August 2014

Testosterone, Dominance, and Depression in Recently Married Couples

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TESTOSTERONE, DOMINANCE, AND DEPRESSION IN RECENTLY MARRIED COUPLES

A Thesis Presented

by

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Submitted to the Graduate School of the
University of Massachusetts Amherst in fulfillment
of the requirements for the degree of

MASTER OF SCIENCE

May 2014
Psychology

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ABSTRACT

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IN RECENTLY MARRIED COUPLES

MAY 2014
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Dominance refers to the wide set of behaviors individuals engage in with the intention of achieving or maintaining social status. Considering the relevance of these behaviors in the dynamics of close relationships, this study examined relations among testosterone, dominance, and the emotional health of a total of 225 opposite sex newlywed couples. An original measure of dominance was developed that accounted for both positive and negative manifestations, as well as situational and dispositional qualities of these status-promoting behaviors. Structural equation analyses revealed that dominance behaviors predict depression for both wives and husbands, and that positive and negative aspects of dominance contribute differently to spouses' depression. Higher levels of depressive symptoms were related to reports of more dispositional hostility for both husbands and wives, as well as to greater submission during a conflict situation. In turn, greater assertiveness was related to fewer depressive symptoms for both husbands and wives. A subset of dominance behaviors reflecting spouses' appraisals of having had more power, influence, and control relative to their partners during the conflict interaction, exclusively predicted more depressive symptoms for wives. Finally, lower levels of testosterone were indirectly associated with more depressive symptoms for husbands, and this relation was partially mediated by dominance behaviors. Implications of our findings, as well as limitations,

are discussed in light of the existent literature and directions for future research on the interpersonal and biological aspects of marital well-being are considered.

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CHAPTER 1

INTRODUCTION

The health-promoting properties of close relationships have been repeatedly documented (Kiecolt-Glaser & Newton, 2001). Numerous studies have established that social isolation, few social ties, and unsupportive close relationships are risk factors for poor emotional and physical health, comparable to other well-established health risk factors such as smoking, high blood pressure, and obesity (Holt-Lunstad, Smith, & Layton, 2010; House, Landis, & Umberson, 1988). For a majority of adults, marriage is the central relationship and this relationship organizes their everyday lives. Compared to unmarried people, married individuals have reliably lower morbidity and mortality rates across a variety of acute and chronic conditions (Kaplan & Kronick, 2006; Wilson & Oswald, 2005). In fact, both married men and women have significantly lower rates of severe depression and at least half the likelihood of developing any psychiatric disorder than never-married, cohabiting and divorced people (Robins & Regier, 1991). In addition to better mental and physical health outcomes, married people are also more likely to describe themselves as happy than non-married people, including those that cohabit (Stack & Eshleman, 1998).

Despite the finding that married people, on average, enjoy better mental and physical health than their unmarried counterparts, the mere presence of a spouse is not necessarily protective. A troubled marriage is itself a prime source of stress for partners that can also limit their ability to seek support in other relationships (Coyne & DeLongis, 1986). Conflicted marriages are reliably associated with increased distress, and unmarried people report higher levels of happiness than unhappily married people (Glenn & Weaver, 1981). A strong association between marital discord and depressive symptoms has been demonstrated within

community-based and clinic samples (Beach, Arias, & O'Leary, 1987; Beach, Fincham, & Katz, 1998; Christian, O'Leary, & Vivian, 1994; Fincham & Beach, 1999; Scott & Córdova, 2002) and longitudinal evidence suggests that marital discord may precede and predict changes in spouses' depressive symptoms (Beach & O'Leary, 1993; Brown & Harris, 1978; Monroe, Bromet, Connell, & Steiner, 1986). As an example of how important the perceived quality of the marital relationship can be in spouses' risk for depression, Weissman's (1987) epidemiological study revealed that married individuals who report they do not get along with their spouses, which is a measure of marital distress, are three times more likely to be depressed than single, separated, or divorced individuals, and are 25 times more likely to be depressed than their satisfied counterparts (as described in Scott & Córdova, 2002). Indeed, behavioral marital therapy has come to be recognized as an appropriate and effective treatment for decreasing depression in individuals who experience marital conflict (Jacobson, Dobson, Fruzzetti, Schmaling, & Salusky, 1991; O'Leary & Beach, 1990), suggesting that changes in the level of marital satisfaction may mediate changes in depression. Despite this strong body of evidence for a robust association between marital distress and depression, both at diagnostic and subclinical levels of depressive symptoms (reviewed by Whisman, 2001), much remains to be known about the mechanisms through which marital discord can influence depression (Christian-Herman, O'Leary, & Avery-Leaf, 2001; Halford, Markman, Kline, & Stanley, 2003).

Patterns of negative interaction between spouses are a well-documented feature of marriages in distress (Clements, Stanley, & Markman, 2004; Karney & Bradbury, 1995) and increased risk for depression. For example, interactions between spouses that are characterized by hostility, poor problem solving, and destructive demand–withdraw patterns have been related to depression and depressive symptoms in one or both spouses (Johnson & Jacob, 1997;

Uebelacker, Courtnage, & Whisman, 2003). Although the effects between depression and marital interactions are likely bidirectional, in this project I focus on the concurrent association between dominance behaviors and spouses' existing depressive symptoms.

Dominance

Dominance is a widely encompassing term that refers to behaviors intended to gain or maintain status or the motivation of an individual to achieve or maintain a high social status (Eisenegger, Haushofer, & Fehr, 2011). Status, in turn, is a socially desired asset as it confers individuals influence, power, or access to valued resources (Mazur & Booth 1998). Though they are related concepts, dominance does not equate to aggression, as the later comprises behavior intended to inflict physical or psychological harm on another individual (Eisenegger, Haushofer, & Fehr, 2011), and the vast majority of dominance episodes do not involve the intent to harm others (Booth, Granger, Mazur & Kivlighan, 2006). Dominance can be of great adaptive value to individuals, and correspondingly, its study includes considerations of both the positive and negative aspects of this broad set of behaviors. Further, research studies on dominance have employed a great variety of operalizations and measures for this construct such as initiation of contact, leadership, competitiveness, provision of commands, and observer ratings and self-report of dominance-submissiveness (Ellyson & Dovidio, 1985). In addition, the construct of dominance can take on multiple meanings. For example, it can describe a feature of an individual's personality or tendency to act in a certain way, his or her relative position in a power hierarchy, or indicate a specific outcome in a power conflict (Patterson, 1983). Dunbar, Bipuss, and Young (2008) refer to dominance as a context- and relationship-dependent interactional pattern in which one actor's assertion of control is met by acquiescence from another. In fact, some argue that instead of speaking about dominance hierarchies, it might be more revealing and

accurate to speak of subordinate hierarchies, as it is only the submission of subordinates that allow us to argue that dominance may function to promote the gaining or maintenance of social status (Gilbert, 2000).This interactional notion of dominance brings attention to the differential effects that dominance behaviors can have over those who dominate and those who are dominated, especially in the context of intimate relationships. Indeed, this relation has long been recognized by ethologists, who focus on the behavioral interactions that result in power asymmetries in a dyad and which in turn lead to the formation of a power structure (Pettit, Bakshi, Dodge, & Coie, 1990).

Dominance and submission in marriage

Social behaviors can be characterized as varying along a basic dimension of dominance versus submission. From an interpersonal perspective, dominance is as a relationally-based communication strategy that is dependent on the context and motives of the individuals interacting and thus, it exists in relation to one's social partner rather that in absolute terms (Dunbar, Bipuss, & Young, 2008). Dominance behaviors are especially important in close relationships because partners depend upon one another to attain their goals and to resolve conflicts in a constructive way. Conflict is an unavoidable aspect of marriage, with both positive and negative consequences for the relationship in the short and long term. While instances of conflict can serve as an opportunity for spouses to strengthen their relationship and enhance their marital satisfaction (Dunbar, Bipuss, & Young), inability to resolve conflicts in a way that is satisfactory for both spouses can have negative physiological and psychological consequences. Dominance behaviors might affect healthy marital functioning by not only increasing negative behaviors during conflicts but also by reducing supportive behaviors that could protect couples from other marital stressors (Cramer, 2004).

Patterns of dominance-submission in marriage can have serious consequences for the physiological and psychological health of spouses. For example, research of specific coronary-prone behaviors has found that socially dominant behaviors are positively associated with the development of cardiovascular disease (Houston, Chesney, Black, Cates, & Hecker, 1992). Epidemiological research on marital patterns and coronary heart disease risk suggests that conflicts involving dominance and control might disrupt the otherwise beneficial effects of marriage (Carmelli, Swan, & Rosenman, 1985; Eaker, Haynes, & Feinleib, 1983). In one study, researchers found that interacting with a spouse perceived as relatively dominant during a discussion task was associated with heightened blood pressure reactivity, thus suggesting that struggles for dominance and control within marriage might be associated with increased cardiovascular disease risk (Brown, Smith & Benjamin, 1998). In addition, studies have shown that frequent displays of subordinate behaviors within close relationships is correlated with other negative health outcomes such as endocrine dysregulation (Laurent & Powers, 2006; Loving, Heffner, Kiecolt-Glaser, Glaser & Malarkey, 2004), suppression of the immune response (Kiecolt-Glaser et al., 1997), and the experience of more negative emotions (Wanic & Kulic, 2011). While attention has been given to the effects of dominance behaviors on physiological health outcomes, (Houston et al., 1992; Smith, Allred, Morrison, & Carlson, 1989; Smith, Baldwin, & Christensen, 1990), fewer studies have investigated the specific effects of dominance behaviors, distinguishable from subtle forms of aggression and more general conflict behaviors, on the psychological health of individuals within the context of marriage.

