PHYSIOLOGICAL RESPONSE TO A BREAKUP:

PREDICTED BY PRONOUN USE IN THE LABORATORY

By

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Abstract

Following stressful life events, the language people use to describe their experiences is associated with physiological stress responses. To date, however, research fails to distinguish between active vs. passive pronoun use in physiological responding. In this study, college students experiencing a recent romantic breakup (*N*= 126) between the ages of 18-26, completed a 4-minute Stream of Consciousness (SOC) recording discussing their separation experience. During this SOC task, measurements of heart rate (HR), systolic and diastolic blood pressure (SBP & DBP) were taken. This SOC transcript was split into four, single minute answers and run through the Linguistic Inquiry and Word Count (LIWC) program. This program determined percentages of pronoun use within each minute. These percentages were then compared to each person's physiological measurements over the four minutes. The use of the singular first-person passive pronoun, 'My', in a previous minute was predictive of a decrease in SBP in the subsequent minute. The use of the plural first-person active pronoun, 'We', in a previous minute predicted increases in DBP of the next minute. This study is the first of its kind and should be replicated to provide further evidence of an active/passive pronoun distinction in physiological responding when discussing a breakup.

Physiological Response to a Breakup: Predicted by Pronoun Use in the Laboratory

Stress is defined as, “a negative emotional experience accompanied by predictable biochemical, physiological, cognitive and behavioral changes that are directed either toward altering the stressful event or accommodating to its effects” (Taylor, 2012, p. 139). Stress, as explained by Delongis, Folkman, and Lazarus (1988), can be thought of as occurring in any situation wherein demands exceed one’s coping resources. Obvious stressors, like predation or other life threatening circumstances, activate certain stress response systems in the body in order to produce a response to the stressor. Chronic activation of these systems is associated with negative health outcomes across a range of bodily functions (Delongis et al., 1988). However, stress leading to negative health outcomes is not always caused by physical exertion. Psychological stressors, in particular those that occur in one’s social environment, can lead to the activation of some of the same stress physiological systems stimulated by stressors in the physical environment. Thus, chronic psychological stress can lead to the same prolonged elevations in heart rate (HR) and blood pressure (BP) produced by physical activity, all of which are linked to risk for cardiovascular disease (Delongis et al., 2008).

The cardiovascular toll of stress is well known, strengthening the notion that stress has important influences on health outcomes. In a laboratory setting, mental stressors are used as a controlled way to examine psychological effects on physical health. Studies have shown that within minutes of performing a mental stress test, participants demonstrate elevated levels of circulating catecholamines, corticoptropin, and cortisol (Brotman, Golden, & Wittstein, 2007). These lead to physiological manifestations of increased HR, BP, sympathetic nerve outflow, and blood viscosity (Brotman et al., 2007). Brotman et al. (2007) state "severe acute emotional stress can precipitate a specific type of myocardial dysfunction," and add that, "major life changes associated with psychological and emotional adjustment are associated with an increased risk of cardiac events" (p.1091). Previous studies show that chronic stress can lead to cardiovascular risk via acceleration of the atherosclerotic process (Brottman et al., 2007).

How people organize their thoughts about a stressful experience can be studied using the language people use to describe their experience; language use is thus an observable behavior that may be linked to physiological stress responses. Various studies show that putting traumatic events into a cohesive, personal narrative can be beneficial mentally and physically, as a therapeutic technique (Pennebaker, 1993). While there are several hypotheses for why this is, Pennebaker (1993) proposes a new theory based on the mind-body connection. Specifically, that writing improves physical health above and beyond being a therapeutic event; language use is directly linked to autonomic activity. That is why only certain narratives improve health; it is dependent on the specific words people use. This research suggests that language can be used as an indicator and predictor of physical health.

Computerized Autonomic Retrieval of Morphemes and Even Neologisms (CARMEN) was developed as a direct link between language use and autonomic paths. This program allowed for the observation of the link between specific text and autonomic activity. Its use revealed (Hughes, Uhlmann & Pennebaker, 1994) a direct mathematical link between specific linguistic measurements and autonomic activity. CARMEN data analysis showed that the body's linguistic expression occurs simultaneously with biological reaction. Although the studies done used Skin Conductance Level (SCL) and HR as physiological markers, it is possible to use other markers of health, as noted by Hughes et al. (1994).

With this connection of language to autonomic activity distinguished, the question arises: Can the words we use drive physiological responses to stress or, can particular words serve to dampen the effects of chronically activated stress response systems, more specifically which words elicit what physical response?

Pennebaker, Mehl, and Niederhoffer (2002) suggested that future research should focus on what types of language precedes what type of physical response. They find that pronouns in general intensely correlate with physical health. They therefore opine that future research should explore in-depth, pronoun use. They use William James' (1890) argument that there are differences in active first-person pronouns and passive first-person pronouns such that not all first-person singular pronouns are the same or result in the same outcomes (Pennebaker et al., 2002).

There is some evidence to suggest that the use of pronouns can predict health outcomes in the literature. The distinction between singular and passive first-pronouns has been studied, albeit separately, in association with health. Scherwitz et al. (1988) demonstrated that a self-involved person, indicated by first-person singular pronoun use (’I’ & ‘Me’), had correlations with increased systolic and diastolic blood pressure (SBP & DBP). On the other hand, in intact romantic relationships, people experienced better health outcomes when using ‘We talk’ vs. singular pronouns (Rohrbaugh, Mehl, Shoham, Reilly, & Ewy, 2008). Researchers investigated the use of singular first-person pronouns vs. plural first-person pronouns in couples where one suffered from heart failure, and showed language use could help or hinder health problems. They also looked more closely at the active vs. passive distinction, deriving categories of active vs. passive pronouns. The active category included ‘I’ and ‘We’ and the passive category included ‘Me’, ‘My’ and ‘Us’. Authors found that only ‘We-talk’ by the spouse of the patient predicted better health outcomes of the patient, independent of the patient's pronoun use. They also showed that spousal usage of active first-person plural pronouns predicted positive symptom change more than passive first-person plural pronouns. ‘We talk’ was used as a "communal coping construct" (Rohrbaugh et al., 2008). While these studies investigate the ‘We’ vs. ‘I’ along with the active vs. passive first-person pronoun distinction, the only significant findings were based on ‘We-talk’ vs. ‘I’ use and say nothing of the active vs. passive pronoun use. Additionally, in the context of a recently ended relationship, there is the possibility that people who use more ‘We talk’ in their reflections, will experience worse outcomes in physiological measurements because they are no longer in a relationship and are discussing it in a way that suggests they are not adjusting well to the relationship’s end. The use of ‘We-talk’ suggests that they are still discussing the break up as if they are in a relationship (Pennebaker, 2011).

The dissolution of a romantic relationship is a relatively common stressor, and, although most people adjust well, there is a small percent that do not. Poor adjustment to a breakup increases the risk for negative health implications due to a heightened physiological stress response (Sbarra, Smith, & Mehl 2012). The question arises, what distinguishes the well adjusted from those adjusting poorly? Sbarra, Putz, Law and Lee (2008) suggest that people’s specific language use when “representing their psychological state” (p. 4) could be a marker for their adjustment process. This is because Pennebaker et al. have shown that language use is an individual variable and representative of people’s psychological states (Sbarra et al., 2008).

