M2)		
Age	55.08 (11.68)	34.00 - 84.00
Male (%)	46.1	--
White (%)	93.3	--
Education (%)		
< High school	3.2	--
High school diploma/G.E.D.	20.7	--
Some college/AA	28.6	--
BA/BS	23.5	--
Graduate school or more	23.9	--
Social Experience		
M1 Network Support	3.44 (0.45)	1.63-4.00
M2 Network Support	3.48 (0.46)	1.69-4.00
M1 Spouse Support*	3.64 (0.50)	1.33-4.00
M2 Spouse Support*	3.63 (0.53)	1.00-4.00
M1 Friend/Family Support	3.38 (0.51)	1.63-4.00
M2 Friend/Family Support	3.43 (0.52)	1.38-4.00
M1 Network Negativity	2.06 (0.42)	1.00-3.63
M2 Network Negativity	1.99 (0.43)	1.00-3.64
M1 Spouse Negativity*	2.19 (0.58)	1.00-4.00
M2 Spouse Negativity*	2.16 (0.62)	1.00-4.00
M1 Friend/Family Negativity	2.01 (0.45)	1.00-3.63
M2 Friend/Family Negativity	1.92 (0.45)	1.00-3.63
Health Behaviors and Health Status (M2)		
Smoking (%)		
Never	56.6	--
Past	32.7	--
Current	10.8	--
Alcohol use (current, %)		
Abstainer	36.1	--
Light/moderate	51.4	--
Heavy	12.5	--
Exercise (hrs/wk)	3.38 (5.03)	0.00 - 44.00
Major Chronic Conditions (# conditions)	1.02 (1.11)	0.00 - 4.00
Functional Status (# impairments)	0.37 (0.98)	0.00 - 6.00
Allostatic Load (M2)		
Allostatic load summary score	1.69 (1.03)	0.00 - 5.03

* $n = 660$

Table 5

Main and Interactive Effects of M1 Support and Negativity

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
	B (SE)	*B (SE)*	*B (SE)*	*B (SE)*	*B (SE)*
M1 Network Support					
M1 Network Support	-0.05 (0.07)	--	-0.05 (0.07)	-0.00 (0.07)	0.01 (0.07)
M1 Network Negativity					
M1 Network Negativity	**0.25 (0.08)****	--	**0.25 (0.08)****	**0.17 (0.07)***	**0.17 (0.07)***
M1 Network Support and Negativity					
M1 Network Support	0.05 (0.08)	0.06 0.08)	0.06 (0.08)	0.07 (0.07)	0.09 (0.07)
M1 Network Negativity	**0.27 (0.09)****	**0.26 (0.09)****	**0.28 (0.08)****	**0.20 (0.08)***	**0.20 (0.08)***
M1 Network Support X M1 Network Negativity	--	-0.13 (0.15)	--	--	--
M1 Spouse Support[1]					
M1 Spouse Support	**-0.20 (0.08)****	--	**-0.21 (0.08)****	**-0.19 (0.08)***	**-0.17 (0.08)***
M1 Spouse Negativity[1]					
M1 Spouse Negativity	**0.15 (0.07)***	--	**0.16 (0.06)***	**0.12 (0.06) †**	**0.11 (0.06) †**
M1 Spouse Support and Negativity [1]					
M1 Spouse Support	-0.16 (0.10)	-0.13 (0.15)	-0.15 (0.10)	**-0.18 (0.10) †**	-0.14 (0.10)

M1 Spouse Negativity	0.06 (0.09)	0.06 (0.09)	0.08 0.09)	0.02 (0.08)	0.03 (0.08)
M1 Spouse Support X Negativity	--	-0.04 (0.14)	--	--	--
<u>M1 Spouse Ambivalence[1]</u>					
M1 Spouse Ambivalence[2]	0.14 (0.08)†	--	0.17 (0.08)*	0.15 (0.07)*	0.14 (0.07)*

Note. Coefficients are unstandardized. Each underlined heading represents a new set of models. Coefficients for intercepts and covariates not shown here. In addition to the social variables listed above, Models 1 and 2 include age; Model 3 includes age and demographic variables; Model 4 includes age, demographic variables, and health status; and Model 5 includes age, demographic variables, health status, and health behaviors. Dash marks (--) indicate that the specified variable was not included in the model.

