Paralinguistic and Nonverbal Behaviour in Social Interactions: A Lens Model Perspective

by

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Abstract

It is widely accepted in our society that people's paralinguistic (i.e., non-semantic characteristics of the voice) and nonverbal (i.e., posture, gestures, and facial expressions) behaviours play an important role in conveying information about their personality traits. Two particularly relevant traits include one's preferred levels of dominance and affiliation, which are the two major axes of the interpersonal circumplex. The current study investigates how dominance and affiliation are conveyed through paralinguistic and nonverbal behaviour using a lens model framework. Two major issues addressed by this framework include: 1) How do observers make inferences about people's dominance and affiliation using paralinguistic and nonverbal behaviours and 2) How do people's trait dominance and affiliation relate to these behavioural cues? To examine these two questions, we collected data from 114 opposite-sex dyads who worked together to complete a relatively unstructured collaborative task. The videotaped interactions were coded for specific paralinguistic (e.g., pitch, volume, resonance) and nonverbal (e.g., hand gestures, trunk posture, facial expressions) behaviours, in addition to coding more global displays of dominance and affiliation. Participants also completed several measures of trait dominance and affiliation, which tapped both their relatively conscious (i.e., explicit) and their relatively unconscious (i.e., implicit) levels of these traits. Our findings suggest that observers used mainly paralinguistic behaviour to infer dominance and mainly nonverbal behaviour to infer affiliation. In comparison to observers' perceptions, there were fewer significant relations between individuals' self-reported trait dominance and affiliation and the nonverbal and paralinguistic behaviours they expressed during the interaction, suggesting that people may have limited conscious awareness of how these behaviours convey information about their trait dominance and affiliation. In line with this idea, several behaviours showed relations to implicit measures of trait dominance and affiliation. We also conducted factor analyses of the measured paralinguistic and nonverbal

behaviours, to examine whether or not these behaviours might co-occur as subsets or factors. We found that paralinguistic and nonverbal behaviours can be captured by overarching factors which relate meaningfully to measures of dominance and affiliation. Finally, we demonstrated that dyad members' paralinguistic and nonverbal behaviours become interdependent as they interact with one another.

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Introduction

A recent headline in the *Toronto Star* reads, "City paid $4500 to fix politician's shrill voice" (Vincent & Brown, 2009). In this news story, a local politician sought voice training to overcome aspects of her voice that created an undesirable impression in others and, consequently, were having a negative impact on her career. Her vocal coach targeted particular aspects of her voice, such as her fast rate of speaking and her high pitch, in hopes of helping her to create a more pleasing and confident impression.

Indeed, voice training is a growing industry, with many companies offering one-on-one coaching, group seminars, workshops, and internet-based teaching tools in various countries around the world, such as the USA (The Sound of Your Voice, 2010), the United Kingdom (Vocal Impact Training, 2010), and Canada (Speech Science, 2010). Such companies attempt to help clients target specific aspects of their voice (e.g., energy, fluency, pitch, resonance), to project impressions of leadership, influence, and likeability.

Individuals can also access training which targets nonverbal communication, including body language, posture, and facial expressions. To illustrate, there are dozens of self-help books written to help people to "harness the power" of nonverbal behaviour to manage issues like gaining control during social interactions (e.g., Bowden, 2010) and forming romantic relationships (e.g., Greene, 2010). These training efforts, both for tone of voice and nonverbal behaviour, likely reflect a wider assumption in our society that these are crucial aspects of social communication which convey telling impressions about an individual's personality.

However, what is actually known about the link between impressions of personality and behavioural channels like tone of voice and body language? At the most basic level, there are two related issues. First, what inferences do people make on the basis of others' tone of voice and nonverbal behaviour? As an example, what personal qualities (if any) do people infer from a

relatively high-pitched voice? Second, are these inferences valid indicators of personality, or are they more like invalid stereotypes? For instance, does a person's relatively high-pitched voice actually indicate something meaningful about what that person is like, or do people just think it does?

To organize these types of questions, researchers such as Gifford (1994,) have utilized a "lens model" framework (Brunswik, 1956), depicted in Figure 1. In the lens model, the arrows on the left are said to represent *encoding* processes, in which vocal and nonverbal qualities may come to serve as valid indicators of individuals' personality traits. The arrows on the right are said to represent *decoding* processes, in which observers make inferences about personality from particular vocal and nonverbal cues. In the centre of the lens are pertinent behavioural characteristics, of which vocal pitch, volume, resonance, speech rate, smiling, and gaze are potentially important examples. The first four characteristics represent examples of *paralinguistic* behaviours, which are qualities of the voice that are separate from the semantic content of speech. The latter two characteristics represent examples of *nonverbal* behaviours, such as body language and facial expressions. The lens model makes clear the distinction between two separable, although related, questions: (1) How do paralinguistic and nonverbal behaviours express personality traits? (2) How do these behaviours lead to inferences about personality?

Although the lens model is an effective framework for studying these two processes simultaneously, Ambady and Weisbuch (2010) recently criticized the terms "encoding" and "decoding" because they seem to connote conscious, deliberate processes on the part of both the person producing the behaviour and the person making personality inferences based on that behaviour. Instead, these underlying processes may be relatively automatic and unintended. To reflect this possibility, these researchers, primarily focusing on nonverbal behaviour, suggested

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replacing the term "encoding" with *nonverbal production*, and the term "decoding" with *nonverbal perception*. We decided to adopt similar terminology, but with two changes. First, instead of *production* we will use the term *expression* to represent the encoding process, which we feel better captures the idea that one's personality is *expressed* through specific behavioural cues. Second, because we focus on tone of voice and nonverbal behaviour, we will refer to both *paralinguistic expression* and *perception*, and *nonverbal expression* and *perception*.

Another possible limitation of the lens model is that it depicts a fixed, unidirectional process starting at a trait and ending at a trait inference. However, consider an interaction unfolding between two individuals, in which each person is both producing their own paralinguistic and nonverbal cues and also perceiving their partner's behavioural cues. During these behavioural interchanges, each individual may continually adjust their own behaviour according to their ongoing perceptions of how their interaction partner behaves. This possibility of an ongoing feedback process raises an important question: What is the role of paralinguistic and nonverbal cues in such mutual adjustments?

These considerations suggest five fundamental questions related to the lens model, which we address in the forthcoming literature review that provides a backdrop for our empirical investigation of these issues.

I. How do observers use paralinguistic and nonverbal behaviour to make inferences about others' personality? This question addresses the underlying nature of paralinguistic and nonverbal *perception*, represented by the "decoding" arrows in the lens model.

II. What is the relation of paralinguistic and nonverbal behaviours to individuals' personality traits? This question addresses the underlying nature of paralinguistic and nonverbal *expression*, represented by the "encoding" arrows in the lens model.

III. What kinds of personality traits may be most relevant in the processes of paralinguistic and nonverbal perception and expression? In addition, should these traits be measured using explicit or implicit measures? Such questions address the specific content of the boxes representing personality at both ends of the lens model.

IV. During a social interaction, how do individuals adjust their paralinguistic and nonverbal behaviours in response to an interaction partner? This question recasts the lens model in a more dynamic way, in which each individual's personal qualities are more fluid and adaptable than a classic trait.

V. What specific paralinguistic and nonverbal characteristics contain relevant information about personality, and how can they best be measured? This question addresses the specific variables that should appear in the center of the lens model.

In the following sections, we review the literature to shed light on each of these five questions.

I. Paralinguistic and Nonverbal Perception (Decoding)

The first major question that we address pertains to how people use paralinguistic and nonverbal behaviour to make inferences about others' personality. A relatively recent and inventive research methodology, called the "thin-slice" paradigm sheds some light on this process. Using this approach, researchers expose strangers to short samples of a target person's behaviour, such as the audio-only or video-only streams, and then ask them to record their impressions of the target person, such as his or her personality.

Paralinguistic Perception

A number of thin-slice studies target the audio stream, in which participants make inferences about individuals' personality without any visual information. For instance, in one thin-slice study participants were exposed to a five-second audio clip of telephone operators talking to customers and then provided ratings of several personality traits (Hecht & LaFrance, 1995).

These personality ratings were highly predictive of the operators' independently assessed job performance (Hecht and LaFrance, 1995). More specifically, higher ratings of operators' enthusiasm and confidence predicted decreased call times. Other studies show that personality ratings such as dominance, competence, likeability, empathy, and enthusiasm inferred from short voice clips predict better outcomes such as higher supervisor-rated job performance (DeGroot & Motowidlo, 1999), increased sales effectiveness (Ambady, Krabbenhoft, & Hogan, 2006), and reduced surgeons' malpractice history (Ambady, LePlant, Nguyen, et al., 2002). In the realm of psychopathology and disordered personality, two recent studies have demonstrated that untrained observers can form consistent inferences about degree of psychopathology from thin-slice presentations. For example, Fowler, Lilienfeld, and Patrick (2009) showed that observers accurately infer psychopathic personality traits even when presented with only vocal information (without any visual cues). Likewise, Friedman, Oltmanns, Gleason, and Turkheimer (2006) showed that thin-slice ratings of personality traits based on voice clips were strongly predictive of various personality disorders in a clinical population.

Nonverbal Perception

Researchers have also exposed participants to brief clips of the visual-only channel, in which nonverbal behaviours were the basis for forming impressions about personality. For instance, Ambady and Rosenthal (1993) showed a short (i.e., six second) muted video of professors delivering a lecture to untrained observers who then completed ratings of the professors' personalities. These ratings were impressively predictive of end-of-term teaching evaluations provided by an independent sample of undergraduate students. Furthermore, the abovementioned researchers examining thin-slice predictions of psychopathology (e.g., Friedman et al., 2006; Fowler et al., 2009) also investigated a video-only condition and found that thin-slice ratings of personality were highly predictive of independently assessed personality disorders.

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As a whole, the thin slice literature suggests that brief exposure to nonverbal or paralinguistic behaviour channels conveys a lot of information, which can be used to draw inferences about a range of personality traits. Furthermore, these inferences show impressive predictive validity, demonstrated by the strong relationship between the inferred personality ratings and subsequent behavioral outcomes, such as teaching evaluations, job performance, and psychopathology. Note that the processes underlying this predictive validity would lie outside of the lens model, and could be visualized in Figure 1 as an arrow located to the right of the "Receiver Inference of Sender Personality" variable to another variable such as "Sender Behavioral Outcome." Nonetheless, they are important to highlight because these very quickly formed personality impressions appear to contain more valid information than we might otherwise imagine. Accordingly, it is interesting to speculate about how such personality impressions may be formed so quickly from thin slices containing only single channels of behaviour.

Some scholars (DePaulo, 1992; Gilbert & Krull, 1988; Patterson, 1995) theorize that much of what occurs during social interaction involves the interpretation and expression of more automatic behaviours, such as paralinguistic and nonverbal behaviours, which do not deplete cognitive resources in the same way as more conscious, contemplative behaviour (e.g., content of speech). Along these lines, the neuroscientist LeDoux (2001) posits that automatic behaviors are governed by limbic circuits in the brain, which are fast acting and relatively independent of the higher, cortical brain circuits that influence controlled, deliberate behavior. As a consequence, the human brain is designed in such a way that the two brain systems develop and operate independently, which, in turn, results in two systems of reasoning that separately govern conscious and unconscious behavior. Thus, people do not typically spend time actively reflecting on how their impression of an interaction partner is influenced by his or her more automatic behaviours. Yet this type of social information has a powerful impact on how people

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are perceived, conveying valid information about personality, as demonstrated by the thin-slice literature.

In summary, current research suggests that people can extract meaningful information from surprisingly short exposures to the paralinguistic and nonverbal channels. For instance, thin-slice research evidence supports the notion that perceptions of personality can be formed through brief exposure to these kinds of behaviour. Furthermore, the processes by which people form impressions based on these channels is hypothesized to occur on a largely automatic basis, governed by brain circuitry that is independent of more conscious processing.

II. Paralinguistic and Nonverbal Expression (Encoding)

Although the foregoing research clearly shows that people form *impressions* of personality on the basis of paralinguistic and nonverbal cues, a separate and less researched question is the extent to which these cues express an individuals' trait personality (Pittam, 1994). Several interesting studies have addressed this question.

Paralinguistic Expression

Moore (1939; see also Mallory & Miller, 1958) had students give a presentation that was then used to provide a voice sample for expert coding on characteristics including breathiness, nasal whine and harshness. Students rated as having more breathy voices were higher in self-reported neuroticism and introversion and lower in self-reported dominance. Similarly, students rated as having more nasal whine reported higher neuroticism and lower dominance.

In research by Scherer (1978), trained phoneticians coded various vocal characteristics from a recording of participants engaged in a mock jury discussion. Scherer found that the vocal characteristics did not relate to self-report ratings of personality; rather, they related to peer assessments of personality. Those who were rated by people who know them as emotionally stable and extroverted spoke more loudly, with greater emphasis (i.e., variability in loudness)

and more nasality. The fact that peer assessments of personality traits, but not self-reports, correlated with the vocal characteristics suggests that people may not have much insight into how their paralinguistic behaviour conveys important messages about their personality.

Nonverbal Expression

An important study on nonverbal expression was done by Gifford (1994), who collected self-ratings of dominance, extroversion, warmth, and agreeableness of participants who interacted in small groups of three people. These videotaped interactions were coded for 38 nonverbal behaviours, such as facial expressions, eye contact, posture, body positioning, and gesturing. Gifford showed that the participants' self-ascribed personality traits of dominance and extroversion were positively associated with gestures and postural openness, warmth was positively associated with head nods, and agreeableness was positively associated with object manipulation (i.e., touching or manipulating proximal items such as pens, paper, etc.). However, it is noteworthy that other associations that Gifford predicted were not significant, suggesting that individuals' self-ascribed traits may relate to a narrower range of nonverbal cues than had been anticipated.

Berry and Hansen (2000) videotaped female dyads engaging in an unstructured social interaction, which was coded for various nonverbal behaviours including facial expressions, gesturing, body openness, and eye contact. Each dyad member also completed a self-report measure of the big five traits. Agreeableness was positively correlated with eye contact (in particular, with looking while listening) and body openness, and inversely related with negative facial expressions and gesturing. Somewhat surprisingly, extroversion, neuroticism, conscientiousness, and openness did not significantly correlate with any of the nonverbal behaviours. One explanation for such sparse findings is that the expression of these sorts of behaviours might occur automatically, thus escaping the conscious scrutiny by the individual that

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may underlie self-report measures of personality.

Indeed, research in this domain suggests that paralinguistic and nonverbal channels of communication occur relatively automatically, without conscious contemplation (Lakin, 2006). For instance, Tiedens and Fragale (2003) showed that people tend to adopt postural stances that are opposite to that of an interaction partner (e.g., when the interaction partner has an expansive posture, the participant adopts a more constricted posture). However, when asked about their behaviour afterward, the participants had no awareness of altering their posture during the interaction. Likewise, other studies demonstrated that when asked to consciously reflect on their nonverbal behaviour during a social interaction, participants' self-accuracy tends to be quite modest, particularly with regard to behaviours such as nodding, gazing, gesturing, self-touch, and smiling (Hall, Horgan, & Carter, 2002; Hall, Murphy, & Schmidt-Mast, 2007).

