Physical Attractiveness Mediates the Relationship Between Resting Heart Rate Variability and Mate Value

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B.A. (Hons.) in Psychology, Lakehead University, 2016

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF MASTER OF ARTS IN CLINICAL PSYCHOLOGY

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Abstract

The present study had two main purposes: (a) to replicate the findings of Vacharkulsemsuk and colleagues (2016) and Joel and colleagues (2017) wherein body language and physical attractiveness each predict desirability, and (b) to determine if body language and physical attractiveness mediate the observed link between heart rate variability (HRV) and mate value as reported by Bailey (2017). A total of 42 university students attended a laboratory session where they rated soundless video monologues of 192 students describing their relationship experiences. Ratings of expansive body language and physical attractiveness were found to predict rater's desire to go on a future date with ratees. Furthermore, physical attractiveness mediated the HRV – mate value link. These results suggest that physical attractiveness acts as a proxy to communicate information about the HRV of a potential date in the mating marketplace.

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As humans we have a fundamental drive to achieve high-quality romantic relationships, yet the process of finding, attracting, and forming such is not always easy (Baumeister & Leary, 1995). For some people these tasks may prove more challenging than for others. These challenges are mirrored and possibly amplified in emerging dating applications and matchmaking services that are gaining popularity. The assessment of human mate value takes into account all desirable characteristics that affect one's ability to successfully attract, pursue, and retain a mate (Buss & Barnes, 1986; Fisher, Cox, Bennett, & Gavric, 2008; Gangestad & Simpson, 2000). Mate value cannot be determined by a single characteristic; rather, it is a collection of traits including but not limited to age, intelligence, physical attractiveness, fertility, social status, and willingness to invest in offspring (Buss & Barnes, 1986). Individuals use perceived mate value to assess and target potential mates and to assess their own worth in the dating marketplace. Although mate value seems relatively straightforward if we assume it is represented by the sum total of an individual's desirable characteristics, convincing others of one's own mate value may prove more challenging.

Some variables that make up one's mate value are easily observable such as physical attractiveness and body language. Recent literature suggests that these observable characteristics may be the best indicators of mate value (Joel, Eastwick, & Finkel, 2017; Vacharkulksemsuk et al., 2016). Other indicators of mate value are subtle and often difficult to identify. For instance, heart rate variability (HRV) is a cardiac variable that is not perceptible to the human eye. It has been associated with many characteristics subsumed under correlates related to mate value including emotion regulation (Williams et al., 2015), anxiety (Park et al., 2014; Park & Thayer,

2014), depression (Calkins, 2007), social skills, and relationship formation (Bailey & Davis, 2017). Heart rate variability has also been shown to predict mate value and relationship success. Specifically, Bailey (2017) found that individuals with high resting HRV were rated as having higher mate value by other potential romantic partners. The question to this intriguing observation is why? The present study sought to replicate the link between HRV and mate value and to explore potential mediating mechanisms of this relationship.

Mate Value

People frequently strive to meet their ideals and standards in a multitude of areas. Individual's standards are important and functional because they inspire continual evaluation of the current situation. Within a dating context, individuals are constantly evaluating potential partners using mate value. Mate value has been defined as "The total sum of characteristics an individual possesses at a given moment and within a particular context that impact on their ability to successfully find, attract, and retain a mate" (Fisher, Cox, Bennett, & Gavric, 2008, p. 157). Mate value is dependent on the genetic quality and fitness of an individual; however, because these traits cannot be directly observed, humans have identified phenotypic characteristics of genetic quality (Buss & Schmitt, 1993; Gangestad & Simpson, 2000). Physical traits like facial attractiveness, waist-to-hip ratio, facial symmetry (Fink & Penton-Voak, 2002; Rikowski, & Grammer, 1999; Singh, 2002) and such psychosocial attributes as personality characteristics, earning potential, intelligence, and sense of humour (Back, Penke, Schmukle, & Asendorpf, 2011; Buss & Barnes, 1986; Shackelford, Schmitt, & Buss, 2005) signal reproductive potential, likelihood of investment in offspring, and the quality of the romantic relationship (Gangestad & Simpson, 2000; Goodwin et al., 2012). These desirable traits act as currency in the "mating market" and thus influence which potential mates are in one's "price range"

(Eastwick & Hunt, 2014; Todd, 1997). Mating competition and rejection can be costly, therefore, pursuing a partner far above one's own mate value would be a wasteful endeavour, consuming resources and providing little to no chance for gain. Conversely, pursuing a partner far below one's own mate value is a poor investment as it is unlikely to maximize reproductive potential (Buston & Emlen, 2003; Kavanagh, Robins, & Ellis, 2010; Penke, Todd, Lenton, & Fasolo, 2007). Therefore, mate value serves as an evolutionary mechanism which allows individuals to properly invest their resources and time when pursuing partners with the highest mate value that one would be likely to successfully court (Back et al., 2011; Miner & Shackelford, 2010).

Mate value involves the assessment of other potential mates and the assessment of one's self. The Mate Value Inventory (MVI; Kirsner, Figueredo, & Jacobs, 2003) is the most widely used assessment tool for measuring the construct. While other instruments have since been developed (e.g., Mate Value Scale; Edlund & Sagarin, 2014) they fail to capture the individuality of each characteristic encompassed by mate value. The MVI is the only published scale to date which provides a multidimensional measure (Fisher et al., 2008). It offers a summed score for 17 individual traits such as ambitious, attractive face, and loyal. Rather than asking a blanket statement such as "Overall, how good of a catch are you?" (Edlund & Sagarin, 2014), the MVI forces individuals to evaluate each desirable trait either for themselves, a potential partner, a current partner, or a hypothetical partner (Kirsner et al., 2003). It can be rated after viewing videos or photos of potential partners and/or after going on a date with a potential partner.

Participants' reactions to dates has been studied with growing interest using the speed dating paradigm. Finkel, Eastwick, and Matthews (2007) established the use of specific standards for using speed dating as a tool to measure initial attraction and relationship formation. They concluded the preferred approach involved approximately 12 dates, each lasting 4 min

followed by a 2-min questionnaire period, wherein 73% of participants reporting that the number of dates was “just right” and 60% reporting that 4 min per date was “just right”. During a speed dating session a 2-min questionnaire period is used to gather information pertinent to the research questions of the study. One question that is universally asked of participants after each speed date is “would you like to go on another date with this partner? Yes / No”. The response to this question is used to calculate matching which occurs when both speed dating partners mutually indicate “yes” to wanting to go on another date.

The number of yeses also provides a measure of desirability and selectivity. An individual who receives a high proportion of yeses to potential dates from speed dating parters is deemed to have high desirability, regardless of the number of mutual matches. The less yeses a participant gives out, the more selective he or she is consdered to be. Desirablity and selectivity tend to be negatively correlated; individuals who receive more yeses typically give out fewer yeses (Back et al., 2011; Kurzban & Weeden, 2005; Todd, Penke, Fasolo, & Lenton, 2007). Selectivity and desirability assist in identifying an individual’s mate value and in the study of mating strategies.

The speed dating paradigm is useful in answering many different types of research questions. A speed dating paradigm can be used to study predictions about speed dating dynamics on the basis of previously collected data such as predicting the number of yeses an individual receives based on their height (Kurzban & Weeden, 2005), initial romantic attraction between two strangers (Tidwell, Eastwick, & Finkel, 2013; Vacharkulksemsuk et al., 2016), and informing future relationship success based on matching success (Asendorpf, Penke, & Back, 2011; Bailey, 2017). The paradigm allows for the collection of multiple third party ratings on

any variable of interest which is completed during the 2-min questionnaire period between successive speed dates (Bailey, 2017; Finkel et al., 2007).

Bailey (2017) utilized the speed dating paradigm to determine whether HRV was predictive of mate value and matching. Results showed HRV predicted participants' mate value as rated by their speed dating partners. Specifically, individuals with higher resting HRV were rated as having higher mate value by other potential partners during a speed dating paradigm.

Mate Value and Desirability Characteristics

Kurzban and Weeden (2005) also employed the speed dating paradigm to investigate which mate value attributes drive romantic attraction and dating choices. Before participating in the speed dating session, participants filled out questionnairs regarding demographics, personality, socioxeuality, mate value, and physical attractiveness. Participants were then able to choose a speed dating session which were stratified by age (25 – 35 and 35 – 45) so that roughly the same ages were participating in the same session. Each speed date was 3-min in length; after each date individuals indicated "yes" or "no" on a scorecard to wanting to see that individual again. They found that speed dating interactions were driven by cross-cultural, mutually agreed-upon mate value characteristics for both men and women that comprised almost exclusively physically observable traits. For men, there were significant correlations between the proportion of yeses they received—a measure of desirability—and attractive face (r = .26), attractive body (r = .22), height (r =.21), age (r = -.19), and body mass index (BMI; weight in kg divided by height in m^2; r = -.18). Variables that were not significant predictors of desirability included education level, income, and religion. For women, the strongest significant desirabiltiy correlations were with the following variables: BMI (r = -.50), attractive body (r = .30), age (r = -.19), and attractive face (r = .17). In a stepwise linear regression, women's desirability was best

predicted by physically observable traits, wherein BMI was able to account for 25% of the variance in woman's desirability. Variables that were not significant predictors of desirability included attractive personality, education, income, religion, and sociosexuality (Kurzban & Weeden, 2005).

It is important to note the predictor variables used by Kurzban and Weeden were all self-reported by participants. This is a limitation of the research as it has been shown that people tend to respond in a socially desirable way when reporting variables such as physical attractiveness (Toma & Hancock, 2010), and weight, which would affect calculations of BMI (Gorber, Tremblay, Moher, & Gorber, 2007; Stommel & Schoenborn, 2009). Furthermore, without isolating physical attractiveness from other variables operating during a speed date itself, such as conversation topic and personality, a direct causal relationship cannot be inferred. Nevertheless, relevant to the present study, Kurzban and Weeden's (2005) findings do support the claim that physical attractiveness is an influential and visibly identifiable marker of mate value for both males and females.

Physical Attractiveness

Physical attractiveness refers to the overall evaluation of an individual's physical attributes and traits. It plays a fundamental role in the assessment of mate value because the evolutionarily advantageous variables of health, sexual maturity, reproductive potential, and investment in offspring are not directly observable. Physical attractiveness serves as a proxy for the aforementioned unobservable facets of mate value. Currently there is no agreed upon gold standard for measuring physical attractiveness. While some scales attempt to operationalize the construct multi-dimensionally (Swami, Furnham, Georgiades, & Pang, (2007), other researchers rely on one or two single-item questions (e.g., Kurzban & Weeden, 2005; Vacharkulksemsuk et

al., 2016). Generally, single-item questions such as "How physically attractive do you find the individual?" are preferred as they capture the totality of physical attractiveness rather than bringing to conscious awareness each individual aspect of a person's physical attractiveness.

Physical attractiveness serves as a marker of mate value because it provides a visual cue of overall health to potential mates (Fisher et al., 2008). It was found that males were able to determine female mate value with a high degree of accuracy simply by visually assessing waist-to-hip ratio (Singh, 2002; Sugiyama, 2004). Research on male mate value has produced similar findings; for male's physical attractiveness has been shown to be a key indicator of mate value to potential female partners (Hönekopp, Rudolph, Beier, Liebert, & Müller, 2007; Penke et al., 2007). Further, physical attractiveness is associated with greater happiness, life satisfaction, relationship success, and overall subjective well-being (Umberson & Hughes, 1987).

While many believe that beauty is in the eye of the beholder, literature on physical attractiveness and mate selection tends not to support this. Research reveals that physical attractiveness ideals are held by the majority of the population. Buss (1989) discovered that individuals across dozens of cultures come to similar conclusions about what is considered physically attractive to romantic partners. Attractiveness has also been shown to be valued in all societies regardless of sex, age, or ethnicity (Fink & Penton-Voak, 2002) which translates into a universally held idea of what is attractive. Research also suggests that physical attractiveness informs mating decisions for both males and females. It has previously been argued that in the mating marketplace men place a higher importance on physical attractiveness while women are more inclined to sacrifice physical attractiveness if there is a gain in resources and higher investment potential (Pawłwski & Dunbar, 1999; Regan, 1998). Nevertheless, research suggests that physical attractiveness influence romantic perceptions for both males and females within the

context of initial romantic interactions (Fink, Weege, Neave, Pham, & Shackelford, 2015; Kurzban & Weeden, 2005) and in the facilitation of already established romantic relationships (Sangrador & Yela, 2000).

From a cognitive perspective, the "what is beautiful is good" hypothesis attempts to explain these positive associations with physical attractiveness. It posits that as humans we are more likely to attribute socially desirable characteristics such as intelligence, personality, success, trustworthiness, and wealth to individuals who are perceived as physically attractive, even in the absence of any other information (Dion, Berscheid, & Walster, 1972). However, from a sociobiological perspective, physical attractiveness is deemed a natural indicator for good health and high reproductive potential. For these reasons, regardless of the "what is beautiful is good" hypothesis, physical attractiveness serves an evolutionary purpose by acting as an inborn biological marker of mate value.

Joel, Eastwick, and Finkel (2017) recently set out to examine the possible predictors of partner desirability during initial contact. Specifically, they investigated the possibility of predicting who would have strong romantic attraction and desirability towards each other during a speed dating session on the basis of previously collected self-report participant information. Speed dating data were collected twice, once in 2005 and again in 2007; therefore, results are presented with reference to sample A (2005) and sample B (2007). It was found that the most consistent and strongest predictors of partner desire included participants' self-reported mate value and self-reported physical attractiveness. For sample A, physical attractiveness was able to account for 16% of the variance and mate value 12%. Sample B had even higher rates of variance explained by these variables; 26% and 41% for physical attractiveness and mate value, respectively. These findings suggest that individuals who self-report high mate value and

physical attractiveness are the most desired during initial interaction by potential romantic partners (Joel et al., 2017). These recent findings are compelling and lend further support to the unique role physical attractiveness plays in mating behaviour. However, self-reported mate value and attractiveness are typically biased and somewhat unreliable. An extension of this study would have others rate predictors of desirability such as mate value and physical attractiveness; one impetus for the present study. Another is the merit in studying body language as another indicator of mate value (Vacharkulksemsuk et al., 2016).

Body Language

The adélie penguin searches the Atlantic coast for rare rocks to present to his beloved; the bowerbird builds a nuptial bower (a tower of sticks) decorated with exclusively blue items and then performs a dance to attract potential mates; the peacock fans his feathers to assert dominance and attract peahens, the prettier the peacock the more peahens he attracts. Humans also convey attraction and availability with different forms of behaviour and body language (Fisher, Aron, & Brown, 2006). For instance, a head tilt, a smile, open arms, or a warm embrace can all convey attraction and interest. Pupil dilation and other nonverbal displays of interest are interpreted by the human mind in as little as 39ms (Bar, Neta, & Linz, 2006). Social cues like eye gaze have been shown to influence decision making about pursuing or passing up a romantic partner (Mason, Tatkow, &Macrae, 2005). One nonverbal behaviour that has been documented throughout the years is hierarchical standing, also known as "postural expansiveness" (Vacharkulksemsuk et al., 2016) or "power posing" (Carney, Cuddy, & Yap, 2010).