[1] $n = 660$

[2] Spouse ambivalence was coded 1 = ambivalent, 0 = not ambivalent.

† $p < .10$, * $p < .05$, ** $p < .01$. *** $p < .001$

Table 6

Change in Social Experience Over Time: Main Effects of M1 and M2 Support and Negativity

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
	B (SE)	*B (SE)*	*B (SE)*	*B (SE)*	*B (SE)*
Network Support					
M1 Network Level Support	-0.05 (0.07)	0.02 (0.09)	0.00 (0.09)	0.04 (0.08)	0.04 (0.08)
M2 Network Level Support		-0.11 (0.08)	-0.08 (0.08)	-0.07 (0.08)	-0.04 (0.08)
Network Level Negativity					
M1 Network Level Negativity	**0.25 (0.08)****	**0.20 (0.09)***	**0.22 (0.09)***	**0.15 (0.09)†**	**0.14 (0.09) †**
M2 Network Level Negativity		0.08 (0.09)	0.06 (0.09)	0.03 (0.09)	0.04 (0.09)
Spouse Support[1]					
M1 Spouse Support	**-0.20 (0.08)****	**-0.17 (0.09) †**	**-0.18 (0.09) †**	**-0.16 (0.09) †**	-0.14 (0.09)
M2 Spouse Support		-0.06 (0.08)	-0.04 (0.08)	-0.06 (0.08)	-0.05 (0.08)
Spouse Negativity[1]					
M1 Spouse Negativity	**0.15 (0.07)***	0.13 (0.08)	**0.15 (0.08) †**	0.09 (0.07)	0.09 (0.07)
M2 Spouse Negativity		0.02 (0.07)	0.02 (0.07)	0.05 (0.07)	0.04 (0.07)

Note. Coefficients are unstandardized. Each underlined heading represents a new set of models. Coefficients for intercepts and covariates not shown here. In addition to the social variables

listed above, Models 1 and 2 include age; Model 3 includes age and demographic variables; Model 4 includes age, demographic variables, and health status; and Model 5 includes age, demographic variables, health status, and health behaviors. Dash marks (--) indicate that the specified variable was not included in the model.

[1] $n = 660$
† $p < .10$, * $p < .05$, ** $p < .01$. *** $p < .001$

Table 7

Main Effects of Support and Negativity, With Age Interactions

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
	B (SE)	*B (SE)*	*B (SE)*	*B (SE)*	*B (SE)*
M1 Network Support					
M1 Network Support	-0.05 (0.07)	-0.05 (0.07)	-0.05 (0.07)	0.00 (0.07)	0.02 (0.07)
M1 Network Support X Age	--	**0.02 (0.01)****	**0.02 (0.01)****	**0.02 (0.01)****	**0.02 (0.01)****
M1 Network Negativity					
M1 Network Negativity	**0.25 (0.08)****	**0.24 (0.08)****	**0.24 (0.08)****	**0.16 (0.07)***	0.16 (0.07)
M1 Network Negativity X Age	--	**-0.01 (0.07) †**	**-0.01 (0.07)†**	**-0.01 (0.01) †**	**-0.01 (0.01) †**
M1 Spouse Support					
M1 Spouse Support	**-0.20 (0.08)****	**-0.18 (0.07)***	**-0.18 (0.07)***	**-0.17 (0.07)***	**-0.14 (0.07)***
M1 Spouse Support X Age	--	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)
M1 Spouse Negativity					
M1 Spouse Negativity	**0.15 (0.07)***	**0.14 (0.07)***	**0.15 (0.06)***	**0.11 (0.06) †**	**0.10 (0.06) †**
M1 Spouse Negativity X Age	--	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)

Note. Coefficients are unstandardized. Each underlined heading represents a new set of models. Coefficients for intercepts and covariates not shown here. In addition to the social variables listed above, Models 1 and 2 include age; Model 3 includes age and demographic variables; Model 4 includes age, demographic variables, and health status; and Model 5 includes age, demographic variables, health status, and health behaviors. Dash marks (--) indicate that the specified variable was not included in the model.