Thus, the prevailing view is that relatively unconscious processes tend to govern these channels of behaviour (e.g., DePaulo, 1992; DePaulo & Friedman, 1998), which can be contrasted with more conscious processes that govern more controlled behaviour. Similarly, dual-processing theories of personality posit that human behaviour is governed by two separate systems, which Epstein (1997) labels "experiential" and "rational". The experiential system governs more automatic, relatively unconscious behaviours, including nonverbal and paralinguistic communication, and the rational system governs more controlled and conscious behaviours, such as semantic content of speech.

Finally, Gestalt therapists often pay close attention to the *way* in which clients speak, rather than the semantic content of what they say, because they believe that people often betray information about themselves through behavioral channels that operate outside of their conscious awareness. Thin-slice research evidence supports the notion that perceptions of personality can be formed through exposure to these kinds of behaviour (Baumgardner & Perls, 1975).

In summary, empirical investigations into the expression of personality traits through one's paralinguistic and nonverbal behaviour has yielded a modest number of findings. Significant associations between self-reported personality traits and specific behaviours have tended to be somewhat sparse. One explanation for such scarce findings is that both the paralinguistic and nonverbal channels of behaviour are conveyed relatively automatically, with little conscious insight.

III.   Relevant Personality Traits

What generalizations can we draw concerning which kinds of personality characteristics seem associated with paralinguistic and nonverbal behaviour? It turns out that the large majority of research on paralinguistic and nonverbal behaviour is focused on two core themes: dominance and affiliation, as highlighted by Ambady and Weisbuch (2010) in their recent chapter on nonverbal behaviour. Likewise, Mehrabian (1970) argues that nonverbal and paralinguistic behaviour serve to convey three messages 1) potency or status; 2) degree of liking, or positive evaluation; and 3) responsiveness. The first of these three themes (potency or status) clearly maps onto dominance, whereas the second two (degree of liking and responsiveness) arguably relate to affiliation (see also Anderson, Guerrero, & Jones, 2006; Prager, 2000). Taken as a whole, this research points toward the importance of two major features of personality that are most relevant for nonverbal and paralinguistic communication, which are dominance and affiliation. These two traits are the major dimensions described by interpersonal theory, which is a framework for understanding how individuals navigate social interactions.

Interpersonal Circumplex Theory

Interpersonal theorists such as Carson (1969), Kiesler (1983, 1996), and Wiggins (1982, 2003) suggest that important variations in interpersonal behavior can be captured by two basic constructs: dominance and affiliation. These two constructs are typically portrayed on vertical

and horizontal axes (respectively) of a Cartesian plane. A person's relatively stable

"interpersonal style" can be located in this two-dimensional space using Cartesian plane co-

ordinates. Although a two-dimensional structure may seem to oversimplify the range of

interpersonal styles, a wide variety of styles are captured within this plane. Kiesler (1996)

describes sixteen prototypical styles that are arranged around the interpersonal circle,

representing varying levels of dominance and affiliation. Theorists have called this circular

structure the interpersonal circumplex, depicted in Figure 2.

Researchers have found links between the interpersonal factors and two of the big five:

extroversion and agreeableness. In particular, studies have shown that these two constructs are

rotational variants of dominance and affiliation, whereby extroversion is located approximately

30 to 35 degrees clockwise from dominance and agreeableness is located approximately 20 to 30

degrees clockwise from friendliness (Pincus, 2002; Pincus & Gurtman, 1995). A person who

tends to be high on both dominance and affiliation would be described as extroverted, and

someone who is low on both would be introverted. Likewise, a person who is low on dominance

and high on affiliation would be described as agreeable, and someone who is high on dominance

and low on affiliation would be disagreeable. Thus, a variety of traits can be incorporated into

the interpersonal circumplex, including traits shown to be related to paralinguistic and nonverbal

behaviour (e.g., Gifford, 1994; Scherer, 1979).

Levels of Personality

To measure the interpersonal traits of dominance and affiliation, researchers will typically ask

participants to make self-report ratings, using scales such as the Interpersonal Adjectives Scale –

Revised (Wiggins, Trapnell & Phillips, 1988), the Circumplex Scale of Interpersonal Values

(Locke, 2000), and the Social Behaviour Inventory (Moskowitz, 1994). Such questionnaires

measure *explicit* levels of personality, which require respondents to have conscious insight into

such aspects of their personality, values, or behaviours. The main limitation to collecting self-report measures is that people can only report on those behaviours of which they are aware. However, interpersonal theorists have devoted considerable attention to processes that are at least partly outside of people's awareness. For example, Kiesler (1996) and Carson (1969) assert that many aspects of one's own behaviour and its impact on others are partly outside of conscious awareness and cannot readily be captured by self-report.

On the other hand, *implicit* levels of personality tend to be less consciously accessible, and must be measured more indirectly. A traditional approach to measuring implicit levels of personality is through the use of projective tests, like the Thematic Apperception Test (TAT; Murray, 1943). To administer the TAT, participants complete stories based on ambiguous pictures. Given this ambiguity, the operating principle of the TAT is that people will project their own needs and motives onto the characters in order to come up with stories, which are coded for various underlying themes (e.g., need for affiliation).

A more recent strategy for measuring implicit traits, which has attracted great interest among social psychologists, is the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998). The IAT operates under the assumption that when concepts are highly associated with each other, people can sort words faster than when concepts are not associated with each other. For example, an IAT that measures implicit dominance uses the concepts of self and dominance (Ethier et al., 2010). To understand the measurement principle underlying the IAT, consider people with high implicit dominance. They should demonstrate a strong association between the self and dominant personality traits, which should translate to faster response times for categorizations of words under certain conditions. They should respond faster when self and dominant share a single response key, compared to when self and submissive share the same response key. This is because the dominant personality trait associated with the

self should interfere as a person is trying to categorize words when self and submissive share a single response key. For more information about our IAT measures, please consult the Method section.

Predicting Behaviour with Implicit and Explicit Personality

There is evidence that relatively controlled behaviours are expressions of explicit traits, whereas relatively automatic behaviours are expressions of implicit traits (e.g., Asendorpf et al. 2002; Egloff & Schmukle, 2002; Langens, 2001). McClelland (1965) argued that implicit and explicit motives are distinguishable and can be combined as joint predictors to improve the prediction of behavior. More recently, Asendorpf et al. (2002) investigated the expression of controlled and automatic shyness behaviours and the extent to which these behaviours could be differentially explained by explicit and implicit personality traits. Using structural equation modeling, these authors demonstrated that controlled shyness behaviours were differentially predicted by measures of explicit shyness (i.e., self-report), whereas automatic shy behaviours were differentially predicted by measures of implicit shyness (i.e., the IAT).

This pattern in which explicit measures predict controlled behaviours and implicit measures predict automatic behaviours has also been shown by social psychologists studying racial attitudes. Dovidio and Kawakami (2002) collected measures of both implicit and explicit racial attitudes and had participants interact with either a black or a white confederate. Their findings showed that participants' explicit attitudes predicted greater bias against the black confederate manifested in verbal (i.e., controlled) behaviour, whereas implicit attitudes predicted bias against the black confederate manifested in nonverbal (i.e., automatic) behaviour.

Thus, across a variety of studies, research demonstrates that automatic behaviours tend to be expressions of implicit (i.e., relatively unconscious) traits, whereas controlled behaviours tend to be expressions of explicit (i.e., relatively conscious) traits. Because paralinguistic and

nonverbal behaviours are generally hypothesized to be relatively automatic, the present research included the measurement of implicit interpersonal traits, as well as their explicit counterparts.

IV.   How Do People Adjust to Each Others' Paralinguistic and Nonverbal Behaviour?

In addition to positing specific interpersonal traits that individuals possess, interpersonal theory also offers a framework and predictions about how individuals mutually adjust to each other during social interaction, based on two fundamental needs or motivations: agency and communion. More specifically, interpersonal theorists suggest that when two people interact, their behavior tends to be "complementary", which is defined as "sameness" on affiliation and "oppositeness" on dominance (Horowitz, 2004; Kiesler, 1983). Thus, they predict that individuals who have a more friendly interpersonal style will tend to act friendly in their interpersonal encounters, which invites others to act friendly in return. On the other hand, individuals who have a less friendly interpersonal style will tend to act less friendly toward others, which will invite less friendly behavior from interaction partners. Furthermore, they suggest that dominant behavior will elicit submissive behavior in others, and vice versa.

A body of literature shows that complementarity tends to occur during social interactions (Sadler & Woody, 2003; Sadler, Ethier, & Woody, 2011). Although some of these investigations include nonverbal behaviour, little or no work in this area looks at give-and-take processes that may occur within these more covert behavioural channels. However, some interpersonal theorists, such as Kiesler (1996) emphasize the importance of these sorts of more automatic behaviours, which are deemed to be "crucial for communication of emotional and relationship messages" (p. 210).

Researchers who study communication accommodation theory, such as Giles, Coupland, and Coupland (1991), place emphasis on how individuals tend to adjust their nonverbal and

paralinguistic behaviors to one another during social interaction. Communication accommodation theorists posit that during an interaction, individuals can become more similar (i.e., convergent) or dissimilar (i.e., divergent) on a variety of paralinguistic and nonverbal behaviours. According to this theory, converging on particular vocal characteristics, such as speech rate and accent, leads interaction partners to experience greater feelings of liking and positivity for each other, signalling greater affiliation and involvement (Burgoon, Stern & Dillman, 1995; Giles, 1973; Giles, Taylor & Bourhis, 1973). Other vocal cues shown to be a target of convergence include response latency (Cappella & Planalp, 1981), pausing length and frequency (Jaffe & Feldstein, 1970), and vocal volume (Natale, 1975). Communication accommodation research has also shown convergence on a variety of nonverbal behaviours, including gestures (Maurer & Tindall, 1983), head nodding and smiling (Hale & Burgoon, 1984). Although communication accommodation theory also addresses the possibility of divergence of partners' behaviours, there is less evidence for this phenomenon than for convergence.

Unlike interpersonal circumplex theory which suggests that there are two prime motivations, agency and communion, communication accommodation theorists posit that there may be a variety of specific motivations that underlie the convergence and divergence of nonverbal and paralinguistic behaviours. For instance, they argue that convergence may stem from motivations to gain social approval, improve communication efficiency, to signal involvement, and maintain a positive social identity. On the other hand, divergence is thought to signal motivations to remain separate or distinct from an interaction partner or to influence a partner's speech behaviour (e.g., to speak quietly as a strategy to rein in an interaction partner who is speaking too loudly). Interestingly, many of these different motivations tend to boil down to two primary motives of agency and communion. For instance, motivations such as remaining

separate or distinct and influencing another's behaviour may be thought of as being agentic in nature. Likewise, motivations to gain social approval and signal involvement appear to be driven by an overarching need for communion.

It is interesting to consider how certain features of interpersonal theory and communication accommodation theory fit together. Interpersonal theory suggests that as two people interact, they become more similar on affiliation. This major principle fits well with research by communication accommodation researchers, who show a positive association between feelings of liking and convergence on specific behaviours. On the dominance dimension, interpersonal theory would suggest that as two people interact they become more opposite in their levels of dominance. But how does this principle translate into the interdependence of paralinguistic and nonverbal behaviours? Interestingly, one study in the area of communication accommodation theory showed that people may actually *converge* on particular behaviours to signal submission. In particular, Gregory and Webster (1996) demonstrated that when individuals interacted with higher status partners, they adjusted their pitch to be more convergent with the partner. Thus, depending on the context and the behaviour in question, convergence may be a way to signal messages about status or dominance to an interaction partner.

Overall, the connection between communication accommodation theory and interpersonal complementarity is an area that merits further research. Although interpersonal theory predicts that interaction partners converge in their levels of affiliation and diverge in their levels of dominance, the implications of these predictions on the interdependence of partners' specific micro-behaviours have not been studied by interpersonal researchers. Communication accommodation researchers can shed some light on which behaviours tend to converge, although this theory does not account for the possibility that divergence may serve an important role in

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conveying dominance or status. Indeed, one criticism of communication accommodation theory is that it does not adequately account for the degree to which people become complementary (i.e., opposite) in dominance-related behaviours (Burgoon, Stern, & Dillman, 1995). Future research should attempt to integrate these two theories, which have much to offer each other.

V.   Measuring Relevant Paralinguistic and Nonverbal Behaviour

Now that we have introduced a framework for understanding the sorts of personality traits that are most relevant during social interaction, we move to discussing how paralinguistic and nonverbal behaviour convey these sorts of messages. More specifically, which behaviours do people use to make inferences about others' levels of dominance and affiliation during social interaction (i.e., perception or decoding)? Likewise, which behaviours are related to trait measures of interpersonal style (i.e., expression or encoding)? Before turning to these more substantive questions, it is first necessary to describe the range of potentially relevant behavioural characteristics and how they are measured.

Measuring Paralinguistic Behaviour

Researchers studying paralinguistic behaviour typically measure four classes of vocal characteristics, which include: 1) vocal pitch; 2) volume; 3) voice quality, or resonance; and 4) speech rate and fluency. These classes of voice characteristics, which can be further broken down into more specific indices, are measured either by using computer software, such as *Praat* (Boersma & Weenink, 2009), or by having trained coders listen to the clips and rate them on each of the pertinent characteristics.

Vocal pitch, to the human ear, is the experience of how high a person's voice sounds. The two major indices involving vocal pitch include the mean (i.e., how high or low does this person sound, overall?) and the variability (i.e., to what extent is this person's voice intonated vs. monotone?) When coded aurally, raters will listen to a clip and rate the voice in terms of mean

and variability of pitch. When using a computer program, the index akin to vocal pitch is called "fundamental frequency", or "F0", which is measured in cycles per second or hertz (Hz). The Hz for the voice clips are computed on a moment-to-moment level, whereby the computer creates a pitch curve representing F0 values across the voice sample. Based on this pitch curve, one can compute the mean level of F0 and the standard deviation of F0.

A second class of vocal characteristics pertains to volume, or loudness of the voice. Like vocal pitch, there are two major indices of volume, mean and variability. The mean captures how loud a person is overall, whereas the variability indexes the degree of volume variability or emphasis. Computer-derived measurement of volume is called "amplitude", which is measured in decibels (dB). Similar to F0, decibels are measured at each point in time across the voice clip. The resulting time series can then be used to compute the mean level of amplitude and the standard deviation of amplitude. When coded aurally, raters make these assessments based on listening to the voice clip and then rating the extent to which the voice is loud and emphatic, often using a Likert scale.

A third class of vocal characteristics pertains to voice quality. To measure voice quality, trained coders, often phoneticians, listen to voice clips and rate them on a variety of qualities such as "nasal", "raspy", "breathy", "thin", and "full" (Moore, 1939; Scherer, 1974). However, through more advanced computing technology, a few researchers use voice analysis programs to index voice quality by assessing the relationship between the vocal overtones, or "formant frequencies", which are measured in Hz. Formants are a series of overtones which are produced as sounds travel through the vocal tract. Each formant represents a wavelength of sound that traverses the vocal tract, and the frequency of this wavelength determines the formant number. For instance, Formant 1 is the lowest frequency overtone, and Formant 2 is the second lowest frequency overtone, and so on. Although there are theoretically an infinite number of formants,

only the first four are audible to the human ear (Kent & Read, 2002). Using a voice analysis computer program, it is possible to compute the average Hz on each of the first four formants over the voice clip of interest, yielding four different means (one for each formant).