Some research has investigated the dichotomy between active and passive pronoun use and health in a sample of suicide notes (Roubidoux, 2012**).** A linguistic study on suicide notes hypothesized that people "with a genuine intent to commit suicide would use more first person active pronouns (‘I’, ‘We’) than first person passive pronouns (‘Me’, ‘Us’), more singular pronouns (‘I’, ‘Me’) than plural pronouns (‘We’, ‘Us’)” . . .among others (Roubidoux 2012). The hypothesis was based on findings by Powell and Yu, which showed that active pronouns demonstrate power and agency as compared to passive pronouns. This connection between active language and actual action was confirmed by suicide note-writers commitment to the actions they detailed in their notes. Roubidoux (2012) found that, people who used more ‘I’ and ‘We’ were more likely to follow through with their suicidal intent than those who used the passive forms (‘Me’, ‘Us’). Under the circumstances of an ending relationship, users of active words may fare better because they become the actors and are in power of the dissolution of the relationship and do not see themselves as the victim.

Additional support for the active vs. passive categories comes from a study by Hughes, Uhlmann, and Pennebaker (1994) showing that "decreases in SCL were most likely to occur among subjects when they used active voice, past tense, facts, and self-references" (p. 579).

Physiology

The cardiovascular system of the body is the targeted system during a stress response. It plays key role in to transmitting nutrients and removing waste in the body. The complete system is comprised of the heart, the blood vessels, and blood. The heart is the pump of the body; this pumping action is what creates blood flow throughout the body. The blood vessels are comprised of arteries, vessels, and capillaries. The arteries carry oxygenated blood away from the heart and to organs/tissues, the vessels carry deoxygenated blood back to the heart, and capillaries are innervated to allow the exchange of nutrients between the vessels and tissues. Blood is the medium that passes through the body carrying nutrients to tissues, and waste out of tissues.

The autonomic nervous system is the system in work during a response to stress. This system connects the central nervous system to all the organs, and is involuntarily controlled. It is regulated by the sympathetic and parasympathetic system branches. The sympathetic system is used to respond to stress, while the parasympathetic works to return the body to normal after a bout of stress. Once the nervous system is stimulated by a stressful event, the endocrine system is signaled to elicit a physical response. The endocrine system is comprised of glands that secrete hormones into the blood. The pituitary gland is the main regulator for the endocrine system. Once signaled, the pituitary gland secretes hormones to signal the adrenal glands. The adrenal glands synthesize and release catecholamines and glucocorticoids in response to stress, which cause physiological changes within the body as protection mechanisms (Porterfield, 2001).

Stress Response

When an event is perceived as stressful the body responds through one of two pathways. The rapid response is known as the sympathoadrenal pathway. When stress becomes long-term the body enacts the Hypothalamic-Pituitary-Adrenal System (HPA axis) (Porterfield, 2001). These stress pathways are connected through a positive feedback mechanism. Therefore, activation of one system leads to the activation of the other (Porterfield, 2001).

The purpose of the sympathoadrenal system is to rapidly increase delivery of oxygen and energy sources to the necessary tissues for mobilization, hence the colloquial term "flight or fight" response (Porterfield 2001). In this system, pre-ganglionic cholinergic nerves within the hypothalamus send a signal, via the neurotransmitter acetylcholine, to the post-ganglionic chromaffin (neurosecretory) cells of the adrenal medulla. This signals the cells to start synthesis of catecholamines. About 85% produced is epinephrine, with norepinephrine comprising only 15%. This pathway is primarily activated as an immediate response to psychological stress (Porterfield, 2001).

Once catecholamines are synthesized and signaled for use, they are released into the blood stream. To elicit any response in the body they must bind to specific receptors, which determine the function of the catecholamine. There are four receptor types: alpha 1, alpha 2, beta 1, and beta 2. Alpha-receptors are mostly mediated by norepinephrine released by SNS nerve endings. Activation via these receptors causes constrictive and excitatory responses. Specifically, activation of these receptors leads to vasoconstriction of non-essential tissues and therefore increases peripheral resistance. Beta-receptors are mostly mediated by epinephrine released from the adrenal medulla. Activation via these receptors causes dilatory and relaxation responses (Porterfield, 2001).

After the initial response to stress, if stress is still perceived, the HPA maintains a person's physiological response. Arginine-vasopressin neurons are signaled in the paraventricular nucleus of the hypothalamus, and they release corticotropin-releasing hormone (CRH). This travels to the anterior pituitary, where it triggers the release of adrenocorticotropic hormone (ACTH). This hormone signals the adrenal cortex to release glucocorticoids. Glucocorticoids mainly modify immune responses, in either inhibitory or activational methods. However, one specific glucocorticoid synthesized is cortisol. Cortisol increases the expression of Phenylethanolamine N-Methyl Transferase (PNMT). This enzyme is responsible for converting norepinephrine to epinephrine (Porterfield, 2001).

Effects of Stress

The body is constantly in a state of fluctuation, it operates in a specific range of ups and downs. This range as well as the body's ability to fluctuate its vital function is defined as allostasis (McEwen & Stellar, 1993). It is when the body is forced beyond this range that health is compromised. When the body is strained by frequent and extreme physiologic changes/activity, a person will become predisposed to disease. The term used to define this continued accumulation of stressors and response is allostatic load (McEwen & Stellar, 1993). When stress becomes chronic, or an extreme level reached, a person will enter this state and that is when the physiologic changes occur in response to the stress. Chronic is defined as something that is persistent or long lasting (Porterfield, 2001). This chronic stress can lead to a long-term response in the body. The short-term responses now become the baseline levels for the body. These permanent changes can cause serious physical damage and health issues leading to disease (McEwen & Stellar, 1993).

Heart rate (HR). The heart contracts and relaxes as a way to pump blood throughout the body. The period of contraction is called systole and period of relaxation is called diastole. The range for a normal HR varies based on gender, age, activity, etc. but is averaged between 60-100 beats/min (Porterfield, 2001). During these stressful events the catecholamines released cause an increase in HR. A chronic increase in HR can lead to hypertension, hypercholesterolemia, and hyperglycemia. One study found death rates to be increasing with an increase in levels of HR. (Seccareccia et al., 2001) HR has been found as an independent predictor of fatalities, not just an indication of pre-existing conditions.

In a study by Seccareccia et al. (2001), an evaluation of the association of resting HR to cardiovascular mortality was conducted. The study showed that men with HR > 90 beats/min, relative to men with normal HR <60 beats/min, were at an increased risk of cardiovascular mortality. The hazard ratio for this group was 2.54. It showed that there was a direct, increasing association between HR and cardiovascular mortality when moving from lowest to the highest HR levels. The study adds evidence to the agreement that HR is associated to cardiovascular disease, by showing a correlation of increased HR to increased cardiovascular mortality (Seccareccia et al., 2001).

Seccareccia et al. (2001) notes that HR is a marker of nervous system states that cause an increase in cardiovascular mortality. This is due to induction of atherosclerosis and rhythm disturbances. This increased HR evidences a chronic prevalence of sympathetic activation over parasympathetic. This stimulation can lead to hypertension, hypercholesterolemia and hyperglycemia. Tachycardia (increased HR) increases work of the heart, and can increase force of vessels. The increased force exerted in these vessels leads to an increase in arterial stiffness and can lead to atherosclerosis as well (Seccareccia et al., 2001).