[1] $n = 660$
† $p < .10$, * $p < .05$, ** $p < .01$. *** $p < .001$

Table 8

Main Effects of Support and Negativity, by Source (Married Participants Only, n = 660)

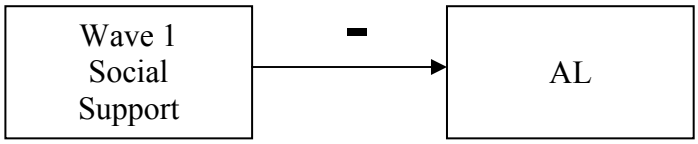
Variable	Model 1	Model 3	Model 4	Model 5
	B (SE)	*B (SE)*	*B (SE)*	*B (SE)*
M1 Support				
M1 Spouse Support	**-0.22 (0.08)****	**-0.22 (0.08)****	**-0.22 (0.08)****	**-0.19 (0.08)***
M1 Friend/Family Support	0.09 (0.08)	0.07 (0.08)	0.11 (0.07)	0.12 (0.07)
M1 Negativity				
M1 Spouse Negativity	0.11 (0.07)	**0.13 (0.07) †**	0.10 (0.07)	0.09 (0.06)
M1 Friend/Family Negativity	0.17 (0.09)†	0.15 (0.09)	0.08 (0.09)	0.09 (0.09)
M1 Support and Negativity				
M1 Spouse Support	**-0.21 (0.10)***	**-0.19 (0.10)†**	**-0.22 (0.10)***	**-0.19 (0.10) †**
M1 Friend/Family Support	**0.14 (0.08)†**	0.12 (0.08)	**0.15 (0.08) †**	**0.16 (0.08)***
M1 Spouse Negativity	0.00 (0.09)	0.03 (0.09)	-0.01 (0.08)	-0.01 (0.08)
M1 Friend/Family Negativity	**0.23 (0.10)***	**0.20 (0.10)***	0.15 (0.10)	0.16 (0.10)

Note. Coefficients are unstandardized. Each underlined heading represents a new set of models. Coefficients for intercepts and covariates not shown here. In addition to the social variables listed above, Mode1 includes age; Model 3 includes age and demographic variables; Model 4

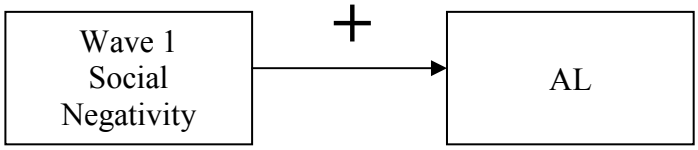
includes age, demographic variables, and health status; and Model 5 includes age, demographic variables, health status, and health behaviors.