To the human ear, a person's pattern of formant frequencies has a direct impact on the extent to which the voice is heard as being resonant and full-sounding versus faint and thin-sounding. When there is a large spread, or dispersion, between adjacent formants the result is a voice lacking in resonance (i.e., faint and thin-sounding). On the other hand, when there is a narrow spread, or small dispersion, between adjacent formants, the result is a voice high in resonance (i.e., full-sounding). Fitch (1997) recently developed an index of formant dispersion (fD). This index measures the spread between the frequencies of each formant, where high values on fD represent low resonance, and low values on fD represent high resonance (Ko, Judd, & Blair, 2005; Puts, Hodges, Cardenas, & Gaulin, 2007). Although it would seem that resonance would be associated with other, more subjective voice qualities like "thinness" and "fullness", these associations have not been empirically examined.

The fourth class of vocal characteristics includes variables such as speech rate and fluency. Speech rate is simply how quickly a person speaks, ranging from slow to fast. Closely akin to speech rate is the speakers' level of fluency. Whereas some individuals' speech tends to flow and be free of excessive pauses and mumbles, other individuals tend to have quite disjointed speech in which they pause and mumble frequently. Much of the research that has looked at these vocal characteristics have relied on aural methods of coding, such as having raters respond to Likert-format items measuring the degree of speed and fluency, or by counting the number of words spoken in a predetermined time interval.

To summarize, there are a variety of specific voice characteristics that researchers use to study the relationship between paralinguistic behaviour and personality. These indices are

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measured by human listeners and, more recently, through the use of voice analysis programs. Although it is not clear if one method of measurement (i.e., aural coding or computer) is superior, each has pros and cons. On one hand, aural coding has the benefit of being directly related to what humans can actually perceive in a voice, whereas computer-based indices are based on the objective qualities of the voice that may or may not be heard by the human ear. To illustrate, these two measurement methods correlate moderately well (at around .50) for vocal pitch (Scherer, 1978), suggesting that the phenomenological experience of vocal pitch is not exactly the same as fundamental frequency computed by a voice analysis program. On the other hand, an advantage to using computer-based measurement is that the content of speech is not a problem, which is often an issue that needs to be addressed with aural coding to avoid the possibility that semantic content could affect the ratings (Scherer, 1971). Ideally, researchers would employ both types of measures, in order to capitalize on the strengths of both approaches and to make stronger claims about findings.

Measuring Relevant Nonverbal Characteristics

Nonverbal communication encompasses a variety of behavioural characteristics, which tend to fall into three distinct categories: proxemics, kinesics, and haptics (Anderson, Guerrero & Jones, 2006). First, *proxemics* can be defined as the physical distance and physical orientation between two or more individuals who are interacting. Examples of this sort of behaviour include interpersonal distance (e.g., amount of physical space between interactants), postural expansion or body openness (e.g., an open vs. closed postural stance), body orientation (e.g., facing toward or away from an interaction partner), and lean (e.g., leaning toward or away from an interaction partner). These features are typically coded using an ordered-response option, in which trained coders watch the videotaped interaction and record the body positions of each partner at set intervals (e.g., five seconds) within a predetermined time frame (e.g., a five minute segment).

For example, coders will pause the videotape every five seconds to record body orientation on a Likert scale ranging from 1 – "turned completely away from the interaction partner" to 5 – "turned completely toward the interaction partner".

A second class of nonverbal characteristics called *kinesics* pertains to facial expressions (e.g., smiling, frowning), eye behaviour (e.g., eye contact with an interaction partner), and body movements (e.g., head nods, head shakes, gestures, self manipulation, object manipulation). To measure these kinesics, trained coders record either the duration or frequency for each of the behaviours at set intervals within a certain time frame. For instance, coders will count the number of smiles that occur at each five second interval (i.e., frequency), or will record the number of seconds spent making eye-contact within the five-second interval (i.e., duration).

Lastly, *haptics* are simply the extent to which individuals touch each other during an interaction. For instance, two people may embrace, hold hands, or engage in other forms of touching (e.g., a reassuring pat on the shoulder) to signal various interpersonal messages. Touching behaviours are more likely to occur between acquainted individuals who are in relatively close relationships rather than between unacquainted dyads.

Now that we have described the types of vocal and nonverbal characteristics that researchers typically measure, the next sections will describe how these characteristics are involved in the *perception* and *expression* of dominance and affiliation. In particular, the following sections will summarize the research findings which address the first two issues raised earlier, focusing on the more specific ways in which dominance and affiliation are perceived and expressed through a variety of paralinguistic and nonverbal characteristics.

Paralinguistic and Nonverbal Perception (Decoding) of Dominance

Paralinguistic Perception of Dominance

Why might paralinguistic behaviour be an important component to communicating

dominance? From an evolutionary perspective, humans likely developed this capacity from our evolutionary predecessors who did not have the luxury of spoken language. Along these lines, Burgoon and Dunbar (2006) argued that humans use paralinguistic behaviour to make inferences about others' levels of dominance, by paying attention to cues that convey physical potency. These authors review literature that suggests the existence of several important components to communicating physical potency. Two of these components place heavy emphasis on paralinguistic characteristics, which include size/strength and expressivity. For instance, to make inferences about *size and strength*, individuals attend to behaviours that indicate intensity, such as loud, deep-pitched voices, as well as rapid speaking tempo, clear articulation, and vocal resonance. In contrast, submissiveness and weakness tends to be inferred when individuals sound high-pitched and lack resonance (Montepare & Zebrowitz-McArthur, 1987). Likewise, *expressivity* is conveyed through energetic and animated behaviours, such as greater vocal inflection and emphasis, as well as increased fluency and rhythm. To summarize, research suggests that people tend to infer dominance using four classes of paralinguistic behaviours, each of which we cover next, in turn: 1) volume, including both mean levels and standard deviation of vocal amplitude; 2) overall pitch, or mean fundamental frequency; 3) overall fullness, or resonance of the voice; and 4) fluency and pace of speech.

   Volume

   Several studies have investigated how perceptions of situational dominance are associated with the mean level of volume, as well as the variability of volume. In a meta-analysis on a variety of behaviors related to dominance, Hall, Coats, and Smith LeBeau (2005) concluded that impressions of dominance are positively associated with overall vocal volume, based on a total of seven studies investigating this relationship. For instance, Tusing and Dillard (2000) asked participants to rate the extent to which individuals' voices sounded dominant, which were

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then related to computer-derived measures of volume, including the mean and standard deviation of amplitude, in decibels. They showed that higher ratings of dominance were associated with greater mean and standard deviation of amplitude, indicating that people who speak more loudly and more emphatically are perceived by others as being more dominant. Likewise, Mehrabian and Williams (1969) showed that perceptions of persuasiveness, a construct closely akin to dominance, are associated with speaking loudly. Furthermore, Montepare and Zebrowitz-McArthur (1987) demonstrated that individuals perceived as "weak" and "incompetent" had softer voices, whereas those perceived as "strong" and "competent" had louder voices.

Vocal Pitch

In addition to vocal amplitude, or volume, another vocal cue associated with perceptions of dominance is overall, or mean, vocal pitch. The predominant finding in the literature is that individuals perceived as being high in dominance have voices that are lower in overall pitch, whereas those who are perceived as weak, feminine or lacking dominance have voices that are higher-pitched (Apple, Streeter & Krauss, 1979; Burgoon & Dunbar, 2006; Gregory & Webster, 1996; Ko, et al., 2005; Puts et al., 2007). However, some authors demonstrated that perceptions of dominance were associated with *higher* overall pitch (e.g., Scherer, London, & Wolf, 1973; Tusing & Dillard, 2000). Although it is not entirely clear what may have produced these inconsistent findings, the way in which vocal pitch was measured may have played an important role (i.e., subjective ratings in the former studies vs. objective computer-derived indices in the latter).

Vocal Resonance

Montepare and Zebrowitz-McArthur (1987) argued that greater dominance is associated with sounding more "mature", which is at least partially due to having greater resonance, whereas lower levels of dominance is associated with more thin-sounding voices, which are

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perceived as being "babyish". Although these authors did not measure resonance directly, the phenomenological experience of resonance ranges from sounding full and mature (i.e., high resonance) to sounding thin and immature (i.e., low resonance). More recent work employing Fitch's (1997) index of resonance using computer-derived formant frequencies (i.e., formant dispersion) showed that greater resonance was positively related with observer perceptions of physical dominance (i.e., able to win physical fights) and social dominance (i.e., viewed as a leader) in men (Puts et al., 2007).

Speech Rate

Studies examining the relationship between speech rate and perceptions of dominance show inconsistent findings. For instance, some researchers demonstrated that increased speech rate was associated with perceptions of increased dominance, and slower speech rate was associated with perceptions of decreased competence and persuasiveness (Apple, Streeter & Krauss, 1979; Brown, Strong, & Rencher, 1973; Mehrabian & Williams, 1969). However, some researchers found the opposite effect, that increased speech rate were associated with decreased perceptions of dominance (Tusing & Dillard, 2000). Attesting to this inconsistency in the literature, a meta-analysis conducted by Hall et al. (2005) suggests that, overall, there is no significant evidence that speech rate is connected to dominance. However, the significant variability in findings across studies suggests that there is evidence of both positive and negative relationships between speech rate and dominance. One possibility that has yet to be investigated is the existence of a curvilinear relation between dominance and speech rate, whereby moderate speech rates yield the highest ratings of dominance and both very fast and very slow speech rates result in perceptions of decreased dominance.

In summary, there appears to be good evidence across a number of studies that perceptions of dominance are represented by a set of vocal characteristics. Overall, the main

findings suggest that greater dominance is associated with *increased* volume (both mean and variability), *increased* resonance, and *decreased* pitch mean. The relationship between dominance and speech rate is more equivocal, with some researchers showing a positive relationship and others showing a negative relationship. One important limitation of the large majority of these studies is that they typically obtain speech samples from contrived settings that most often involve reading a script or passage rather than engaging in naturalistic conversation with another person.

Nonverbal Perception of Dominance

A relatively small body of research suggests that nonverbal behaviour also plays an important role in perceptions of dominance. However, these studies are mainly from the area of communications (rather than psychology). From these studies, it is clear that a subset of behaviours within both proxemic (i.e., interpersonal distance and posture) and kinesic (i.e., gestures and facial behaviour) classes are relevant for the perception of dominance.

Proxemics

Of the studies that examined how individuals form impressions of dominance, several demonstrated the importance of proxemic behaviours. For instance, Gifford (1994) had observers watch groups of three people interact and record their perceptions of dominance for each individual. He showed that perceptions of greater dominance were associated with greater body openness, such as open arms and legs. This finding that dominance perceptions are positively associated with body openness has also been supported by other researchers (Mehrabian, 1969, Tiedens & Fragale, 2003), and a recent meta analysis by Hall et al. (2005) showed that this relation was significant across multiple studies. In addition to body openness, Gifford (1994) and Hall et al. (2005) showed that individuals who oriented themselves toward an interaction partner and had less interpersonal distance were perceived to have greater dominance.

Kinesics

Of the large variety of kinesic behaviours, the single behaviour that is consistently related to dominance perceptions is gesturing. In fact, nearly every study that has investigated nonverbal behaviour and dominance perceptions showed that increased gesturing was associated with greater perceived dominance (Burgoon & Dunbar, 2006; Dunbar & Burgoon, 2005; Gifford, 1994; Guerrero & Floyd, 2006; Mehrabian & Williams, 1969). In addition to gesturing, a few researchers also found a positive relation between dominance perceptions and eye contact. More specifically, individuals perceived as having greater dominance displayed a higher "visual dominance ratio" in which looking-while-speaking exceeds looking-while-listening (Dunbar & Burgoon, 2005; Guerrero & Floyd, 2006). A final type of nonverbal behaviour that is related to dominance perceptions is self and object manipulation. More specifically, some researchers showed that greater dominance perceptions were associated with less self-manipulation (i.e., scratching, picking, rubbing, or biting parts of the body), and more object manipulation (i.e., touching or playing with objects in the immediate environment; Gifford, 1994; Mehrabian & Williams, 1969).

In summary, research evidence suggests that perceptions of dominance are based on a subset of nonverbal behaviours. More specifically, greater perceived dominance is associated with proxemic behaviours such as *increased* body openness and orientation toward others, and *decreased* interpersonal distance. Kinesic behaviours that represent greater dominance include *increased* gesturing, eye contact (particularly while speaking), and object manipulation, and *decreased* self manipulation.

Paralinguistic and Nonverbal Expression (Encoding) of Dominance

Now that we have a better idea about what specific paralinguistic and nonverbal

behaviours are used to make inferences about dominance, what is known about how well these behaviours correspond to personality traits? That is, to what extent do people's self- or peer-ascribed levels of dominance become expressed through these specific vocal and nonverbal cues?

Paralinguistic Expression of Dominance

Empirical findings suggest that trait dominance is expressed through several vocal cues, which we next describe in turn: 1) overall loudness, or mean amplitude; 2) vocal pitch, including mean and standard deviation; 3) resonance.

Volume

A few studies have shown a relationship between the personality trait of dominance and volume of speech. Kimble and Musgrove (1988) had two individuals at a time interact in a lab setting who also completed a measure of assertiveness prior to the interaction. In this study, trait assertive people spoke more loudly. In addition, work by Scherer (1978, 1979) showed that higher levels of peer-ascribed extroversion were associated with greater overall volume, or vocal amplitude. Likewise, Mallory and Miller (1958) showed that higher scores on introversion were negatively associated with loudness. Given that the extroversion-introversion dimension is considered to be a rotational variant of the dimensions in the interpersonal circumplex, this would indicate that people who are both dominant and friendly tend to speak loudly, whereas those who are submissive and hostile tend to speak more quietly.

Vocal Pitch

To our knowledge, only one study has shown that overall pitch is related to trait dominance, which was conducted by Mallory and Miller (1958). These authors found that self-reported trait dominance was associated with decreased pitch mean, as measured by trained coders. A few researchers have also investigated how *variability* in pitch, or "intonation" might

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convey dominance, although it is important to note that they did not measure trait dominance directly. Instead, they asked participants to enact a particular role, which we may consider as a proxy for trait dominance. For instance, using an experimental design, Mehrabian and Williams (1969) showed that when participants were asked to read a passage persuasively, they employed greater intonation (as rated by independent coders) than those who were asked to read the passage in a neutral manner. Furthermore, Scherer et al. (1973) found that when individuals read a script that conveyed confidence (which can be considered to be a facet of dominance), they spoke with greater intonation (i.e., greater standard deviation of F0) than when they performed the same script while trying to convey doubtfulness. In addition, Scherer (1974) demonstrated a positive correlation between *self-report* trait ratings of dominance and pitch range (rated by a phonetician), a vocal cue that is another index of scatter, akin to pitch variability. In this study, speech samples were obtained from individuals who were engaging in a mock jury discussion, rather than reading a script. This unscripted setting likely allowed participants to display more naturalistic vocal behaviors.

Vocal Resonance

The relationship between trait dominance and resonance is also sparse. In two studies conducted decades ago, researchers had participants complete the Bernreuter Personality Inventory (which indexes trait dominance, among other personality traits) and provide a sample of their speech by reading a script or speech (Mallory & Miller, 1958; Moore, 1939). Both studies showed that greater resonance was associated with higher self-reported trait dominance.

Nonverbal Expression of Dominance

Much like the paralinguistic literature, only one study (Gifford, 1994) demonstrated a connection between trait dominance and specific nonverbal behaviours. Results from this study suggested that there are four nonverbal cues that tend to convey trait dominance: leg openness,

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gesturing, nodding, and object manipulation.