Blood pressure (BP). The pumping of the heart and therefore pushing of the blood through the vessels causes BP. By definition, BP is the force that blood exerts against the vessel walls (Porterfield, 2001). The force exerted is greatest during systole and the lowest during diastole. These are referred to as SBP and DBP. The ratio for mean arterial pressure is SBP/DBP and the average healthy BP is 120/80 (Porterfield, 2001).

During a stressful event the catecholamines released cause an increase in BP. This increase, when experienced chronically, can result in negative health outcomes. According to the World health Organization and the International society of Hypertension, the high-normal range of BP is categorized as an SBP 130-139 mmHg and DBP 80-89 mmHg. (Vasan et al., 2001)

In a study conducted by Vasan et al. (2001), they showed a correlation of baseline-elevated BP to cardiovascular risk. They recorded baseline readings of individual's BP and grouped them into 1 of 3 categories. The study showed that the rate of cardiovascular events increased sequentially among the 3 categories of BP: optimal, normal, and high to normal. People with optimal BP, < 120/80 mmHg, had lowest incidences of cardiovascular events. People with normal BP, 120-129 SBP and DBP < 80 mmHg, had median number of cardiovascular events. People in the high-normal range, SBP 130-139 and DBP 85-89, evidenced the highest rates of cardiovascular events. (BP > 139-89 are considered hypertensive and are already experiencing cardiovascular disease due to increased BP, and as a result were not included in this study). Risk factor hazard ratios of cardiovascular disease were conducted for the high-normal range and the normal range of BP as compared to optimal BP. High-normal BP had a ratio of 2.5 in women, and 1.6 in men. Normal BP had a ratio of 1.5 in women, and 1.3 in men. This study not only presented evidence of the link between cardiovascular risk and high BP, but determined rates of risk and calculated incidences of all cardiovascular events, not just fatalities (Vasan et al., 2001).

Thus, high BP, even a little outside normal, can lead to cardiovascular risk. These risks include: death, myocardial infarction, stroke, and congestive heart failure. If BP becomes too high, >139/89, it is categorized as hypertensive and can lead to permanent and fatal changes to the heart and body (Vasan et al., 2001)

The Present Study

The current study seeks to provide further clarification regarding the link between language use and physiological outcomes. We use a commonly employed software program, LIWC (Pennebaker, Francis, & Booth, 2007), for examining language use and its association with psychological and physiological outcomes. LIWC works by counting specific words, determined by a set dictionary, within a typed text. It then presents various percentages of word usage within the whole text, as a function of total word count. This can then be used to compare against other covariates assessed in the study to determine if specific language use categories predict outcomes of interest over-and-above other variables (Pennebaker et al., 2007).

In order to assess language use in response to a stress, this study investigates students who had recently broken up with a romantic partner, asking them to reflect on and speak about their breakup experiences in a laboratory setting. During their oral reflections, physiological data was collected on a minute-by-minute basis. The physiological measurements used are HR, SBP, and DBP. In order to examine the potential associations between language and physiological reactions to the stress of re-experiencing their breakup, we evaluated participants' language use and physiology in a lagged multilevel growth model. Thus, language use in the first minute was used to predict the physiological measurements in the next minute accounting for physiology in the concurrent minute. We hypothesized that specific words, namely first-person pronouns ('I', 'Me', 'My', 'We', 'Us', 'Our') in active ('I', 'We') vs. passive ('Me/My', 'Us/Our') categories, would predict the subsequent HR and BP observed. Given previous research findings regarding passive pronouns in intact romantic relationships, active pronoun use in predicting agency and control in suicide notes, as well active words predicting decreases in skin conductance level, we expected that the active first-person pronoun, 'I', would result in decreased physiological responding, exhibited as decreases in HR and BP. In comparison, we expected passive first-person pronouns, 'Me' and 'My', along with the use of 'we-talk' to result in increased physiological responding, exhibited as increases in BP and HR.

Methods

Participants

The participants for this study were recruited at the University of Arizona through flyers, ads in the Daily Wildcat, and through community outreach (newspaper, MySpace, Facebook). For this study, there were 126 participants (men = 27). The average age of the participants was 19.44 (*SD* = 1.55 years). The average length of relationship for the participants was 21.28 months (*SD* = 13.72 months). The average length since the breakup was 3.54 months (*SD* = 2.65 months). Participants were paid for participation, and participants missing any data from the four minutes of their visit (physiological measurement records, or SOC transcripts/recordings) were excluded from the study.

Those eligible fulfilled specific criteria: They had to be between 18-28 years old, have experienced a romantic breakup (in a relationship longer than four months) within six months and have been experiencing moderate distress or severe distress. Participants had to be in good health, normotensive, and have no history of medical conditions (diabetes, cardiovascular dysfunction). Those who were pregnant as well as those who had plans to conceive were excluded. People who reported any history of psychotic disorders or symptoms, as well as substance abuse/dependence were excluded.

Those chosen were asked to not ingest anti-inflammatory, antihistamines, or alcohol the 24 hours before testing, and, to refrain from caffeine and tobacco for 6 hours prior to testing. They had to report all medications they were taking to the tester and provide consent for a review of their medical history. No participants were accepted that had any “current active suicidal potential necessitating immediate attention”.

Procedures and Measures

For the study, the participants attended 4 visits, each separated by three weeks. However, the current study used data solely from the initial visit.

This initial visit was approximately 2 hours long. Participants filled out questionnaires first. After doing so, they were equipped with the physiological measurement devices recording HR, SBP, and DBP. A period of resting baseline data was collected while participants watched a relaxing nature video. Participants were then instructed to perform the Mood Induction Paradigm (MIP) and immediately after to answer a series of questions in Stream of Consciousness (SOC) interview task. Their physiological measurements were recorded through the entire SOC task. After the SOC the participants completed a cognitive processing task, which is not part of the current study. The SOC narratives from this first visit were then transcribed and split into minute-by-minute categories, for four total transcriptions. These transcriptions were then run through LIWC (described in detail below) and analyzed against a pronoun word dictionary. This created word counts and percentages of pronoun use within each minute of the SOC task.

Psychological Tasks

Mood induction paradigm (MIP). The MIP was conducted directly before the Stream of Consciousness task. In this task, the participants were asked to picture distinct mental images of their ex-partner. The examiner told them that we were gathering an understanding of their thoughts and feelings about their experience with the breakup. The directions were as follows: close your eyes and for 30-seconds develop an image of your ex-partner. They were told to be careful in creating a detailed image of them doing something either alone or together. They were instructed that it was most important to create a detailed image of the person. The RA then left the room allowing a 30-second reflection period to picture this image.

Stream of consciousness task (SOC). After the 30-seconds were done, participants completed SOC task. During this task the participant was asked to answer 4 questions regarding their breakup experience, and to speak continuously for 4 minutes on the subject. During the task they were video and audio recorded, as well as their physiological signals measured. Each question was presented for 1 minute, with four questions total. The participants were told that the questions were about their recent breakup experience, and they were free to speak about the prior question even when a new one appeared, or to stop and talk about the new question shown. They were told they were free to speak about anything with only two rules. The rules were: 1. To speak continuously for the entire time (4 minutes), just to remain on the topic of the breakup/relationship; and, 2. Every response should stay on the topic of the relationship and the separation in some way. See Appendix A for the specific questions of the SOC.