† $p < .10$, * $p < .05$, ** $p < .01$. *** $p < .001$

Hypotheses 1ai, 1aii



Hypotheses 1bi, 1bii



Hypotheses 1ci, 1cii

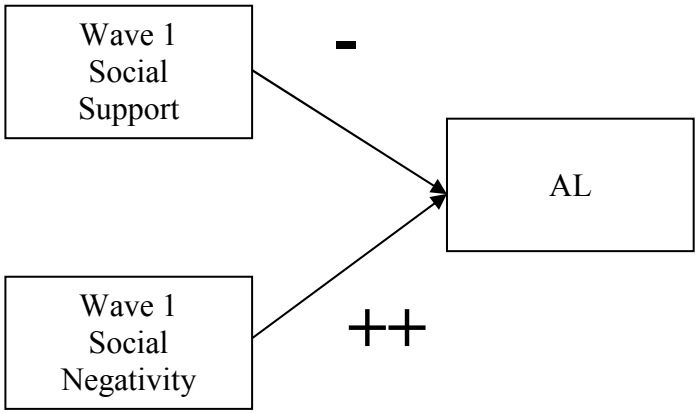
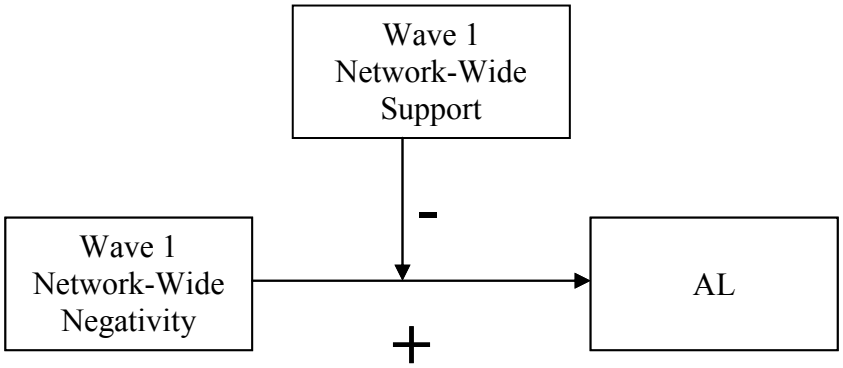


Figure 1. Conceptual models of Hypotheses 1ai-1cii.

Hypothesis 1di.



Hypothesis 1dii.

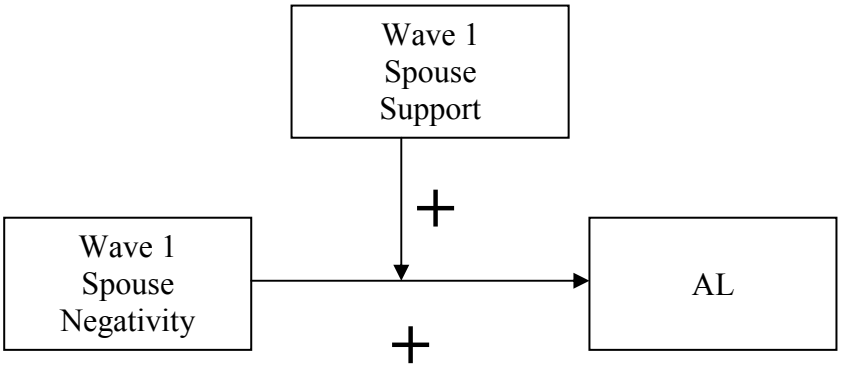
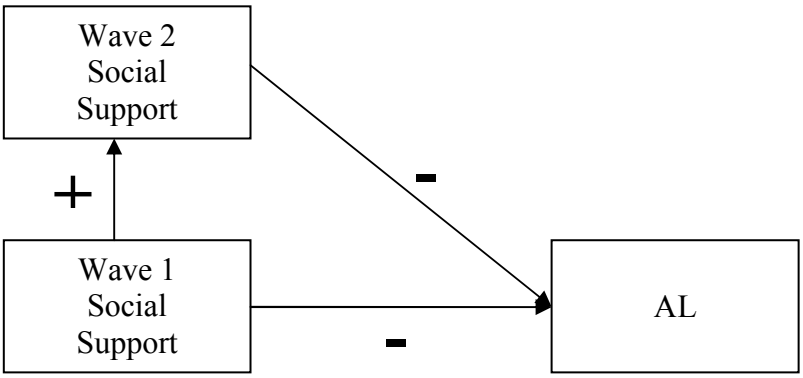


Figure 2. Conceptual models of Hypotheses 1di-1dii.