Summary of Dominance-Related Paralinguistic and Nonverbal Behaviour

To summarize, there is growing evidence that paralinguistic behaviour, and to a somewhat smaller extent, nonverbal behaviour both play an important role in how observers make inferences about others' dominance. Regarding the paralinguistic findings, observers will infer greater dominance when individuals speak more loudly and emphatically and have a lowered pitch with increased pitch variation. Furthermore, individuals rated as having greater dominance tend to have full, resonant voices. More research is needed to clarify the role of speech rate, which has been shown to have both a positive and negative relationship with perceptions of dominance. Notably, some of the same vocal characteristics have been shown to relate to trait dominance. For instance, a small amount of research has shown that those high in trait dominance tend to speak loudly, with lower and more variable pitch, and greater resonance. However, there is currently no evidence that trait dominance is connected to variation in volume (i.e., emphasis), or speech rate. It is important to note that nearly all of these studies measured the vocal characteristics by having participants read scripts or passages, which limits the ecological validity of the findings.

To summarize the nonverbal findings, observers infer greater dominance when individuals engage in proxemic behaviours including greater body openness, orientation toward an interaction partner, and less interpersonal distance. Furthermore, kinesic behaviours that elicit higher ratings of dominance include increased gesturing, eye-contact, and object manipulation, and decreased self-manipulation. As with the paralinguistic findings, there is a subset of these behaviours that are relevant for the expression of trait dominance, although less research has examined this question. Greater trait dominance is associated with increased leg openness (a type of body openness), more gesturing and object manipulation.

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Paralinguistic and Nonverbal Perception (Decoding) of Affiliation

Paralinguistic Perception of Affiliation

Although the body of research relating dominance to a variety of vocal characteristics has grown quite a lot over recent decades, the research demonstrating a connection between affiliation and paralinguistic behaviour is very scarce (Anderson et al., 2006). It is not clear if this is due to a lack of empirical work in this area, or if these relations are difficult to demonstrate. Nevertheless, one study showed evidence that both mean and variability of vocal pitch play an important role in perceptions of affection (Floyd & Ray, 2003). In this study, perceptions of women's affection were associated with higher mean pitch, whereas perceptions of male affection were associated with lower mean pitch. Although these gender differences were evident for mean pitch, for both men and women perceptions of affection were associated with greater variability in pitch. In this experiment, tone of voice was studied in a relatively naturalistic context, in which a sample of unacquainted, opposite-sex dyads interacted in a lab-setting, while observers coded the interaction in terms of how affectionate each member of the dyad was toward the other. Other researchers have shown similar findings using an experimental design in which they manipulated voice clips to have higher or lower intonation and then collected listeners' ratings of personality inferences after listening to the clips (Brown et al., 1973). In comparison to lower intonation clips, voice clips with greater intonation conveyed more "benevolence", a construct that may be thought of as similar to affiliation.

Nonverbal Perception of Affiliation

Anderson, Guerrero and Jones (2006) reviewed the literature connecting impressions of affiliation or affection with specific nonverbal behaviours and argued that affiliation is communicated through two nonverbal domains: positive affect and engagement or involvement.

The specific nonverbal behaviours that communicate positive affect include smiling and head nodding, and the behaviours that communicate engagement include looking at one's interaction partner, forward lean, and close interpersonal distance. Furthermore, in acquainted dyads, perceptions of affiliation are also associated with increased touching (Anderson et al., 2006; Burgoon, 1991).

Paralinguistic and Nonverbal Expression (Encoding) of Affiliation

Paralinguistic Expression of Affiliation

To our knowledge, no studies have directly examined the relation between individuals' trait affiliation and paralinguistic behaviour. However, as previously mentioned, some work has looked at how trait extroversion relates to specific vocal cues (Mallory & Miller, 1958; Scherer, 1978). Given that extroversion is, in part, an index of affiliation, it is worth mentioning again here that increased trait extroversion was positively associated with greater volume, whereas increased trait introversion was positively associated with greater pitch mean.

Nonverbal Expression of Affiliation

The literature connecting trait affiliation and nonverbal behaviour is also very meagre. In one study, Gifford (1994) showed that increased trait affiliation was associated with increased head nods. In another study, Berry and Hansen (2000) demonstrated that trait agreeableness (a rotational variant of affiliation, representing high affiliation and low dominance) was associated with more gazing toward the interaction partner and a more open body posture.

Summary of Affiliation-Related Paralinguistic and Nonverbal Behaviour

In summary, the literature connecting paralinguistic behaviour to both perceptions of affiliation and trait affiliation is quite scarce. The one vocal characteristic that has a proven relationship with perceptions of affiliation is vocal pitch, whereby women with higher pitched voices are perceived as warm and men with lower pitched voices are perceived as warm. In both

genders, greater pitch variability is associated with perceptions of greater affiliation. Interestingly, no studies to our knowledge have looked at the association between trait affiliation and vocal characteristics, and so it remains to be seen whether or not the same relations would exist in the expression of affiliation through vocal pitch.

Perceptions of greater affiliation are associated with a set of nonverbal behaviours, which include increased smiling, head nodding, gaze, forward lean, and physical closeness. However, there is less evidence linking actual trait affiliation to nonverbal behaviour. For instance, Gifford (1994) showed only one significant association, with head nodding, whereas the other expected correlations (e.g., smiling, gaze, forward lean) were not significant.

Implications and Limitations of Previous Work

There are several important key issues and limitations to highlight from the foregoing review of the literature connecting dominance and affiliation to paralinguistic and nonverbal behaviour. First, of all the studies that examine the relationship between personality traits like dominance and affiliation with paralinguistic and nonverbal behaviours, the majority have investigated *perceptions* of personality traits rather than *expressions* of personality traits. One possibility for this imbalance in the literature might be researchers who do study these sorts of phenomena tend to get nonsignificant results, which go unpublished. In support of this perspective, some authors have highlighted the fact that expression (or encoding) findings tend to be more infrequent and weaker in magnitude than perception (or decoding) findings (Berry & Hansen, 2000; Borkenau & Liebler, 1995; Gifford, 2011)

Furthermore, of the studies that have examined the expression of trait dominance and affiliation, nearly all of them collected this information using self-report questionnaires rather than using alternative methods of measurement, such as using measures that tap a more implicit level of dominance and affiliation. Given that a body of research suggests that paralinguistic and

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nonverbal behaviour tend to be governed by relatively automatic processes, it seems plausible that individuals' self-reported (i.e., consciously accessible) personality may not be as well tuned to these channels of behaviour.

Another potential explanation for the lack of expression (i.e., encoding) findings is that these relationships are typically based on correlations between single-item measures of specific behaviours and single measures of personality traits (in comparison to averaging across several observers for the perception findings). Thus, it is possible that the difference in the number and magnitude of the correlations for the expression vs. perception findings are the result of greater measurement error in the former. Gifford (2011) highlights this issue in a recent chapter on lens model methodology and argues that future research in this area should attempt to overcome reliability limitations by computing disattenuated correlations for both the encoding (expression) and decoding (perception) sides of the lens model.

A final point about the foregoing literature review is related to ecological validity. A very large proportion of the findings just described were demonstrated in quite unnaturalistic contexts. For instance, when coding paralinguistic and nonverbal behaviours, many researchers had participants read scripts or passages rather than collect data from interacting dyads. As a result, we have limited knowledge about how paralinguistic and nonverbal behaviour is expressed during a naturalistic social interaction between two people, and how these behaviours relate to trait and observational ratings of dominance and affiliation.

The Current Study

In the current study, we strove to overcome the limitations of previous work in several ways. First, our study included components which address the entire lens model. That is, we connect specific paralinguistic and nonverbal behaviours performed by dyad members to information about observers' impressions of dominance and affiliation (i.e., perception or

decoding), and to trait dominance and affiliation (i.e., expression or encoding). Thus, the current study contributes to the literature on the expression (i.e., encoding) of personality traits through these more covert channels of communication, an area that is currently quite underrepresented in literature in comparison to perception (i.e., decoding) processes. This research design also allows us to readily compare the *encoding* and *decoding* components of the lens model.

In addition, this is the first lens model study that incorporates alternative measures of trait personality to better understand the expression or encoding processes. To supplement the explicit interpersonal measures, we also administered two types of implicit measures, which we expected to relate to nonverbal and paralinguistic behaviour. Furthermore, as recommended by lens model theorist, Robert Gifford (2011), all lens model correlations in the current study are disattenuated in order to correct for random measurement error.

Another unique aspect of the current study was our measurement of paralinguistic behaviour. We used both computer-derived and aurally coded measures of a wide variety of paralinguistic behaviours, which allowed us to compare findings across different methods of measurement. Furthermore, we conducted factor analyses of the measures of specific paralinguistic and nonverbal behaviours, which allowed us to examine whether or not these behaviours co-occur as subsets or overarching factors and how these factors might relate to other measures of dominance and affiliation.

Finally, we collected data from dyads engaging in a social interaction, which has strong ecological validity. Our participants interacted in a naturalistic setting, in which they were asked to work together on a joint task, rather than enact scripts or read passages. Thus, our results represent perception and expression processes that occur in a situation that is closely akin to what would occur in a real-world setting. In addition, this paradigm allowed us to examine how interaction partners' nonverbal and paralinguistic behaviours become interdependent as a result

of interacting with each other.

The specific research questions that we examined include:

1) How do observers make inferences about participants' levels of dominance and affiliation using their nonverbal and paralinguistic behaviour? Based on the preceding literature review, we expect that perceptions of increased *dominance* will be associated with paralinguistic behaviours including increased volume, emphasis, pitch variability, speech rate and resonance. Regarding nonverbal behaviours, we expect greater dominance to be associated with greater frequency of gesturing, and increased body openness and self-manipulation. We expect that *affiliation* perceptions will be positively associated with one paralinguistic behaviour; pitch variability, and with several nonverbal behaviours including greater frequency of smiles, gaze, head nods, and leaning toward the interaction partner.

2) A) To what extent are observers' inferences about dominance and affiliation valid indicators of the participants' personality? That is, how do participants' explicit levels of dominance and affiliation (i.e., self-report) correlate with their nonverbal and paralinguistic behaviours? Based on past research, which is rather scarce, we expect that explicit levels of trait *dominance* will be positively associated with paralinguistic behaviours such as overall volume, pitch variability, and resonance and nonverbal behaviours such as gesturing and body openness. Regarding explicit levels of trait *affiliation*, we do not make any specific predictions for paralinguistic behaviour, given that there are no studies that directly examine this question, to our knowledge. However, we do posit that greater explicit levels of affiliation will be associated with greater frequency of head nods.

B) How do implicit measures of dominance and affiliation relate to nonverbal and paralinguistic behaviours? Because of the exploratory nature of this research question, we forward no specific hypotheses about which characteristics will be associated with implicit dominance and affiliation. However, we might expect that implicit measures may be related to characteristics unexplained by explicit measures.

3) What structure or overarching organization characterizes nonverbal and paralinguistic behaviour? In other words, which of them co-occur as subsets or factors?

4) How might these overarching paralinguistic and/or nonverbal factors relate to measures of dominance and affiliation?

5) How do interaction partners' nonverbal and paralinguistic behaviour affect each other during social interaction? For instance, do partners' behaviours become correlated with each other? Are these correlations consistent with the predictions of interpersonal complementarity, whereby dominance-related behaviours are negatively correlated and affiliation-related behaviours are positively correlated? Or will the correlations demonstrate evidence of convergence across all behaviours, consistent with communication accommodation theory?

Method

Participants

Introductory psychology students were recruited from participant pools at the University

of Waterloo and Wilfrid Laurier University over the course of two school terms. All 228 (114

men and 114 women) participants received course credit towards their grade in introductory

psychology as compensation for their participation. Participants completed a measure of trait

interpersonal style, the Social Behaviour Inventory (SBI; Moskowitz, 1994) as a part of a larger

internet-based questionnaire at the beginning of each term. Based on the self-reported

interpersonal styles of the individuals (derived from their scores on the SBI), previously

unacquainted opposite-sex pairs of participants were then recruited in pairs to come to the lab.

Participants were selected using a stratified sampling technique, to ensure that our sample

represented a large variety of different interpersonal styles. More specifically, using a median

split on each dimension, we classified participants as being high or low on each of dominance

and affiliation. Therefore, participants could be one of four types: 1) Friendly-Dominant 2)

Hostile-Dominant, 3) Friendly-Submissive, and 4) Hostile-Submissive. We recruited participants

in a way that ensured equal numbers of every possible pairing of interpersonal styles.

Materials

Explicit Interpersonal Measures

Explicit dominance and affiliation can be readily assessed using self-report inventories

that inquire about a person's typical behaviour within social interactions. In the current study,

participants completed the SBI, which is a set of 46 statements that assess the behaviours that

underlie the broader dimensions of dominance and affiliation. These two dimensions are

obtained using four subscales that measure dominance, submissiveness, quarrelsomeness and

agreeableness. For instance, a dominance dimension score can be obtained by subtracting the

mean of the submissiveness subscale items from the mean of the dominance subscale items;

likewise, an affiliation dimension score can be obtained by subtracting the quarrelsomeness

subscale mean from the agreeableness subscale mean. For each statement on the SBI,

participants were asked to decide how often in the past month they engaged in the described

behaviour on a six-point Likert scale (1 – Never, 6 – Almost always). A sample item on the

affiliation dimension of the SBI is, "I complimented or praised others", whereas an item on the

dominance dimension is "I expressed an opinion". This scale has good internal consistency, is

highly stable over time, and has good validity (Moskowitz, 1994; Sadler & Woody, 2003; Sadler,

Ethier, Gunn, Duong, & Woody, 2009). In the current sample, the internal consistency

reliabilities (i.e., Cronbach's alpha) of the affiliation dimension scores were .68 for men and .66

for women, whereas for the dominance dimension scores, the internal consistency reliabilities

were .83 in both men and women.

Implicit Interpersonal Measures

We measured implicit dominance and affiliation using both traditional and more recent methods.

Thematic Apperception Test

A traditional measure of implicit interpersonal traits involved administering the Thematic

Apperception Test (TAT; Murray, 1943), in which participants viewed six TAT cards depicting

ambiguous scenes and had five minutes to write a story about each card. These stories were later

coded for themes of power and themes of intimacy. Although a coding system that indexes the

need for affiliation does exist (Koestner & McClelland, 1992) – which would appear to be more

conceptually relevant to the affiliation construct – research demonstrates that the need for

intimacy is a better measure of one's inner desire to develop close, harmonious interpersonal

relationships with others. The need for affiliation, on the other hand, is associated with fear of

rejection and social anxiety (Byrne, 1961; Mussen & Jones, 1957). Consequently, we coded the

TAT stories using the intimacy motivation coding scheme (McAdams, 1980) and the power motivation coding scheme (Winter, 1992).

The intimacy motivation coding scheme indexes a person's preference for or openness to experiences of warm, close and communicative interactions with others. It is assessed using ten thematic categories, which are scored as either present or absent in each story (e.g., dialogue between two characters that is non-instrumental in nature). The score for each story ranges between 0 and 10, and an average across the six stories results in a overall intimacy motivation score for each participant. The power motivation coding scheme measures a person's concern with establishing or maintaining his or her impact or influence over another person, group of persons, or the world at large. It is scored by indicating the presence or absence of 11 different thematic categories (e.g., a character's prestige or status for each story), which are then averaged across the stories to compute the overall power motivation score.