Based on the available literature, there seems to be several mechanisms by which dominance behaviors within couples could affect spouses' psychological functioning, and specifically their risk for developing depression. By promoting status seeking behaviors,

excessive dominance might prevent couples from successfully resolving their conflicts and thus lead to marital dysfunction, placing them at a greater risk for depression. This prediction is consistent with Beach, Sandeen, and O'Leary's (1990) marital discord model of depressive symptoms, which posits that marital dysfunction decreases available support from partners while it increases negative factors such as overt hostility, threats of divorce, severe denigration, and disrupted marital routines, all which can account for the relation between marital dysfunction and depressive symptoms.

Another way in which dominance could increase spouses' risk for depression is by promoting a power differential that would consistently place a partner in the subordinate position. Dyadic power theory, originally proposed by Rollins and Bahr (1976) and later revised by Dunbar (2004), asserts that power is an integral part of close romantic relationships as it determines how partners relate to one another and how they make decisions (Dunbar, Bipuss, & Young, 2008). This theory proposes that perceptions of legitimate authority over decision-making increase an individual's perceptions of his or her power compared to a partner and that this perceived power increases his or her likelihood of using dominance behaviors as a way to control interactions. A spouse's excessive use of dominance behaviors can become problematic if during the couple's conflict interactions his or her spouse consistently assumes the subordinate position and engages in involuntary submissive and defeat strategies, factors that are at the core of depression (Gilbert, 2000). Problems in acting assertively, behaving overly submissively, perceiving oneself as being subordinated and lacking control, and feeling defeated during interpersonal conflicts have long been associated with depression (Gilbert, 2000).

Testosterone and dominance

Understanding the physiological processes that may contribute to dominance behaviors is of great relevance for a more complete comprehension of these set of socially relevant behaviors

that are such an intrinsic aspect of marital relationships. Research provides considerable evidence that testosterone is associated with dominance. Both naturally occurring and experimentally elevated testosterone levels are positively related to dominance behaviors in a variety of animal species, especially when social status is threatened (Archer, 2006). Interestingly, research to date has found that this hormone's effects on human behavior are clearer in males than females (Booth, Granger, Mazur, & Kivlighan, 2006). This is likely because, just as Sapolsky (1997) has pointed out, the nature of the link between testosterone and behavior is not simply a biological cause-and-effect mechanism but rather a bi-directional relationship that is highly dependent on intrinsic individual differences in social perception, previous experience and propensity for specific behavior, as well as the demands or pressure of the social context for particular behaviors (*referenced in* Booth et al., 2006). In this sense, testosterone, like any other hormone, is not assumed to be a mechanism in and of itself that causes or creates behavior but instead it is a factor that increases the likelihood that certain behaviors will be expressed, given that a propensity for that behavior already exists, and that the expression of that behavior is consistent with the demands of the social context (Booth et al., 2006). Consistent with the findings in animal experiments, human studies indicate that testosterone is linked to dominance under conditions of status threat or challenge (Archer, 2006; Booth et al., 2006; Mazur & Booth, 1998; Mehta & Beer, 2010) and experimental studies with men provide evidence for testosterone's causal role in directing dominance behaviors (Kouri, Lukas, Pope & Oliva 1995; Pope, Kouri & Hudson 2000).

Another substantial set of evidence for the testosterone-dominance link comes from competition studies, which are based on the notion that changes in status are preceded by face-to-face competition between interacting individuals. As Booth and colleagues note (2006), face-to-

face status competition often occurs during polite conversation and is often done without violence or overt aggressiveness, as the objective of each adversary is not to harm but rather to out-stress his or her opponent. Competition studies suggest that testosterone might play a fundamental role in dominance behaviors related to face-to-face competition at least in males (Mazur & Booth, 1998). These studies have shown that prior to and during a face-to-face match, men's testosterone increases, and afterward testosterone levels of winners often remain higher than the testosterone of losers. However, the majority of these results come from studies of male athletes and the few existing studies of women suggest a different profile than the one found in men (Booth et al., 2006). For example, Bateup, Booth, Shirtcliff, and Granger (2002) conducted a study in which they explored relationships between testosterone and cortisol production in anticipation of and response to aggressive and physical competition among female rugby players. Similar to the patterns seen in men, these women experienced an anticipatory rise in testosterone that was related to performance. They differed from men in that their pre-competition testosterone rise was not related to the magnitude of the threat posed by their opponent. Also, different from what has been consistently documented in male competition studies, the female rugby players' rise in testosterone during competition was unrelated to either their self-evaluation of performance, or to winning and losing.

Testosterone in marriage

It has been found that testosterone declines when men marry (Gray, Kahlenberg, Barrett, Lipson &, Ellison, 2002), declines further when they become fathers (Storey, Walsh, Quinton, & Wynne-Edwards, 2000), but climbs when they divorce (Mazur & Michalek 1998). In Western countries, men with higher testosterone levels have more sexual partners and are less likely to marry. Once married, these high testosterone men experience greater marital conflict, engage in more extra-marital affairs, and are more likely to divorce (For a thorough review of these

findings see the articles of Alvergne, Faurie, and Raymond, 2009, as well as Booth and Dabbs, 1993). Fathers with lower testosterone are more attuned to their infant's cries (Fleming, Corter, Stallings, & Steiner, 2002), and more responsive to auditory, visual and olfactory cues from newborn infants (Storey et al., 2000). These, along with other findings, suggest that variations in testosterone levels regulate male reproductive strategy, that is, the alternation between investing in mating versus parental effort (Alvergne, Faurie, & Raymond, 2009). There are a limited number of studies linking testosterone to female peer and marital relationships. One study found that women with higher levels of testosterone were less likely to marry and assigned a lower priority to marrying (Udry, Morris & Kovenock, 1995). In addition, these women reported less interest in children and indeed had fewer children. Following this pattern, Cashdan (1995) found that women with higher testosterone-associated dominance behavior felt less need for a partner. The limited number of studies connecting testosterone to female peer and marital relationships makes it difficult to reach general conclusions about the role of this hormone in women's close relationships, and suggest an important area of inquiry to address in future research (Booth et al., 2006).

Based on recent findings, Eisenegger, Haushofer, and Fehr (2011) argue that the role of testosterone in human social behavior might be best understood in terms of driving behaviors that tend to increase an individual's motivation and ability to acquire and defend social status. These recent findings suggest that testosterone facilitates a host of social emotional processes that result in the enhanced ability of an individual to achieve and maintain social status (i.e. dominance) such as: reduced collaboration during decision-making by increase of egocentric choices (Wright et al., 2012); reduced facial mimicry (Singer & Lamm, 2009), emotion inference (Van Honk, Schutter, Bos, Kruijt, Lentjes, & Baron-Cohen, 2011), and trust during competition

(Bos, Terburg, & van Honk, 2010); increased threat vigilance (Hermans, Ramsey, & van Honk, 2008); and reduced fear and buffered stress response (Hermans, Putman, Baas, Koppeschaar, & van Honk, 2006). Thus, by facilitating spouses' engagement in a competition for status that could lead them to upward movement in a status hierarchy within their relationship, high levels of testosterone could promote marital discord, which in turn would place couple members at a greater risk for depression.

The relation between testosterone and dominance behaviors is not a simple one and it appears to be even more complex within the context of a dyadic relationship. In couple relationships, high testosterone in men relates to poorer marital quality (Julian & McKenry, 1989), less interaction with spouse, more separations, and a higher likelihood of divorce (Booth & Dabbs, 1993). Research on testosterone in marital interactions further reveals that it is not the absolute level of testosterone itself what matters in the adaptiveness of interactions, but rather the level of this hormone relative to the average for one's gender and to one's partner's relative level (Cohan, Booth, & Granger, 2003). Findings from Cohan, Booth, and Granger's (2003) study of problem-solving and support-seeking conversations among married couples suggested that men interact most positively and the least aggressively in a relationship when they and their wives have concordant testosterone levels. Wives, on the other hand, provided more positive support when they had higher testosterone and their husbands had lower testosterone, and provided less positive support when both had higher testosterone, suggesting that women interact best when testosterone levels are complementary, with theirs being relatively higher. However, a similar study conducted by Kaiser and Powers (2006) yielded different findings. In their study of the relation between testosterone levels and self-reported conflict tactics in late adolescent heterosexual couples, Kaiser and Powers found that the interaction of his and her testosterone

levels predicted the male's frequency of both psychological aggression and physical assault within the relationship. When both male and female were concordant for higher or lower levels of testosterone for their gender group, the male was more aggressive than if they had complementary levels. There was also a trend toward this same synergistic interaction in predicting females' physical assault. Both of the described studies emphasize the role that the interaction between spouses' relative levels of testosterone might have in predicting spouses' behavior. Further, research on marital quality suggests that high levels of testosterone might be related to both positive and negative relationship outcomes depending on spouses' perceptions of their social environment (Booth, Johnson, & Granger, 2005). This important finding brings our attention to the complex relation of hormones and human behavior, a relation that, unlike that of other social animals, is often moderated by a host of other uniquely human variables and the social environment. Finally, these studies suggest that when looking at the effects of testosterone on spouses' behavior, we should consider testosterone levels relative to subjects' sex, as well as the possible interactions between each spouse's testosterone.