2ai, 2aii



2bi, 2bii

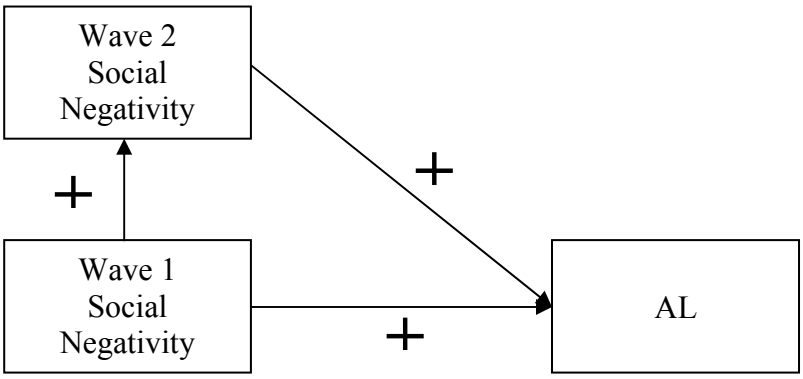
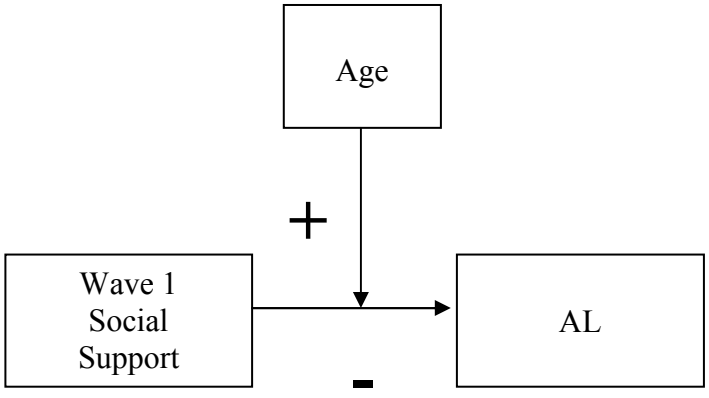


Figure 3. Conceptual models of Hypotheses 2ai-2bii.

Hypotheses 3ai, 3aii



Hypotheses 3bi, 3bii

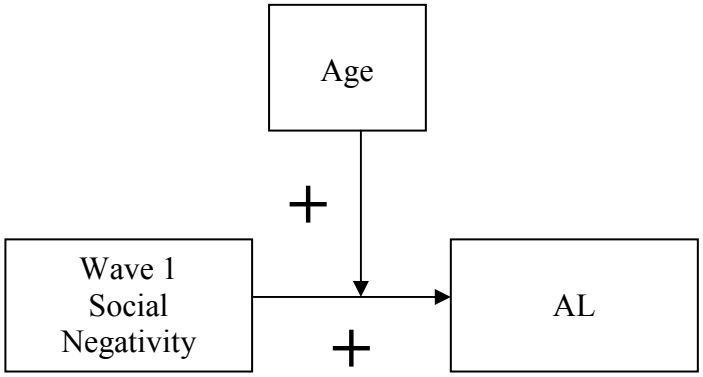


Figure 3. Conceptual models of Hypotheses 3ai-3bii.