To complete the TAT coding, two coders underwent extensive training, which took approximately 20 hours for each of the two coding schemes. Once they attained adequate levels of reliability with the expert training materials (McAdams, 1980; Winter, 1992), coders independently coded the entire set of stories (1368 stories) for each of the schemes, which took approximately 100 hours for each coder. The inter-rater reliability for the intimacy coding scheme was .95 for women and .96 for men and for the power coding scheme was .96 for women and .97 for men.

Implicit Association Test

Our second measure of implicit interpersonal traits was the implicit association test (IAT), which was designed to measure implicit dominance and implicit affiliation (Ethier, Sadler, & Woody, 2010). To illustrate, consider the dominance IAT. Participants began by completing two blocks of practice trials, in which only one set of words was categorized. In one

practice block, words that were either dominant or submissive in nature (e.g., forceful, timid) appeared consecutively on the computer screen and participants indicated if the word related either to dominance or submissiveness by pressing one of two response keys. In a second practice block, participants sorted words that were either self related or not-self related (e.g., me, it).

After these practice trials, participants completed the critical blocks of the IAT by responding to each of a mixed list of dominant versus submissive words (e.g., forceful, timid) *and* self versus not-self words (e.g., me, it). During these critical trials, participants sorted both categories at the same time (e.g., self versus not-self words and dominant versus submissive words), using only two response keys. In the first type of critical trial, self and dominant shared a single response key, while not-self and submissive shared a second response key. The second type of critical trial followed the same principle as the first, except the categories were switched so that self and submissive were paired to one response key, while not-self and dominant were paired to the other response key. The stimuli words included 40 interpersonal descriptors (20 for each IAT), which included ten words that reflected each of dominance, submissiveness, friendly and unfriendly. A list of the words is included in Appendix A.

IAT instruments are typically scored by computing the difference between average response times in the two types of critical blocks. Following from the above example using implicit dominance, the average response time in the set of critical trials in which self and dominant share a response key would be subtracted from the average response time in the set of critical trials in which self and submissive share a response. Consequently, higher scores would indicate higher implicit dominance. Although this is the most typical method of scoring the IAT, recent research has heavily criticized this practice (e.g., Blanton, Jaccard, Gonzales & Christie, 2006; Ethier, Sadler & Woody, 2010) because it assumes that the two types of critical blocks are

negatively correlated. However, after controlling for general processing speed, the two types of critical blocks have near-zero correlations, suggesting that the constructs measured by the two types of critical blocks are relatively independent when controlling for processing speed. As a result, in some of our previous work we have recommended alternative scoring guidelines, which control for general processing speed, using methods detailed in Ethier et al. (2010). One implication of this modified scoring practice is that each IAT is decomposed into *two* underlying constructs, which are not simply bipolar opposites. For instance, the dominance IAT is comprised of *implicit dominance* and *implicit submissiveness.* Likewise, the affiliation IAT is comprised of *implicit affiliation* and *implicit hostility*. The scores from these four can then be used individually to predict outcome variables, rather than relying on the traditional IAT difference score.

In the current sample, the internal consistency for the dominance IAT construct was .59 in men and .78 in women, and for the submissiveness IAT construct it was .53 in men and .68 in women. The internal consistency for the affiliation IAT construct was .80 in men and .74 in women, and for the hostility IAT construct it was .62 for both genders. The correlation between implicit dominance and implicit affiliation (both corrected for general speed) was approximately zero in both genders (for males, $r = .01$, and for females, $r = -.02$); correcting for general speed tended to produce modestly negative correlations between the other pairs of IAT constructs (e.g., implicit dominance with implicit submissiveness), around -.30.

Procedure

After completing the online questionnaire measuring trait interpersonal style, the SBI, participants were invited to the lab in pairs to complete the study. During recruitment by phone or email, participants were told that the study was about problem solving ability and that they would be interacting with another student while being videotaped. Once participants arrived at

the laboratory, the experimenter provided a fuller description of the study. They were told the study was about problem solving in different contexts, such as open-ended vs. closed-ended tasks, and solitary vs. group tasks. This cover story provided a justification for the various tasks that the participants would then be asked to complete. After this introduction, participants completed a written version of the TAT. They looked at six different TAT pictures in succession, and had five minutes to write a short story about each picture. The directions given for this task were taken from the protocol typically followed for research administration of the TAT (Smith, Feld, & Franz, 1992). In total, this portion of the study took approximately 30 minutes.

Once the TAT responses had been collected, participants worked together on a joint task. They read a third person's responses to the TAT (based on a different set of TAT cards) and worked together to form an agreement about that person's personality. Before starting the activity, the experimenter gave participants some general background information about the TAT, including information about its typical administration and the fact that psychologists use the story contents to assess personality. They were left for 20 minutes to negotiate the task in any way they chose, with the only direction being to come to an agreement on the nature of the TAT respondent's personality. During this period, participants sat at a table, side-by-side, while being videotaped through a one-way mirror, to reduce the distraction that the video-recorder might otherwise have caused. Trained coders used these videotapes to code various aspects the participants' interpersonal behaviour, which will be described a bit later.

After the joint task, we separated participants into different rooms. Here, they completed measures of implicit dominance and affiliation, using the IAT (Ethier et al., 2010). The IATs took approximately 20 minutes to complete, after which participants completed a final package of self-report questionnaires, which included measures of participants' own interpersonal

behaviour during the 20-minute interaction, as well as the interpersonal behaviour of their interaction partner.

Observer Assessments of Situational Interpersonal Behaviour

To assess situational dominance and affiliation, three observers (one graduate student and two undergraduate students) viewed the videotaped interactions and completed situational judgments of interpersonal behaviour using the SBI. The original SBI was modified so that the questions pertained to the particular situation, rather than behaviours exhibited over the last month (as it is stated in the original, self-report form). Furthermore, we eliminated two items from the original SBI, because of the low base-rate that would be expected for such behaviour in the context of the situation ("I asked for a volunteer" and "I gave incorrect information"). Each observer received 15 hours of training and then provided SBI ratings for all 114 pairs (228 participants). Observers completed the coding in a counterbalanced order, which was organized so that the members of a dyad were not coded during the same session. Inter-rater reliability estimates for dominance and affiliation were .90 and .83 for women and .91 and .83 for men, respectively. To obtain an overall score on dominance and affiliation from the SBI, we took an aggregate across the three coders.

Measurement of Paralinguistic and Nonverbal Behaviour

Paralinguistic Behaviour

To measure paralinguistic behaviour, we selected voice clips from the same five-minute segment used for the body language coding, described below. For each participant we compiled a voice clip that was approximately 30 seconds in length. This clip was constructed by selecting between five and ten segments containing full sentences. Full sentences were chosen in order to maintain the prosodic features of the voice. This 30-second voice clip was divided into two shorter clips, each approximately 15 seconds in length. As a result, two separate voice clips for

each participant were used to measure a variety of vocal indices, both by using a computer program called *Praat* and by having coders aurally rate the clips on a variety of vocal characteristics. It is important to emphasize that we made efforts to reduce the potential impact of semantic content, which has particular relevance for the aural coding. First, on average, each voice segment (i.e., sentence) was approximately 4 to 5 seconds long, which limits the amount of semantic meaning contained therein. Second, when combining the voice segments into longer voice samples, we employed a technique called "randomized splicing", originated by Scherer (1971). Using this technique, we randomly selected the smaller voice segment units to create the longer voice clip and avoided placing the clips in a sequential order. The result is a voice clip that has minimal semantic meaning.

Computer-Derived Indices

Using *Praat*, we measured five characteristics for each of the two clips: 1) mean fundamental frequency (i.e., pitch mean), or F0, measured in hertz (Hz); 2) standard deviation of F0 (i.e., pitch standard deviation), also measured in Hz; 3) mean amplitude (i.e., volume mean), measured in decibels (dB); 4) standard deviation of amplitude, also measured in dB; 5) formant dispersion (Fitch, 1997), which is a measure of resonance. One problem with measuring fundamental frequency is that there are clear gender differences. On average, men have lower pitched voices than women. This difference becomes complicated when estimating the standard deviation of fundamental frequency, because as the voice gets higher, the difference, in hertz, between two given tones is greater. To illustrate, the difference between two notes on a piano at a low octave, in hertz, is much smaller than the difference between the same two notes on a piano at a higher octave. As a result, women have inflated estimates of F0 variability in comparison to men, even though their variability may span the same range of tones. To correct for this differential inflation of pitch variability, we took a logarithm of the F0 values and used

these log-transformed values to compute the mean and standard deviation. It is important to emphasize that this transformation did not eliminate legitimate gender differences that may exist for pitch mean and variability; rather, it simply ensured that men and women were scaled equivalently.

Aurally Coded Indices

In addition to our computer-derived indices, three trained coders completed a 24-item scale which measured a comprehensive set of vocal characteristics using Likert-format items (see Appendix B). In addition to coding items that tap the five characteristics obtained using *Praat*, coders also provided ratings of patterns of pitch variability (e.g., falling or rising), patterns of volume variability (e.g., trail off or crescendo), as well as items which measure speech rate and vocal fluency (e.g., mumbling, pausing). Coders also rated a variety of subjective qualities of the voice, such as the extent to which the person's voice sounded full, child-like, nasal, or whiney. Three raters coded all participants (N = 220) on the two separate clips, totalling 440 ratings per coder. Prior to these ratings, coders underwent a training procedure that took approximately four hours. As part of the training, they discussed the definitions for each of the questionnaire items and then rated ten practice clips. Once the agreement was within two or fewer points on the six-point scale, they began coding the participants' voice clips. Coders listened to each clip approximately seven times to complete the 24-item questionnaire.

One reason for coding two voice clips for each participant was that we wanted to evaluate the stability of the vocal characteristics. To assess this, we computed correlations between the individual items across the two clips, each aggregated across the three raters. These correlations were quite high (average *r* = .52), suggesting that these cues are quite stable across different voice clips. It is worth noting that there was some degree of variability in the stability of our vocal characteristics. In particular, certain characteristics demonstrated quite strong correlations

(in the .70 to .79 range), such as the mean level of pitch and volume, and the extent to which the voice was full sounding. However, others showed relatively modest agreement, with correlations in the .30 to .60 range, such as the variability of pitch and volume, as well as voice qualities like rough, nasal, raspy, and hoarse. Given that overall the intercorrelations between the two voice clips were high, we computed an aggregated score on each item by averaging across the two clips.

To assess inter-rater reliability of the aurally coded vocal characteristics, we used the coders' ratings on each item (aggregated across the two clips) to compute a Cronbach's alpha for every vocal characteristic, treating the three raters as "items". These estimates of reliability, summarized in Table 1, were uniformly high across both male and female participants, except for two items for males, one which assessed the degree to which the voice increased in volume across each sentence (i.e., crescendo), and the other which assessed how child-like the voice sounded. In men, there was a very low base rate of both of these items, which likely led to such low estimates of reliability. Otherwise, the estimates of inter-rater reliability ranged from .76 to .93 in women, and from .75 to .95 in men.

Nonverbal Behaviour

Nonverbal behaviour was coded for a 5-minute segment of the videotaped interaction, the same length of time selected by Gifford (1994), who used a lens-model approach to link various aspects of nonverbal behaviour to the eight octants of the interpersonal circumplex. We chose to code a five-minute segment that fell in the second half of the interaction, after 10 minutes had passed. The reasons for choosing this window were twofold. First, we wanted to ensure that the participants had finished reading the TAT stories and had begun to interact with each other. Second, we wanted participants to have enough time to become familiar with the setting, so we could capture their most typical way of behaving.

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Two students (one graduate and one undergraduate) completed all of the nonverbal coding. Each coded all 114 dyads (228 participants), after receiving approximately ten hours of training. The protocol used to code participants' body language drew heavily from the Seated Kinesic Activity Notation System (SKANS Version 5.2; Gifford, 1994). We altered this coding scheme in two ways. First, whereas Gifford (1994) investigated the various aspects of body language that are associated with all eight octants of the interpersonal circumplex, we focused only on the behaviours that were related to the four poles (dominance, submissiveness, affiliation and hostility). Second, we did not code behaviours that occurred below the waist, because they were concealed by the table at which participants were sitting. In this pared-down version of SKANS, we coded for fifteen kinesic and facial behaviours.

These behaviours were coded in one of three different ways depending on which method was best suited to the behaviour in question. One type of coding was based on *frequency*, in which certain behaviours were counted for the number of times they were performed in each 5-second window. Frequency-scored behaviours included smiles, head-shakes, and head-nods. The second type of coding was based on *duration*, in which we measured the number of seconds that certain behaviours were performed in each 5-second window (ranging from 0 to 5 seconds). Duration-scored behaviours included gestures, object manipulation (e.g., playing with pens, paper, personal belongings), self-manipulation (e.g., scratching, picking, rubbing, or biting parts of the body), and gazing at the other person. Lastly, *time-sampled* coding was performed by pausing the video every 5 seconds to measure body positioning. These measurements included head recline (i.e., looking up or down), trunk lean (i.e., leaning away or toward partner), trunk orientation (i.e., body turned toward or away from partner), arm height and extension, and arm wrap (i.e., arms open vs. crossed).

We evaluated the inter-rater reliability for each of the specific behaviours by computing the correlation between the observers' ratings on each of the behaviours and then boosting the estimate using the Spearman-Brown prophecy formula. Overall, agreement was extremely high for the set of behaviours, with an average inter-rater reliability of .92 for both men and women. Table 2 contains a full listing of the measured nonverbal behaviours and their corresponding inter-rater reliability estimates for men and women. Despite the high level of inter-rater agreement, we decided to exclude five of our coded behaviours because they were highly confounded with the activity being performed. These included left and right arm height and arm extension, and object manipulation. Because participants were actively working on the task at hand (e.g., organizing the cards, moving the materials around), their arm placement and object manipulation were more of a reflection of working on the task, rather than being indicative of interpersonally relevant behaviour.

Results

Paralinguistic and Nonverbal Perception (Decoding)

To examine the degree to which participants' nonverbal and paralinguistic behaviour was related to observers' assessments of dominance and affiliation, we computed disattenuated bivariate correlations between each behaviour and the observers' ratings of the two interpersonal dimensions. We chose this approach because the magnitude of typical bivariate correlations would be inherently limited by the reliability of both of the components going into them, whereas we are interested in the extent of these relations correcting for random measurement error. The disattenuated correlations correct for the unreliability of both the specific behavioural characteristics and the situational judgments of interpersonal style. It is important to note that the process of disattenuating the correlations did not affect their significance levels, only the sheer magnitude of the coefficients. However, we did choose a more conservative cut-off of $p < .01$, rather than the typical $p < .05$ criterion. Our reason for choosing this criterion was that it corresponded with correlations that reached at least .20 in magnitude, whereas correlations that reached the $p < .05$ criterion tended to be quite small in magnitude (i.e., $r = .11$), limiting their practical significance.

To compute the disattenuated correlation coefficients for each pair of variables we used the structural equation model depicted in Figure 3, which uses computer-derived volume and observers' perceptions of situational dominance (aggregated across the three observers) as an example. The model has four latent variables, two for each dyad member. Each latent variable has a single measurement indicator. To correct for random measurement error, we set error variances to be equal to $(1 - r_{xx})*\text{var}_x$. In the present example, these values are shown above the error variables for each measure. In addition to computing disattenuated correlations, this model allowed us to statistically evaluate the presence of gender differences for each such pair of

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associations. To do so, we evaluated the fit of a model in which the relevant covariances (labelled *a* and *b* in Figure 3) were set equal.