Postural Expansiveness

Expansive and open posture can be described as involving widespread open limbs, stretched torso, and/or an increase in occupied physical space; such open-body positions tend to

be more persuasive, interpersonally oriented, and attractive (McGinley, LeFevre, & McGinley, 1975; Renninger et al., 2004). Contractive posture can be described as closed off or constricted, limbs held close to the torso, and/or a decrease in occupied space by folding the body inward (Renninger et al., 2004; Vacharkulksemsuk et al., 2016). To date there has been no validated scale used to measure expansive body language; rather, researchers tend to use a Likert-type scale anchored "*contractive*" to "*expansive*". Research has shown that body language plays a role in forming first impressions, communicating romantic intentions, and regulating the progression of relationship contingencies (Givens, 1978). Research has found that individuals who engaged in expansive, open (high-power) body language, self-report higher feelings of power and had increased levels of testosterone and decreased levels of cortisol (Carney, Cuddy, & Yap, 2010). Cuddy, Wilmuth, and Carney (2015) found that individuals who engage in expansive body language before a job interview, performed better and were more likely to be chosen for hire. Ranehill and colleagues (2015) sought to replicate the previously aforementioned findings; results indicated a significant effect of expansive body language on self-reported feelings of power, however there were no significant change in hormonal levels due to the expansive body language. Renninger, Wade, and Grammer (2004) found that males who successfully made romantic contact with females displayed precontact body language that was different from males who did not successfully make contact with females. The successful precontact behaviour included significantly more space-maximizing movements and less closed-body, contractive movements (Renninger et al., 2004). Short (1979) reported that in the absence of substantial nonverbal indications of interest, individuals are hesitant and reluctant to approach a potential mate. Multiple research studies have also found that power posing is one of the fastest ways to influence trait attributions. Specifically, a perceiver will rate a person's dominance, power,

persuasion, socioeconomic status, and sociometric status as higher when the target assumes a more expansive and open posture (Carney et al., 2010; Carney, Hall, & LeBeau, 2005; Oosterhof & Todorov, 2008; Todorov, Pakrashi, & Oosterhof, 2009). Germane to the present study, the previously aforementioned variables relate to mate value; thus, it may be inferred that expansive body language plays a role in signaling individual mate value in the mating marketplace.

In a courtship setting, nonverbal behavior is a source of mate-choice information. In recent years there has been considerable progress in identifying which nonverbal behaviours are involved in romantic attraction (Buss & Schmitt, 1993; Moore, 2010; Renninger et al., 2004; Vacharkulksemsuk et al., 2016). Variables such as head nods, gestures, and leaning forward have been shown to be associated with higher self-reported feelings of love (Gonzaga, Keltner, Londahl, & Smith, 2001). These nonverbal behaviours associated with initial romantic attraction are particularly important with the modern era of dating. With today's current technology and generation of immediacy, attraction decisions are often made within a few seconds of viewing an online photo, a quick glance at a social gathering, or during a 4-min speed dating session. With these advances in modern dating, the decision of selecting a partner can be reduced from days and weeks to mere minutes and seconds. Most literature investigating body language and interpersonal interaction focuses on rapport building between platonic individuals; for instance, positive facial expressions along with laughing and smiling facilitates rapport (Johnston, Miles, &Macrae, 2010; Tickle-Degnen & Rosenthal, 1990). Additionally, research that has investigated body language and romantic attraction tends to focus on long-term committed partners. Gonzaga and colleagues (2001) reported that gestures and nodding were associated with feelings of love among individuals in long-term relationships. Few studies to date have investigated nonverbal

behaviours involved in initial romantic attraction (Renninger et al., 2004; Vacharkulksemsuk et al., 2016); this being another impetus for the present study.

Mate Value and Body Language

Vacharkulksemsuk and colleagues (2016) set out to experimentally examine the association between postural expansiveness and initial attraction using a two-part study. In the first part the authors employed a speed dating paradigm to investigate expansive body language in a real-world dating setting. Participants went on 12 consecutive dates with individuals of the opposite sex, with each date lasting 4 min. Speed dating participants indicated at the end of each date if they were "interested in romantically pursuing this person in the future". Speed dating participants also indicated their overall romantic attraction and impression of each of their speed dating partners. Participants were video recorded during each date and later coded by trained raters for postural expansiveness and other associated cues such as laughing, smiling, and nodding (Vacharkulksemsuk et al., 2016). Videos were rated without sound with the exception of coding for laughs so that variables such as topic of conversation, personality, and tone of voice would not influence ratings of body language. Postural expansiveness was coded once at the beginning of the dating video and again at the end, and then averaged across both time points. Results from study 1 indicated that individuals who displayed higher levels of postural expansiveness during a speed dating paradigm had the highest probability of having potential romantic partners interested in future dates. Furthermore, participants' expansive body language was able to predict partners' romantic attraction (b = .52, SE_b= .14, p < .01), chemistry (b = .50, SE_b = .14, p < .01), vitality (b = .39, SE_b= .13, p < .01), warmth (b = .35, SE_b= .10, p < .01), and dominance of the participant in the speed date (b = .33, SE_b= .14, p < .05). Postural expansiveness predicting attractiveness was also trending towards significance (b = .27, SE_b=

.15, $p < .10$). While this study adds support to the role of body language in romantic attraction, it is unclear whether expansive body language led to more liking and attraction from partners or, alternatively, if more liking and attraction from romantic partners caused participants to display more expansive body language. A study is required that methodologically rules out the bidirectional influence these two variables may have upon each other; another impetus of the present research.

The second part of the Vacharkulksemsuk et al. (2016) study sought to clarify the predictive role of body language. A local online dating application that matched singles within close proximity of one another using GPS was used. Dating profiles on this application featured the participant's primary photo, name, and age. Users were presented with one profile at a time and indicated sexual attraction or interest by responding to a forced-choice "Yes" or "No" and were presented with the next profile. Much like the dynamics of a speed date, if two individuals responded yes to one another they were considered a "mutual match" and then able to begin communication. Six confederates (three males and three females) were involved in create dating profiles on the previously described application. Each confederate created two dating profiles differing only in photograph: one displaying expansive body language and and the other contractive body language. Results found that photographs of males and females displaying expansive body language received a significantly higher proportion of yeses in an online dating scenario than did photographs of the same individuals displaying contractive body language. Collectively, results from both parts of this study suggest that body language, whether observed during a brief 4-min speed date interaction or in a static photograph, conveys critical aspects of an individual's mate value to other prospective partners (Vacharkulksemsuk et al., 2016).

Although compelling, the research findings reported by Vacharkulksemsuk and colleagues (2016) are not without limitations. In study 1, the authors failed to control for certain variables like personality and topic of conversation during the speed date, thereby limiting the ability to infer a causal connection between expansiveness and desirability. Additionally, data from 144 speed dates were collected over a number of different sessions; however, only the one speed dating session containing 24 participants were coded for expansiveness, thereby rendering a limited sample size. It was reported that this particular dating session was selected to be coded because the data was reasonably complete and had equal number of male and female participants. However, it was not mentioned by the authors if participants with more complete data differed significantly from the larger pool of participants with incomplete date. A larger sample size may alter the findings in this study. Finally, by relying solely on still frame photographs, study 2 failed to capture the dynamic interplay of social interaction.

To summarize thus far, body language and physical attractiveness appear to be linked to mate value. It is postulated that the underlying biological mechanisms which are sought after in the mating marketplace are being signaled by these two attributes. However, what biological markers predict physical attractiveness and postural expansiveness remains illusive. One candidate that has been gaining considerable attention in explaining genetic fitness is HRV.

Heart Rate Variability

Heart rate variability is a measure of parasympathetic functioning as indexed by the variability in inter-beat intervals across successive heartbeats. It is computationally extracted from the electrocardiogram (ECG) of a recorded individual. The variability found between successive heartbeats is a result of the dynamic interplay between multiple physiological mechanisms that regulate the heart's responsiveness to the environment (Bilchick, & Berger,

2006). A healthy heart will more often respond to environmental cues and return to baseline more quickly, which results in higher variability, while lower variability indicates less ability to adaptively respond (see Figure 1).

While there are a wide range of physiological factors responsible for regulating the heart's function, the autonomic nervous system (ANS) is predominantly responsible for regulating the rhythm of the heart. The ANS is divided into two major branches: the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS) that operate antagonistically to reach a state of equilibrium. The interaction between the PNS and SNS on the sinoatrial node initiates each beat of the heart (Stauss, 2003). SNS activity being associated with excitatory functions and energy mobilization; for example, fight or flight responses. Conversely, greater PNS activity being associated with restorative functions and periods of reduced levels of activity (Appelhans & Luecken, 2006; Thayer & Brosschot, 2005; Thayer & Sternberg, 2006).

An increase in sympathetic activity is associated with an increase in heart rate and shortened inter-beat intervals while an increase in parasympathetic activity has the opposite effect. Thus, the SNS and PNS interact to influence the moment to moment changes observed in inter-beat intervals. Typically, during times when heart rate is elevated, the time between consecutive heartbeats is diminished, resulting in low HRV. Conversely, when heart rate decreases there is a greater average length of time between heartbeats resulting in greater variability and thus higher HRV. Therefore, there is a negative correlation between heart rate and HRV (Appelhans & Luecken, 2006; Thayer, Ahs, Fredrikson, Sollers, & Wager, 2012).

Higher resting HRV has been linked to more adaptive responses to environmental demands, increased ability for self-regulation, coping strategies, autonomic flexibility, and

positive health outcomes (Appelhans & Luecken, 2006; Segerstrom & Solberg Nes, 2007; Thayer & Lane, 2007; Williams et al., 2015). In contrast, lower resting HRV has been associated with maladaptive cognitive and emotional self-regulation, rigid attentional processing, emotional stress, and negative health outcomes such as depression, anxiety, increased risk of all-cause mortality, obesity, and diabetes (Appelhans & Luecken, 2006; Friedman, 2007; Park & Thayer, 2014; Rottenberg, Clift, Bolden, & Salomon, 2007).

Behavioural research has shed light upon the personality and mental health outcomes associated with HRV. High HRV has been associated with better control over emotional reactions (Denson et al., 2011; Pu, Schmeichel, & Demaree, 2010; Schneiderman, Zilberstein, Kra, Leckman, and Feldman, 2011), better cognitive performance, and flourishing interpersonal relationships (Cosley, McCoy, Saslow, &Epel, 2010; Schneiderman, Zilberstein-Kra, Leckman, & Feldman, 2011; Smith et al., 2011; Uno, Uchino, & Smith, 2002), and—most recently—mate value (Bailey, 2017).

Heart Rate Variability and Mate Value

Bailey (2017) investigated the predictive ability of resting HRV in romantic attraction. Employing a three-part study, she had participants fill out online questionnaires, measured their HRV in a laboratory, and then participate in a speed dating session. Resting HRV, measured in the laboratory during a 5-min eyes-closed ECG recording period, was found to predict how an individual's mate value would be rated by potential partners during a speed dating session held a week later. Specifically, individuals with higher resting HRV were rated as having higher mate value. Bailey (2017) also found that high resting HRV increased the probability of matching during the speed dating session. These finding are in line with previous research investigating positive health outcomes and HRV. Although this establishes a link between HRV, mate value,

and romantic attraction, nothing is known about what human characteristics are able to convey the unobservable biological variable of HRV. As previous research has suggested that physical attractiveness and body language are among the better indicators of mate value, perhaps these variables telegraph information about a person's HRV—a form of biological fitness— to potential mates.

Heart Rate Variability and Physical Attractiveness

According to Brosschot, Verkuil, and Thayer's (2016) generalized unsafety theory of stress (GUTS), chronic stress and anxiety are caused by the inability to recognize safety signals in the immediate environment. An individual is born with a default stress response; this response can be inhibited when the individual perceives safety. Problems arise when an individual is not able to inhibit this default response even in the absence of immediate threat (Brosschot et al., 2016). According to GUTS, high resting HRV has been linked to greater prefrontal cortical inhibition of subcortical areas. When the safety of a situation is in doubt, the subcortical inhibition is decreased which in turn increases activity in the amygdala. The decrease in subcortical inhibition has been shown to be present in individuals with low resting HRV even in the absence of threat. Thus, such individuals are typically unable to recognize safety signals in an otherwise safe environment; they perpetually perceive safe situations as threatening (Brosschot et al., 2016). The GUTS may help to explain the possible role physical attractiveness plays in the link between resting HRV and mate value reported by Bailey (2017). Compromised body, such as poor physical health and obesity are consequences of generalized uncertainty because of the individual's reduced capacity to recognize and deal successfully with stressors (Brosschot et al., 2016). These poor physical health outcomes result in unhealthy looking and

thus less attractive people; therefore, based on GUTS, one can postulate that an individual who has low resting HRV would possess lower physical attractiveness.

Heart Rate Variability and Body Language

The polyvagal theory proposed by Porges (1995,1998) provides another possible explanation for the observed association between HRV and romantic attraction. The vagus nerve is responsible for tasks such as regulating gastrointestinal peristalsis, sweating, muscle movements in the mouth that control speech, and heart rate and its variability. The polyvagal theory proposes that the ventral vagal complex controls the social engagement system which is at the root of courting behaviours. For instance, the social engagement system controls behaviours such as facial expression, head tilt, and pupil dilation, all of which are implicated in the communication of availability and romantic interest (Porges, 1995, 1998). The vagus nerve has two branches, the evolutionary recent myelinated vagus and the older unmyelinated vagus. The older branch is rarely activated in mammals but can function to elicit the immobilization behaviour of freezing in the face of threat. Therefore, in humans the heart is mainly controlled by the more recently evolved myelinated vagus, also known as the ventral vagal complex which controls parasympathetic activity (Porges, 1998).

In mammals, the ventral vagal complex serves the function of a vagal brake which inhibits heart rate in response to environmental cues. Under normal conditions, the vagus actively inhibits heart rate; however, the polyvagal theory proposes that under stressful conditions there is a temporary withdrawal of vagal tone (Porges, 1996). This removal of the vagal brake facilitates sympathetic mobilization for fight-or-flight behaviours. Thus, the regulatory processes required for social engagement can only occur in situations that are perceived as safe (Porges, 1998). Consistent with the proposed theory, research has indicated

that individuals with higher vagal tone experience lower rates of anxiety and depression (Chambers & Allen 2002; Cohen et al., 1997, 2000).

The ventral vagal complex controls the social engagement system and the vagal regulation of the heart; therefore, measuring HRV provides a biological proxy for the status of the social engagement system (Porges, 1998). Relevant to the present study, the ventral vagal complex is the component of this system of interest as it theoretically links HRV to initial attraction by controlling behaviours such as head tilt, seduction, and availability, all of which fall under the umbrella for body language.

The Present Study

Several studies have investigated the effects of postural expansiveness in social settings (Grammer, 1990; Vacharkulksemsuk et al., 2016); however, few have investigated its effects on initial romantic attraction. In addition, none of these studies have been successful in controlling or accounting for potential confounding variables or capturing the real world setting of human interaction. Vacharkulksemsuk and colleagues (2016) initially investigated this link using a speed dating paradigm, yet the results were only correlational in nature and did not account or control for the role of conversation topic during the date, mutual interests, and physical attractiveness. Furthermore, there was no way of knowing if individuals were engaging in postural expansion because they were liked by their speed dating partner, or if they were liked because of their postural expansion. To address this question, the researchers conducted a second study utilizing an online dating application. Individuals were purposefully posed to exhibit contractive and expansive body language in separate photos in an attempt to test the causal role of body language. While the findings of this study were significant regarding expansive body language predating desirability, it can be argued that a picture is not an accurate representation of

body language which itself is dynamic and therefore best be captured by observing an individual interacting with the environment.