Testosterone and depression

Testosterone has been linked to depressive symptoms in both men and women, and for both sexes the relation between the hormone and depressive symptomatology appears to be parabolic. As found in the largest study of the link between testosterone and depression in males, men with above- and below-average testosterone levels reported more symptoms of depression (Booth, Johnson, & Granger, 1999). However, this relationship disappeared for those with above average testosterone when authors controlled for antisocial and risk behaviors, and for the absence of protective factors such as marriage and steady employment. Similarly, low as well as high testosterone levels have been related to depression in women (Rohr, 2002). Though as a neuroactive steroid it appears that testosterone can influence various affective and

behavioral tendencies, including symptoms of depression through modulation of GABAA receptors as well as through antagonism of certain serotonin receptors (5-HT3) and glutamate receptors (Rupprecht, 2003), its connection to depression might be also related to the moderating or mediating role of other testosterone-dependent behaviors. For example, both women and men experience decreased libido as a consequence of testosterone deficiency (Rohr, 2002), and inability to maintain a satisfying sexual life may be one of the ways in which testosterone affects depression. Higher levels of testosterone are also related to greater criminal and antisocial behavior in both women and men, which can have negative effects on quality of life and relationships and increase risk for developing depressive symptoms (Rohr, 2002). Given the already established relation between testosterone and dominance behaviors, testosterone and depression, and the possible role that dominance dynamics might play in couple's overall well-being and emotional health, it seems very possible that dominance behaviors might constitute a mechanism through which testosterone can affect spouses' levels of depressive symptoms.

The present study

This study examined the relations among testosterone, dominance, and depressive symptoms in opposite-sex newlywed couples. Couples engaged in a conflict resolution task in order to elicit the dominance behaviors hypothesized to be associated with testosterone, based on the assumption that this situation represents a status challenge or threat encounter (Powers, Pietromonaco, Gunlicks, & Sayer, 2009). Based on dyadic power theory, the conflict resolution task was viewed as a scenario where partners could challenge each other and defend their status, gain control over decisions, and exert influence over the other. In order to assess dominance, I created a measure based on participants' self-report which assesses two distinct dimensions of dominance: 1) a dispositional and more generalized tendency to act dominantly and 2) the

situational use of dominance behaviors in response to a marital conflict task. The dispositional portion of the dominance measure is captured by two separate scales, one reflecting a positive aspect of this trait-like dimension, and a second reflecting a –presumably– negative aspect of dominance in the context of marriage. The situational dimension of this dominance measure is captured by two separate scales that describe participants' experiences during a conflict interaction with their spouses: one reflects spouses' perceptions of not having being submissive, and another reflects spouses' perceptions of having dominated the discussion relative to their partners.

I hypothesized that higher levels of testosterone of husbands and wives would be associated with their own experience of having more positive and negative trait dominance, and with their own reports of using more situational dominance behaviors during the conflict resolution task (H_1 in Figure 1-a). I also hypothesized that these associations would be stronger for men. Based on the theorized nature of dominance interactions, which requires that the assertion of control by one individual be followed by the subordination of the other (Dunbar, Bipuss, and Young, 2008), I expected that higher testosterone of a partner would predict weaker positive and negative trait dominance, and less situational dominance behaviors in his or her spouse during conflict (H_2 in Figure 1-a).

In terms of the dominance-depression link, I expected to find that: (1) higher levels of negative trait dominance, (2) lower positive trait dominance, (3) higher situational dominance of the sort describing perceptions of having dominated over one's spouse, and (4) lower situational dominance reflecting one's perceptions of having been submissive, would be all related to more elevated levels of depression symptoms for that person (H_3 in Figure 1-a). This hypothesis was based on the knowledge that excessive dominance can lead to marital discord, which in turn can

increase symptoms of depression, and that in the absence of dominance behaviors, individuals can assume a more permanent role of subordination which is also related to depression. In addition, I hypothesized that greater negative trait dominance and situational dominance in a spouse would predict his or her partner's increased depressive symptoms, a dyadic effect commonly known as an "actor-partner effect" (H_4 Figure 1-a).

Finally, I predicted that testosterone would be related to husbands' and wives' own increased risk for depression (i.e. actor effects) through the mediation of dominance behaviors (H_5 in the Figure 1.b). I further hypothesized that this mediated association between testosterone and depression could exist between spouses such that a person's testosterone and dominance could be predictive of his or her spouse's depression (i.e. actor-partner effects depicted in Figure 1-c).

CHAPTER 2

METHOD

Participants

Participants in this study were part of a larger NIH grant-funded (5R01CA33908-2) longitudinal study that investigates physiological and behavioral processes through which insecure attachment in marriage may serve as a risk factor for depression and anxiety disorders. For this study, 225 recently married opposite-sex couples were recruited from the western Massachusetts area. Analyses exclusively used data from time 1, when couples were within the first 6-7 months of their marriage. Participants were eligible to participate if (a) they were in their first marriage and could participate in the study within the first 7 months of their marriage; (b) both spouses were willing to participate; and (c) they were between the ages of 18 and 50 years, spoke English, and planned to remain in the area for the next 3 years. The majority of participants were in their late twenties to early thirties, with the mean age for wives being 27.7 years (SD = 4.8) and 29.1 years for husbands (SD = 5.2), and were predominantly white. A summary of relevant sample characteristics is provided in Table 1.

Participants were screened before admission to the study for the presence of any existing disease conditions, including disorders that may directly cause hypothalamic-pituitary-adrenal axis (HPA) dysregulation (e.g. Addison's disease, Cushing's syndrome), and conditions and treatment regimens that may indirectly affect HPA functioning because these are known to affect normal testosterone patterns. We focused on recently married couples because their relationships were established long enough that they were likely to meet the criteria for an attachment relationship (Diamond, 2001). Also, this period appears to be a critical one given that patterns

observed in the first two years of marriage forecast marital outcomes years later (Huston, Caughlin et al., 2001).

Procedure

Participating couples were invited to our laboratory where they provided several saliva samples at times before, during, and after a conflict interaction task. In this behavioral task, spouses engaged in a 15 minute discussion about a major area of unresolved disagreement in their relationship with the goal of resolving this conflict. In addition, couple members provided an additional saliva sample, at home during the same time of the first sample drawn at our lab to serve as a baseline measure of spouses' hormonal levels. Interactions during the conflict resolution task were video-recorded, and after performing this task participants completed computer-based questionnaires that included items pertaining to dominance behaviors, among many other variables.

Measures

Assessment of Testosterone

Saliva samples were assayed for testosterone using an enzyme immunoassay (EIA) specifically designed for use with saliva according to the manufacturer's recommended protocol (Salimetrics, State College, PA). This assay has a range of sensitivity from 1.5 to 360 pg/mL, and average intra- and interassay coefficients of variation less than 10% and 15%, respectively. All saliva samples were assayed for testosterone in duplicate in Dr. Douglas Granger's lab at John Hopkins University. Although testosterone levels are known to vary by certain factors such as time of day, season, and age (Dabbs, 1990), the overall stability of a given person's testosterone level relative to that of other people allows us to treat testosterone as an individual difference variable (Dabbs, 1993). Testosterone levels were assessed from the first sample that

participants provided prior to the conflict interaction task and about 30-40 minutes after arriving at our lab.

Dominance

A measure of dominance was created based on the self-reported data of participants collected through our study's questionnaires. A subset of items from these questionnaires were identified as being related to dominance and were explored in reliability and exploratory factor analyses. Ten items were retained and transformed to be in the same metric (7 point Likert scale) and direction (Appendix A). A series of confirmatory factor analyses performed in LISREL (version 8.8) revealed a structure of four different factors for the composite dominance measure. These factors captured different dimensions of dominance, including both positive and negative qualities, as well as situational and dispositional expressions of this construct. These factors were labeled to reflect these distinct dimensions in the following way: "Situational Dominance 1", "Situational Dominance 2", "Positive Trait Dominance", and "Negative Trait Dominance".

Depression

Symptoms of depression were assessed using the Inventory of Depressive Symptomatology: Self-Report (IDS-SR; Appendix B). The IDS-SR (Rush, Carmody, & Reimitz, 2000) is a self-rated scale comprised of 30 items that assess all the criterion symptom domains designated by the American Psychiatry Association Diagnostic and Statistical Manual of Mental Disorders- 4th edition (APA, 1994), mostly known as the DSM-IV, to diagnose a major depressive episode. It improves on other standard measures because each item assesses a single symptom only and all items are equally weighted; it also is sensitive to mild changes in symptoms in clinical samples. As published by Rush and colleagues (Rush, 1996), the IDS-SR is a reliable measure of depression ($\alpha = .93$) and correlates highly with the Hamilton Rating Scale

for Depression (r = .88), the Beck Depression Inventory (r =.93), and the clinician-rated version of the IDS (r = .91).