After the SOC was conducted the RA returned to the room to collect the recorder and the participants were asked to answer questions about the SOC and MIP tasks to determine their external validity**.** During the SOC, physiological measurements of BP and HR were recorded.

Physiological Measures

Heart Rate Assessment. HR was assessed using an electrocardiograph (ECG). This measures the electrical activity of the heart using sensors placed on the body. The three sensors were placed at the inside of the right forearm, the lower left leg, and inside the left forearm. Participants were then asked to sit gently and keep their arms as still as possible during the tests. They must resist moving around in order to ensure the collection of accurate data. The graph produced by the ECG can then be used to determine the HR of the participant. The ECG data was scored on a minute-to-minute basis across the entire 4-minute SOC task.

Blood Pressure Assessment. BP measurements were recorded using a non-invasive tonometry device. This device works by recording the various pressures of the artery during determined time intervals. The device works by detecting the compression and decompression of the radial artery on the wrist. It then displays arterial pressure every 12 to 15 beats (Lee, Sbarra, Mason, Law, 2011). This device recorded information on the SBP and DBP, as well as the mean arterial pressure for every minute within the 4 minute SOC task of the first visit. The device was placed over the participant's non-dominant hand, over the radial artery located in the wrist. The arm was placed on a table and told to keep still throughout the study. Mean values of SBP and DBP were calculated for every minute of response. Every minute of data includes the time the participant spent talking, as well as reading the question. (During analysis we found a problem in the physiology data for the participants. The BP measurements were too high due to a calibration error for the machine. We adjusted all the BP measurements -9.5 mmHg to all cases. Participants were then eliminated if they were ± 3 S.D. from the mean. This corrected the problem and removed anyone with BP ratings outside the average range.)

The mean SBP of the participants 138.59 mmHg, with a minimum of 90.38 mmHg, and a maximum of 183.74mmHg (*SD* = 16.02 mmHg). The mean DBP was 77.71 mmHg, with a minimum of 43.87 mmHg, and a maximum of 115.51 mmHg (*SD*= 12.72 mmHg). The mean HR of the participants was 82.10 bpm, with a minimum of 53.33 bpm and a maximum of 121.36 bpm (*SD*= 11.07 bpm).

Language Quantification Software

Linguistic Inquiry and Word Count (LIWC). LIWC was the software program used to determine percentages of pronoun usage within each 1-minute transcript from the SOC task, with a total of 4 transcripts per participant (each of which corresponds to a minute of the SOC task). LIWC works by using an internal dictionary to determine what words to count in the file. It then gives percentages of words used across the dictionary categories. The typed and split transcripts of each individual minute, among the 4 minute SOC transcript, were submitted to LIWC analysis to determine the word counts and percentages of pronoun use within each minute (of 4 minutes) of every participants SOC task.

The LIWC sub-dictionary we used involved word categories specifically of pronouns. The word categories included in this dictionary were ‘I’, ‘Me’, ‘My’, and ‘We’. Specific ratios were also created between these categories for analysis. The ratios we created were Active:Passive, Passive:Active. This meant taking the total active usage and putting it over the total of active and passive combined and vice versa (I/I+Me and Me/I+Me). We repeated this, but with my replacing me. And then again repeated this with adding my to the denominator of the first ratios and adding a my variable numerator (my/I+Me+My etc.) See Appendix B for specific dictionary and ratios.

Results

We conducted Mixed Regression analysis using SPSS MIXED (SPSS System Version 20.0) predicting each of the three physiological outcomes on a minute-to-minute basis across the SOC task; thus, we were modeling the within person trajectory of each physiological outcome across the task. We first analyzed unconditional means models to determine the functional form of each physiological indicator separately (HR, SBP and DBP) before entering pronoun use and subsequently lagged pronoun use into our models. These lagged models were used to examine whether pronoun used from a previous minute was associated with physiological responding in the subsequent minute.

Heart Rate. Our HR model included several significant covariates; sex (p = .03), time (p <.001), and quadratic time (p< .001), however we found no significant associations between HR and any LIWC pronoun use, lagged or otherwise

Systolic Blood Pressure. Within our SBP model we checked for the same significant covariates, but found that only sex was a significant predictor (p < .01). Quadratic time was also a significant predictor (p < .01). Within the LIWC categories, we found a significant correlation with the singular first-person active pronoun 'I' and SBP (b=0.25 mmHg, SE=.0.11, p=.03), but not for the lagged effects of 'I' and so the use of 'I' , while positively correlated, was not a predictor of SBP over the four minutes.

We also found the lagged first-person passive pronoun 'My' was significantly associated with SBP after controlling for the use of concurrent 'My'. (b=-1.56 mmHg, SE=0.72, p=.03). The negative correlation shows that, the use of 'My' in the previous minute's transcript was predictive of lower SBP in the following minute. Figure 1 shows the effects of 'My' usage, in a lagged model, on SBP for males vs. females.

Diastolic Blood Pressure. In analyzing DBP we found sex to be the only significant covariate (*p* = .02), however, we did find a significant predictor within the LIWC word categories. Lagged use of the first-person plural active pronoun 'We' was significantly associated with DBP after controlling for the use of concurrent 'we'. (*b* = 0.54 mmHg, *SE* = 0.23, *p* = .02). This positive correlation shows that, the use of 'We' in the previous minute's transcript was predictive of increases in DBP in the following minute. Figure 2 shows the effects of 'We' usage, in a lagged model, on DBP for males vs. females.

Discussion

Romantic breakups are psychologically stressful events and considerable evidence suggests that psychological stress is associated with physiological reactivity. Studies show that in cases of psychological stress, language use may be an important behavioral expression of one's psychological states and associated with health-relevant physiological changes, largely as a function of link between language use and autonomic activity (Pennebaker 1993). Specifically, pronouns have a distinct link to this physiological response, and in this study we deconstructed active vs. passive pronoun use (Pennebaker et al., 2002) to determine if specific language would demonstrate predictive utility for understanding young adults' cardiovascular responses when they reflected over and discussed a recent breakup experience.

Based on the existing literature, we hypothesized that the use of the active singular first-person pronoun 'I' would lead to better physiological outcomes compared to the use of the passive singular first-person pronouns 'Me', and 'My'. We speculated that the active pronoun would reflect a sense of empowerment over the breakup, whereas the use of passive forms would reflect a sense of victimization and therefore worse adjustment to the breakup as indexed by greater physiological reactivity during the SOC tasks. We also looked at the plural first-person pronoun of ‘We’, hypothesizing that any use of ‘We’ would reflect a person’s sense of still being actively involved with their ex-partner and thus be associated with greater physiological activation when discussing the separation (which, presumably, reflects a greater physiological stress response).

The results showed that use of the active singular first-person pronoun ‘I’, was associated with a within-occasion increase in SBP, but no effect was seen in a lagged model for a connection of language use driving physiological responding. Thus, use of ‘I’ within the minute was associated with an increase in SBP for that same minute. (b=0.25 mmHg, SE=0.11, p=.03). The study also concluded that when a person used the passive singular first-person pronoun ‘My’, this was predictive of an increase SBP in a lagged model. Thus, the use of ‘my’ in the previous minute was associated with a decrease in a person’s SBP within the subsequent minute (b=-1.56 mmHg, SE=0.72, p=.03). Finally, our study showed that when a person used ‘We’ when discussing their breakup in the preceding minute, this positively predicted an increase in their DBP in the subsequent minute (b = 0.54 mmHg, SE = 0.23, p = .02).