Perception of Dominance

First, we computed disattenuated bivariate correlations between perceptions of dominance from the SBI and each of the 33 behavioural characteristics (10 nonverbal, 18 aurally coded paralinguistic, 5 computer-derived paralinguistic). Of the 33 correlations, 18 reached statistical significance and are shown in Table 3. Remarkably, 17 of the 18 significant correlations were paralinguistic in nature. To first summarize the aurally coded paralinguistic behaviors, the strongest correlations were for volume, emphasis, full-sounding, fluent, mumbling, and fast-paced. Specifically, individuals perceived as demonstrating greater dominance spoke more loudly, fluently, with greater emphasis, fuller sound, and faster pace. Furthermore, individuals high in dominance tended to mumble less often. We also found moderate correlations for other aurally coded paralinguistic characteristics. For example, individuals who were perceived as showing greater dominance spoke with greater pitch variability and a falling intonation. They also paused less and sounded less child-like and whiney.

Next, let's consider the relations with the computer-derived paralinguistic behaviours. Given the positive correlation between dominance perceptions and aurally coded volume, pitch and fullness, we would expect to find a positive association between perceptions of dominance and computer-derived measures of pitch variability, volume mean, volume variability, and resonance. As shown in Table 3, we found the expected pattern of associations for pitch variability, volume mean, and volume variability. For resonance, a gender difference emerged, where the correlation for men was $r = .35$ and for women was $r = .01$.

Notably, just one of the nonverbal behaviours was significantly related to perceptions of

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dominance. In particular, individuals who were perceived as having greater dominance tended to gesture more ($r = .42$).

A final aspect of these results deserving some attention is the general lack of gender differences. Only the correlations for resonance were significantly different for men and women. This finding is not particularly surprising, given that men tend to have a much larger range of resonance, given their larger physical stature (Kent & Read, 2002). However, overall, our findings suggest that observers rely on the same characteristics in order to make inferences about dominance in both men and women.

Perception of Affiliation

As with the dominance dimension, we computed the disattenuated bivariate correlations between observers' perceptions of affiliation and each of the 33 behavioural characteristics, for both men and women simultaneously. There were five significant correlations, shown in Table 4. To summarize, four of the five correlations were for the nonverbal indices. Observers perceived both men and women as more affiliative when they gazed at their interaction partner, smiled, and gestured. In addition, one gender difference emerged. Observers perceived women as more affiliative when they nodded their heads, whereas this relation was not significant for men. Aside from these nonverbal behaviours, only one paralinguistic characteristic was significantly associated with affiliation perceptions: observers inferred higher levels of affiliation when participants had greater pitch variability.

Summary of Nonverbal and Paralinguistic Perception

Recall that our first research question asked, "What paralinguistic cues do observers use to make inferences about dominance and affiliation?" Observers in our study inferred dominance using mainly paralinguistic behaviours, such as volume, emphasis, pitch variability, speech rate, and fullness of the voice. Although the paralinguistic behaviours were primarily

used to infer dominance, gesturing also had a strong impact on dominance perceptions. On the other hand, observers inferred affiliation using more nonverbal behaviours, such as nodding, smiling, and gazing. Pitch variability was the only paralinguistic behaviour that was significantly associated with perceptions of affiliation.

Thus, our results demonstrate that observers do, in fact, employ nonverbal and paralinguistic information when forming impressions about others' social behaviour. However, do participants' self-ascribed interpersonal traits relate to the same behaviours?   In the next section, we address this question by reviewing the findings on the other half of the lens model.

Nonverbal and Paralinguistic Expression (Encoding)

To evaluate the extent to which individuals' interpersonal traits are expressed through their paralinguistic and nonverbal behaviour, we used SBI self-ratings of trait dominance and affiliation and computed disattenuated correlations (using SEM) for each dimension score with the set of 33 nonverbal and paralinguistic behaviours. To compute these disattenuated correlations we used the same type of SEM model used in the previous section, depicted in Figure 3.

Expression of Dominance

The six statistically significant correlations between self-reported trait dominance and each of the behaviours are presented in Table 5. To summarize, all of the significant correlations were for paralinguistic behaviours, all in the moderate range. For the aurally coded behaviours, those who described themselves as dominant spoke louder, more fluently, and faster. In addition, they had more full-sounding, less child-like voices. As we would expect given the correlations with the aurally coded behaviours, the computer-derived index of volume was also positively correlated with self-reported dominance.

Expression of Affiliation

Upon examination of the 33 disattenuated correlations between self-reported trait affiliation and the behavioural characteristics, only three associations reached statistical significance. These correlations are reported in Table 6. Of all the nonverbal behaviours, only smiling was significantly associated with trait affiliation. Surprisingly, this relation was found for women ($r = .36$), but not for men ($r = .04$), as indicated by a significant reduction of fit [$\Delta \chi^2(1) = 6.34$, $p < .01$] of the model in which the covariance paths were set equal for both genders. Regarding paralinguistic behaviour, both men and women with greater levels of trait affiliation had less child-like voices. Furthermore, men high in trait affiliation had whinier voices ($r = .40$), whereas this relation was not significant for women ($r = .05$). This difference between men and women was also statistically significant, where the model constraining the covariance paths to be equal in both genders resulted in lack of fit [$\Delta \chi^2(1) = 7.81$, $p < .01$].

Summary of Nonverbal and Paralinguistic Expression

In our second research question we asked, "Do participants' self-reported trait dominance and affiliation relate to their own nonverbal and paralinguistic behaviour?" Our findings suggest that, to some extent, the answer is "yes". For the dominance dimension, there were several paralinguistic behaviours that were significantly correlated with self-ratings of personality. In particular, increased self-reported dominance was associated with greater volume, speaking rate, and fullness of the voice. As with the dominance dimension, self-reported ratings of affiliation were also related to several nonverbal/paralinguistic behaviours. For instance, greater self-ratings of trait affiliation were associated with sounding less child-like, more whiney (in men only) and smiling more often (in women only).

Comparison of Perception and Expression Findings

Although there were a handful of significant correlations between trait interpersonal style

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and paralinguistic/nonverbal behaviour, many of the measured behaviours did not emerge as significant. For the dominance dimension, (e.g., Table 3 vs. Table 5), many items which *observers* used to infer dominance were not related to self-reported dominance. Some examples include pitch variability, volume variability and emphasis. Interestingly, these three behaviours are all indices of vocal variability. For the affiliation dimension (e.g., Table 4 vs. Table 6), we again can see that observers used a greater number of behavioural cues in making affiliation inferences. Some of the characteristics used by observers that were not related to trait affiliation include head nods, gaze, and gestures, and pitch variability.

In sum, there are two main implications that emerge from our perception and expression results. The first is that, overall, paralinguistic behaviour is mainly associated with dominance, whereas nonverbal behaviour is mainly associated with affiliation. The second implication is that there are far more significant associations on the right side of the lens model (i.e., perception or "decoding", shown in Tables 3 and 4) in comparison with the left side of the lens model (i.e., expression or "encoding", shown in Tables 5 and 6) for both dominance and affiliation constructs. In the same vein, the associations on the right side tend to be stronger in magnitude than those on the left.

Expression of Implicit Dominance and Affiliation

How might we account for the relative dearth of significant associations on the left side of the lens model? One explanation might be the explicit nature of our measures of trait interpersonal style. Recall that we measured trait dominance and affiliation using a self-report measure which requires conscious contemplation and awareness. Given that nonverbal and paralinguistic behaviour are thought to be governed by automatic processes, one could wonder how *implicit* measures of trait dominance and affiliation relate to these behaviours, as highlighted in the part B of our second research question. To examine this possibility, we

computed the disattenuated bivariate correlations between our measures of *implicit* dominance and affiliation (using the IAT and TAT) with each of the 33 nonverbal and paralinguistic behaviours.

Implicit Dominance and Submissiveness

Recall that our dominance IAT measured two distinct constructs: implicit dominance and implicit submissiveness. Thus, we computed disattenuated bivariate correlations separately for each of these two constructs with the 33 paralinguistic and nonverbal behaviours. Implicit dominance as measured by the IAT was positively associated with volume variability ($r = .24$, $p < .01$), whereas implicit submissiveness was negatively related to head shakes ($r = -.35$, $p < .001$) and volume variability ($r = -.61$, $p < .001$). Thus, whereas implicitly dominant individuals spoke more emphatically, implicitly submissive individuals were inclined to speak less emphatically, and displayed fewer head shakes.

Unfortunately, our TAT measure of implicit need for power did not show significant associations with our behavioural characteristics. Although some of the correlations were trending in the expected direction, they did not reach our criterion cut-off of $p < .01$. In particular, there were positive correlations between need for power and volume ($r = .16$, $p < .05$), volume variability ($r = .16$, $p < .05$) and emphasis ($r = .15$, $p < .05$). However, these correlations are quite modest in magnitude.

Implicit Affiliation and Hostility

As with the dominance dimension, our affiliation IAT measured two distinct constructs: implicit affiliation and implicit hostility. We computed the disattenuated correlations for each of these constructs separately. First, implicit affiliation was positively associated with volume variability ($r = .37$, $p < .01$), and was negatively associated with arm wrap ($r = -.41$, $p < .001$) in women. There were no significant correlations between implicit hostility and any of the

behavioural characteristics. Thus, we would conclude that individuals high in implicit affiliation speak with greater variability in volume, and have a more open postural stance (for women). Unfortunately, our TAT measure of need for intimacy was not significantly correlated with any of the behavioural indices.

To summarize, our implicit measures of dominance and affiliation were associated with a subset of participants' nonverbal and paralinguistic behaviours. Of particular interest are the behaviours that were significantly related to the implicit measures, but not their explicit counterparts. For instance, implicit measures of dominance were positively associated with volume variability, whereas explicit measures of dominance were not. Likewise, implicit measures of affiliation were associated with behaviours not explained by their explicit counterparts, such as body openness (i.e., arm wrap) and volume variability. Thus, it is plausible that certain subsets of nonverbal and/or paralinguistic behaviours are more indicative of implicit interpersonal style, escaping conscious awareness.

Factor Analysis of Paralinguistic and Nonverbal Behaviour

Now that we have covered the bivariate correlations between the various behavioural characteristics and our measures of dominance and affiliation (both observer assessments and trait measures), we consider how this group of paralinguistic and nonverbal behaviours might be characterized more broadly. For instance, how could these behaviours be combined to create an overall impression that conveys dominance and/or affiliation? As stated in our third research question, how might our measures of paralinguistic and nonverbal behaviours be understood in terms of overarching factors or constructs? To examine this question, we conducted factor analyses on the paralinguistic and nonverbal behaviours, separately.

Factor Analysis of Paralinguistic Behaviour

To conduct the exploratory factor analysis of participants' paralinguistic behaviour, we used the aurally coded paralinguistic behaviours (see Appendix B), aggregated across the three raters. However, we eliminated three items that were redundant with "hoarse" (i.e., rough, raspy, clear) and three items that were based on relatively complex impressions that may involve more than one otherwise distinguishable vocal component, (i.e., radio-announcer, pleasant, melodic). For men and women separately, we conducted principal axis factor analyses with promax rotation using the remaining 18 items. In both men and women, the results supported a two-factored solution, with eigenvalues of 5.43 and 2.90 for women and 5.55 and 2.59 for men. The pattern matrices of the two-factored solution are summarized in Table 7. On the far left of the table is a list of the aurally coded paralinguistic characteristics included in the factor analyses. The items above the dashed line resulted in consistent findings for men and women, with factor loadings of at least .30 on one of the factors. The items below the dotted line had inconsistent results across men and women, or had factor loadings of less than .30.

Based on highly consistent factor loadings for men and women, we interpreted the underlying factors as follows. We called Factor 1 "vocal expressivity", because many of the items represent how dynamic the voice is (e.g., emphasis, crescendo, pitch variability, fast-pace). High scores on this construct represent a voice that is highly dynamic and expressive. Likewise, we called Factor 2 "vocal immaturity", because the items representing this factor relate to how immature the voice sounds (e.g., child-like, higher pitch mean, lacking fullness). High scores on this construct represent a voice that sounds relatively immature or child-like.

We created two equivalent subscales for men and women, using only the items that were consistent across the genders (above the dotted line in Table 7). Our rationale for leaving out inconsistent items is that we wanted to ensure the two subscales in men and women represented

the same construct. The subscale representing vocal expressivity included nine items with high

internal consistency in both men (α = .85) and women (α = .86). Likewise, the subscale

representing vocal immaturity included four items with moderate to high internal consistency in

men (α = .70) and women (α = .80). In addition, we evaluated the inter-rater reliability by

computing subscale scores for each of the three raters and then computing the Cronbach's alpha

of the three scores. The results of the reliability analyses suggest very high inter-rater

consistency for the two subscales in both men and women, with α ranging from .87 to .95.

To examine the validity of the subscales, we computed the disattenuated correlations

between these two vocal subscales and the five computer-derived paralinguistic cues, which may

be thought of as purely objective indicators of five main vocal characteristics: pitch mean (F0

mean), pitch variability (F0 SD), volume mean (dB mean), volume variability (dB SD), and

resonance (formant dispersion).

As outlined in Table 8, the vocal expressivity subscale was positively related to pitch

mean, pitch variability, volume mean and volume variability. Thus, people who are higher in

vocal expressivity speak with a higher overall pitch and greater pitch variability. Furthermore,

they speak with a louder volume and with greater volume variability (i.e., emphasis). Resonance

was significantly positively correlated with vocal expressivity for men but not women. Men who

are high in vocal expressivity tend to have greater resonance. As also shown in Table 8, the vocal

immaturity subscale was positively associated with pitch mean and negatively associated with

volume mean, volume variability, and resonance. Thus, people who are higher in vocal

immaturity speak with a higher overall pitch, with lower overall volume and emphasis, and less

resonance.

In summary, the patterns of correlations between our new paralinguistic constructs and

the computer-derived vocal characteristics provide some impressive convergent validity

evidence. That is, people who are high in vocal expressivity have voices that can be characterized by objective expressive vocal characteristics, such as pitch variability (F0) and volume variability (dB). Likewise, people who are high in vocal immaturity have voices that can be characterized by immature vocal characteristics, such as higher pitch mean (F0), lower volume mean (dB), and lower resonance.

Factor Analysis of Nonverbal Behaviour

Recall that we measured ten different nonverbal behaviours, using Gifford's (1994) SKANS coding scheme. Using this set of behaviours, we conducted exploratory factor analyses for men and women separately. In men, a principal axis factor analysis with a promax rotation yielded three factors (factor loadings shown in Table 9), whereas in women, the same analysis resulted in two factors (factor loadings shown in Table 10).

To summarize these results, in men Factors 1 and 2 seem to be tapping two distinct sets of seemingly affiliative behaviours. Factor 1 appears to measure behaviours that may underlie a tendency to be attentive to one's interaction partner, such as looking up and toward the partner and leaning slightly away from her. We speculate that the negative factor loading for trunk lean may be explained by the close quarters in which participants were working together (i.e., sitting side by side at a table). In particular, leaning slightly away may have been a strategy that men used to signal respect for their partners' personal space. Factor 2 appears to measure behaviours consistent with positive affect displayed toward the interaction partner, including smiles and head shaking, and head nods. Factor 3 measures additional nonverbal items that do not load on the first two factors. Interestingly, Gifford (1994) demonstrated several of these items to be dominance-related (e.g., gesturing, trunk posture). However, in the current sample, an aggregate of these items were not significantly correlated with either self-report or perceived dominance in either men or women.