Recent studies have also suggested that physical attractiveness is one of the most significant indicators of human mate value (Fink et al., 2017; Joel et al., 2017; Kurzban & Weeden, 2005). However, two major flaws are consistently seen in this type of research: the reliance on self-reported measures of physical attractiveness, and failure to control for potential confounding variables inherent during social interactions that may affect ratings of physical attractiveness and mate value such as conversation topic, mutual likes and dislikes, personality, and compatibility.

The present study had two primary purposes: The first was to replicate and expand upon the key findings reported by Vacharkulksemsuk and colleagues (2016) and Joel and colleagues (2017) while also filling the gaps identified in the current literature. The current study investigated physical attractiveness and body language in the prediction of desirability. Expansive body language and physical attractiveness were measured in the form of a participant brief monologue video without audio to further isolate physical attractiveness and body language from other possible confounding variables; specifically, personality and conversation content. Because body language and physical attractiveness are not mutually exclusive it was not feasible to completely isolate one from the other; therefore, the other was controlled for in each statistical prediction model of desirability. The brief monologue videos of the present study were rated to produce an other-assessed measure of physical attractiveness and body language. Body language was used as a predictor variable in hypothesis 1 and as a mediating variable in mediation hypothesis 3. Physical attractiveness was used as predictor variable in hypothesis 2 and as a mediating variable in mediation hypothesis 3.

Specifically, the replication hypotheses were as follows:

1. Higher levels of expansive body language as rated during a separate laboratory-based brief monologue video will predict higher desirability (i.e., more yeses) during a subsequent speed dating session held weeks later.
2. Higher levels of observer-rated physical attractiveness during the same videotaped monologue will predict higher desirability during a subsequent speed dating session.

High HRV has been associated with positive health outcomes while lower resting HRV has been associated with negative health outcomes. Brosschot et al. (2016) state that HRV is inborn and represents an individual's ability to recognize safety signals in the environment. Individuals who cannot identify these safety signals experience negative outcomes such as a lack of fitness, social problems, and obesity, which translates to a decreased mate value and physical attractiveness.

The polyvagal theory proposes that the ventral vagal complex controls the social engagement system which facilitates courting and seduction (Porges, 1995, 1998). Expansive body language is an area of interest, particularly with regards to the communication of romantic availability. Research conducted by Vacharkulksemsuk et al. (2016) found that individuals body language was able to predict desirability. Body language may therefore serve as a biological proxy for an individual's HRV.

The second purpose of the present study draws its inspiration from the observation that individuals with higher resting HRV are rated as having higher mate value by potential mates (Bailey, 2017). However, the underlying mechanisms responsible for this link have yet to be determined. The current study investigated two possible mediators of the link between between

HRV and mate value: physical attractiveness and expansive body language. The third hypothesis tested in the present study was as follows:

3. Higher expansive body language and/or physical attractiveness mediates the link between resting HRV and mate value (see Figure 2).

Method

Participants

Forty-two participants (12 males, 30 females) were recruited in 2018 from Lakehead University Orillia campus through mass e-mail and classroom announcements. The e-mail (see Appendix A) provided a brief description of the study, an overview of the eligibility criteria, and a hyperlink to an online questionnaire hosted on SurveyMonkey. Prior to the completion of the online questionnaire, participants were provided with an information letter (Appendix B) and a participation consent form (Appendix C). To be eligible to participate, individuals had to be Orillia campus students between the ages of 18-29. The mean age was 20.21 years (SD = 2.45). The majority identified their ethnicity as Caucasian (75%), followed by African-Canadian (8%), South Asian (7%), First Nations (3%), Hispanic (2%), East Asian (1%), and other (4%). For female participants, the majority were single, had no romantic partner, and were interested in dating (41%). Another 36% were in a romantic relationship. Twelve percent were single, had no romantic partner, and were not interested in dating. The final 11% were currently casually dating. For male participants, the majority were single, had no romantic partner, and were interested in dating (54%). Thirty-three percent were in a romantic relationship. Another 10% were casually dating. Only 3% of males reported that they were single, had no romantic partner, and were not interested in dating.

Archival Participants

Two hundred postsecondary students (103 females and 97 males) were recruited in 2014-2016 from Lakehead University Thunder Bay campus and Confederation College through mass email and posters placed throughout each campus. To be eligible to participate individuals had to be (a) not currently in a romantic relationship; (b) interested in forming a monogamous romantic relationship in the next 6 months; (c) between the ages of 17-29; (d) a nonsmoker; and (e) not currently taking cold, antidepressant, or hypertension medications.

Of the 200 participants, eight were excluded from analyses; two due to technical errors resulting in no ECG recordings, one because the individual was not single at the time of the laboratory session, and five because there were technical difficulties recording the relationship videos resulting in no recorded video. The remaining 192 participants comprise the sample of interest in the present study. The mean age was 19.99 years (SD = 2.48). The majority identified their ethnicity as Caucasian (76%), followed by South Asian (7%), African American (7%), Chinese and Filipino (3%), Aboriginal (3%), West Asian (2%), South East Asian (1%), and other (1%).

Materials

Demographics questionnaire. (Appendix D). The demographics questionnaire was administered as part of the online questionnaire. It included questions to determine if the individual met eligibility criteria, such as age, as well information to allow for the description of relevant sample characteristics such as ethnicity and current relationship status.

Expansive versus contractive body language. A single-item question was used to rate body language as there is no psychometrically sound scale developed to measure this characteristic. Body language is typically coded for using single trait item questionnaires. Thus,

consistent with past literature, body language was measured using a Likert type scale with responses ranging from -3 (*closed*) to +3 (*expanded*) (Appendix E; Vacharkulksemsuk et al., 2016). In the study conducted by Vacharkulksemsuk and colleagues there was high interrater reliability ($\alpha = .78$) and in the current study high as well ($\alpha = .84$).

Physical attractiveness. (Appendix E). As there is no psychometrically sound measure established for physical attractiveness, the present study measured it the same way as Vacharkulksemsuk and colleagues (2016). Physical attractiveness was assessed using a two-item questionnaire rated on a scale ranging from 1 (*not at all*) to 9 (*extremely*). The two items included "How sexy/hot did you find the individual" and "How physically attractive did you find the individual". These two items combined have been shown to provide a highly reliable measure of physical attractiveness ($\alpha = .93$; Vacharkulksemsuk et al., 2016) In the present study the interrater coefficients were $\alpha = .80$ and $\alpha = .81$, respectively.

Rater desirability. Video tape raters answered "Yes" or "No" to the question "Hypothetically speaking, under the right circumstances (e.g., timing, availability, personal circumstances), I would be interested in going on a date with this individual" after viewing each video. The ratio of yeses to number of raters was used to create the variable "rater desirability" which is a proportion.

Other characteristics. The following items were also rated of the participants: "How dominant did you find the individual in the video" rated on a scale ranging from 1 (*not at all*) to 9 (*extremely*), this was an identical measure used in the study conducted by Vacharkulksemsuk and colleagues (2016); the valence, dominance, and arousal Self Assessment Manikin (SAM; Bradley & Lang, 2007); "Did the individual in the video make eye contact with the interviewer off camera to the left?" rated on a scale ranging from 1 (*not at all*) to 9 (*the whole time*); and

"How facially expressive did you find the individual in the video?" rated on a scale ranging from 1 (*not at all*) to 9 (*extremely*). While these items were not germane to the central hypotheses of the present study, they were deemed ancillary with regards to physical attractiveness and body language.

Video hosting technology. Videos were hosted on a private server and accessed through a password protected website via university computers at the Orillia campus. The videos hosted on the server were encrypted, guaranteeing that video raters were not able to copy or save the videos in any way.

Archival Materials

Mate Value Inventory (MVI; Kirsner, Figueredo, & Jacobs, 2003; Appendix F). The MVI comprises a list of 17 traits that are important in mate attraction (e.g., attractiveness, intelligence, health). Fisher and colleagues (2008; $\alpha = .83$) and Kirsner and colleagues (2003; $\alpha = .86$ - .93) found reliability of all versions of the MVI to be high. Convergent and discriminant validity were established through the prediction of assortative mating by mate value and differential exchange rates of mate value for different types of partners (Kirsner et al., 2003). The MVI was collected during the speed dating paradigm of Bailey (2017). Each participant rated their speed dating partner on the MVI at the end of each date. Responses range from -3 (*extremely low on this characteristic*) to +3 (*extremely high on this characteristic*). Mate value is the summed score of these, thereby possessing a theoretical range of -52 to +52.

Speed dating desirability. Desirability was operationally defined in a second way with regards to archival data collected during the speed dating paradigm, at the end of each date participants answered either "Yes" or "No" to the question "I wish to go on another date with

this partner". The number of yeses each participant received relative to the number of partners they dated was used to create the variable "partner desirability" which is a proportion.

Videos. Participants in the original Bailey (2017) speed dating study first attended a laboratory session to film two 5-min video clips. The first video clip recorded was of the participant talking about their past negative relationship experiences (Appendix G). The second video clip recorded was of the participant talking about their ideal relationship (Appendix H). For purposes of the present study, each of these recordings were parsed into three, 20-s soundless segments taken from the middle of the first minute, third minute, and fifth minute. This ensured that the participant's body language, attractiveness, and other characteristics would be rated at the beginning, middle, and end of each recording. To date there has been no research conducted investigating the optimal video viewing time when rating videos for body language. The 20-s video duration was therefore chosen for two practical reasons: to try to limit boredom effects of the video rater while viewing multiple silent videos; and to allow one video segment from each participant to be rated by each of the video raters. One hundred and ninety-six participants, each with two separate 5-min videos (negative relationship experiences and the ideal romantic relationship), totaling 392 videos, each parsed to create three, 20-s videos which calculates to 1,176 video segments to be rated. Video raters viewed only one of the six 20-s segments for each participant of the sex they choose to rate. The six 20-s segments were randomly assigned to one of six rating conditions. The order of the videos was then randomized for each condition, thus yielding six possible male conditions (96 videos to be rated per condition) and six possible female conditions (100 videos to be rated per condition). Video raters were randomly assigned to one of the six conditions when they signed up for the study. Twelve male raters participated in

the present study, meaning that each female condition was rated twice. Additionally, 30 female raters participated, allowing each male condition to be rated five times.

Electrocardiogram. Electrocardiogram (ECG) was measured using a 72-channel amplifier (Advanced Neuro Technology, Enschede, Netherlands), sampled at 1024 Hz. Participants were fitted with three electrodes with snap-on Ag-AgCI placed on skin cleaned with alcohol wipes. Electrodes were attached in a lead-II ECG configuration which consisted of the negative electrode applied one inch below the right clavicle and two inches from the armpit; the ground electrode opposite to the right electrode one inch below the left clavicle and two inches from the armpit; and the positive electrode one inch below the bottom of the ribcage on the left-hand side as per the electrode placement instructions (Appendix I). Raw ECG data was extracted and inspected using ASA-Lab software (Version 16; Advanced Neuro Technology, Enshede, Netherlands) and then imported into Kubios HRV specialized analysis software (Biosignal Analysis and Medical Imaging Group; http://kubios.uef.fi/; version 2.2) to derive $HFms^2$ (frequency band – spectral analysis divides it up into frequency bands – hertz (number of cycles per second)) as the metric of HRV. An eyes-closed baseline recording of HRV served as the measure of resting HRV. Resting HRV was used as the criterion variable *X* in mediation hypothesis 3.

ECG Recordings were visually inspected for ectopic heart beats. None of the participants' recordings breached the convention of five percent threshold for ectopic heart beats relative to total beats and all recordings were retained in the analyses. Using a fast Fourier transform (FFT) method, a distinct peak known as an R-spike was identified throughout the recording. Interval series between R-spikes were then calculated for each recording by power

spectrum density (PSD), yielding HF as a continuous measure of high frequency HRV expressed in absolute power (ms^2) within the band .15-.4.

Procedure

Data was collected in 3 phases: archival laboratory sessions, online questionnaires, and video rating sessions.

Phase 1: Archival Data

Laboratory session. This data was collected in 2014 – 2016 as part of the original Bailey (2017) speed dating study. Prior to the laboratory session participants were asked to refrain from eating and exercising for 2 hours, and drinking alcohol for 24 hours, as these variables have been shown to suppress HRV. First, the experimenter greeted participants who then reviewed and signed a hard copy of the consent form identical to the one they had previously signed electronically. Researchers then offered a brief explanation of the activities in which the participants would be engaging over the next 50 min and offered instructions for attaching the ECG electrodes. Participants attached the electrodes, the correct placement of which was checked by the experimenter before proceeding. Participants were then seated and asked to remain still during the ECG recordings. Participants sat quietly for 5 min with their eyes closed while HRV was recorded. This measurement will be used as the index of resting HRV.

Free speech task. Participants engaged in filming two short "dating videos" which served as the material to be rated by the video raters utilizing the video rating form in Appendix E in the third phase of the present study. The free speech task involved the participant being filmed while talking about, negative then positive relationship experiences. Participants were given 3 min to prepare for the free speech task as they were required to fill the full 5-min video

segment without stopping. During the preparation period, participants were given a sheet containing possible topics that they could choose to discuss (see Appendices G and H).

During the free speech task participants were seated in front of a video camera and the experimenter who was not visible on the video. Upon the signal of the experimenter, the participant began their monologue. If the participant finished before the end of 5 min, the experimenter told the participant how much time was still remaining. If the participant finished short of 5 min for a second time, the experimenter waited 3 s before prompting the participant with a question from the preparation sheet. The experimenter smiled and nodded but did not speak while the participant spoke during the free speech task.

Prior to recording the 5-min video clip, participants were informed that video raters would later review the videotapes to monitor both verbal and non-verbal behaviour and predict relationship success based on attributes observed in the video. At the end of the laboratory session participants were debriefed.

Speed dating session. After participating the laboratory session participants signed up for a speed dating session to occur days to weeks in the future. The speed dating events followed the procedure set out by Finkel and colleagues (2007) who set the standards for using speed dating as a tool for investigating relationship formation. Each speed date lasted 4 min during which time participants were free to engage in conversation. Each session lasted approximately 1.5 hours and consisted of 8-13 dates that occurred in quick succession with 2-min questionnaire periods directly after each speed date, during which each participant rated each partner on the MVI (Appendix F) and answered “Yes” or “No” to the question “I wish to go on another date with this partner”.

Phase 2: For the Present Study in 2018

Online questionnaires. Mass emails were sent out to all students at the Orillia campus of Lakehead University who had an account on Sona experiment manager system. Students were also recruited by word of mouth and classroom announcements. Thunder Bay campus Lakehead University students were excluded from being raters in the present study because the archival videos to be rated are of Thunder Bay campus students taken in 2014 – 2016. To eliminate the chance that students would be rating fellow classmates, only Orillia campus students rated these videos. The email directed potential participants to a brief online questionnaire securely hosted by SurveryMonkey. After following the link, participants began by reading and completing the Participant Information Letter and Consent Form. Participants signified their voluntary consent to participate by clicking a box at the bottom of the screen. Participants then completed the Demographics Questionnaire and indicated which gender they wished to view in the video clips (Appendix D). It should be noted that there was the option for males to rate males and females to rate females, however no participants selected same sex rating. Thus, only heterosexual rating occurred. The online questionnaire took on average 1 min to complete. Participants were then directed to sign up for a laboratory video rating session.