CHAPTER 3

RESULTS

Analytic Strategy

In order to examine the hypothesized relations among spouses' testosterone, dominance, and depression levels, a series of structural equation models were fitted using LISREL (version 8.8), a software program for structural equation modeling (SEM). The models were created using the option of path analysis, which allowed for the simultaneous exploration of multiple dependent variables, and for a given variable to be dependent with respect to some variables and independent with respect to others, which is a crucial feature of mediation. In addition, because path analyses in SEM can incorporate measurement components for every latent variable, I was able to examine the different factors of the dominance construct directly from their corresponding measured items without having to create factor scores.

Missing data in the sample was minimal and the few values that were missing for participants were imputed using the expected maximization algorithm prior to creating the covariance matrix that was read into LISREL. My analyses focused on depression as the outcome variable predicted by participants' testosterone and their self-reported dominance behaviors, and all analyses were performed using maximum likelihood estimation. Two assessments of testosterone levels, taken from the same saliva sample, were transformed using a log10 function in order to correct for positive skewedness and were used as indicators specifying the *Testosterone* latent variable created for each participant. Four different latent variables, *Situational Dominance 1*, *Situational Dominance 2*, *Positive Trait Dominance*, and *Negative Trait Dominance* were developed as measures of different aspects of dominance, each specified by two or three questionnaire items as previously described in the Measures section (see

Appendix A for item descriptions). Finally, the Inventory of Depressive Symptomatology (IDS), an instrument that provides a single global measure of depressive symptoms, was used to specify the latent variable of *Depression.* Given the unidimensionality of the IDS, items from this scale were assigned to one of three parcels of similar size and these parcels were used as the indicators for the outcome variable of *Depression*. The measurement models depicted in Figures 2-3 illustrate the relationships between each latent variable and its indicators.

This study focused on dynamics that take place within the marital relationship and as such, analyses needed to account for the dependency in husbands' and wives' outcomes. Therefore, a dyadic structural model was used in all analyses allowing us to capture the degree of correlation between spouses' dominance and depression levels within a given couple.

Descriptive statistics of latent variables

Spouses had a wide range of testosterone levels[1] (wives: M= 47.84 pg/ml, SD = 30.60, Range= 139.60; husbands: M= 105.62 pg/ml, SD = 60.40, Range= 491.66), which were within normative ranges for their corresponding sexes. In spite of the fact that our sample was composed of community individuals who were not selected for symptoms or diagnoses of depression, spouses evidenced a wide range of depression levels with average IDS scores of 10.17 (*SD*= 6.0) for husbands and 11.76 (*SD*= 7.62) for wives. Many participants had levels of symptoms that corresponded to a clinical depression diagnosis as specified in the DSM-IV. In fact, 21% of husbands (X= 48, N = 225) and 26 % of wives (X= 58, N= 228) met criteria for "mild depression", 1.6% of husbands (X= 4, N= 225) and 5% of wives (X= 11, N= 225) scored on the "moderate depression" range, and 1.6% (X= 4, N= 225) of wives had scores placing them in the "severe depression" range. See Appendix C for a description of IDS scores and their

[1] Testosterone is measured in picograms per milliliter (pg/ml)

clinical significance.

A Dyadic Actor-Only Structural Equation Model

A dyadic structural equation model (see Figure 4) was analyzed in order to establish: a) whether individuals' levels of testosterone predicted depressive symptoms and self- reports of dominance behaviors; b) whether these dominance behaviors predicted symptoms of depression; and c) if testosterone was indeed a predictor of depression symptoms, to what extent this relationship was mediated by dominance behaviors. In this actor-only path model, a person's testosterone level was set to predict each of their four dominance factors and their depression symptoms, and these four dominance factors were in turn set to predict a person's depression. Paths for wives and husbands were estimated separately but simultaneously within the same structural model. The non-independence of spouses' responses was accounted for by allowing the error variances of participants' indicators for every exogenous variable to correlate with their partners' corresponding indicators (see measurement models, Figures 2-3). The correlation between husbands' and wives' testosterone levels was 0.58, suggesting a high degree of relatedness between members of each couple. Multiple fit indices provided support for the model having a good fit to our data (χ^2 = 708.81, df= 378, p =.00; χ^2/df = 1.88, RMSEA = .056, NNFI = .867, Standardized RMR = .098). Estimated parameters for this model are summarized in Tables 3.1 and 3.2 and relevant findings are described below.

Testosterone as a Predictor of Dominance

In the following results, regression coefficients (*b*) are reported in their unstandardized form while, to facilitate interpretation, they are presented as partial correlations (standardized) in the model figures. Of the four dominance measures, *Negative Trait Dominance* was the only

factor significantly predicted by testosterone (b = -.55, SE = .28, p <.05), and this effect was exclusively found for husbands. The negative association suggests that for husbands, lower levels of testosterone are related to their self-reports of typically being more dominant and aggressive.

Dominance as a Predictor of Depression

For wives, all four dominance measures were significant predictors of their depressive symptoms. Greater ratings of *Negative Trait Dominance* (b = .89, SE = .30, p <.01) and *Situational Dominance 2* (b = .82, SE = .33, p <.05) were related to higher levels of depressive symptoms, while higher ratings of wives' *Positive Trait Dominance* (b = -.65, SE = .21, p <.01) and *Situational Dominance 1* (b = -.70, SE = .30, p <.05) were associated with fewer depression symptoms. For husbands, three of the four measures of dominance predicted their depressive symptoms and in the same direction as those of their wives. Greater self-reports of *Negative Trait Dominance* (b = .62, SE = .16, p <.001) predicted higher levels of husbands' depressive symptoms, while lower ratings of *Positive Trait Dominance* (b = -.92, SE = .19, p <.001) and *Situational Dominance 1* (b = -.26, SE = .10, p <.01) were related to more symptoms of depression.

Testosterone as a Predictor of Depression

While no direct effects of testosterone on depression were found for either husbands or wives, lower levels of testosterone significantly predicted more depressive symptoms for husbands (c' = -.77, SE= .40, p <.05) through the mediation of their *Negative Trait Dominance.* Specifically, lower testosterone was associated with a more aggressive or hostile behavioral style, as captured by the *Negative Trait Dominance* measure, which in turn predicted greater

depressive symptomatology for husbands. Whereas older approaches to mediation analysis held that a significant relation between the independent and dependent variable (*c*) must be present as a requisite for both testing and establishing mediation (Baron & Kenny, 1986), emerging perspectives in the field question the requirement that a total X →Y effect be present before assessing mediation (Hayes, 2009; MacKinnon, Lockwood, Hoffman, West, & Sheets 2002; Shrout & Bolger, 2002; Zhao, Lynch, & Chen 2010). In fact, Rucker, Preacher, Tormala, & Petty, (2011) have provided systematic evidence that significant indirect effects (*c'*) can occur in the absence of significant total or direct effects (*c*). This was precisely the case with my model, where prior to and after introducing the dominance variables, the direct relation between testosterone and depression was not significant. Following Rucker et al.'s (2011) suggestion of deemphasizing the focus on the significance between the independent and dependent variable— both before and after mediation tests— and advocating for a shift in mediation analyses towards assessing the magnitude and significance of indirect effects, we feel safe with concluding that *Negative Trait Dominance* mediated the effect of testosterone on husband's depression.

Actor-Partner Effects

A final question regarding the association between latent variables within our couples needed to be answered: Can a participant's testosterone and dominance behaviors be predictive of his or her spouse's depression? In order to test this set of hypothesized actor-partner relations, an additional structural equation model was explored that contained all the paths from the dyadic actor-only model previously described, and ultimately retained, plus paths from husbands' *Testosterone* and *Dominance* measures to wives' *Depression,* and from wives' *Testosterone* and *Dominance* measures to husbands' *Depression*. None of the added paths were significant and a model comparison test indicated this actor-partner model was not an improvement over the

actor-only model ($\Delta\chi^2 = 140.42$, df = 36, $p < .000$). Thus, the dyadic actor-only model with mediation effects that has been described throughout this paper (Figures 2-4) was the one retained.

CHAPTER 4

DISCUSSION

This study yields several important findings regarding the particular relations among testosterone, behavior, and the emotional health of recently married couples. Dominance behaviors predicted depression for wives and husbands. Both positive and negative aspects of dominance, as well as trait and maritally specific (situational) aspects are important factors for predicting depression in married couples, a finding that was made possible through the use of an innovative dominance measure. Testosterone predicted depression in relatively young husbands, an age-population for which research on the testosterone-depression link has been scarce. Finally, the relation between testosterone and emotional health of husbands was mediated by one type of dominance behaviors.

Consistent with my hypothesis, dominance behaviors were significant predictors of both husbands' and wives' depressive symptoms. These effects were found using an original measure of dominance that not only included the positive aspects of this construct, in addition to the more widely known negative ones, but also simultaneously captured dispositional and situational components of dominance. For both husbands and wives, higher levels of depressive symptoms were related to reports of more dispositional hostility (*Negative Trait Dominance*) and greater submission during a conflict situation (lower *Situational Dominance 1*). These findings align well with previous research documenting submissive behaviors as predictors of current and future internalizing problems in adolescents (Powers, Battle, Dorta, & Welsh, 2010) and with theories about the etiology of adult depression, such as the "learned helplessness" model (Abramson et al., 1978), and evolutionary nature of "involuntary defeat strategies" (Gilbert, 2000; Sloman, Gilbert, & Hasey, 2003), which feature subordination as a core component of

depression. The finding that greater hostility is associated with more depressive symptoms in our newlyweds is also congruent with long-established characterizations of depressed individuals as displaying greater hostility and anger (Kahn, Coyne & Margolin, 1985; Segrin & Dillard, 1992) and of their family relationships being hostile and conflictful (Coyne & DeLongis). More recent research also suggests that hostile exchanges in marriage are associated with increased depressive symptoms (Uebelacker, Courtnage, & Whisman, 2003).