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In women, Factor 1 is akin to the combination of Factors 1 and 2 in men. That is, both the attentiveness and positive affect combined into one factor for women, with the exception of trunk lean, which loaded only on the second factor.

Because the third factor did not correlate with dominance ratings, the subsequent results will focus on items that load on Factors 1 and 2 in men, and Factor 1 in women. However, to make the analyses more comparable across men and women, we decided to maintain two distinct constructs for both men and women, which are 1) attentiveness and 2) positive affect. As such, we created subscales that correspond to both of these constructs. Before computing these subscales we analyzed the internal consistency reliability of the items comprising the factors. In both men and women, the attentiveness construct (i.e., head recline, gaze, and, in men, trunk lean) resulted in a moderate Cronbach's alpha, of .65 and .67 respectively. On the other hand, the positive affect construct (i.e., smiles, head nods, and head shakes) resulted in marginal internal consistency reliabilities of .49 in men and .50 in women.

Predictive Validity of Vocal and Body Language Factors

To address our fourth research question, we can examine how these overarching factors or constructs might be related to general perceptions of participants' levels of dominance and affiliation, which we measured using observer ratings. Recall that our findings for our first research question suggested that paralinguistic behaviours predicted perceptions of dominance, whereas nonverbal behaviours predicted perceptions of affiliation. Given these findings, we hypothesized that the two underlying paralinguistic factors (vocal expressivity and vocal immaturity) would be comparatively more predictive of dominance, whereas nonverbal factors (positive affect and attentiveness) would be comparatively more predictive of affiliation. The following results first present the paralinguistic findings, followed by the nonverbal findings.

Paralinguistic Predictors of Dominance and Affiliation Perceptions

Using structural equation modeling in AMOS, we constructed two models, one for each of dominance and affiliation. Consider the dominance model without any results as an example, shown in Figure 4. In this model we included both interaction partners, which allowed us to represent the dependence between the two interactants. On the left of the model are four latent variables representing vocal expressivity and vocal immaturity for men and women, and on the right of the model are two latent variables representing observers' perceptions of dominance for men and women. Each latent variable has three indicators, which are the subscales computed for each of three observers. For instance, vocal expressivity has three indicators, each of which represents the vocal expressivity subscale for each observer. It is important to note that with one exception, the observers who provided ratings for the variables on the left were different from those who provided ratings for the variables on the right.

In this model, we set the measurement paths to be equal within observers. For example, the letter "a" represents the measurement paths for Observer 2 for each of the vocal constructs. Likewise, the letter "d" represents the measurement paths of Observer 3's assessments of dominance in both dyad members. Our rationale for making such constraints was that the items were scaled equally (e.g., a 6-point Likert scale), which would likely lead observers to scale the items similarly regardless of the particular content that the items are measuring. In addition to the measurement path equality constraints, we also set certain parameters to be equal across the men and women. One type of equality constraint was for the covariances between the vocal constructs on the left. As an example, the covariance between vocal expressivity and vocal immaturity were set to be equal across the genders, denoted by the letter "g". We also set the regression paths to be equal across genders, denoted by the letters "e" and f". We constrained paths for men and women to be equal because there is no evidence from prior research

suggesting that we should expect gender differences in these particular relations. Another feature of this model is the covariance between the latent disturbances, d1 and d2. This represents possible dependence between dyad members, in which one person's dominance may be affecting the other person's dominance, and vice versa.

The resulting model fit very well, where $\chi^2 (134) = 185.56$, $p < .01$, CFI = .97, RMSEA = .06, *pclose* = .24. Shown in Figure 5 (standardized estimates), the two paralinguistic constructs account for a significant proportion of the variance in dominance ratings in both men and women (30%). Furthermore, both vocal constructs are unique contributors to this variance. Vocal expressivity is the stronger predictor of the dominance perceptions in both men and women, with regression weights more than twice the size of those for vocal immaturity (e.g., in men $\beta = .47$, $p < .001$ in the former and $\beta = -.16$, $p < .001$ in the latter). In addition, we see that the latent correlation between the disturbances associated with dyad members' dominance is very high at $r = -.78$. This suggests that interaction partners' behaviour is dependent, whereby greater dominant behaviours in one person lead to less dominant behaviours in the other. This finding is in line with the principle of interpersonal complementarity. Interestingly, however, the correlations between interaction partners' latent vocal constructs were relatively weakly positive ($r = .29$, $p < .01$ for Vocal Expressivity and $r = .18$, $p < .01$ for Vocal Immaturity).

We also evaluated a parallel model in which the two vocal constructs predicted perceptions of men's and women's affiliation, shown in Figure 6. This model also fit very well, where $\chi^2 (134) = 187.45$, $p < .01$, CFI = .96, RMSEA = .06, *pclose* = .22. Here, we would expect that there should be little relation between the vocal constructs and perceptions of affiliation, given that our earlier findings showed that vocal behaviours are primarily related to dominance perceptions. Indeed, neither the vocal expressivity nor vocal immaturity constructs predicted perceptions of affiliation, with only 2% of the variance explained in both men and women. Both

regression weights in this model were nonsignificant. As expected, the latent correlation between the disturbances associated with dyad members' affiliation perceptions was significant and positive, $r = .34$, $p < .01$. Thus, greater affiliative behaviours in one person lead to a corresponding increase in affiliative behaviours in the other, also in line with interpersonal complementarity. In sum, based on these findings, the vocal constructs are integral to the impression formation of dominant, but not friendly, interpersonal behaviour.

Nonverbal Predictors of Dominance and Affiliation Perceptions

As with the paralinguistic analyses above, we used structural equation modeling to construct two separate models in which the two latent nonverbal constructs predict perceptions of dominance and affiliation. These models were slightly different than the paralinguistic models in two ways. First, there were only two coders for the nonverbal constructs, rather than three. However, we maintained equality constraints for the indicators measured by the same coders as in the previous models. Second, the covariances between the nonverbal latent variables were not set equal across genders, because we knew in advance that the two constructs were more highly correlated in women (given that they loaded on the same factor) than in men. (Indeed, setting these covariances to be equal resulted in significant lack of fit.)

Shown in Figure 7, this model fit well, $\chi^2 (70) = 103.34$, $p < .01$, CFI = .98, RMSEA = .06, *pclose* = .18. In contrast to the results obtained for the vocal constructs, we expected that the nonverbal constructs of attentiveness and positive affect would be unrelated to situational dominance. It is clear that the body language facets of attentiveness and positive affectivity did not account for any significant proportion of variance in perceptions of dominance ($R^2 = .01$ in both genders), nor were the regression paths significant.

On the other hand, we expected the nonverbal constructs to be positively associated with perceptions of affiliation. This model is shown in Figure 8. Once again, the model fit well, χ^2

(70) = 106.47, $p < .01$, CFI = .97, RMSEA = .07, *pclose* = .13. Attentiveness and positive affect explained 17% of the variance in general perceptions of male affiliation and 19% of the variance in general perceptions of female affiliation. Notably, only the positive affect constructs significantly predicted the affiliation perceptions, where $\beta = .41$, $p < .001$ in men and $\beta = .44$, $p < .001$ in women. Surprisingly, attentiveness did not predict perceptions of affiliation. Also of interest are the intercorrelations between the partners' nonverbal factors, both of which are significantly positive. Attentiveness was correlated between partners at .77 and positive affect was correlated at .49. These correlations are quite strong, particularly in comparison to the overall correlation between the disturbances associated with observers' perceptions of affiliation (i.e., the correlation between d1 and d2), which was .29.

Interdependence of Dyad Members' Nonverbal and Paralinguistic Behaviour

Our fifth research question shifts from focusing on individuals' nonverbal and paralinguistic behaviour in relation to their own interpersonal style to examining how partners' behaviours become more or less similar as a product of their interaction with each other. We hypothesized that, overall, partners' nonverbal and paralinguistic behaviour would become correlated while interacting with each other. However, there are two ways in which this could happen. One possibility is that individuals' nonverbal and paralinguistic behaviours become more similar regardless of which specific behaviour is addressed. Indeed, a body of literature supports this idea, showing that people unconsciously mimic each other's facial expressions, mannerisms and vocal characteristics (Chartrand and Bargh, 1999; Giles, Coupland & Coupland, 1991; Giles, Taylor, & Bourhis 1973). If this were the case in our data, we would expect positive correlations between the dyad members' specific behaviours. However, a second possibility is that some subsets of behaviours may be positively correlated, whereas other subsets may be negatively correlated. Such a pattern of findings would be in line with interpersonal

complementarity. More specifically, for behaviours that signal dominance, such as vocal volume, we might expect to see negative correlations between the dyad members. On the other hand, for behaviours that signal affiliation, such as smiling, we might expect to see positive correlations between the dyad members.

The disattenuated correlations between dyad members' nonverbal and paralinguistic behaviours are summarized in Table 11. The correlations across the 33 behaviours ranged from -.10 to .79 and the average correlation was .27. Of the entire set of behaviours, 14 were statistically significant, all in a positive direction. Three of the strongest correlations among the nonverbal behaviours included gaze, smiles, and head recline. Interestingly, these are behaviours which tend to signal affiliation. Likewise, among the paralinguistic behaviours, volume, full-sounding, and fast-paced produced the strongest associations. Interestingly, none of the significant correlations were negative, which suggests that individuals tend to mimic each others' nonverbal and automatic behaviour, regardless of whether or not the behaviour is related to dominance or affiliation. The implications of this finding will be discussed a bit later.

Discussion

Summary of Findings

Paralinguistic and Nonverbal Perception (Decoding)

Recall that our first research question investigated the extent to which observers make inferences about dominance and affiliation through paralinguistic and nonverbal channels. Overall, we found that observers use a variety of these behaviours to make inferences about the two major interpersonal traits. On the dominance dimension, observers attended almost exclusively to paralinguistic information. The strongest findings included positive correlations between perceived dominance and volume, emphasis, full-sounding, pitch variability, fluency, and speech rate. Moreover, these correlations spanned computer-derived and aurally coded behaviours. On the affiliation dimension, observers' perceptions were formed mainly based on nonverbal behaviours. Observers perceived greater affiliation when targets smiled, gazed, and nodded at their interaction partners. Thus, one important discovery resulting from this research is that observers mainly attend to the paralinguistic channel when inferring information about dominance, whereas they mainly attend to the nonverbal channel when formulating inferences about affiliation.

Paralinguistic and Nonverbal Expression (Encoding)

Our second research question investigated how individuals' trait interpersonal style is expressed through their paralinguistic and nonverbal behaviours. On the whole, in comparison with observers' perceptions, there were fewer significant relations between individuals' self-reported trait dominance and affiliation and the nonverbal and paralinguistic behaviours they expressed during their social interaction. Trait dominance was associated with four paralinguistic behaviours, including positive correlations with overall volume, speech rate, fluency, and full-sound, and a negative correlation with sounding child-like. Trait affiliation, on the other hand,

was associated with relatively few behavioural characteristics. In women, individuals high in trait affiliation tended to smile more and spoke in less child-like fashion. In men, individuals high in trait affiliation were less child-like and more whiney sounding. Thus, overall, we found that there were fewer correlations between trait interpersonal style and the measured paralinguistic and nonverbal behaviours, the implications for which will be discussed a bit later. However, of the existing correlations, we continue to see a trend that dominance relates with paralinguistic behaviours, whereas affiliation relates with nonverbal behaviours.

Expression of Implicit Traits

To overcome a possible limitation of insight-oriented self-report measures, we also administered two implicit measures, the IAT and TAT, and examined their correlations with paralinguistic and nonverbal behaviour. On the dominance dimension, there were a number of significant correlations between our implicit measures and the behavioural cues. Greater implicit dominance as measured by the IAT was associated with greater volume variability. Likewise, greater scores on implicit submissiveness were associated with decreased volume variability and head shakes. On the affiliation dimension, higher scores on the IAT measure of implicit affiliation were associated with greater volume variability and a more open body posture in women. Thus, our implicit measures of dominance and affiliation did correlate with a subset of our measured behaviours, some of which were not apparent for their explicit counterparts. As a result, one might imagine particular subsets of paralinguistic behaviours that are representative of implicit interpersonal style. We will return to the idea of measuring implicit interpersonal traits a bit later.

Paralinguistic and Nonverbal Factors

In addition to examining the bivariate correlations between each specific behaviour and the interpersonal constructs of dominance and affiliation, we examined the extent to which the

sets of paralinguistic and nonverbal behaviours could be characterized by overarching factors, or groups of behaviours that tend to occur together. We showed that paralinguistic behaviours are captured by two overarching factors, which we named vocal expressivity and vocal immaturity. Furthermore, each of these factors was significantly related to targets' situational dominance, whereby increased vocal expressivity and decreased vocal immaturity led to ratings of greater dominance in the targets, jointly explaining 30% of the variance in observers' ratings. On the other hand, the two factors were unrelated to targets' situational affiliation, explaining just 2% of the variance. Thus, the paralinguistic factors were associated with dominance perceptions, but not affiliation perceptions.

Unlike our findings for the paralinguistic behaviours, the nonverbal behaviours combined into somewhat different factors for men and women. In particular, we found evidence for a three-factored solution for men and a two-factored solution in women. Two of the factors in men corresponded to attentiveness and positive affect. Interestingly, in women, these two factors were combined into one. In order to treat the genders as comparably as possible, we created two subscale scores for both men and women for each of these two constructs and examined the relationship between these constructs and situational dominance and affiliation. We found that the nonverbal factors accounted for a significant proportion of variance in perceptions of affiliation (i.e., 19% in women and 17% in men), but not dominance. Interestingly, of the two factors, only positive affect was a significant predictor of affiliation perceptions.

We were somewhat surprised that our construct of nonverbal attentiveness did not predict affiliation perceptions, particularly given that prior research suggests that specific behaviours, like gaze, play a role in expressing warmth to an interaction partner (e.g., Anderson et al, 2006). One potential explanation for this result is that our paradigm may have pulled for visual attentiveness for reasons other than affiliation. In particular, the successful completion of the

joint activity required participants to be attentive to each others' ideas. Thus, attentiveness may have been an index of their task productivity rather than their levels of affiliation.

Mutual Adjustment of Paralinguistic and Nonverbal Behaviours

A final area we investigated was the interdependence of dyad members' paralinguistic and nonverbal behaviours. Research in the area of communication accommodation suggests that nonverbal and paralinguistic behaviour may become more convergent or divergent, depending on the context and underlying motivations of the interaction partners. Although these two processes are specified by the theory, the large majority of research by communication accommodation theorists shows that paralinguistic and nonverbal behaviours tend to converge between interaction partners, a finding also demonstrated by social psychologists studying mimicry (Chartrand & Bargh, 1999). On the other hand, it stands to reason that individuals might become divergent in specific behavioural cues as a way to signal adjustments in their levels of dominance.

Interestingly, we found evidence only for convergence, which occurred across many of the behaviours that we measured. In fact, even among behaviours shown to be related to dominance, there was a tendency for dyad members' paralinguistic and nonverbal behaviours to become more similar as a result of their interaction with each other. Some especially strong associations emerged for vocal volume, smiling, and gaze. There were no significant negative correlations, meaning that there were no instances of divergence in our sample. This set of findings will be discussed in the coming section on theoretical implications.