Phase 3: For the Present Study in 2018

Video rating session. A timeline of the experimental procedures is presented in Figure 3. First, the experimenter greeted participants and had them review the participant information letter and sign a hard copy of the consent form. Experimenters then offered a brief explanation of the activities the participants would be engaging in over the next 2 hours. Video raters were randomly assigned to a seat. Seats were staggered throughout the computer laboratory with a cardboard divider surrounding their computer work station to minimize distractions.

Video raters were instructed to view each 20-s video in its entirety and then complete the video rating form on the computer hosted on SurveyMonkey. While watching and rating each video participants were instructed to think of the participant in the video as a potential mate, regardless of whether they were single or in a romantic relationship, as well as regardless of whether they were interested in dating or not. Raters were not permitted to drink anything other than water or eat anything while viewing and rating the videos as research suggests that taste can alter romantic perceptions (Ren, Tan, Arriaga, & Chan, 2014). At the end of the video rating session participants were debriefed (Appendix J).

Results

Data Analytic Approach

The primary analytic techniques used for this study were negative binomial regression and parallel mediated ordinary least-squares regression. Negative binomial regression was used because the criterion *Y* variable in replication hypotheses 1 and 2 was count data; that is, participant and rater desirability defined as number of "Yeses" relative to number of partners or raters. Linear regression is not appropriate in the circumstances because linear regression assumes normality, linearity, and constant variance. Count data often violates these assumptions. For example, it is unlikely that the error will be normally distributed because count data can contain a value of zero and a transformation cannot be used to remedy the skew (Norušis, 2010). Additionally, a negative binomial regression was chosen over a Poisson regression for a few reasons. First, a Poisson distribution has an interesting property in which its mean is equal to its variance. The Poisson distribution assumes that all experimental units have the same probability of experiencing an event. However, with count data it is entirely possible that there is greater clustering within the dependent variable, consequently the mean of the distribution would no

longer be equal to the variance. When the variance is greater than the mean, the model is said to have overdispersion. The negative binomial regression allows for overdispersion, thus combating this drawback presented by a Poisson distribution. Furthermore, by using a negative binomial regression over a Poisson regression it forces the test to be more conservative by automatically setting the $\beta = 1$. A β of one adjusts the *SE* to make the tests of individual regression coefficients more conservative (Norušis, 2010).

Hypothesis 3 was tested using a parallel multiple mediation regression wherein predictor variable *X* is modeled as influencing the criterion variable *Y* directly as well as indirectly through two or more mediators *M* (Hayes, 2013). Specifically, hypothesis 3 tested whether the prediction of mate value *Y* from resting HRV *X* is mediated by body language $M_1$and physical attractivenessM_2. This parallel multiple mediation analysis was conducted using Hayes' (2013) PROCESS macro model 4. A distinct feature of a parallel mediation model is the constraint that no mediator is modeled as having influence on another mediator; this is visually represented in Figure 2 with the absence of any directional arrows linking the two mediators. However, this does not imply that the mediators are assumed to be independent and, in fact, in most cases are correlated. An important advantage to using a parallel mediation model over several simple mediations is the ability to compare the indirect effects through different mediators (Hayes, 2013).

Parametric assumptions. Data for all variables included in analyses were assessed for violations of parametric assumptions to ensure appropriate generalization of the findings. All continuous variables were assessed for normality using z_{skewness}, calculated as skewness / *SE*. Any z_{skewness} scores of 1.96 and above or below were considered significantly skewed at $p < .05$

(Field, 2013) and subsequently transformed. When a transformation remedied or significantly reduced the skew, the transformed variables were retained.

Hypotheses 1 and 2. Hypotheses 1 and 2 were tested using negative binomial logistic regression which does not require the same strict assumptions of normality that general linear models do. Independence of variables is still assumed; however, homoscedasticity is no longer assumed.

Variables were inspected to confirm that the mean was not equal to the variance for the predictor variable, thereby eliminating a Poisson regression. Cook's distance was examined for each negative binomial regression. A Cook's distance score exceeding 1 is said to have an undue influence on the model and it is suggested that the score in question be removed and the analysis rerun. In theory, if the results stay the same then the score(s) were not exerting undue influence. However, if the results differ appreciably then the score should not be included in the final analysis (Field, 2013). No value of Cook's distance greater than 1 was detected in the current dataset. Goodness of fit for a model can be examined when the scale parameter is estimated by the deviance divided by its degrees of freedom (value/df); additionally, by inspecting the Alaike's information criterion (AIC) and Bayesian information criterion (BIC; Norušis, 2010, p.257). Lower values on all the aforementioned variables indicate a better model fit.

Hypothesis 3. Parallel mediation, which was used to test Hypothesis 3, like any linear model, requires that the assumption of normality, additivity and linearity, homogeneity of variance, and independence of errors must be met.

SPSS PROCESS macro model 4 was used to test this hypothesis (Hayes, 2013). This model can test up to 10 mediators in parallel. The goal of mediation analysis is to establish the intervening variable(s), or mediator(s) *M*, through which *X* exerts is effects on *Y* (Hayes, 2013).

These models employed the ordinary least squares method to estimate unstandardized regression path coefficients (β), standard errors (*SE*), and 95% confidence intervals (95% CIs) for each hypothesized path. Statistical significance of the indirect effects was determined using bootstrapping to construct the sampling distribution with 10,000 replications along with bias-corrected 95% confidence intervals.

The assumption of linearity was tested by checking that the continuous variables were linearly related to the log of the outcome variables; i.e., the linearity of the logit. Nonsignificant interactions were found between each of the predictors and their logs which indicated linear relationships (Hayes, 2013). The assumption of homoscedasticity of residuals assumes that the variance of the outcome variable is stable at all levels of the predictor variable (Field, 2013). As suggested by Aguinis (2004), scatterplots were visually inspected and revealed no violations of the assumption of homoscedasticity. Linear regressions using the variables were produced to test the multicolinearity assumption. All tolerance statistics had values over 0.1 and VIF values well below 10 which indicated that there were no multicolinearity concerns (Field, 2013). Residuals were also investigated to isolate points for which the model may fit poorly or that exert an undue influence on the data.

Independence of errors can be assessed statistically using the Durbin-Watson test. This test identifies any serial correlations between errors (Field, 2013). For the main analyses in the present study, the Durbin-Watson tests did not identify any concerns that the assumption of independence of error had been violated. Therefore, the theoretical concerns over lack of independence were assuaged by the finding of statistical independence of errors.

Data Preparation

Data was entered into SPSS v. 25. Interrater reliability was calculated between video raters using intraclass correlation (ICC). Technical errors rendered eight HRV recordings across four participants unusable; these participants were dropped from all analyses. There was no missing data from the psychometric video-rated variables. However, 18% of items of the MVI were left blank during the speed dating session[1]. These missing values were prorated for each individual from the data provided by other speed dating partners and then summed. An average score was created across video raters for each condition and then one average score was taken across all conditions to create the final variables used for analyses. Interrater reliability was calculated using intraclass correlation coefficients (ICC). Values less than .50 indicate poor reliability, values between .50 and .75 are indicative of moderate reliability, while values between .75 and .90 indicate good reliability, and values greater than .90 indicate excellent reliability (Koo & Li, 2016). Typically, ICC scores of .75 or higher are considered acceptable (Shrout & Fleiss, 1979). Intraclass correlations were examined between raters across each condition, all of which fell in the moderate to good reliability range. Final item scores were then averaged across all conditions (see Table 1). Only two ICC values fell below the acceptable range of .75, "single item dominance" and "SAM: dominance"; neither of which are germane to the present study.

Rater variables. Descriptive information, correlations, and interrater reliability are presented in Table 1. Variables "sexy hot" and "single-item physical attractiveness" were

[1] The large number of items left blank may have resulted from the fast-paced and distraction-rich speed dating environment. Participants only had 2 min to complete the IR and did so sitting across from their next speed dating partner. The dates were back to back with no breaks in between except the time to complete the IRs. This issue should be addressed in future speed dating studies.

averaged to create physical attractiveness given they were rated on the same Likert type scale and their high correlation of $r = .98$. Similar averaging across items was conducted to create the variables dominance (items single-item dominance and SAM: dominance; $r = .92$) and expressiveness (facial expression and SAM: arousal; $r = .89$). The correlation matrix including these new collapsed variables is presented in Table 2. $Z_{Skewness}$ was calculated to determine the skew of each variable wherein +/-1.96 represented significant skew (Field, 2013). Physical attractiveness exceeded this cutoff and was therefore subjected to the square root transformation, which produced a $z_{Skewness} = 1.76$, thereby remedying the skew. This transformed variable was used in all further analyses. Rater desirability also exceeded this cutoff, however no transformation could be performed as this variable represents count data that may include a value of zero. All variables were examined for univariate outliers defined as $z = \pm 3.29$ (Field, 2013). A single outlier was detected for expressiveness which was remedied using the Wnsorized method of replacement (Field, 2013). With regards to rater desirability, on average, women were chosen by 24% of men ($SD = 20\%$), and men were chosen by 29% of women ($SD = 23\%$).

Hypothesis Testing

Hypothesis 1. The first *replication* hypothesis predicted that participants displaying more expansive body language (*X*) would be given a higher rater desirability score (*Y*). To examine this prediction a negative binomial regression was performed. Results indicated that body language significantly predicted rater desirability (see Table 3). Graphical representation of this relationship is displayed in Figure 4. To enhance interpretability of this relationship, an incident rate ratio is represented as $Exp(\beta) = 1.54$, meaning that for every one-unit increase in expansive body language there is an increase in log counts of 54% in the criterion variable rater desirability (Norušis, 2010).

The same negative binomial regression model was tested using partner desirability as the criterion, the results of which were statistically significant (see Table 4 and Figure 5). With the obtained $Exp(\beta) = 1.20$, this means a one-unit increase in expansive body language according to raters is associated with a 20% increase in partner desirability. To summarize, expansive body language, as evidenced in short, silent video clips, significantly predicts both laboratory-based objective raters' and speed dating partners' impressions of the desirability of participants.

Hypothesis 2. The second *replication* hypothesis predicted that participants rated as more physically attractive (*X*) would be given a higher rater desirability score (*Y*). A negative binomial regression was performed to investigate this hypothesis. Results indicated that physical attractiveness significantly predicted rater desirability (see Table 5). A graphical representation of this relationship is displayed in Figure 6. Unlike the previous analyses, it was not possible to extrapolate an odds ratio because the independent variable physical attractiveness was transformed using the square root transformation. The same analysis was also performed using partner desirability as the criterion, the results of which were statistically significant (see Table 6 and Figure 7). To summarize, physical attractiveness, as evidenced in short, silent video clips, significantly predicts both laboratory-based objective raters' and speed dating partners' impressions of the desirability of participants.

Hypothesis 2 exploratory follow-up analysis. To follow-up on the results of hypothesis 2, an exploratory negative binomial regression was run with rater desirability as the criterion (*Y)* and using the predictor variable of MVI: physical attractiveness (*X*), which is the sum of two attractiveness items from the MVI completed by speed dating partners (see Table 7). Recall that the MVI is comprised of 17 items; two of the items are attractive face and attractive body; these two items were combined to create MVI: physical attractiveness (physical attractiveness rated by

the speed dating partners). The analysis resulted in $Exp(\beta) = 1.85$, which means that for every one-unit increase in MVI: physical attractiveness there is an 85% increase in rater desirability. The correlation between the two physical attractiveness variables (physical attractiveness and MVI: physical attractiveness) was $r = .53$. In summary, not only is physical attractiveness as rated in a laboratory setting able to predict how desirable an individual is in a real life speed dating session, physical attractiveness rated during a real life interaction is able to predict rater desirability during a 20-s soundless video clip.

A negative binomial regression was then performed to include both expansive body language and physical attractiveness in the prediction of rater desirability and partner desirability (see Tables 8 & 9); both of which were statistically significant, meaning that a model including both variables better accounted for the criterion variable than either model including only a single predictor variable.

Another negative binomial regression was also investigated which included body language, physical attractiveness, and sex, as well as the body language × sex interaction, and physical attractiveness × sex interaction. Sex was not a significant predictor of rater desire or partner desirability nor was there a significant sex interaction effect (see Table 10 & 11). Therefore, sex did not have a significant moderating effect on either of the relationships observed. The regression model that included both body language and physical attractiveness was chosen as the final model based on fit statistics; the value/df = 1.53 for the model including body language and physical attractiveness is less extreme than the value/df = 5.40 for the regression including only body language or the value/df = 1.70 for the regression including only physical attractiveness. To summarize, body language when taken together with physical attractiveness, as evidenced in short, silent video clips, has the most significant predictability for

both objective raters' and potential romantic partners' impressions of the desirability of participants.

Hypothesis 3. The *mediation* hypothesis predicted that expansive body language (M_1) and physical attractiveness (M_2) would mediate the relationship between resting HRV (X) and mate value (Y). These two potential mediating variables were tested in a parallel mediation model (Figure 8) using Hayes' Process Macro model 4 (Hayes, 2013). The indirect effect of resting HRV (X) on mate value (Y) through body language (M_1) was not significant, $a_1b_1 = .016$, $p = .797$. A significant indirect effect was found for resting HRV (X) on mate value (Y) through physical attractiveness (M_2), $a_2b_2 = .304$, $p < .01$. The direct effect of X on Y was not significant, $c' = .731$, $p = .051$. Thus, results indicate that physical attractiveness is a mediating variable for the HRV – mate value link while expansive body language is not.

Hypothesis 3 exploratory follow-up analysis. Based on the results from hypothesis 3, a second parallel mediation model was run using a slightly altered mate value variable. Again recall that the criterion variable in hypothesis 3 was mate value, which was operationalized as the total score on the MVI. The MVI is comprised of 17 items; two of those items refer to physical attractiveness (attractive face and attractive body) while the other items refer to psychosocial features which may be physically unobservable (e.g., emotional stability, desires to have children, financial stability). Therefore, to ensure that the findings were not confounded by the overlap between the physical attractiveness items in the MVI and the variable of physical attractiveness, the hypothesis 3 analyses were rerun using a mate value total score for only the 15 psychosocial items "MVI:15"; the two attractiveness items on the MVI were excluded (see Figure 9). Removing these two attractiveness items did not significantly alter the results of the

parallel mediation model which supports the finding that physical attractiveness mediates the link between resting HRV and mate value.

Discussion

There were two primary purposes of the present study; the first was to replicate key findings reported by Vacharkulksemsuk and colleagues (2016) and Joel and colleagues (2017) that physical attractiveness and expansive body language both predict desirability, while also filling the gaps identified in the current literature. This objective was explored in replication hypotheses 1 and 2, as well as during exploratory analyses. The second objective was to replicate and extend the findings reported by Bailey (2017) to determine if physical attractiveness and expansive body language served as mediators in the HRV – mate value link. This objective was explored in mediator hypothesis 3 and exploratory follow-up.