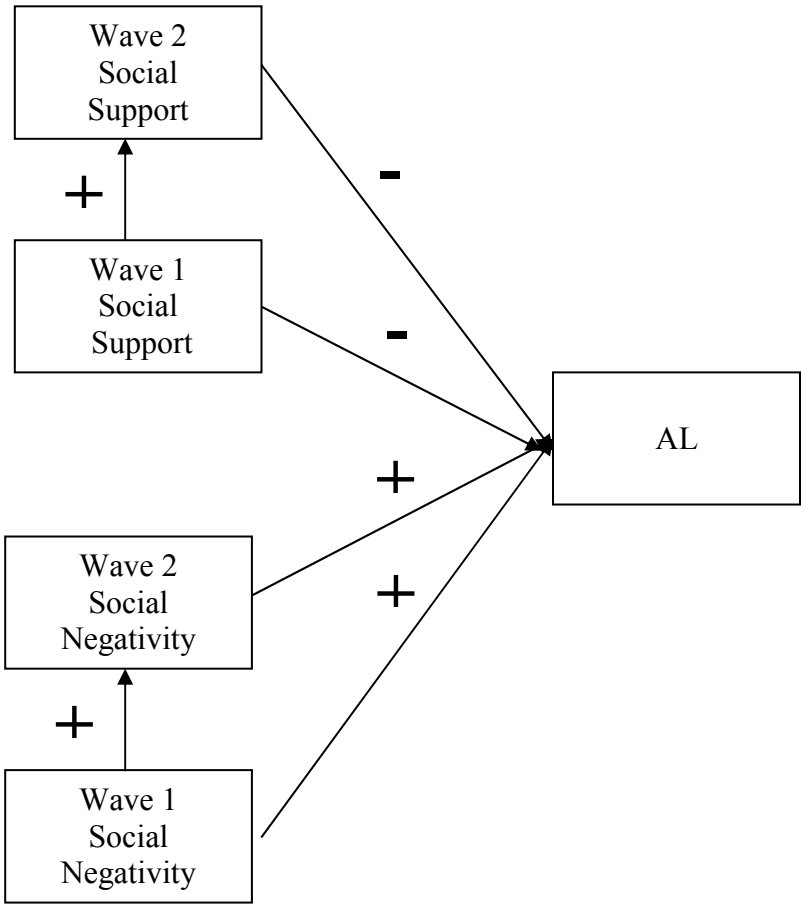


Figure 4. Integrated conceptual model of the effects of support and negativity on AL.

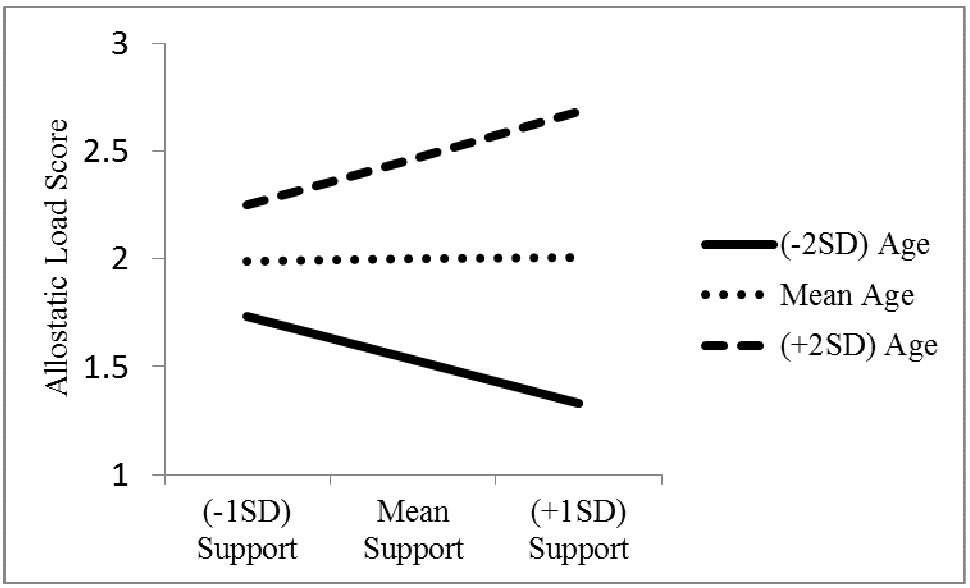


Figure 5. Predicted AL by Age and M1 Network Level Support

Note: Predicted values control for demographics, health status, and health behaviors.