One important positive dimension of dominance in the context of marriage is assertiveness because it allows spouses to negotiate conflict with their partners from a position of equality. Assertiveness enables spouses to affirm their rights or point of view in relationship-enhancing ways, that is, without aggressively threatening the rights of their spouse or submissively permitting their spouse to ignore or deny them. In this study, greater assertiveness, as captured by the *Positive Trait Dominance* measure, was related to fewer depressive symptoms for both wives and husbands. This finding, taken together with that of greater submission predicting more depressive symptoms for our spouses, suggests that a healthy amount of dominance is a protective factor against depression for married individuals. This finding regarding the assertiveness facet of dominance within couples is not surprising if one considers that the vast majority of couple therapies include as a goal the promotion of communication exchanges in which partners can honestly express their thoughts, feelings and desires in a way that also takes into consideration the rights of their partner and portrays mutual respect —which in other words means teaching couples how to be more assertive (Gurman, 2008). Besides, failure to act assertively, behaving overly submissively, perceiving oneself as being subordinated and lacking control, and feeling defeated during interpersonal conflicts have long been associated with depression (Gilbert, 2000).

Interestingly, the subset of dominance behaviors captured by our *Situational Dominance 2* measure was only predictive of depressive symptoms for wives. This dimension of dominance refers to one's appraisals of having had more power, influence, and control during a conflict interaction with one's spouse. In this study, wives who perceived themselves as having dominated the conflict discussion they had just completed with their husbands reported higher levels of depressive symptoms. This finding was not true for husbands, for whom this type of context-dependent dominance was not related to their depression. This finding is of interest because of two reasons, one being the sex specificity of the dominance effect on depression, and the other related to the direction of the said effect. Based on the knowledge that one's perception of being subordinated in a close relationship is related to one's depression, I expected that perceptions of having had more power, influence, and control than one's partner during the conflict discussion would have predicted fewer symptoms of depression for oneself. Our finding of women reporting higher levels of depression when they perceived they had prevailed over their husbands during their discussion can be explained in several ways. It is possible that wives' appraisals of having been more dominant than their husbands during the conflict interaction could be reflective of them experiencing their partners as withdrawn or disengaged, and thus indicative of greater demand-withdraw patterns in their marriage. The demand-withdraw communication pattern, in which one partner attempts to discuss a problem while the other avoids the issue or ends the discussion, ranks among the most destructive and least effective interaction patterns in couples' problem-solving strategies and has been repeatedly associated with relationship dysfunction (Eldridge & Christensen, 2002) and individual maladjustment (Malis & Roloff, 2006). Furthermore, some researchers suggest that withdrawal of husbands during marital conflict is, far from submission, a behavioral assertion of his status and power

(Jacobson, 1989; Noller, 1993). In this sense, the *Situational Dominance 2* measure could be — albeit counterintuitive— more indicative of their subjective experiences of subordination within their relationship than of actual dominance.

It has been argued that husbands and wives have different perceptions of power and control in their relationships based on their different roles and culturally-prescribed norms (Rollins and Bahr, 1976). Generally speaking, traditional gender norms are not supportive of women assuming power or dominant positions, especially in relational contexts. It is possible then that women in our study, by having internalized this notion, may be experiencing distress to the extent they perceive themselves as transgressing the culturally-prescribed, gender-based dominance-submission dynamics of traditional heterosexual marriages. This conjecture would be in line with previous research showing that perceptions of equal as opposed to asymmetrical influence in decision-making is related to greater relationship satisfaction in wives (Steil, 1995).

Finally, it is possible that *Situational Dominance 2* for wives, more than a measure of dominance, might be reflective of their perceptions of having been highly conflictive during the discussion with their husbands. Powers et al. (2010) argue that gender role socialization produces sex differences in interpersonal vulnerabilities to internalizing problems. Gender roles for women emphasize lack of assertiveness, interpersonal dependency, and greater passivity. In their study of adolescent and mother dyads, girls' perceptions of their interpersonal behaviors being high in *conflict* and *submission* during a conflict resolution task predicted increases in current and future internalizing problems, a behavioral pattern which they termed "agitated submission". Boys' internalizing problems, on the other hand, increased only as their *submission*, but not *conflict* increased, a pattern they called "disengaged submission" (Powers, Battle, Dorta, & Welsh, 2010). Our findings show in married adults what Powers' study found in adolescent-

mother dyads. Thus, our finding that wives' self-perceptions of high power and dominance (as captured by *Situational Dominance 2*) with respect to their husbands predicts higher levels of depressive symptoms for her might stem from the fear that their perceived high levels of conflict threatened their connection with their husbands supporting the notion that women's gender role socialization produces interpersonal vulnerabilities to depression.

In regards to the hypothesized testosterone-depression link, this study found that testosterone is indirectly related to men's depression, as husbands who had lower levels of testosterone reported higher levels of depressive symptoms. Most importantly, the effect of testosterone on depression was found to be mediated by the influence of dominance behaviors, thus confirming my central hypothesis. In this case, lower testosterone in husbands was related to a more aggressive or hostile behavioral style, as reflected by the *Negative Trait Dominance* measure, which in turn predicted more depressive symptomatology for them. This finding is consistent with other studies in which below-average testosterone levels have been related to more symptoms of depression in middle-age and older men (Barrett-Connor, von Muhlen, & Kritz-Silverstein, 1999; Booth, Johnson, & Granger, 1999; Joshi et al., 2010), and more recently in young men as well (Sankar & Hampson, 2012). While testosterone has typically been positively related to dominance in earlier studies, our finding of lower testosterone predicting greater *Negative Trait Dominance* in men is not incongruent if one holds the following theoretical notions: (1) dominance refers to status-seeking behaviors and is thus a distinct behavioral expression than aggression, (2) a disposition to act aggressively and hostile, which is what the *Negative Trait Dominance* scale measures, is more related to the construct of aggression than to dominance.

This study offers an important line of inquiry into the biological and behavioral correlates of dyadic functioning and individual levels of emotional health. To our knowledge, no other research has examined the connection between testosterone, dominance, and depression in the context of intimate relationships. To this effect I developed an original measure for dominance that not only takes into account the positive aspects of this construct, but also simultaneously captures a dispositional and a situational component. By making separate analyses of the different dominance factors as predictors of depression, I was able to determine that these distinct expressions of dominance relate differently to spouses' emotional health, thus expanding on the body of dominance research and literature.

Given the dearth of research examining testosterone-behavior associations among females, this study offers an important contribution to the field by clarifying how spouses' levels of testosterone are related differently to dominance behaviors for men and women that are in monogamous committed relationships. Also, it constitutes an important addition to the literature by having validated the testosterone-depression link in healthy younger men, as the existent research has been almost exclusively done in older men or on younger men with hypogonadism.

More broadly, this study contributes to the growing body of knowledge on hormones and behavior and marital health. This study's findings are relevant to a wide range of couples in the sense that it explored dominance—a set of normative dominance behaviors—as a potential risk and protective factor for depression instead of focusing on more deviant behaviors like overt or physical aggression—which have been long and well-studied. We view this study as a first step in a program of research that may have implications for understanding long-term marital outcomes for spouses. This study will enable a better understanding of how dyadic patterns of

testosterone and dominance behaviors might help identify couples that are at greatest risk for the onset of communication problems that can contribute to the onset or exacerbation of depression.

Notwithstanding the significant contributions of this study, several limitations can be noted. First, the sample of this study was not ethnically diverse and mostly included white European Americans from the small geographic area of western Massachusetts. In addition, participant couples of this study were only different-sex couples. These sample features limit the generalizability of our findings to couples of more diverse backgrounds. Second, the hypothesized —and confirmed—association between dominance and depression for newlyweds was mostly based on the knowledge that excessive dominance in a marriage can create discord and that marital discord in turn predict spouses' depression yet marital discord was not a variable examined in this study. Therefore, it could be said that a limitation of my mediation model is that it includes a fourth invisible variable (i.e. marital discord) that is not being measured.

Correspondingly, future studies will examine the effect of marital discord within the dyadic mediation model hereby presented. It could be argued that one limitation of this study lies in its reliance on self-reported data to measure the construct of dominance. Given the rich body of behavioral observations we have from these couples, future studies will include observational methods to expand the scope of this dominance measure and to assess the extent to which self-reports of dominance behaviors are reflective of couples' interpersonal behaviors during conflict negotiation. While the creation of our dominance measure is an original contribution and an important first step, further conceptualization of its factors and comparison against the available literature are needed in order to ensure its construct validity. A final limitation of this study is that it uses a cross-sectional design. In order to establish the causality between testosterone and dominance and of testosterone leading to depression, which are both requisites for fully

demonstrating mediation, temporal precedence between the predictor variable and the outcomes is needed. While this can only be established with a longitudinal design, the data used in the presented study is part of longitudinal study so future directions shall include temporal precedence for testing these hypothesized variable relations.