Hypotheses

Replication hypothesis 1. As predicted in the first replication hypothesis, the current study found that higher levels of expansive body language predicted desirability. This model replicated the findings of Vacharkulsemsuk and colleagues (2016) as well as filled the gaps in the literature by isolating body language without the influence of variables such as conversation topic, mutual interests, and personality. Importantly, the dynamic interplay of movement that occurs during a real-life dating scenario was still captured by utilizing soundless dating videos. Furthermore, the present study was able to replicate these findings while using the correct data analytic approach, negative binomial regression, rather than ordinary least squares regression. Ordinary least squares regression, which was used inappropriately by Vacharkulsemsuk and colleagues (2016), cannot be used when working with count data because the data often violates the primary assumptions of normality, linearity, and constant variance.

The results of hypothesis 1 are consistent with the past finding that individuals who engage in expansive body language experience feelings of power (Cesario, Jonas, & Carney, 2017). In addition, expansive body language has also been shown to positively effect emotions, affect, self-evaluations, and attitudes (Jonas et al., 2017; Keltner, Gruenfeld, & Anderson, 2003). All of the aforementioned studies display strong evidence of the positive and long-lasting effects of expansive body language (Cuddy, Schultz, & Fosse, 2018). Further support can be found in Table 2 where expansive body language is shown to correlate significantly with dominance r = .84, valence r = .72, and expressiveness r = .76. Individuals using expansive body language would therefore feel more powerful, have improved emotions, affect, and self-evaluations and thus appear more desirable to partners, which was apparent during both 20-s soundless video clip and also during speed dating sessions. The significant findings across both the laboratory-based ratings of desirability and the ratings by speed dating partners speak to the robustness of these results. If your body language is expansive in the laboratory, then you are more desirable to those who are rating you in a controlled laboratory-based environment and also to real potential partners after a 4-min date.

These findings may have potential implications for researchers, dating application and website developers, and individuals interested in maximizing their mating potential. Programs could be developed and put in place to teach individuals how to be more expansive. For example, workshops that teach the art of expansive body language or a cellphone application that has tutorials and daily reminders to be expansive. Dating websites and applications may consider including a brief explanation of expansive body language and the importance of selecting a profile picture displaying expansiveness when members are creating dating profiles. Simple changes such as these have the possibility of increasing individuals' initial desirability, and since

technology has made initial impressions even more important, potentially increasing relationship success.

Replication hypothesis 2. Consistent with replication hypothesis 2, higher physical attractiveness was found to predict higher desirability. This model not only replicated Joel et al.'s (2017) findings, but also extended them by including a measure of physical attractiveness that was not self rated. This is the first study to this writer's knowledge to examine physical attractiveness in the prediction of desirability that used other-reported measures of physical attractiveness. Individuals often are not accurate in their self-assessment of physical attractiveness, regularly overvaluing or undervaluing themselves depending on factors such as personality characteristics, sociosexuality (Back et al., 2011), mental health (Kirsner et al., 2003), and self-esteem (Kavanagh, Robins, & Ellis, 2010). Individuals who overvalue themselves usually end up pursuing mates far above what is personally realistic. From an evolutionary perspective these individuals would end up wasting time and resources courting unattainable individuals. Conversely, individuals who undervalue their physical attractiveness end up pursuing individuals far below what they could realistically attain and thus do not maximize their reproductive potential (Buston & Emlen, 2003; Kavanagh et al., 2010; Penke, Todd, Lenton, & Fasolo, 2007). Thus, physical attractiveness measures should not solely rely on self-report and, as done in the current study, should instead employ third party raters to obtain a more accurate and objective measure of physical attractiveness.

Again, these findings have implications related to dating websites and applications. Dating websites such as Plenty of Fish and Match.com place a high emphasis on the written portion of the dating profile and even allow members to go without a profile photo. The findings

from the present study would indicate that the profile photo is an integral aspect of a dating profile, at least for initial romantic attraction.

Replication hypothesis 2 exploratory follow-up. Exploratory analyses uncovered further support for the role of physical attractiveness in the prediction of desirability. It was found that physical attractiveness rated in a speed dating session by actual potential romantic partners was able to predict the desirably of a rater viewing a 20-s soundless video clip in a laboratory setting. Additionally, it was found that sex was not a moderating variable. This goes against previous research that suggests men place a higher importance on physical attractiveness, while women are more interested in earning potential, security, and dominance (Pawłwski & Dunbar, 1999; Regan, 1998). Because sex did not have a moderating effect on the relationship, it suggests that there is not a significant discrepancy between the importance men and women place on physical attractiveness when selecting a romantic partner.

Mediation hypothesis 3. Hypothesis 3 sought to contrast two competing mediating variables against each other to investigate which would surmount the other. Specifically, body language and physical attractiveness were tested as parallel mediating variables of the HRV – mate value link. Physical attractiveness was the variable that prevailed, while body language was unable to reach statistical significance. The generalized unsafety theory of stress (GUTS) provides theoretical backing as to how physical attractiveness has come to act as a mediator of the resting HRV – mate value link. Chronic anxiety, lack of social skills and support, obesity, and poor physical health are all consequences of generalized unsafety; all of which are unattractive characteristics in the mating marketplace. Patterns of high generalized unsafety and its physiological index of low resting HRV are hypothesized to be present at birth and are further shaped and exacerbated by life experiences (Brosschot et al., 2016). Poor physical health and

obesity decrease an individual's physical attractiveness. Thus, the current findings that individuals with low resting HRV are rated as less attractive and, in turn judged as having lower mate value, is consistent with the GUTS. These physically observable traits also help to explain why individuals with higher resting HRV are sought after in a mating marketplace despite the inability of a potential romantic partner to actually observe another's HRV. Thus, it is conceivable based on the present findings that physical attractiveness may serve as a proxy for the biological marker of HRV.

Hypothesis 3 also investigated a second potential mediator, expansive body language. The polyvagal theory proposes that the ventral vagal complex controls the social engagement system which facilitates courting and seduction (Porges, 1995, 1998). The social engagement system, which can be indexed by HRV, affects romantic relationship formation and attraction through its control over behaviours and other signals of availability and interest that are crucial in attracting a partner (Porges, 1995, 1998). As found in replication hypothesis 1, expansive body language increases the desirability of an individual which should facilitate romantic relationship formation; however, expansive body language was not found to mediate resting HRV – mate value link. Expansive body language may not fall under the courting and seduction signals that are controlled by the social engagement system. Another potential explanation for the lack of significant findings may have to do with the stressor used during the video recordings, the Trier Social Stress Test (TSST).

The TSST consists of a brief preparation period followed by a test period in which the subject has to deliver a speech in front of an audience and/or video camera (Kudielka et al., 2007). In the present study, the task was modified to include relationship-relevant content. Participants were filmed to create a "dating video". These video dating profiles were meant to

mimic the videos often found on online dating profiles and are structured similarly to a speed date (albeit one-sided). Because the videos were not interactive, it may have prevented the social engagement system from activating and stopped courting behaviours and potentially expansive body language from being fully expressed.

Strengths, Limitations, and Future Directions

There present study had a number of notable methodological strengths. A multi-method data collection strategy was used which combined objective physiological recordings as well as psychosocial other-reported measures. The dependent variable was also measured in two ways; one utilizing a controlled yet ecologically valid method which utilized real world dating interactions, and another laboratory-based method that was able to control for many confounding variables. Additionally, the present study was able to maintain independence of the predictor, dependent, and mediating variables by ensuring that the data for each were collected at different time periods and within different research modalities. Furthermore, the present study was able to replicate previous research findings while also filling in many methodological gaps. For example, topic of conversation, mutual interests, and personalities were eliminated from the ratings on body language and physical attractiveness. This was also the first study to date in the realm of desirability research to measure physical attractiveness using an other-reported measure rather than a self-reported one.

Nonetheless, the study was not without limitations. First, the dating videos that were rated depicted the individual sitting at a table, thus only from the waist up was visible. Forthcoming research should attempt to capture the entire body as body language can be expressed throughout the body. Furthermore, physical attractiveness is also evidenced across the entire body.

The second limitation regards the design of the study; because this study was not a true experiment and did not experimentally manipulate the variables of interest, a true mediation model cannot be claimed by way of cause and effect. Based on all the findings from the current study a mediation model is supported, however, physical attractiveness may simply be a covariate rather than a true mediator. Researchers should be wary about claiming absolute mediation in models where the study design is anything other than a true experiment.

Finally, three 20-s video clips were taken from each of the negative and positive dating videos. These six videos per participant were later randomly assigned to one of six rating conditions and then the order of videos was randomized. This method used for randomization made it impossible to tease apart the negative video ratings from the positive video ratings. This can be taken both as a strength and a weakness. A person's body language and physical attractiveness can be altered based on their emotional state; thus, the body language – desirability link and physical attractiveness – desirability link examined may have been even stronger if the videos could have been teased apart and hypotheses analyzed separately for positive and negative videos. On the other hand, the findings have more generalizability as they were investigated across both positive and negative emotional states.

The current findings can be used to inform many lines of future research and serve as a starting point for various new areas of study. One such line of research would be investigating relationship success and longevity in association with body language and physical attractiveness. The present study suggests that more expansive body language and physical attractiveness leads to higher desirability. Further studies should examine these findings in a longitudinal design collecting data regarding relationship formation and the quality and duration of the relationships.

Additionally, while altering an individual's physical attractiveness is by no means easy or feasible in a research context, future research investigating physical attractiveness should explore ways to increase the accuracy of self-perception. Mating endeavors are guided by self-perception, thus having a more accurate evaluation of one's self would help to maximize relationship attempts.

Another interesting extension of this study would be the inclusion of an experimental group that received expansiveness body language training. By doing so, a causal relationship between body language and desirability may be supported. Moreover, if body language training was effective in increasing desirability and subsequently relationship formation, it may also be effective in decreasing loneliness and conserving time and resources that may have been unsuitably invested into relationship endeavors.

Lastly, a longitudinal research design could be implemented to investigate the course of an individuals HRV; measuring HRV in infancy and across the lifespan to see how it predicts physical attractiveness in later years.

Conclusions

The present study was embarked upon to predict the desirability of an individual during initial romantic interaction based on their body language (Vacharkulksemsuk et al., 2016) and physical attractiveness (Joel et al., 2017). Both body language and physical attractiveness were found to positively predict desirability. These findings further add to the growing literature on the variables necessary for romantic attraction. Investigating key aspects of desirability are integral in today's society with the increased popularity of online dating and speed dating. Knowing how to optimize chances of desirability will help individuals to maximize their

investment in the mating marketplace. Expansive body language and looking your best in a profile picture will increase success in finding romance.

Secondly, body language and physical attractiveness were investigated as possible mediating variables which may be responsible for the findings reported by Bailey (2017). Bailey had reported that HRV predicted participants' mate value as rated by their speed dating partners. While body language was ruled out, physical attractiveness may be the underlying mechanism responsible for this link. This finding helps to clarify how a desirable but seemingly undetectable physiological trait can be selected for and sought after in romantic efforts.

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Table 1

Correlation Matrix, Reliability Coefficients, and Descriptive Statistics of the Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Body language	—											
2. Sexy hot	.20*	—										
3. Single-item physical attractiveness	.23*	.98*	—									
4. Single-item dominance	.83*	.45*	.49*	—								
5. SAM: valence	.72*	.38*	.40*	.64*	—							
6. SAM: arousal	.76*	.26*	.29*	.66*	.91*	—						
7. SAM: dominance	.82*	.37*	.39*	.92*	.70*	.72*	—					
8. Eye contact	.74*	.16*	.18*	.62*	.64*	.63*	.61*	—				
9. Facial expression	.73*	.35*	.35*	.67*	.89*	.90*	.71*	.73*	—			
10. Rater desirability	.35*	.88*	.92*	.57*	.51*	.42*	.49*	.27*	.45*	—		
11. Mate Value Inventory	.24*	.39*	.43*	.35*	.32*	.26*	.33*	.11	.26*	.41*	—	
12. Resting heart rate variability	.04	.14	.16*	.07	.02	-.02	.00	.09	-.03	.15*	.20*	—
M	-0.1	2.76	3.31	3.62	5.30	4.70	4.54	4.13	4.03	.29	23.89	6.63
SD	1.2	1.54	1.76	1.71	1.39	1.47	1.49	1.73	1.71	.31	6.15	1.12
Skew	.20	4.48	3.50	1.58	-.30	1.78	-.48	.16	1.22	5.36	-1.16	-1.45
ICC	.84	.80	.81	.73	.83	.79	.72	.77	.82	—	—	—

Note: SAM = Self Assessment Manikin; ICC = intraclass correlation. $N = 192$ except correlations including Mate Value Inventory where $N = 162$. *$p < .05$.

Table 2

Correlation Matrix and Descriptive Statistics of the New Collapsed Variables

Variable	1	2	3	4	5	6	7	8	9	10
1. Sex	—									
2. Body language	-.13	—								
3. Physical attractiveness	.11	.21*	—							
4. Dominance	-.15*	.84*	.44*	—						
5. SAM: valence	.01	.72*	.39*	.68*	—					
6. Expressiveness	.05	.76*	.33*	.72*	.92*	—				
7. Eye contact	.12	.74*	.17*	.63*	.64*	.70*	—			
8. Rater desirability	-.12	.33*	.84*	.49*	.48*	.41*	.28*	—		
9. Mate Value Inventory	-.09	.24*	.41*	.35*	.32*	.26*	.11	.49*	—	
10. Resting heart rate variability	-.11	.04	.15*	.04	.02	-.02	.09	.18*	.20*	—
M	—	-0.1	3.17	2.95	5.30	4.40	4.13	.29	6.15	1.12
SD	—	1.2	1.21	.84	1.39	1.02	1.73	.31	-1.16	-1.45
Skew	—	0.20	4.0	.56	-0.30	1.33	0.16	5.36	-1.16	-1.45

Note: SAM = Self Assessment Manikin. $N = 192$ except correlations including Mate Value Inventory where $N = 162$. *$p < .05$.