Our results contradicted our initial hypothesis regarding pronoun use; with the active pronoun ‘I’ was associated with an increase SBP but the passive pronoun ‘My’ was associated with a decrease in SBP. The effects seen with the use of ‘I’ are consistent with literature demonstrating that “verbal immediacy” is associated with hyperactive attachment anxiety after a breakup. In a paper by Lee et al. (2011), people who were divorced and reported greater attachment anxiety and were also high in verbal immediacy experienced a greater initial BP at the start of the laboratory testing. In this study attachment style was not accounted for, and therefore it could be due to high anxiety over the relationship with the use of ‘I’ causing an increase in SBP, instead of a feeling of empowerment and a decrease in SBP. However, verbal immediacy includes all first-person pronouns, and this would not explain and in fact contradict the finding of ‘My’ in our study.

Very little research has been conducted on this distinction of active and passive pronoun use and for this reason it is difficult to pinpoint a reason for why our results evidenced the opposite effects of our hypothesis. One theory is that active pronouns would increase physiological responding because they are active. This means the body is aroused and aware of the situation, , and this is associated with the general arousal of emotion not its valence. With a passive pronoun the body could take on a passive response, not largely aware of the situation. In other words, these pronoun choices could reflect the person’s attitude on the event, i.e. the breakup. The use of active pronouns could thus denote an active attitude toward the breakup and therefore poor psychological adjustment leading to a heightened physiological stress response. The use of the passive pronouns could reflect a passive attitude on the event and therefore a decrease in the body’s physiological stress response when talking about the event.

This negative effect of ‘We talk’ on a person’s health when discussing a breakup is consistent with other findings in the *psychological* literature. Although, use of ‘We talk’ within a relationship can be beneficial to a person’s health (Rohrbaugh et al., 2008), we can view this same language as reflecting continued, ongoing attachment following a breakup. In this study conducted by Rohrbaugh et al. (2008) they state that use of first-person plural pronouns within “couple communication” (p. 781) is evidence for “relational commitment, shared identity . . .” (p. 781). However, after a breakup this feeling of being one unit as compared to two separate people would, I predict, be negatively associated with adjustment, hyperactivation, and an anxious attachment style. Studies show that attachment styles are associated to adjustment to a divorce, which may or may not extend to a breakup. One attachment style, attachment anxiety, is associated with hyperactivating tactics by the individual. Hyperactivating is characterized by an effort to still feel attached to your significant other after a breakup and to reunite (Lee et al., 2011). These hyperactivating strategies have a distinct connection to an increase in physiological response during stressful tasks (Feeney & Kirkpatrick, 1996). The use of ‘We talk’ of participants, after a breakup, would be an indicator of a hyperactivating strategy and therefore result in a heightened physiological response during the stressful SOC task.

One final point about this finding on ‘We’ was that the lagged use of ‘We’ was only significant in predicting an increase in DBP, independent of SBP. Normally changes to BP either occur concurrently or with an isolated affect on SBP and normal DBP. Studies show that psychological stress can increase lipoprotein levels in the blood, primarily Low Density Lipoprotein (LDL; O’Donnell et al., 1987). LDL is responsible for cholesterol levels in the blood, as a transport vesicle. Therefore, higher LDL levels would increase serum cholesterol in the body. There are two mechanisms proposed by O’Donnell et al. (1987) for the association of stress and lipoprotein levels. The first mechanism was that “catecholamines affected the rate limiting step of hepatic cholesterol metabolism” (p. 341). The second was that catecholamines may change the activity of LDL receptors. Neither are confirmed as definitive mechanisms for this association seen (O’Donnell et al. 1987).

A study conducted by Brett, Ritter, and Chowienczyk (2000) showed a correlation between increased cholesterol and an isolated rise in DBP. They found that during exercise, a physical stressor, any change in DBP was related to rising serum cholesterol levels. DBP is created from cardiac output multiplied by vascular resistance. Therefore an isolated increase in

DBP would be due to an increase in cardiac output or decrease in vasodilation. One theory for the association of hypercholesterolemia to isolated increases in DBP is that the excess serum cholesterol causes an impaired reaction to vasodilators in circulation (Brett et al., 2000). This would cause an increase in vascular resistance by reducing dilation and as a result increase DBP independent of SBP.

Limitations

The results of this study are to be interpreted in light of several limitations, the first of which is the low frequencies of the pronouns within each minute transcript of the SOC task. We examined the frequencies of ‘We’ and ‘I’ within each minute transcript as well as over all the four minutes of SOC. The mean value of ‘I’ use over the four minutes was only 6.58% (such that of all the words contained in the transcript, ‘I’ comprised only 6.58% of them), while ‘We’ was 2.23%. Using ‘We’ as an indication, we also looked at variability on a minute-to-minute basis. Although, the data showed variance between minutes, the low frequencies prohibited any effects based on variability.

No significant differences were found with the main pronouns word categories of ‘I’ and ‘Me’ alone. Thus, we created various word ratios among the LIWC dictionary words. This was done in an attempt to see if any effects were seen with comparisons. However, none of these ratios were significant predictors of the physiological responses. We also flipped our output and input to determine whether physiological reactions could predict word choice within the SOC. Again, no results showed significance in physiology predicting language use.

Although these findings are statistically significant, clinically there is little to be concerned about regarding these college students’ physiology following their breakup. Any effects on BP, predicted by pronoun use, were minimal. The changes to DBP in a subsequent minute, due to the us of 'We' in the previous minute, were very small (b=0.54 mmHg) considering it takes a 9 mmHg raise on the BP scale to jump to an unhealthy range. Figure 2 shows that BP from no 'We talk' as compared to the most frequent 'We talk' (of the sample) only caused a 1 mmHg raise in BP, out of the 9 mmHg needed to be considered in an unhealthy range. The effect on SBP associated with the use of 'My' is more clinically relevant (b=-1.56), because the range from healthy to unhealthy in BP is separated by only 9 mmHg. However, the effects of 'My' are positive by decreasing BP and therefore it is still not clinically relevant as a health risk.

Conclusion and Future Research

Despite the limitations, this is the first study of its kind to explore differences in the use of active and passive pronouns in response to psychologically taxing events, as well as identifying the changes produced by language use at such a minute level of detail. The minute-by-minute examination of language and physiology may be a method worth perpetuating in the presence of a high enough pronoun usage to achieve significance.

These findings on pronoun use and health implications are important within the realm of psychology. Literature suggests that forming a narrative about the event causing psychological stress can be beneficial to adjustment and subsequent health following this trauma. However, this study provides evidence that narrative alone cannot be trusted as therapeutic, and further research must be done to show what type of language is beneficial compared to some language use that could prove detrimental to therapy, adjustment and health.

Therefore, future research should attempt to replicate these findings by (a) increasing frequency of pronoun use within each SOC task in order to see a more pronounced effect and (b) over longer time periods (1-month, 2-month, 3-month etc.) to see how the active vs. passive dichotomy relates, on a larger scale, to adjustment to the breakup and subsequent physical health in physiological responding.