Table 1. Summary of Sample Characteristics

	Husbands			Wives		
	N	*M*	*SD*	N	*M*	*SD*
Age	222	29.06	5.23	221	27.66	4.77
Relationship length (months)	221	59.84	35.62	225	59.82	35.10
Cohabitation length (months)	187	33.05	26.65	186	32.84	26.72
Highest level of education completed	Frequency	Percentage		Frequency	Percentage	
Some high school	1	.4		1	.5	
High school or equivalent	52	23.2		26	11.8	
Associate/Vocational degree	30	13.4		18	8.1	
Bachelor's degree	132	59.0		167	75.2	
Graduate Program	9	4.0		10	4.5	
Total	224	100		222	100	
Ethnicity						
White	216	94.3		208	93.3	
Black	3	1.31		1	0.45	
Hispanic	4	1.75		8	3.59	
Asian	1	0.44		5	2.24	
American Indian	5	2.18		1	0.45	
Native Hawaiian or other Pacific Islander	0	0		0	0	
Total	229	100		223	100	

Table 2. Maximum Likelihood Estimates for a Dyadic Path Model of Depression Factors in Recently Married Couples – Husbands' Estimates

Parameter	Unstandardized	SE	Standardized
Husbands			
<u>Direct effects</u>			
Testosterone → Situational Dominance 1	.287	.416	.046
Testosterone → Situational Dominance 2	-.142	.213	-.050
Testosterone → Positive Trait Dominance	.406	.351	.089
Testosterone → Negative Trait Dominance	-.552*	.277	-.134
Situational Dominance 1 → Depression	-.260**	.097	-.181
Situational Dominance 2 → Depression	-.155	.237	-.049
Positive Trait Dominance → Depression	-.916***	.188	-.468
Negative Trait Dominance → Depression	.620***	.164	.287
Testosterone → Depression	-.037	.270	-.004
<u>Indirect effects</u>			
Testosterone → Depression	-.766*	.402	-.086
<u>Disturbance variances</u>			
Situational Dominance 1	1.96***	.184	.002
Situational Dominance 2	.400***	.072	.003
Positive Trait Dominance	1.04***	.198	.008
Negative Trait Dominance	.842***	.165	.018
Depression	2.64***	.599	.341

*$p < .05$, **$p < .01$, ***$p < .001$
Standardized estimates for disturbance variances are proportions of unexplained variance.

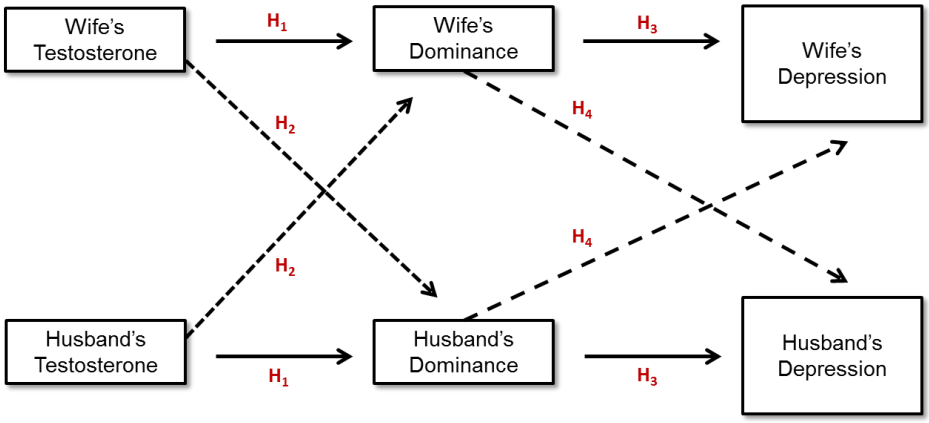
Table 3. Maximum Likelihood Estimates for a Dyadic Path Model of Depression Factors in Recently Married Couples – Wives' Estimates

Parameter	Unstandardized	SE	Standardized
Wives			
Direct effects			
Testosterone → Situational Dominance 1	.370	.290	.112
Testosterone → Situational Dominance 2	-.093	.183	-.038
Testosterone → Positive Trait Dominance	.203	.300	.051
Testosterone → Negative Trait Dominance	-.082	.175	-.031
Situational Dominance 1 → Depression	-.703*	.301	-.220
Situational Dominance 2 → Depression	.815*	.329	.192
Positive Trait Dominance → Depression	-.645**	.213	-.242
Negative Trait Dominance → Depression	.894**	.302	.222
Testosterone → Depression	.325	.407	.031
Indirect effects			
Testosterone → Depression	-.541	.367	-.051
Disturbance variances			
Situational Dominance 1	.746*	.345	.013
Situational Dominance 2	.425***	.067	.001
Positive Trait Dominance	1.08***	.190	.003
Negative Trait Dominance	.475***	.132	.001
Depression	6.21***	1.01	.193

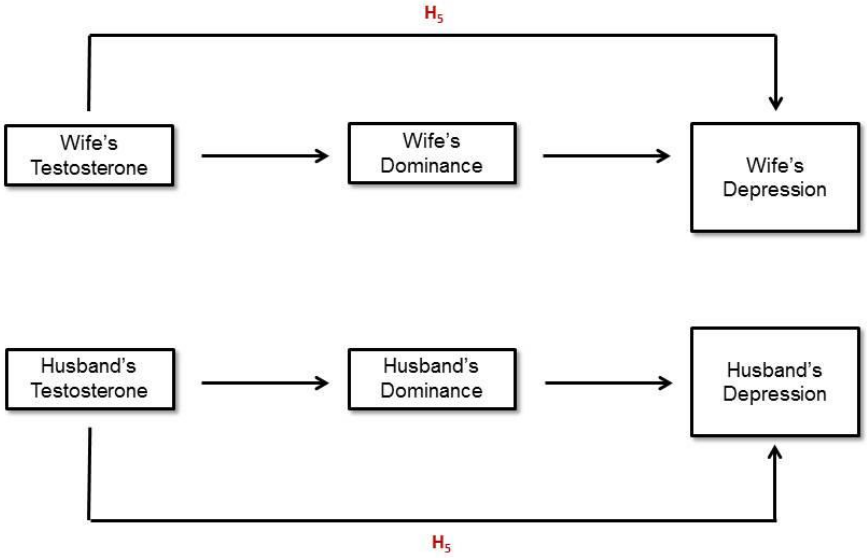
*$p < .05$, **$p < .01$, ***$p < .001$
Standardized estimates for disturbance variances are proportions of unexplained variance.

Figure 1. Visual representations of research hypotheses

a)



b)



c)

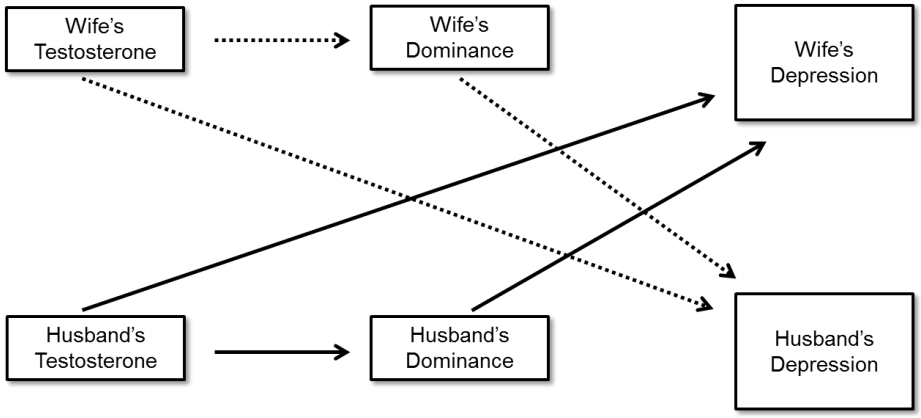
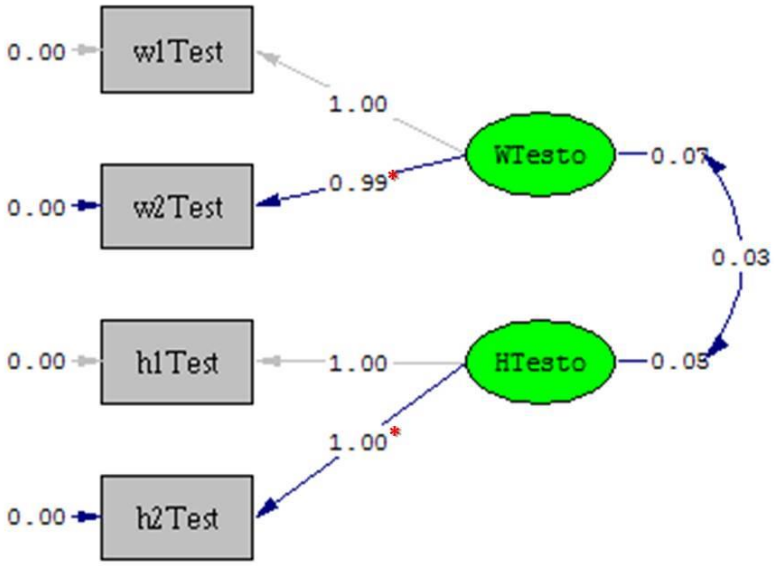


Figure 2. Standardized coefficients for the exogenous variables' measurement piece of the dyadic structural equation model of dominance as a mediator between testosterone and depression in recently married couples.