Table 3

Negative Binomial Regression of Rater Desirability on Body Language

Variable	Wald Chi-Square	*df*	*p*	*Exp(β)*	95% Wald CI for Exp(*β*)	
					Lower	Upper
Body language	131.47	1	.001	1.54	1.43	1.66

Note: Fit statistics for this model are *Value/df* = 5.40, *AIC* = 1583.05, *BIC* = 1595.90. *N* = 192

Table 4

Negative Binomial Regression of Partner Desirability on Body Language

Variable	Wald Chi-Square	*df*	*p*	*Exp(β)*	95% Wald CI for *Exp(β)*	
					Lower	Upper
Body language	9.63	1	.01	1.20	1.10	1.34

Note: Fit statistics for this model are *Value/df* = 4.24, *AIC* = 1016.47, *BIC* = 1027.17. *N*= 162

Table 5

Negative Binomial Regression of Rater Desirability on Physical Attractiveness

Variable	Wald Chi-Square	df	*p*	*Exp(β)*	95% Wald CI for *Exp(β)*	
					Lower	Upper
Physical attractiveness	668.58	1	.001	22.96	18.10	29.11

Note: Fit statistics for this model are *Value/df* = 1.70, *AIC* = 879.82, *BIC* = 892.67. *N* = 192

Table 6

Negative Binomial Regression of Partner Desirability on Physical Attractiveness

Variable	Wald Chi-Square	*df*	*p*	*Exp(β)*	95% Wald CI for *Exp(β)*	
					Lower	Upper
Physical attractiveness	166.10	1	.001	9.76	6.90	13.81

Note: Fit statistics for this model are *Value/df* = 3.11, *AIC* = 834.12, *BIC* = 844.82. *N* = 162

Table 7

Negative Binomial Regression of Rater Desirability on MVI:Physical Attractiveness

Variable	Wald Chi-Square	*df*	*p*	*Exp(β)*	95% Wald CI for *Exp(β)*	
					Lower	Upper
MVI:Physical attractiveness	260.85	1	.001	1.85	1.72	1.99

Note: $N = 162$

Table 8

Negative Binomial Regression of Rater Desirability on Body Language and Physical Attractiveness

Variable	Wald Chi-Square	*df*	*p*	*Exp(β)*	95% Wald CI for *Exp(β)*	
					Lower	Upper
Body language	33.62	1	.001	1.27	1.17	1.37
Physical attractiveness	599.11	1	.001	20.13	15.83	25.61

Note: Fit statistics for this model are *Value/df* = 1.53, *AIC* = 847.72, *BIC* = 866.99. *N* = 192

Table 9

Negative Binomial Regression of Partner Desirability on Body Language and Physical Attractiveness

Variable	Wald Chi-Square	*df*	*p*	*Exp(β)*	95% Wald CI for *Exp(β)*	
					Lower	Upper
Body language	0.09	1	.763	1.02	.90	1.15
Physical attractiveness	158.37	1	.001	9.66	6.78	13.75

Note: Fit statistics for this model are *Value/df* = 3.12, *AIC* = 836.03, *BIC* = 852.08. *N* = 162

Table 10

Negative Binomial Regression of Rater Desirability from Body Language, Physical Attractiveness, and Sex

Variable	Wald Chi-Square	*df*	*p*	*Exp(β)*	95% Wald CI for *Exp(β)*	
					Lower	Upper
Sex	.14	1	.712	1.20	.46	3.15
Physical attractiveness	203.85	1	.001	19.67	13.07	29.60
Body language	3.54	1	.060	1.20	.99	1.46
Sex × Physical attractiveness	.39	1	.533	1.18	.71	1.95
Sex × Body language	.00	1	.966	1.01	.81	1.24

Note: Fit statistics for this model are *Value/df* = 1.55, *AIC* = 850.43, *BIC* = 868.98. *N* = 192.

Table 11

Negative Binomial Regression of Partner Desirability from Body Language, Physical Attractiveness, and Sex

Variable	Wald Chi-Square	*df*	*p*	*Exp(β)*	95% Wald CI for *Exp(β)*	
					Lower	Upper
Sex	.49	1	.485	.63	.17	2.31
Physical attractiveness	61.60	1	.001	9.14	5.26	15.89
Body language	4.13	1	.042	1.28	1.01	1.61
Sex × Physical attractiveness	.10	1	.751	1.13	.54	2.32
Sex × Body language	4.26	1	.039	.75	.57	.99

Note: Fit statistics for this model are *Value/df* = 3.13, *AIC* = 837.69, *BIC* = 865.79. *N* = 162.

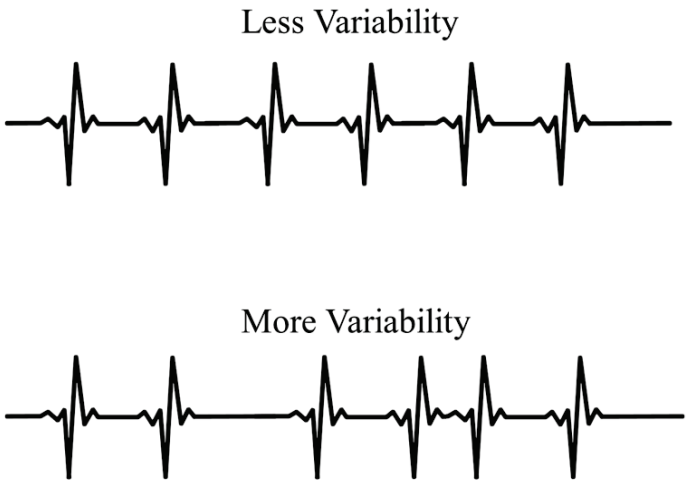


Figure 1. A pattern of heart beats with less (above) and more (below) variability. The bottom image depicts higher HRV.

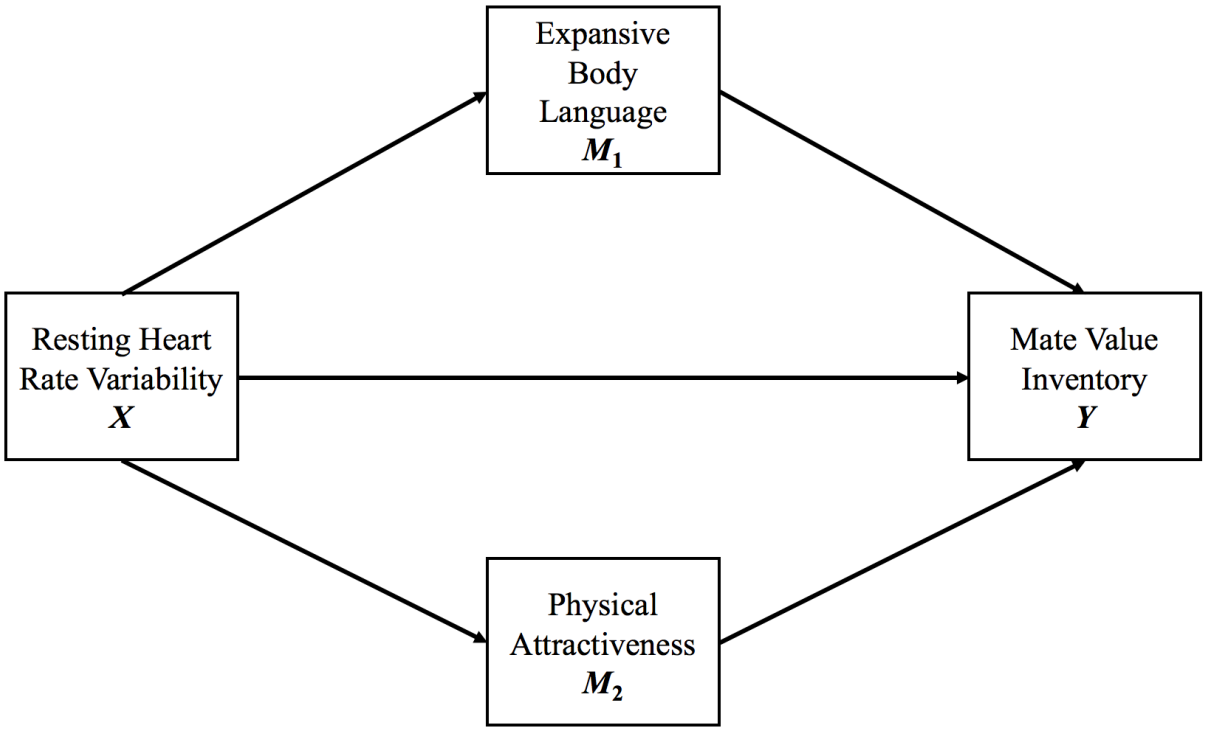


Figure 2. Conceptual model of the parallel multiple mediating effect of expansive body language and physical attractiveness on the relationship between resting heart rate variability and mate value.

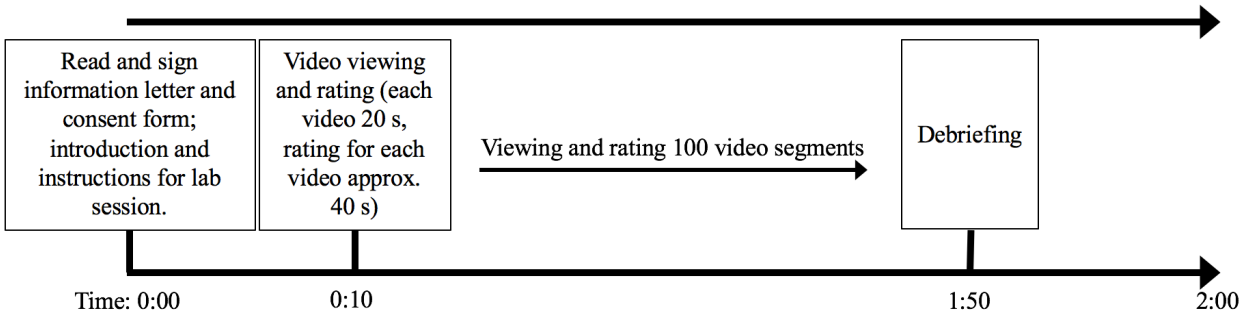


Figure 3. Timeline of activities during the video rating session.

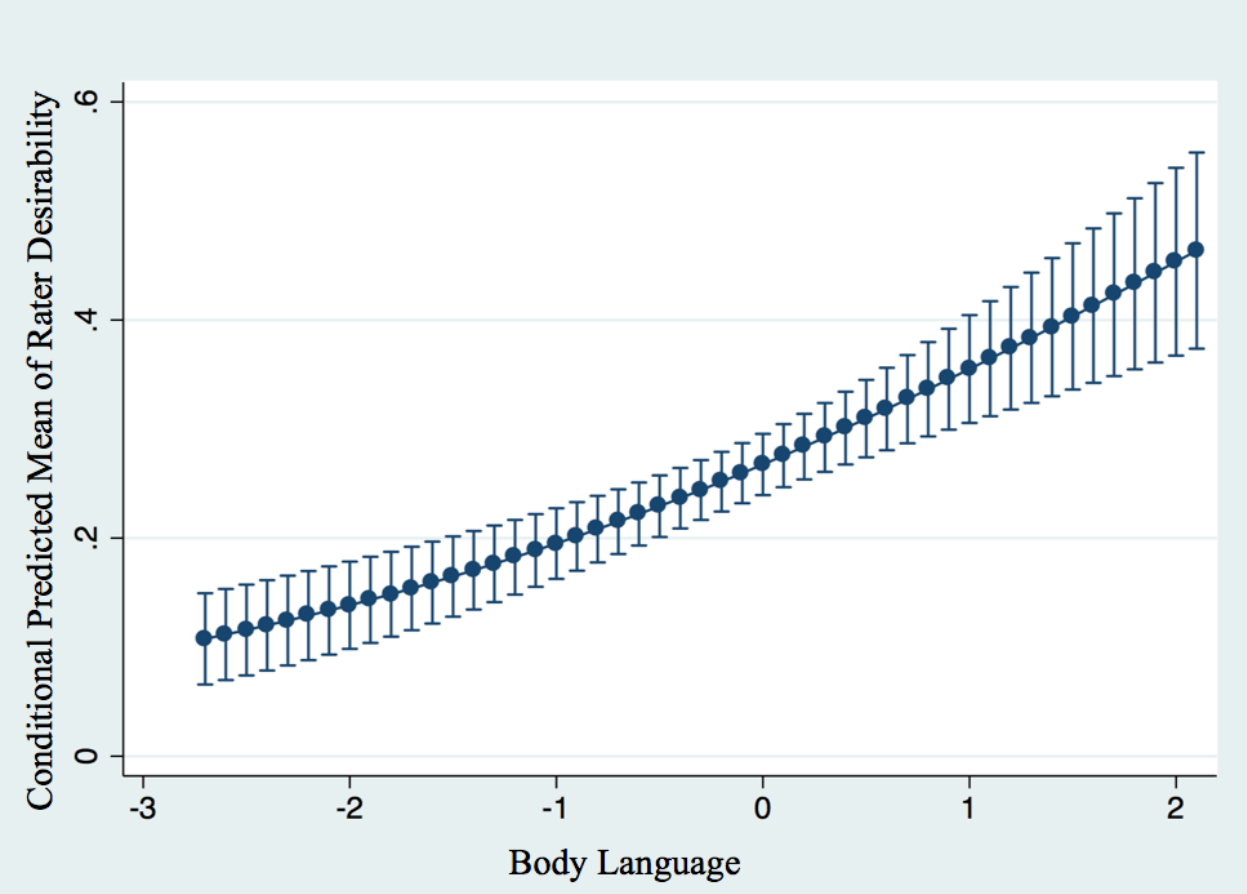


Figure 4. Conditional mean of rater desirability (95% CIs) at mean centered values of body language where higher values are more expansive.

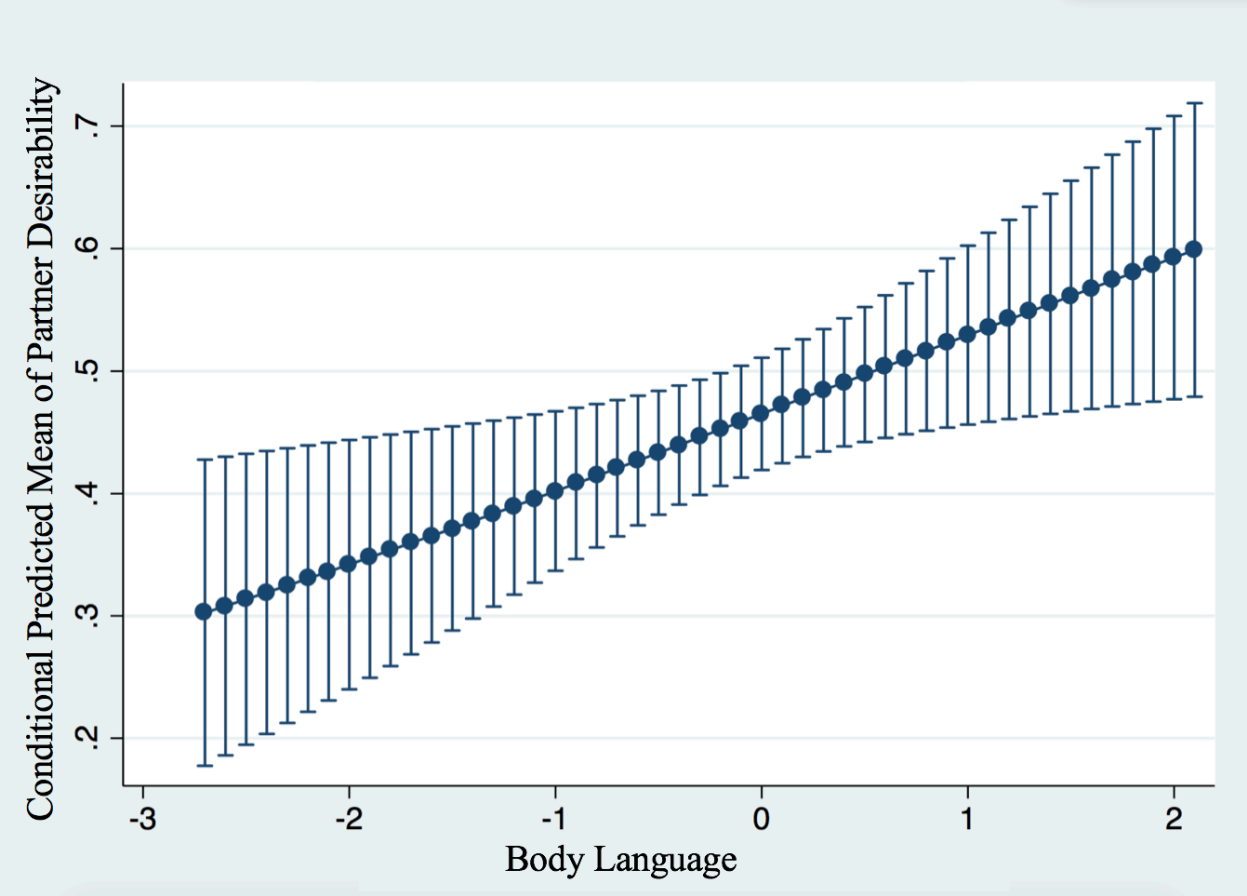


Figure 5. Conditional mean of partner desirability (95% CIs) at mean centered values of body language where higher values are more expansive.