References

Axelrod, J., & Reisine, T. (1984). Stress Hormones: Their Interaction And Regulation. *Science*, *224*(4648), 452-459.

Brett, S. E., Ritter, J. M., & Chowienczyk, P. J. (2000). Diastolic Blood Pressure Changes During Exercise Positively Correlate With Serum Cholesterol and Insulin Resistance. *Circulation*, *101*(6), 611-615.

Brotman, D. J., Golden, S. H., & Wittstein, I. S. (2007). The Cardiovascular Toll Of Stress. *The Lancet*, *370*(9592), 1089-1100.

Delongis, A., Folkman, S., & Lazarus, R. S. (1988). The impact of daily stress on health and mood: Psychological and social resources as mediators.. *Journal of Personality and Social Psychology*, *54*(3), 486-495.

Hughes, C. F., Uhlmann, C., & Pennebaker, J. W. (1994). The Body's Response to Processing Emotional Trauma: Linking Verbal Text with Autonomic Activity. *Journal of Personality*, *62*(4), 565-585.

Lee, L. A., Sbarra, D. A., Mason, A. E., & Law, R. W. (2011). Attachment anxiety, verbal immediacy, and blood pressure: Results from a laboratory analog study following marital separation. *Personal Relationships*, *18*(2), 285-301.

Mcewen, B. S., & Stellar, E. (1993). Stress and the Individual: Mechanisms Leading to Disease. *Archives of Internal Medicine*, *153*(18), 2093-2101.

O'connor, T. (2000). The stress response and the hypothalamic-pituitary-adrenal axis: from molecule to melancholia. *QJM*, *93*(6), 323-333.

O’Donnell L., O’Meara N., Owens D., Johnson A., Collins P., and Tomkin G. (1987). Plasma Catecholamines and Lipoproteins in Chronic Psychological Stress. *Journal of the Royal Society of Medicine*, 80, 339-342.

Pennebaker, J. W. (1993). Putting Stress Into Words: Health, Linguistic, And Therapeutic Implications. *Behaviour Research and Therapy*, *31*(6), 539-548.

Pennebaker, J. W. (2011). *The secret life of pronouns: what our words say about us*. New York: Bloomsbury Press.

Pennebaker, J. W., Francis, M. E., & Booth, R. J. (2001). *Linguistic Inquiry and Word Count (LIWC): A computer-based text analysis program*. Mahwah, NJ: Erlbaum.

Pennebaker, J. W., & Seagal, J. D. (1999). Forming A Story: The Health Benefits Of Narrative. *Journal of Clinical Psychology*, *55*(10), 1243-1254.

Pennebaker, J. W., Mehl, M. R., & Niederhoffer, K. G. (2003). Psychological Aspects Of Natural Language Use: Our Words, Our Selves. *Annual Review of Psychology, 54*(1), 547-577.

Porterfield, S. P. (2001). *Endocrine physiology* (2nd ed.). St. Louis, Mo.: Mosby.

Rohrbaugh, M. J., Mehl, M. R., Shoham, V., Reilly, E. S., & Ewy, G. A. (2008). Prognostic significance of spouse we talk in couples coping with heart failure.. *Journal of Consulting and Clinical Psychology*, *76*(5), 781-789.

Roubidoux S. M. (2012). *Linguistic Manifestations of Power in Suicide Notes: An Investigation of Personal Pronouns* (Unpublished Masters Thesis). The University of Wisconsin Oshkosh, Oshkosh, WI.

Scherwitz, L., & Canick, J. (1988). Self-reference and coronary heart disease risk. In K. Houston & C. R. Snyder (Eds.), *Type A behavior pattern: Research, theory, and intervention* (pp. 146–167). New York: Wiley.

Sbarra, D. A., Putz J. W., Law R. W., & Lee L. A. (2008). *It's All About Me: Attachment, Language, and Cardiovascular Reactivity Following Romantic Relationship Dissolution.* Unpublished Manuscript, Department of Psychology, University of Arizona, Tucson, Arizona.

Sbarra, D. A., Smith, H. L., & Mehl, M. R. (2012). When Leaving Your Ex, Love Yourself: Observational Ratings of Self-Compassion Predict the Course of Emotional Recovery Following Marital Separation. *Psychological Science*, *23*(3), 261-269.

Seccareccia, F., Pannozzo, F., Dima, F., Minoprio, A., Menditto, A., Noce, C. L., et al. (2001). Heart Rate as a Predictor of Mortality: The MATISS Project. *American Journal of Public Health*, *91*(8), 1258-1263.

Taylor, S. E. (2012). *Health psychology* (8th ed.). New York: McGraw-Hill.

Vasan, R. S., Larson, M. G., Leip, E. P., Evans, J. C., O'Donnell, C. J., Kannel, W. B., et al. (2001). Impact Of High-Normal Blood Pressure On The Risk Of Cardiovascular Disease. *New England Journal of Medicine*, *345*(18), 1291-1297.

Table 1. Unstandardized Regression Coefficients from Concurrent and Lagged Models Predicting Systolic Blood Pressure from Various Pronouns Used

	b	***SE***	***p***		***b***	***SE***	***p***
Model 1:				**Model 2:**			
Intercept	143.47	2.10	<0.001	Intercept	143.82	2.55	<0.001
Sex	-6.85	2.35	<0.01	Sex	-5.43	2.69	0.05
Time	/	/	/	Time	/	/	/
Time^2	-0.52	0.16	<0.01	Time^2	-0.4	0.29	0.17
Me	0.10	0.25	0.7	Me_Lagged	0.25	0.53	0.64
Model 3:				**Model 4:**			
Intercept	143.77	2.09	<0.001	Intercept	146.53	2.42	<0.001
Sex	-6.77	2.34	<0.01	Sex	-4.77	2.66	0.07
Time	/	/	/	Time	/	/	/
Time^2	-0.53	0.16	<0.01	Time^2	-0.37	0.30	0.21
My	-0.41	0.31	0.19	My_Lagged	-1.56	0.72	0.03
Model 5:				**Model 6:**			
Intercept	142.48	2.15	<0.001	Intercept	144.02	2.35	<0.001
Sex	-6.92	2.35	<0.01	Sex	-6.06	2.20	<0.01
Time	/	/	/	Time	/	/	/
Time^2	-0.58	0.16	<0.001	Time^2	-0.17	0.14	0.23
I	0.25	0.11	0.03	I_Lagged	0.956	1.87	0.96
Model 7:				**Model 8:**			
Intercept	144.04	2.11	<0.001	Intercept	144.55	2.57	<0.001
Sex	-6.77	2.35	<0.01	Sex	-5.31	2.70	0.05
Time	/	/	/	Time	/	/	/
Time^2	-0.53	0.16	<0.01	Time^2	-0.42	0.31	0.17
We	-0.22	0.13	0.10	We_Lagged	0.06	0.28	0.82

Note. Unstandardized beta weights, standard errors, and significance values ($p<.05$ as significant) for concurrent and lagged models of all pronouns analyzed predicting Systolic Blood Pressure (SBP), accounting for sex and quadratic time (time^2) (/ = no significant effect on SBP) Model 1 = Concurrent 'Me' use predicting SBP; Model 2 = Lagged 'Me' use predicting SBP, accounting for concurrent 'Me' use; Model 3 = Concurrent 'My' use predicting SBP; Model 4 = Lagged 'My' use predicting SBP, accounting for concurrent 'My' use; Model 5 = Concurrent 'I' use predicting SBP; Model 6 = Lagged 'I' use predicting SBP, accounting for concurrent 'I' use; Model 7 = Concurrent 'We' use predicting SBP; Model 8 = Lagged 'We' use predicting SBP, accounting for concurrent 'We' use.