All estimates with an asterisk * are significant at $p < .05$

Model fit indices:

$\chi^2(378) = 708.81$ ($p = .00$)
$\chi^2/df = 1.88$
RMSEA = .056
NNFI = .867
Standardized RMR = .098

Figure 3. Standardized coefficients for the endogenous variables' measurement piece of the dyadic structural equation model of dominance as a mediator between testosterone and depression in recently married couples.

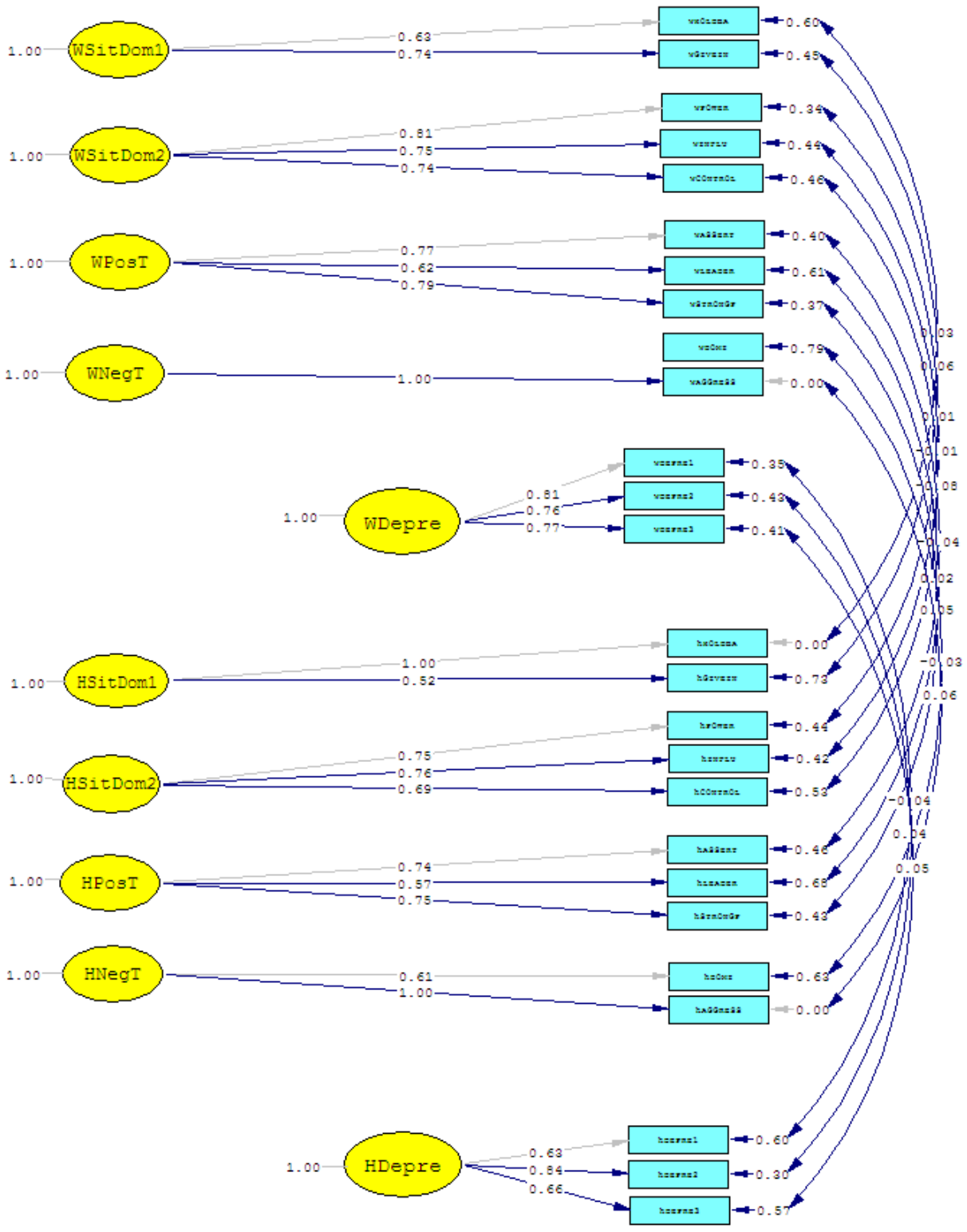
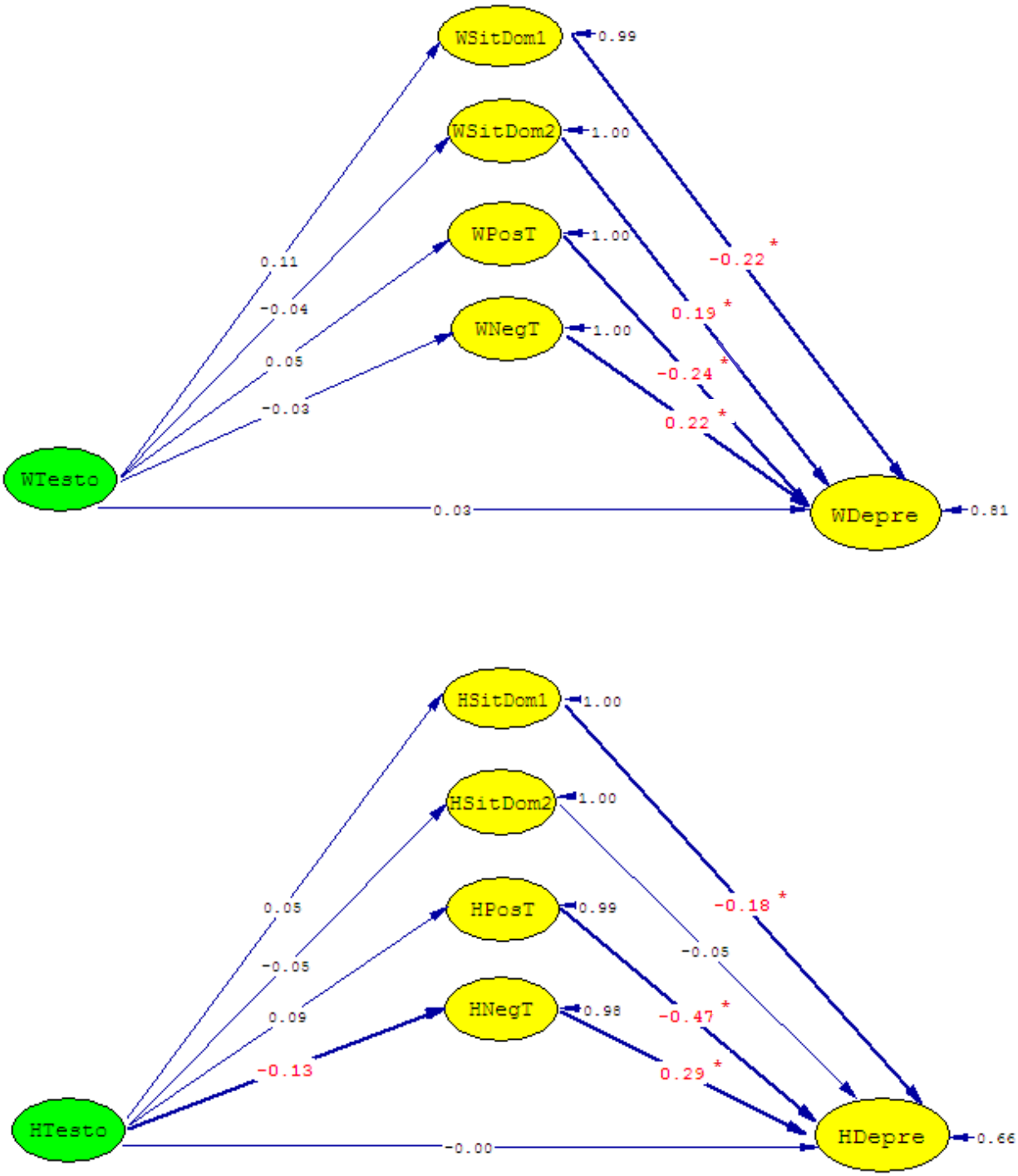


Figure 4. Standardized coefficients for the full actor-only dyadic structural equation model of dominance as a mediator between testosterone and depression in recently married couples.



Note. All estimates with an asterisk * are significant at $p < .05$. Correlations between spouses' indicator error variances are included (as depicted in Figure 3) but not visible in this model.

APPENDIX A

ITEMS COMPRISING THE DOMINANCE MEASURE

1. Situational Dominance 1

Measure composed of two reverse-coded items answering to the following query:

During the discussion with my spouse, I felt:

0	3	6
Not at all		Extremely

1. *Like I was holding back (R)*
2. *Like I was giving in (R)*

2. Situational Dominance 2

Measure composed of three items answering to the following query:

Please answer the following questions using the 1-7 scale.

1	3	7
Spouse had much more	Spouse and I had equal amount	I had much more

1. *In the discussion you just had with your spouse, who had more **control**?*
2. *In the discussion you just had with your spouse, who had more **power**?*
3. *In the discussion you just had with your spouse, who had more **influence**?*

3. Positive Trait Dominance

Measure composed of three items answering to the following query:

Please describe yourself using the 1-7 scale.

1	3	7
Never true	Occasionally true	Always true

1. Assertive
2. Strong personality
3. Have leadership abilities

4. Negative Trait Dominance

Measure composed of two items answering to the following query:

Please describe yourself using the 1-7 scale.