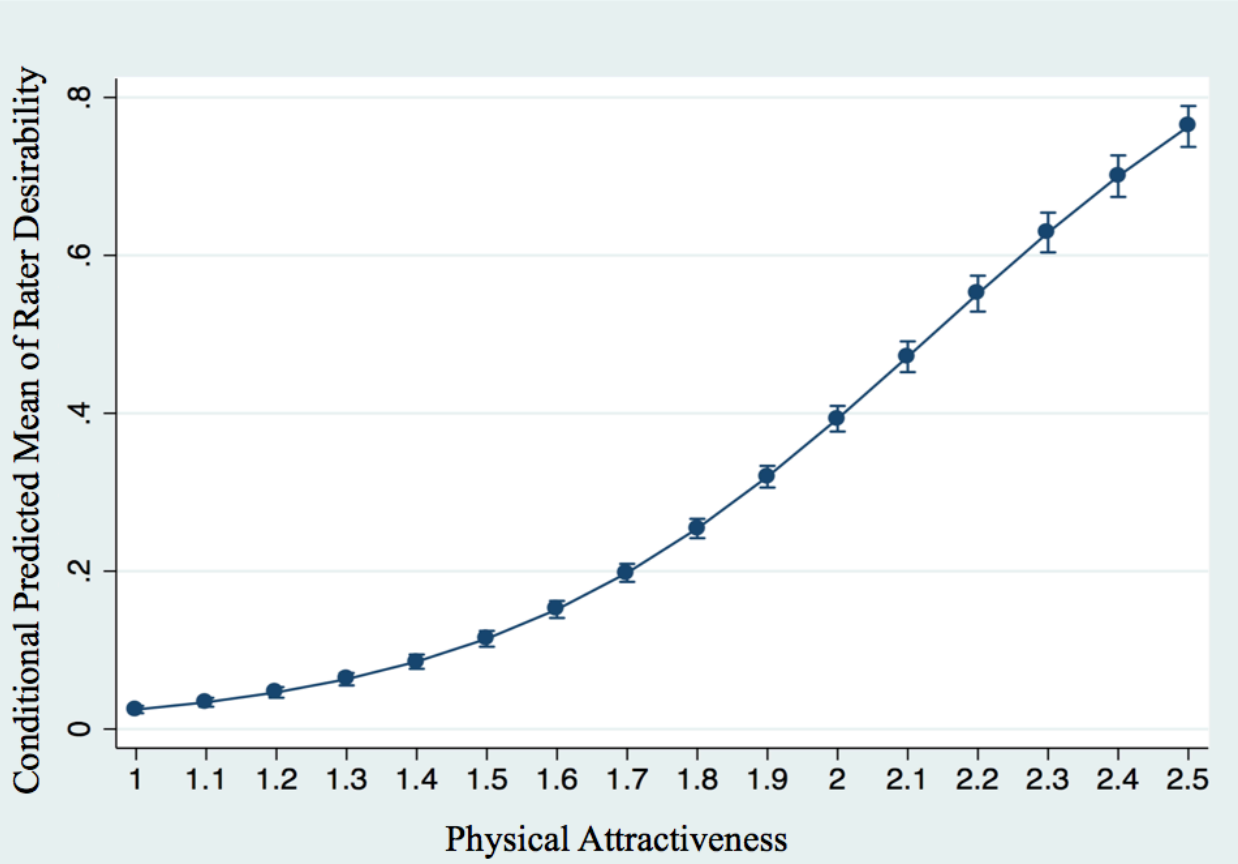


Figure 6. Conditional mean of rater desirability (95% CIs) at square-root transformed values of physical attractiveness.

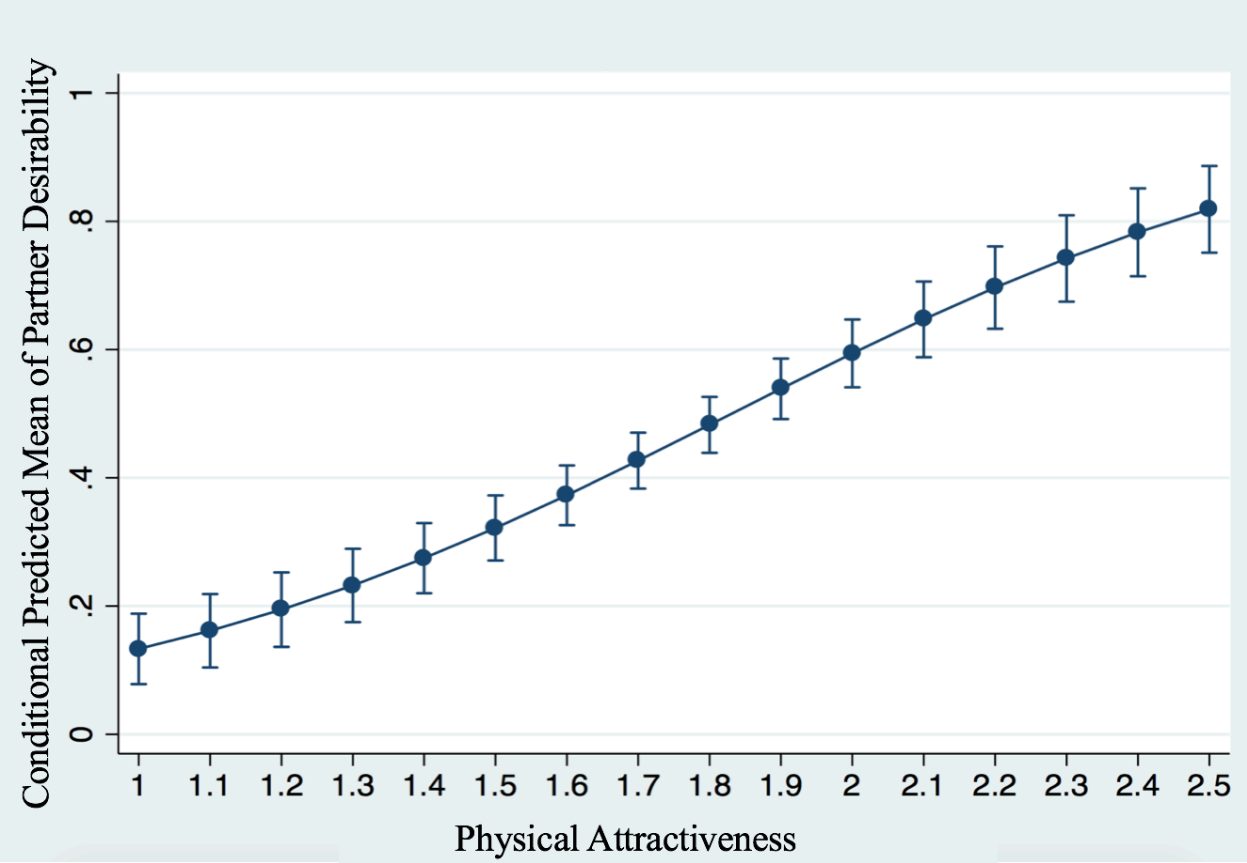


Figure 7. Conditional mean of partner desirability (95% CIs) at square-root transformed values of physical attractiveness.

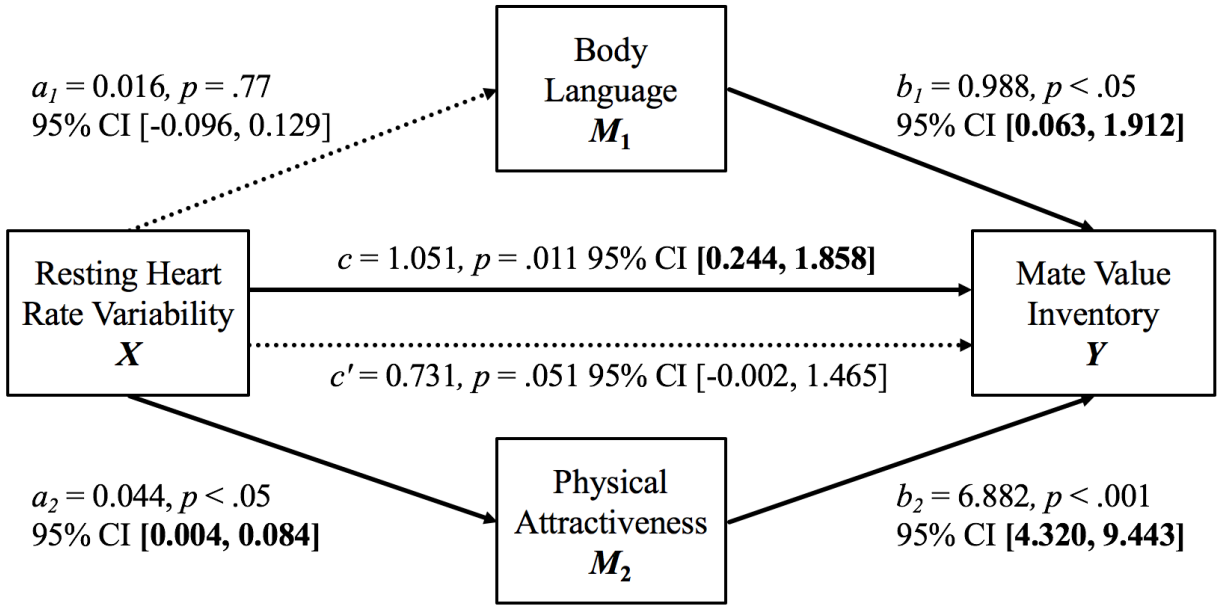


Figure 8. Unstandardized regression coefficients (*SE*) and 95% CIs for the paths in the mediation of Mate Value Inventory *Y* from resting heart rate variability *X* through body language and physical attractiveness *M*. Broken lines depict nonsignificant effects.

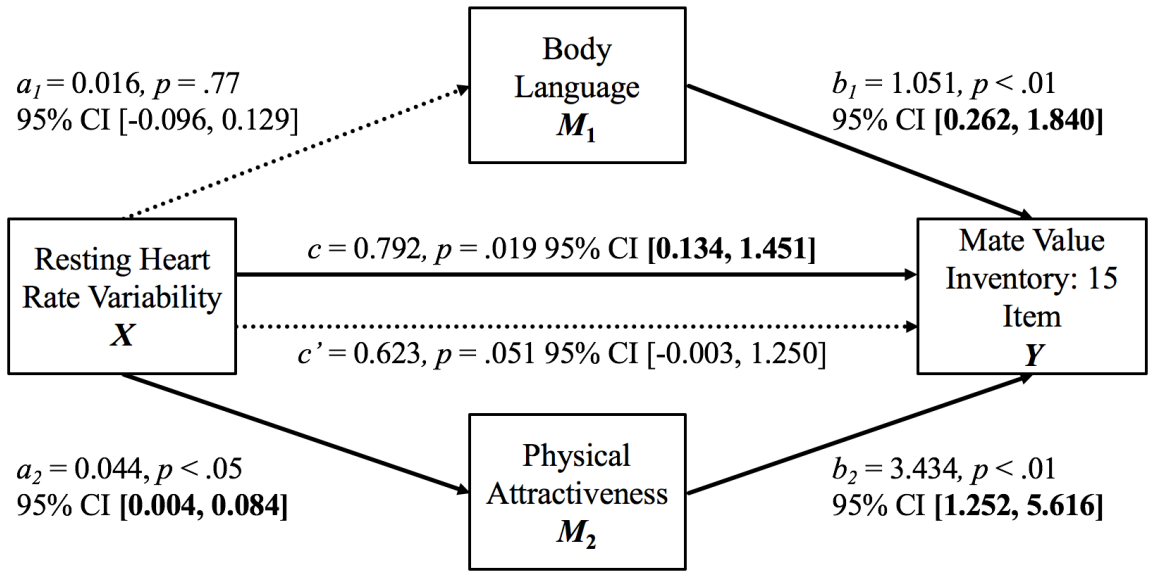


Figure 9. Unstandardized regression coefficients (*SE*) and 95% CIs for the paths in the mediation of Mate Value Inventory: 15 items *Y* from resting heart rate variability *X* through body language and physical attractiveness *M*. Broken lines depict nonsignificant effects.

Appendix A

Participant Recruitment Mass Email

Dear Potential Participant,

My name is Rachel Kushnier, a graduate student and research assistant working with Dr. Ron Davis in the Department of Psychology at Lakehead University. We are conducting a research project called the ***Would you date this person?Body language and attraction***. The purpose of this study is to examine specific variables involved in romantic attraction.

To be eligible to participate, you must be:

- A Lakehead University Orillia campus student; and
- Between the ages of 18 and 29 years of age

If you are eligible to participate in this study, you would first complete some questionnaires questionnaires assessing demographics and mating potential. The questionnaires will take approximately 5 minutes to complete

To complete the online questionnaire, click on this:
https://www.surveymonkey.com/r/Attraction_Study

Then you would sign up to attend a laboratory session. During the laboratory visit will watch and rate short, soundless video clips. The laboratory visit will take approximately 2 hours of your time. Your participation in this study is completely voluntary and you may withdraw from it at any time without penalty.

If you are registered in a Psychology undergraduate course eligible for bonus points, your participation by way of questionnaire completion and attending the laboratory session would lead to 2 bonus points credited to your final grade in that course. Please feel free to contact myself and/or Dr. Ron Davis with any questions that you might have. This study has been approved by the Lakehead University Research Ethics Board. If you have any questions related to the ethics of the research and would like to speak to someone outside of the research team please contact Sue Wright at the Research Ethics Board at 807-343-8283 or research@lakeheadu.ca.

Sincerely,

Rachel Kushnier rbkushni@lakehadu.ca (807) 621-6000
Dr. Ron Davis ron.davis@lakeheadu.ca (807) 343-8646

Appendix B

Participant Information Letter

Dear Potential Participant:

My name is Rachel Kushnier, a graduate student and research assistant working with Dr. Ron Davis in the Department of Psychology at Lakehead University Thunder Bay campus. We are conducting a research project titled ***Would you date this person?Body language and attraction***. The purpose of this project is to examine the perceptions of people we observe and our interest in dating them. We are looking for participants from Lakehead University Orillia campus who are age 18 and older. This is what's involved should you choose to participate:

1. Complete a 1-minute online questionnaire to obtain your demographic information such as age, gender and preference.
2. Join us in the computer lab on the Orillia campus for a 2-hour session at a day and time convenient for you where you would:
    - watch up to 100, silent, 20-second videoclips of other college/university students of the gender of your choosing;
    - rate each for body posture, attractiveness, mood, and other features;
    - and then indicate whether you would date the person, hypothetically speaking of course.

There are no risks for harm of a physical or psychological nature should you wish to participate. Benefits include:

1. learning about the inner workings of a piece of psychological research like this,
2. earning 2 bonus points towards your final grade in eligible Psychology courses that allow for such.