Table 2. Unstandardized Regression Coefficients from Concurrent and Lagged Models Predicting Diastolic Blood Pressure from Various Pronouns Used

	b	***SE***	***p***		***b***	***SE***	***p***
Model 1:				**Model 2:**			
Intercept	81.84	2.33	<0.001	Intercept	81.90	2.44	<0.001
Sex	-4.86	2.60	0.06	Sex	-4.68	2.66	0.08
Time	/	/	/	Time	/	/	/
Time^2	/	/	/	Time^2	/	/	/
Me	0.12	0.27	0.64	Me_Lagged	0.20	0.42	0.64
Model 3:				**Model 4:**			
Intercept	82.00	2.31	<0.001	Intercept	82.84	2.39	<0.001
Sex	-4.83	2.60	0.07	Sex	-4.47	2.64	0.09
Time	/	/	/	Time	/	/	/
Time^2	/	/	/	Time^2	/	/	/
My	-0.05	0.32	0.87	My_Lagged	-0.79	0.55	0.16
Model 5:				**Model 6:**			
Intercept	81.23	2.35	<0.001	Intercept	81.22	2.54	<0.001
Sex	-4.89	2.60	0.06	Sex	-4.84	2.64	0.07
Time	/	/	/	Time	/	/	/
Time^2	/	/	/	Time^2	/	/	/
I	0.16	0.10	0.12	I_Lagged	0.05	0.14	0.75
Model 7:				**Model 8:**			
Intercept	82.34	2.33	<0.001	Intercept	81.29	2.52	<0.001
Sex	-4.79	2.60	0.07	Sex	-4.76	2.66	0.08
Time	/	/	/	Time	/	/	/
Time^2	/	/	/	Time^2	/	/	/
We	-0.17	0.14	0.24	We_Lagged	0.54	0.23	0.02

Note. Unstandardized beta weights, standard errors, and significance values ($p<.05$ as significant) for concurrent and lagged models of all pronouns analyzed predicting Diastolic Blood Pressure (DBP), accounting for sex (/ = no significant effect on DBP) Model 1 = Concurrent 'Me' use predicting DBP; Model 2 = Lagged 'Me' use predicting DBP, accounting for concurrent 'Me' use; Model 3 = Concurrent 'My' use predicting DBP; Model 4 = Lagged 'My' use predicting DBP, accounting for concurrent 'My' use; Model 5 = Concurrent 'I' use predicting DBP; Model 6 = Lagged 'I' use predicting DBP, accounting for concurrent 'I' use; Model 7 = Concurrent 'We' use predicting DBP; Model 8 = Lagged 'We' use predicting DBP, accounting for concurrent 'We' use.

Table 3. Unstandardized Regression Coefficients from Concurrent and Lagged Models Predicting Heart Rate from Various Pronouns Used

	b	***SE***	***p***		***b***	***SE***	***p***
Model 1:				**Model 2:**			
Intercept	80.42	1.67	<0.001	Intercept	77.41	1.82	<0.001
Sex	4.70	1.87	0.01	Sex	5.87	1.86	<0.01
Time	-3.14	0.81	<0.001	Time	-0.21	0.61	0.74
Time^2	0.78	0.09	<0.001	Time^2			
Me	0.02	0.12	0.90	Me_Lagged	-0.34	0.37	0.36
Model 3:				**Model 4:**			
Intercept	80.49	1.66	<0.001	Intercept	77.18	1.75	<0.001
Sex	4.72	1.86	0.01	Sex	5.98	1.86	<0.01
Time	-3.11	0.81	<0.001	Time	-0.13	0.62	0.84
Time^2	0.78	0.09	<0.001	Time^2			
My	0.12	0.15	0.41	My_Lagged	-0.24	0.51	0.64
Model 5:				**Model 6:**			
Intercept	80.59	1.68	<0.001	Intercept	78.85	2.47	<0.001
Sex	4.72	1.86	0.01	Sex	4.94	1.53	<0.01
Time	-3.15	0.81	<0.001	Time	-0.35	2.12	0.87
Time^2	0.79	0.09	<0.001	Time^2	0.09	0.53	0.87
I	-0.04	0.06	0.53	I_Lagged	-0.19	0.14	0.17
Model 7:				**Model 8:**			
Intercept	80.46	1.67	<0.001	Intercept	76.12	1.79	<0.001
Sex	4.71	1.87	0.01	Sex	5.78	1.86	<0.01
Time	-3.14	0.81	<0.001	Time	-0.36	0.63	0.57
Time^2	0.78	0.09	<0.001	Time^2			
We	-0.01	0.07	0.91	We_Lagged	0.21	0.19	0.28

Note. Unstandardized beta weights, standard errors, and significance values ($p<.05$ as significant) for concurrent and lagged models of all pronouns analyzed predicting Heart Rate (HR), accounting for sex, time, and quadratic time (time^2). Model 1 = Concurrent ‘Me’ use predicting HR; Model 2 = Lagged ‘Me’ use predicting HR, accounting for concurrent ‘Me’ use; Model 3 = Concurrent ‘My’ use predicting HR; Model 4 = Lagged ‘My’ use predicting HR, accounting for concurrent ‘My’ use; Model 5 = Concurrent ‘I’ use predicting HR; Model 6 = Lagged ‘I’ use predicting HR, accounting for concurrent ‘I’ use; Model 7 = Concurrent ‘We’ use predicting HR; Model 8 = Lagged ‘We’ use predicting HR, accounting for concurrent ‘We’ use.

Figure 1. Changes in Systolic Blood Pressure (SBP) predicted by the use of low, average, and high ‘My’ Talk across the 4-minute Stream of Consciousness (SOC) task. Range of low ‘My’ talk calculated as one standard deviation below the mean. Average ‘My’ talk equal to the mean. Range of high ‘My’ talk calculated as one standard deviation aove the mean. Models accounted for a difference between men and women in blood pressure measurements.