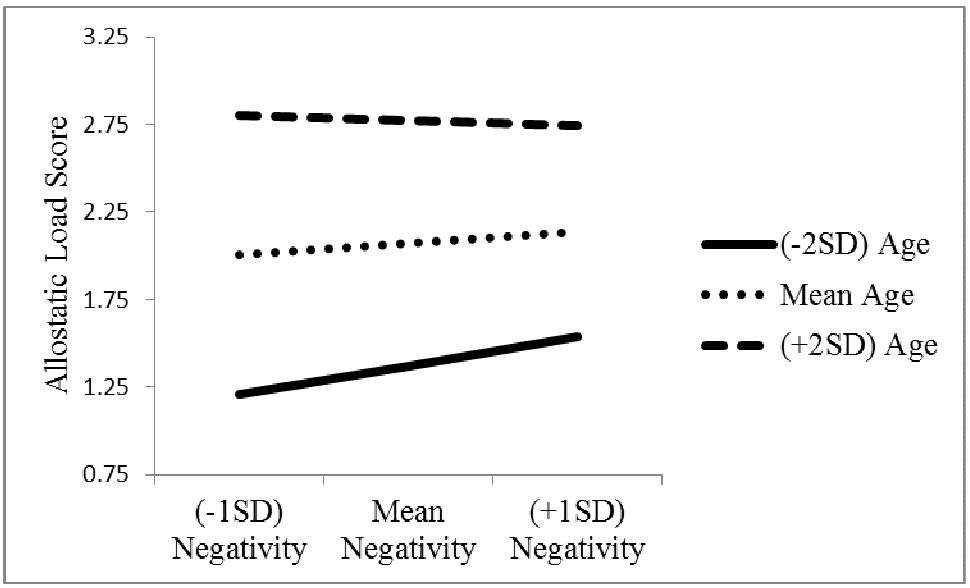


Figure 6. Predicted AL by Age and M1 Network Level Negativity

Note: Predicted values control for demographics, health status, and health behaviors.

Appendix A

Family Support and Negativity

J2. The next several questions are about your family. Please circle the appropriate number for each item.

Answer how much for each of these items.	A lot	Some	A little	Not at all
a. Not including your spouse or partner, how much do members of your family really care about you?	1	2	3	4
b. How much do they understand the way you feel about things?	1	2	3	4
c. How much can you rely on them for help if you have a serious problem?	1	2	3	4
d. How much can you open up to them if you need to talk about your worries?	1	2	3	4
Answer how often for each of these items.	Often	Sometimes	Rarely	Never
g. Not including your spouse or partner, how often do members of your family make too many demands on you?	1	2	3	4
h. How often do they criticize you?	1	2	3	4
i. How often do they let you down when you are counting on them?	1	2	3	4
j. How often do they get on your nerves?	1	2	3	4

Appendix B

Friend Support and Negativity

J4. The next several questions are about your friends. Please circle the appropriate number for each item.

Answer how much for each of these items.	A lot	Some	A little	Not at all
a. How much do your friends really care about you?	1	2	3	4
b. How much do they understand the way you feel about things?	1	2	3	4
c. How much can you rely on them for help if you have a serious problem?	1	2	3	4
d. How much can you open up to them if you need to talk about your worries?	1	2	3	4
Answer how often for each of these items.	Often	Sometimes	Rarely	Never
e. How often do your friends make too many demands on you?	1	2	3	4
f. How often do they criticize you?	1	2	3	4
g. How often do they let you down when you are counting on them?	1	2	3	4
h. How often do they get on your nerves?	1	2	3	4

Appendix C

Spouse/Partner Support and Negativity

L11. The next several questions are about your spouse/partner. Please circle the appropriate number for each item.

Answer how much for each of these items.	A lot	Some	A little	Not at all
a. How much does your spouse or partner really care about you?	1	2	3	4
b. How much does he or she understand the way you feel about things?	1	2	3	4
c. How much does he or she appreciate you?	1	2	3	4
d. How much can you rely on him or her for help if you have a serious problem?	1	2	3	4
e. How much can you open up to him or her if you need to talk about your worries?	1	2	3	4
f. How much can you relax and be yourself around him or her?	1	2	3	4

Answer how often for each of these items.	Often	Sometimes	Rarely	Never
g. How often does your spouse or partner make too many demands on you?	1	2	3	4
h. How often does he or she make you feel tense?	1	2	3	4
i. How often does he or she argue with you?	1	2	3	4
j. How often does he or she criticize you?	1	2	3	4
k. How often does he or she let you down when you are counting on him or her?	1	2	3	4
l. How often does he or she get on your nerves?	1	2	3	4

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