4. Dominant
5. Aggressive

*All items were transformed into a 0-6 Likert scale and items 1-2 were coded into their reverse version.

APPENDIX B

INVENTORY OF DEPRESSIVE SYMPTOMATOLOGY- SELF-REPORT (IDS-SR)

Instructions: Please select the one response to each item that best describes you for the past seven days.

1. Falling Asleep:
   - I never take longer than 30 minutes to fall asleep.
   - I take at least 30 minutes to fall asleep, less than half the time.
   - I take at least 30 minutes to fall asleep, more than half the time.
   - I take more than 60 minutes to fall asleep, more than half the time.

2. Sleep During the Night:
   - I do not wake up at night.
   - I have a restless, light sleep with a few brief awakenings each night.
   - I wake up at least once a night, but I go back to sleep easily.
   - I awaken more than once a night and stay awake for 20 minutes or more, more than half the time.

3. Waking Up Too Early:
   - Most of the time, I awaken no more than 30 minutes before I need to get up.
   - More than half the time, I awaken more than 30 minutes before I need to get up.
   - I almost always awaken at least one hour or so before I need to, but I go back to sleep eventually.
   - I awaken at least one hour before I need to, and can't go back to sleep.

4. Sleeping Too Much:
   - I sleep no longer than 78 hours/night, without napping during the day.
   - I sleep no longer than 10 hours in a 24hour period including naps.
   - I sleep no longer than 12 hours in a 24hour period including naps.
   - I sleep longer than 12 hours in a 24hour period including naps.

5. Feeling Sad:
   - I do not feel sad.
   - I feel sad less than half the time.
   - I feel sad more than half the time.
   - I feel sad nearly all of the time.

6. Feeling Irritable:
   - I do not feel irritable.
   - I feel irritable less than half the time.
   - I feel irritable more than half the time.
   - I feel irritable nearly all of the time

7. Feeling Anxious or Tense:
   - I do not feel anxious or tense.
   - I feel anxious (tense) less than half the time.
   - I feel anxious (tense) more than half the time.
   - I feel extremely anxious (tense) nearly all of the time.

8. Response of Your Mood to Good or Desired Events:
   - My mood brightens to a normal level which lasts for several hours when good events occur.
   - My mood brightens but I do not feel like my normal self when good events occur.
   - My mood brightens only somewhat to a rather limited range of desired events.
   - My mood does not brighten at all, even when very good or desired events occur in my life.

9. Mood in Relation to Time of Day:
   - There is no regular relationship between my mood and the time of day.
   - My mood often relates to the time of day because of environmental events (e.g., being alone, working).
   - In general, my mood is more related to the time of day than to environmental events.
   - My mood is clearly and predictably better or worse at a particular time each day.

10. Is your mood variation attributed to the environment?
   - Yes
   - No

11. The Quality of Your Mood:
   - The mood (internal feelings) that I experience is very much a normal mood.
   - My mood is sad, but this sadness is pretty much like the sad mood I would feel if someone close to me died or left.
   - My mood is sad, but this sadness has a rather different quality to it than the sadness I would feel if someone close to me died or left.
   - My mood is sad, but this sadness is different from the type of sadness associated with grief or loss.

Please complete either 12 or 13 (not both)

12. Decreased Appetite:
   - There is no change in my usual appetite.
   - I eat somewhat less often or lesser amounts of food than usual.
   - I eat much less than usual and only with personal effort.
   - I rarely eat within a 24hour period, and only with extreme personal effort or when others persuade me to eat.

13. Increased Appetite:
   - There is no change from my usual appetite.

- I feel a need to eat more frequently than usual.
- I regularly eat more often and/or greater amounts of food than usual.
- I feel driven to overeat both at mealtime and between meals.

Please complete either 14 or 15 (not both)

14. Within the Last Two Weeks:
    - I have not had a change in my weight.
    - I feel as if I've had a slight weight loss.
    - I have lost 2 pounds or more.
    - I have lost 5 pounds or more.

15. Within the Last Two Weeks:
    - I have not had a change in my weight.
    - I feel as if I've had a slight weight gain.
    - I have gained 2 pounds or more.
    - I have gained 5 pounds or more.

16. Concentration/Decision Making:
    - There is no change in my usual capacity to concentrate or make decisions.
    - I occasionally feel indecisive or find that my attention wanders.
    - Most of the time, I struggle to focus my attention or to make decisions.
    - I cannot concentrate well enough to read or cannot make even minor decisions.

17. View of Myself:
    - I see myself as equally worthwhile and deserving as other people.
    - I am more self-blaming than usual.
    - I largely believe that I cause problems for others.
    - I think almost constantly about major and minor defects in myself.

18. View of My Future:
    - I am occasionally pessimistic about my future, but for the most part I believe things will get better.
    - I'm pretty certain that my immediate future (12 months) does not hold much promise of good things for me.
    - I see no hope of anything good happening to me anytime in the future.

19. Thoughts of Death or Suicide:
    - I do not think of suicide or death.
    - I feel that life is empty or wonder if it's worth living.
    - I think of suicide or death several times a week for several minutes.
    - I think of suicide or death several times a day in some detail, or I have made specific plans for suicide or have actually tried to take my life.

20. General Interest:
    - There is no change from usual in how interested I am in other people or activities.
    - I notice that I am less interested in people or activities.

- I find I have interest in only one or two of my formerly pursued activities.
- I have virtually no interest in formerly pursued activities.

21. Energy Level:
    - There is no change in my usual level of energy.
    - I get tired more easily than usual.
    - I have to make a big effort to start or finish my usual daily activities (for example, shopping, homework, cooking or going to work).
    - I really cannot carry out most of my usual daily activities because I just don't have the energy.

22. Capacity for Pleasure or Enjoyment (excluding sex):
    - I enjoy pleasurable activities just as much as usual.
    - I do not feel my usual sense of enjoyment from pleasurable activities.
    - I rarely get a feeling of pleasure from any activity.
    - I am unable to get any pleasure or enjoyment from anything.

23. Interested in Sex (Please rate interest, not activity)
    - I'm just as interested in sex as usual.
    - My interest in sex is somewhat less than usual or I do not get the same pleasure from sex as I used to.
    - I have little desire for or rarely derive pleasure from sex.
    - I have absolutely no interest in or derive no pleasure from sex.

24. Feeling slowed down:
    - I think, speak, and move at my usual rate of speed.
    - I find that my thinking is slowed down or my voice sounds dull or flat.
    - It takes me several seconds to respond to most questions and I'm sure my thinking is slowed.
    - I am often unable to respond to questions without extreme effort.

25. Feeling restless:
    - I do not feel restless.
    - I'm often fidgety, wring my hands, or need to shift how I am sitting.
    - I have impulses to move about and am quite restless.
    - At times, I am unable to stay seated and need to pace around.

26. Aches and pains:
    - I don't have any of these symptoms: heart pounding fast, blurred vision, sweating, hot and cold flashes, chest pain, heart turning over in my chest, ringing in my ears, or shaking.
    - I have some of these symptoms but they are mild and are present only sometimes.
    - I have several of these symptoms and they bother me quite a bit
    - I have several of these symptoms and when they occur I have to stop doing whatever I am doing.

27. Other bodily symptoms:
    - I don't have any of these symptoms: heart pounding fast, blurred vision, sweating, hot and cold flashes, chest pain, heart turning over in my chest, ringing in my ears, or shaking.
    - I have some of these symptoms but they are mild and are present only sometimes.
    - I have several of these symptoms and they bother me quite a bit
    - I have several of these symptoms and when they occur I have to stop doing whatever I am doing.

28. Panic/Phobic symptoms:
    - I have no spells of panic or specific fears (phobia) (such as animals or heights).
    - I have mild panic episodes or fears that do not usually change my behavior or stop me from functioning.
    - I have significant panic episodes or fears that force me to change my behavior but do not stop me from functioning.
    - I have panic episodes at least once a week or severe fears that stop me from carrying on my daily activities.

29. Constipation/Diarrhea:
    - There is no change in my usual bowel habits.
    - I have intermittent constipation or diarrhea which is mild.
    - I have diarrhea or constipation most of the time but it does not interfere with my day to day functioning.
    - I have constipation or diarrhea for which I take medicine or which interferes with my day today activities.

30. Interpersonal Sensitivity:
    - I have not felt easily rejected, slighted, criticized or hurt by others at all.
    - I have occasionally felt rejected, slighted, criticized or hurt by others.
    - I have often felt rejected, slighted, criticized or hurt by others, but these feelings have had only slight effects on my relationships or work.
    - I have often felt rejected, slighted, criticized or hurt by others and these feelings have impaired my relationships and work.

31. Leaden Paralysis/Physical Energy:
    - I have not experienced the physical sensation of feeling weighted down and without physical energy.
    - I have occasionally experienced periods of feeling physically weighted down and without physical energy, but without a negative effect on work, school, or activity level.
    - I feel physically weighted down (without physical energy) more than half the time.
    - I feel physically weighted down (without physical energy) most of the time, several hours per day, several days per week.

APPENDIX C

CLINICAL SIGNIFICANCE OF IDS SCORES BASED ON DSM-IV SYMPTOM CRITERIA FOR A MAJOR DEPRESSIVE DISORDER

Scores	*Severity of depression*
0-13	None
14-25	Mild
26-38	Moderate
39-48	Severe
49-84	Very severe

Taken from: http://www.ids-qids.org/index.html

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