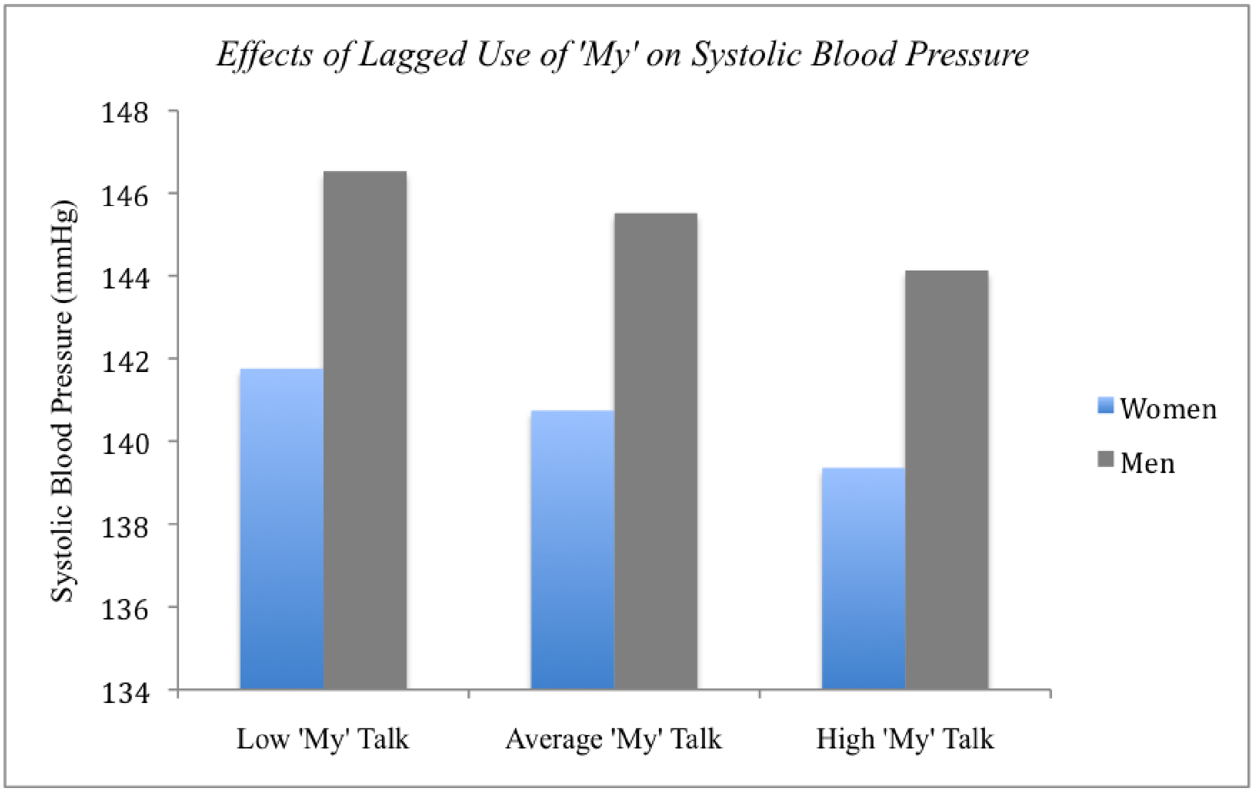
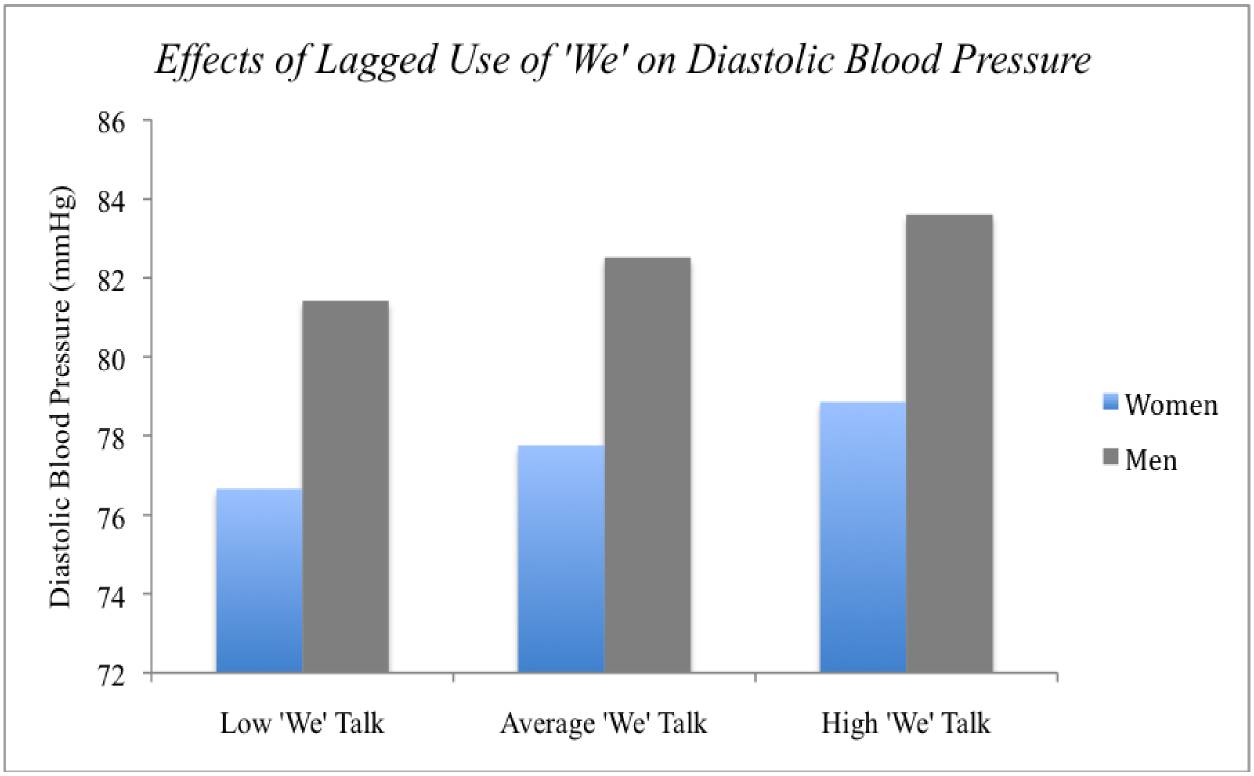


Figure 2. Changes in Diastolic Blood Pressure (DBP) predicted by the use of low, average, and high 'We' Talk across the 4-minute Stream of Consciousness (SOC) task. Range of low 'We' talk calculated as one standard deviation below the mean. Average 'We' talk equal to the mean. Range of high 'We' talk calculated as one standard deviation aove the mean. Models accounted for a difference between men and women in blood pressure measurements



Appendix A

Questions for the Stream of Consciousness Task

1. When did you first realize you and your partner were headed towards breaking up?
2. What do you remember about the separation itself, the actual time when you and your former partner separated?
3. How much contact have you had with your former partner? What kind/s of contact?
4. How has the breakup affected your thoughts and feelings regarding romantic relationships?

Appendix B

LIWC Pronoun Word Dictionary

%	
1	I
2	memyself
3	mymine
4	we
5	usourselves
6	ourours
7	firstps
8	firstpp
9	me
10	myself
11	us
12	ourselves
13	my
14	mine

%	
I	1,7
Id	1,7
I'd	1,7
I'll	1,7
Im	1,7
I'm	1,7
Ive	1,7
I've	1,7
Lets	5,8
Let's	5,8
Me	2,7,9
Mine	3,7,14
My	3,7,13

Excluded My, Mine from Analysis

- No usage (frequencies = 0)

LIWC Word Category Ratios

*Ratios calculated for every minute

Active Singular : Singular

- 1/(1+ Me)
- I/(I + My)

Passive Singular : Singular

- Me/(I + Me)
- My/(I + My)

Active Singular : Total Singular

- I/(I + Me + My)

Passive Singular : Total Singular

- (Me + My)/(I + Me + My)

All Active* : Total First Person Pronouns*

All Passive* : Total First Person Pronouns*

- All Active
    - I, We
- All Passive
    - Me, My, Us, Our, Ours, Ourselves
- Total First Person Pronouns
    - I, We, Me, My, Us, Our, Ours, Ourselves