Your participation in this project is completely voluntary and you may withdraw from it or choose not to answer any question at any time without penalty. All personal information that you provide will be kept completely confidential by assigning an anonymous code to it without your name. Your information will be securely stored at Lakehead University for 5 years as per University regulations. Only myself, Dr. Davis, and research assistant Lauren Kushnier will have access to the information. In addition, your identifying information will be kept completely confidential in reports of results.

Please note that the online survey tool used in this study (SurveyMonkey) is hosted by a server located in the USA. The US Patriot Act permits U.S. law enforcement officials, for the purpose of anti-terrorism investigation, to seek a court order that allows access to the personal records of any person without the person's knowledge. In view of this we cannot absolutely guarantee the full confidentiality and anonymity of your data. With your consent to participate in this study, you acknowledge this

Please feel free to contact myself, Rachel Kushnier, with any questions that you might have. This project has been approved by the Lakehead University Research Ethics Board. If you have any questions related to the ethics of the research and would like to speak to someone outside of the research team, please contact Sue Wright at the Lakehead University Research Ethics Board at 807-343-8283 or at research@lakeheadu.ca.

Thank you for considering participation in this project.

Rachel Kushnier
rbkushni@lakeheadu.ca
(807) 621-6000

Dr. Ron Davis
ron.davis@lakeheadu.ca
(807)343-8646

Lakehead UNIVERSITY

Appendix C

Consent Form for the for the study titled "Would you date this person? Body language and attraction"

Consent to Participate

By providing my name and signature below, I indicate that I have read the *Participant Information Letter* and that I have had the opportunity to receive satisfactory answers from the researchers concerning any questions that I might have about my participation in the study. I understand and agree to the following:

1. I understand the information contained in the *Participant Information Letter*;
2. I agree to participate in the manner outlined in the *Participant Information Letter*;
3. I am a volunteer and can withdraw at any time from this study without penalty or consequence;
4. I may choose not to answer any question asked in the questionnaires without penalty or consequence;
5. There are no anticipated physical or psychological risks of harm associated with participation in this study.
6. My personal information will remain confidential and will be securely stored in the Department of Psychology at Lakehead University for 5 years as per University regulations;
7. I acknowledge the breach of confidentiality risk I might incur by completing SurveyMonkey online questionnaires as outlined in the *Participant Information Letter*;
8. My personal information will remain anonymous should any publications or public presentations come out of this study;
9. I may receive a copy of the research findings upon completion if I so request;
10. I give my permission to be contacted by email for the purpose of participation in this study; and
11. I understand and agree to this "Consent to Participate"

_____ _____

Full Name (*please print*) Date

_____ _____

Signature *(please sign)* Email

_____ _____

Lakehead University Student Number Phone

_____

Name of LU Psychology course and Professor (if applicable, for purposes of crediting bonus points._____

I wish to receive via email a summary of the findings of this study when made available:

Yes___ No__

Appendix D

Demographics Questionnaire for Rater Participants

1. How old are you in years? _____
2. How would you describe your ethnic background? (please choose one or more)
    - Caucasian
    - South Asian
    - Hispanic
    - African-Canadian
    - First Nations
    - East Asian
    - Other

      (please specify)_____
3. What is your current romantic relationship status? (check one)
    - Single, no partner, and not interested in dating
    - Single, no partner, and interested in dating
    - Casually dating
    - In a romantic relationship
4. What is your gender?
    - Female
    - Male
    - Non-binary/third gender
5. As part of your involvement in this study, in the near future you will be viewing short video clips of 100 people. You will indicate for each whether you would date that person, hypothetically speaking of course. Please indicate the gender of people whose videos you wish to view. (choose one)
    - Female
    - Male

Appendix E

Video Rating Form

1. Participant video identifier: _____

Expanded body language can be described as involving widespread and open limbs, stretched torso, and/or an increase in occupied physical space. While closed body language can be described as involving constricted limbs, closed off torso, and/or a decrease in occupied space.

2. Overall, how would you rate the current individual's body language.

-3 -2 -1 0 +1 +2 +3

Closed Expanded

3. How sexy/hot did you find the individual in the video

1 2 3 4 5 6 7 8 9

Not at all Extremely

4. How physically attractive did you find the individual in the video

1 2 3 4 5 6 7 8 9

Not at all Extremely

5. How dominant did you find the individual in the video

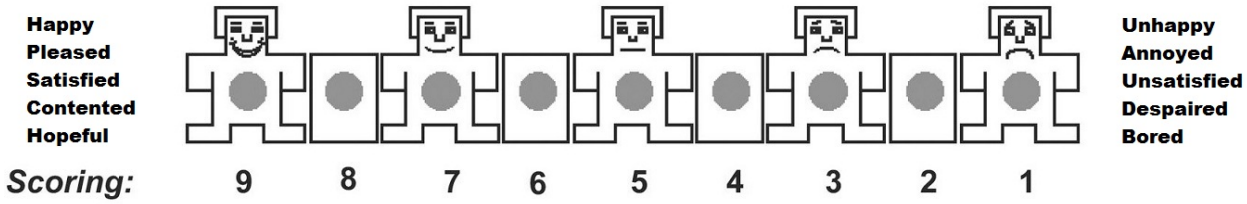
1 2 3 4 5 6 7 8 9

Not at all Extremely

6. Please rate the individual in the video clip on this happy-unhappy scale, in which the drawings range from a smiling figure to a frowning figure. At one extreme of this scale, the individual in the video clip felt happy, pleased, satisfied, contented, hopeful. If you felt the individual in the video clip was completely happy during the video clip, you can indicate this by filling in the bubble in the figure on the left (9). The other end of the scale indicates that they felt completely unhappy, annoyed, unsatisfied, melancholic, despairing, bored. If you felt the individual in the video clip was completely unhappy during the video clip, you can indicate this by filling in the bubble in the figure on the right (1). The figures also allow you to evaluate intermediate feelings of pleasure. If you felt the individual in the video clip was completely

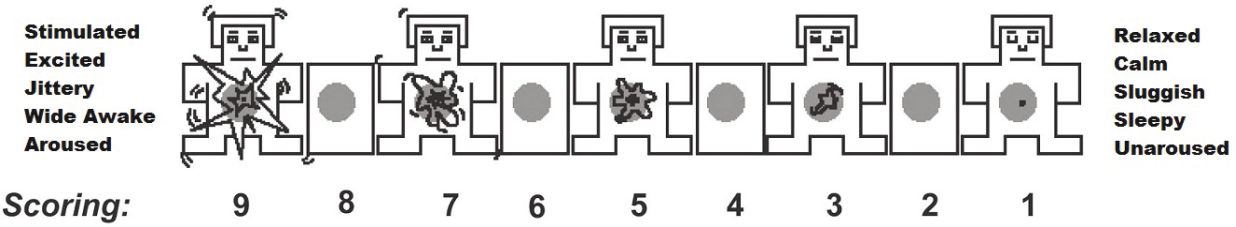
neutral, neither happy nor unhappy, fill in the bubble in the figure in the middle. If, in your judgment, you feel the individuals feeling of pleasure or displeasure falls between two of the figures, then fill in the circle between the figures. This allows you to make more finely graded ratings of the clips.

The individual in the video felt:



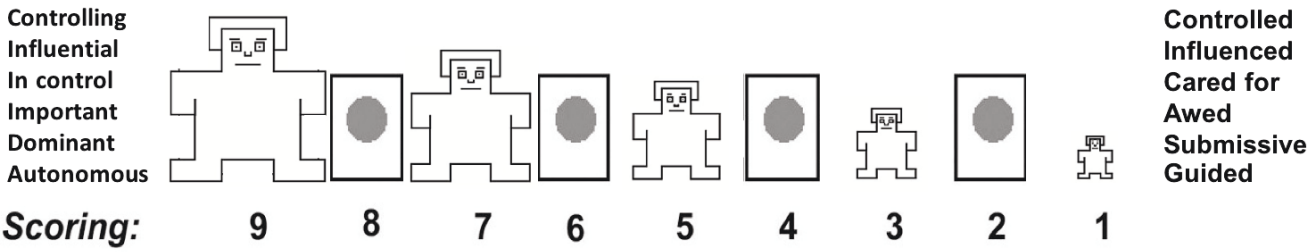
7. This is the excited/calm scale. At one extreme of this scale, the individual in the video clip felt stimulated, excited, frenzied, jittery, wide awake, and aroused. If you felt the individual in the video clip felt completely aroused, fill in the bubble corresponding to the figure at the left of the row (9). On the other hand, at the other end of the scale, the individual in the video clip felt completely relaxed, calm, sluggish, dull, sleepy, and unaroused. You can indicate that the individual in the video clip felt completely calm by filling in the bubble corresponding to the figure at the right (1). As with the happy/unhappy scale, you can represent intermediate levels by selecting the number which corresponds to the bubble in any of the other figures. If you felt the individual in the video clip was not at all excited nor at all calm, fill in the bubble which corresponds to the figure in the middle (5). Again, if you wish to make a more finely tuned rating of how excited or calm you felt the individual in the video clip felt, fill in the circle between any of the figures.

The individual in the video felt:



8. This is the dominance/submissive scale. At one extreme of this scale, the individual in the video clip felt controlling, influential, in control, important, dominant, and autonomous. If you felt the individual in the video clip felt completely dominant, fill in the bubble corresponding to the figure at the left of the row (9). On the other hand, at the other end of the scale, the individual in the video clip felt completely controlled, influenced, cared for, awed, submissive, and guided. You can indicate that the individual in the video clip felt completely submissive by filling in the bubble corresponding to the figure at the right (1). As with the happy/unhappy scale, you can represent intermediate levels by selecting the number which corresponds to the bubble in any of the other figures. If you felt the individual in the video clip was not at all dominant nor at all submissive, fill in the bubble which corresponds to the figure in the middle (5). Again, if you wish to make a more finely tuned rating of how dominant or submissive you felt the individual in the video clip felt, fill in the circle between any of the figures.

The individual in the video felt:



9. Did the individual in the video make eye contact with the interviewer off camera to the left?

1 2 3 4 5 6 7 8 9

Not at all The whole time

10. How facially expressive did you find the individual in the video?

1 2 3 4 5 6 7 8 9

Not at all Extremely

11. Hypothetically speaking, under the right circumstances (e.g., timing, availability, personal circumstances), I would be interested in going on a date with this individual?

- Yes
- No

Appendix F

Mate Value Inventory - Other-Rating

How well do you feel that these attributes apply to your current speed dating partner?

Please rate each attribute on the following scale:

-3 ---------- -2 ---------- -1 ---------- 0 ---------- +1 ---------- +2 ---------- +3

Extremely low on this trait Extremely high on this trait

Ambitious ____
Attractive face ____
Attractive body ____
Desires children ____
Faithful/value fidelity ____
Generous ____
Good sense of humour ____
Healthy ____
Independent ____
Intelligent ____
Kind and understanding ____
Loyal ____
Financially secure ____
Responsible ____
Enthusiastic about sex ____
Sociable ____
Emotionally stable ____

Appendix G

Negative-Relationship Experiences Free Speech Preparation Period Instructions

In 3 minutes you will be filmed while talking about your negative relationship experiences. You will be asked to speak for 5 minutes. Anonymous raters will subsequently review the videotapes to monitor nonverbal behaviour and predict relationship success based on the attributes observed in the video.

Please use this sheet (front and back) to organize your thoughts in preparation for this task. You are encouraged to fill the entire 5 minutes talking about yourself, your experiences, and how you felt during those experiences - not about what happened to others. For example, you may choose to discuss personal experiences that might fall into any of the following topics:

- Failing to have your romantic feelings returned
- Being stood up
- When you had to reject/dump a partner
- A bad date
- Breaking up
- The discovery that your partner had cheated on you
- The fallout after you cheated on your partner
- Abusive experiences in a dating context
- If you have never been in a dating relationship you may wish to discuss the personal characteristics that have prevented you from having one.

Please begin preparing now.

Appendix H

Ideal-Relationships Free Speech Preparation Period Instructions

In 3 minutes you will be filmed while talking about your idea of an ideal relationship. You will be filmed for 5 minutes. Anonymous raters will subsequently review the videotapes to monitor nonverbal behaviour and predict relationship success based on the attributes observed in the video.

Please use this sheet (front and back) to organize your thoughts. You must fill the entire 5 minutes; you may refer to your notes during filming. You may wish to discuss some of the following topics:

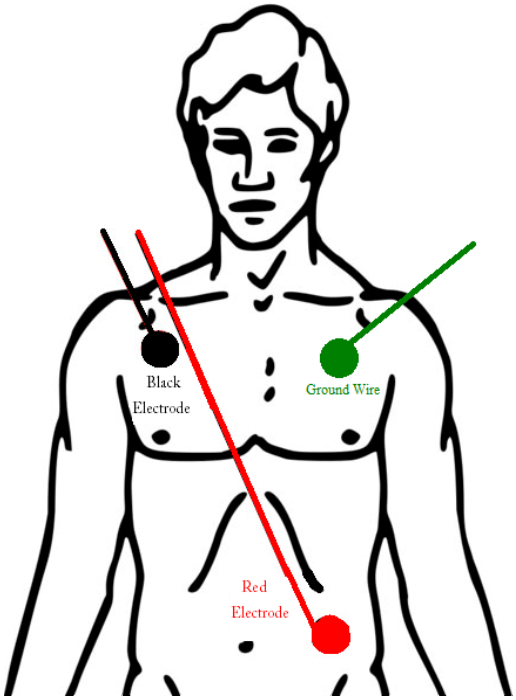
- The ideal relationship – what it looks like
- The ideal romantic partner of your preferred gender
- A perfect date
- The benefits of being in an ideal relationship
- Examples of good relationships

Please begin preparing now.

Appendix I

Heart Rate Electrode Placement

As part of this experiment we are interested in collecting information on your heart rate. In order to do this, we will be asking you place electrodes on your skin in the locations below. There should be no need for you to remove any of your clothing in order to apply the electrodes. The researcher will check the electrode placement when you are done.



Please Follow These Steps:

1. Use the alcohol napkin to clean the areas that you will be placing the electrodes.

2. Peel back the protective covering from the black electrode. The surface will now be very sticky, so try not to catch it on your clothes. Place the electrode approximately 1 inch below your collarbone and 2 inches from your right armpit.

3. Peel back the protective covering on the red electrode. Place the electrode below your left ribcage. It sometimes helps to find you lowest left rib with your fingers and then place the electrode approximate 1 inch below this.

4. Peel back the protective covering on the green ground electrode. Place the electrode directly opposite the black electrode on the left side of the body.

This line is 1 inch long

Appendix J

Debriefing Form for Laboratory Session for the study titled "*Would you date this person? Body language and attraction"*

Dear Participant:

This sheet gives you a brief summary of the experience that you just completed in this study on romantic relationships.

Previous research has shown that body language can predict romantic attraction as well as, patterns of heart rate variability (HRV) can predict mate value as rated by others. This study seeks to understand the mechanisms underlying this heart – mate value link. To do so we had you rate videos of individuals who had previously had their HRV measured in the lab.

If you would like to speak to a mental health professional about these experiences, can feel free to contact the Student Health and Counseling Centre at (807) 343-8361 (UC 1007).

Thank you for participating in our study so far!