Methodological Advances

In addition to the substantive contributions of the current research, our methodology is a significant improvement over much of the previous research in the domain of paralinguistic and nonverbal behaviour. First and foremost, we collected data from a naturalistic social interaction,

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in order to collect samples of nonverbal and paralinguistic behaviour. In contrast, much of the research to date has involved the measurement of these sorts of behaviours in very controlled settings, such as enacting scripts or reading standardized passages. Although the reasoning behind this method of data collection is to control for confounding information (such as the semantic content of speech), it comes at the expense of ecological validity. Thus, the current study is one of very few empirical investigations which measures both nonverbal and paralinguistic behaviour occurring in a naturalistic social interaction (see also Borkenau & Liebler, 1995). Other naturalistic studies have typically focused on either paralinguistic (e.g., Scherer, 1974, 1978) or nonverbal behaviour (e.g., Berry & Hansen, 2000; Gifford, 1994), but not both.

One reason that researchers opt for using videotaped enactment of scripts or reading passages is to control for the content of what a person says. However, more recent computing technology allows researchers to circumvent this problem, through the analysis of specific vocal cues that are devoid of semantic content. Another advantage of the current study is that we employ both traditional and modern approaches to measuring paralinguistic behaviour. In addition to having trained coders aurally listen to and rate voice clips using randomized splicing of each spoken sentence (to minimize the impact of semantic content), we also analyzed each voice clip using a computer program designed to extract information about the vocal characteristics. These two methods of measurement allowed us to demonstrate convergent validity of our findings, and also to have confidence that our results are not influenced by confounding variables such as the semantic content of speech.

Another methodological advantage to our study design was that we collected data from both sides of the lens model; that is, we collected both observer assessments of interpersonal style, as well as multiple measures of trait interpersonal style (i.e., both implicit and explicit).

Many studies focus only on perception processes, which limit the comparison of findings across both sides of the lens model. For instance, by collecting information on both sides of the lens model, we showed that there are comparatively fewer significant associations between trait interpersonal style and the specific behavioural cues. This finding has important implications, which have mainly not been addressed in the literature and is discussed further in the next section.

Theoretical Implications

Imbalance between Perception and Expression Processes

One important implication of our findings is the apparent imbalance between the range of behavioural cues used to infer dominance and affiliation (i.e., perception or decoding) in comparison to the range of behavioural cues that are related to trait dominance and affiliation (i.e., expression or encoding). More specifically, we found evidence for a far greater number of perception associations compared to expression associations. Furthermore, the significant expression associations tended to be smaller in magnitude.

Interestingly, a pattern in which the expression (or encoding) associations are quite weak and the perception (or decoding) associations are strong has been shown by several lens model researchers who study body language (e.g., Bull, 1983; Gifford, 1994). The typical reasoning that goes along with this pattern of findings is that observers must be making biased or erroneous personality inferences, based on invalid behavioural indicators (e.g., Gifford, 1994, 2011). In other words, even though observers tend to agree with each other, they are making incorrect assumptions about the targets' personality, evidenced by the fact that target's traits do not show similar associations. In the current study, we employed disattenuated correlations to better address whether there is truly a difference in strength between the two sides of the lens model, and indeed there was.

We propose an alternative and novel perspective on the apparent imbalance between the strengths of the relations on the encoding and decoding sides of the lens model. Rather than being biased, we believe that observers made valid personality inferences, based on behaviours into which the targets' themselves have limited insight. There are two reasons why we believe this idea is plausible. First, the sorts of behaviours that are measured by many lens model researchers are ones that have been shown to be automatic in nature, rather than being rooted in conscious deliberation. For instance, Gifford (1994, 2011) studies various nonverbal behaviours, including body posture and gestures. These channels of behaviour are posited to occur on a largely unconscious or automatic basis, in contrast to more conscious or controlled channels of behaviour (Asendorpf et al., 2002; Egloff & Schmukle 2002; Tiedens & Fragale, 2003). Given that nonverbal and paralinguistic channels of behaviour are thought to operate automatically, it makes sense that observers may notice particular behavioural cues which the targets themselves may produce unwittingly.

A second reason why we believe observers may not simply be making biased inferences pertains to the way in which lens model researchers have measured personality traits. As mentioned previously, some researchers would argue that personality exists on two levels: the explicit and the implicit (e.g., Epstein, 1997; McClelland et al., 1989). Whereas self-report measures tend to assess explicit personality, some researchers have devised implicit measures that attempt to measure personality more indirectly. To date, lens model research has focused on measuring personality using self-report measures. Given that many of the specific behavioural cues that we are interested in are thought to occur relatively automatically, it is not overly surprising that self-report measures of personality do not demonstrate strong correlations with these behaviours. Alternatively, researchers might consider measuring implicit personality traits as a complement to traditional self-report measures, which is what we did in the current study.

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Indeed, our implicit measures showed several significant associations with several paralinguistic and nonverbal behaviours, which were not apparent for their explicit counterparts.

Paralinguistic and Nonverbal Behaviour as Indicators of Implicit Personality

Taken together, our results suggest that our participants had relatively limited insight into how their interpersonal style came across through aspects of the paralinguistic and nonverbal channels of behaviour. Combined with the literature on automaticity, which suggests that these sorts of behaviours occur on a relatively unconscious basis, we argue that at least a portion of paralinguistic and nonverbal behaviour happens on an unconscious basis. One interesting implication is to conceptualize certain constellations of paralinguistic and nonverbal behaviours as indicators of *implicit* dominance and affiliation. Thus, one way to measure implicit personality in future research may be to index the expression of relevant behaviours, which can be aggregated as a behavioural measure. For instance, to measure implicit dominance, it may be advantageous to aggregate the behaviours shown to be related to dominance perceptions, such as our constructs of vocal animation and vocal expressivity. Likewise, to measure implicit affiliation, one might choose to sample people's nonverbal behaviour (e.g., smiles, gaze, head nods) and aggregate behaviours which tap positive affect and attentiveness. Such behavioural measures would have advantages over other types of implicit measures (i.e., the IAT or TAT), in that they may be more proximally related to other variables of interest. As an example, consider a researcher who is interested in examining how implicit levels of dominance predict leadership ability, and designs a dyadic study in which one participant is assigned to be the leader. Rather than measuring implicit dominance using participants' scores on a reaction time test before the interaction, she might choose to measure implicit dominance using more concrete behavioural indicators exhibited during the leadership task, which may offer greater ecological validity.

Mimicry Findings

Our findings regarding the interdependence of partners' paralinguistic and nonverbal behaviours were in line with research on convergence and mimicry. That is, across multiple channels of behaviour, participants' behaviours were positively correlated. On one hand, this finding is somewhat surprising, because interpersonal theory would have predicted that dominance-related behaviours should become negatively correlated during a social interaction as two people become more opposite on dominance. Indeed, in our sample, observers' ratings of dominance suggest that partners did become more opposite on overall demonstrations of dominance, as measured by the SBI. Yet, this divergence was not apparent in any of the paralinguistic or nonverbal behaviours. How can this make sense? One possible interpretation of this pattern of findings relates to the context in which the interaction took place. Research on convergence or mimicry has shown that when two people interact with affiliation goals in mind, they tend to mimic each other across a variety of paralinguistic and nonverbal behaviours, more so than individuals who interact without an affiliation goal (Lakin & Chartrand, 2003). Thus, it is possible that the collaborative context of the current study pulled for interaction partners to behave in an affiliative fashion with each other, leading to greater convergence on a variety of paralinguistic and nonverbal behaviours. Indeed, convergence was greatest for indices such as smiling and gaze, both of which are shown to be affiliation-based behaviours. Thus, in the future we might investigate how partners' behaviour becomes correlated in a more competitive context, which may lead to greater divergence on specific facets of behaviour.

Future Directions

Alternatives to Measuring Pitch Variability

To date, studies investigating the relationship between personality and pitch variability (often termed "intonation") have relied on measuring the standard deviation or range of pitch

across a voice clip. Indeed, this was our approach to measuring pitch variability in the current study. Although this measure has shown interesting relations with a variety of personality variables including both dominance and affiliation (Floyd & Ray, 2003; Mehrabian & Williams, 1969; Scherer et al., 1973), we believe that more complexity might be captured in the measurement of this particular vocal characteristic.

Consider, for example, a person with a striking rising intonation compared to a person with an equally striking falling intonation. Although two such individuals would sound very different from each other, measures of either the standard deviation or range of the two pitch curves could be indistinct, yielding approximately equal estimates. Likewise, if the order of pitches were rearranged, the sound of the sentence would be very different (i.e., likely eliminating a rising or falling intonation), but the standard deviation or range of a pitch curve for this rearranged sentence would be the same. This latter example would be analogous to scrambling up the notes in a musical melody; although the mean and standard deviation of the melody's pitch would remain the same, the scrambling would destroy the time-dependent melodic pattern.

An interesting question is whether or not people's vocal "melodies" are interpersonally expressive. For instance, perhaps the individual with a rising intonation would be perceived as meek or submissive, whereas the individual with a falling intonation would be perceived as confident or dominant. To date, the literature has not made these sorts of fine distinctions when it comes to pitch variability. To do so, researchers would need to establish the patterns in pitch over time, which could then be examined, either qualitatively or quantitatively for recurring patterns (i.e., melodies) across several voice samples. Such a detailed analysis of pitch could illuminate how individuals use time-dependent patterns of intonation to convey different types of messages, rather than treating all types of intonation as equal.

Body Language Coding

In addition to the proposed modifications for measuring pitch variability, we believe research on nonverbal behaviour in social contexts would benefit from a revised coding scheme. In the current study we adopted our nonverbal behaviour coding scheme from Gifford's (1994) Seated Kinesic Activity Notation System. The SKANS coding scheme is extremely comprehensive, covering almost every conceivable domain of nonverbal behaviour. However, a downfall to this scheme is that it fails to incorporate important contextual variables which are inherent in a social interaction. As such, we believe nonverbal behaviour coding schemes could be further refined in order to improve sensitivity to more interpersonally-relevant nonverbal behaviour. For instance, in Gifford's original coding scheme, participants' trunk orientation and lean was coded from left-to-right, regardless of where an interaction partner might be located relative to the target participant. In the current study, we changed the coding scheme so that trunk orientation and lean were coded relative to the interaction partner (i.e., toward vs. away from the other person) rather than using a left-to-right metric.

Another example of how nonverbal behaviour might be scored in more interpersonally relevant ways is the coding of (left-to-right) head shaking. In the current study, head shaking did not perform in expected ways; rather than being related to dominance, as past researchers have shown, head shaking was an indicator of "positive affect", which related to perceptions of affiliation. Because this finding was somewhat unexpected, we returned to the videotaped interactions and examined the contexts in which individuals in our sample shook their heads. In many instances, head shakes occurred in an empathic context, where one partner was telling a personal story and the other responded by shaking his or her head, as though trying to demonstrate understanding. In this type of scenario, head shaking seemed indicative of

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affiliation. However, the coding scheme we employed did not make finer distinctions about the context in which the head shakes occurred. Future researchers may benefit from coding specific types of head shakes to better get at the underlying interpersonal intentions; one type of head shaking may be the sort that we just described, representing an affiliative intention. In contrast, head shaking that communicates "no" to the other person or expresses disagreement would represent a more dominant intention.

In summary, we believe that the coding of nonverbal behaviour may be further refined to be more sensitive to the interpersonal context in which it was produced. The examples of trunk lean/orientation and head shakes are two possible areas for refinement, and there may be other such behaviours that would warrant similar fine-tuning.

Studying Interpersonal Deficits

Another promising area for future research on paralinguistic and nonverbal behaviours is with clinical populations, particularly with those who suffer from interpersonal problems. According to the lens model scheme, people may experience two distinct classes of difficulties in social contexts. One type of problem stems from problems with the "encoding" or *expression* side of the lens model, and the other area of difficulty has to do with the "decoding" or *perception* side of the lens model.

Expression Deficits

One area in which interpersonal functioning can go awry is in the process through which one's interpersonal traits are *expressed* through multiple channels of behaviour. For instance, a person may intend to convey a warm or affiliative impression to an interaction partner and without realizing it, he may end up coming across as rude or insensitive. How could such mixed messages occur? Given that social behaviour occurs across so many different channels of behaviour, it is quite possible that someone may unwittingly convey hostility through channels of

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behaviour that escape their conscious awareness. Such instances of mixed messages may be more likely to occur when explicit and implicit levels of personality are at odds with each other; in this case, an individual's controlled behaviour may be conveying relatively explicit levels of personality, whereas he may be unconsciously leaking contradictory behaviour through more automatic streams, representing a more implicit level of personality. For individuals who have discrepancies in their implicit and explicit levels of personality, the result could be behaviour that is quite difficult to interpret due to the mixed messages that are being conveyed across the multiple channels of behaviour. To date, research investigating these sorts of hypotheses is quite limited. Although there is a small body of research supporting the notion that implicit traits tend to predict automatic behaviour and explicit traits tend to predict controlled behaviour (e.g., Asendorpf et al, 2002; Dovidio & Kawakami, 2002; Egloff & Schmukle, 2002), the extent to which the two channels of behaviour might convey competing or conflicting messages has received little attention in the literature. As a result, whether or not paralinguistic and nonverbal behaviour provides consistent or inconsistent information in comparison to verbal channels of behaviour is an empirical question which requires more research.

   Perception Deficits

   A second type of problem that people may encounter in their social worlds occurs on the "decoding" or *perception* side of the lens model. The extent to which people accurately perceive interpersonal messages from others will have a large impact on their interpersonal functioning. Research in the area of "interpersonal sensitivity" suggests that perceiving others' interpersonal behaviour is a skill of sorts, which varies from person to person. It turns out that some individuals are quite good at decoding others' interpersonal messages, whereas others do not possess as much decoding skill. In a recent meta-analysis on interpersonal sensitivity (Hall, Andrezejewski, & Yopchick, 2009), researchers demonstrated that individuals with greater

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interpersonal sensitivity function better in a variety of domains, including personal and social functioning. These individuals are more socially competent, have greater empathy, and are less neurotic, depressed, and anxious. Thus, low interpersonal sensitivity is associated with a variety of maladaptive outcomes, suggesting a potentially important role in this type of interpersonal deficit in the development and maintenance of psychological problems. Further research in the area of interpersonal sensitivity might focus on understanding what specific factors contribute to improved sensitivity. One possibility is that individuals high in interpersonal sensitivity are well tuned to the full range of interpersonal behaviour, including paralinguistic and nonverbal behaviour, and are able to make accurate inferences about others based on this information.

Conclusions

In conclusion, this thesis presents evidence that both nonverbal and paralinguistic behaviour play an important role in social behaviour, from the perspective of both the person *perceiving* the behaviour and the person *expressing* the behaviour. To date, research in the area of interpersonal theory has not focused on understanding how dominance and affiliation might be conveyed through these more covert channels of behaviour. However, the current work shows that this is a fruitful area for further investigation, which may also forge connections with researchers in the area of communications who study both paralinguistic and nonverbal behaviour.

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Appendix A: Words used for Dominance and Affiliation IATs

Affiliation IAT	Dominance IAT

Friendly Words	Dominant Words
Charitable	Assertive
Cooperative	Bold
Courteous	Confident
Helpful	Controlling
Kind	Firm
Pleasant	Forceful
Supportive	Leading
Sympathetic	Persistent
Tender	Persuasive
Thoughtful	Self-Assured

Unfriendly Words	Submissive Words
Argumentative	Bashful
Critical	Compliant
Detached	Docile
Distant	Following
Guarded	Meek
Indifferent	Passive
Impersonal	Self-Doubting
Impatient	Shy
Unaffectionate	Timid
Unsociable	Yielding

Self Words (used in both IATs)
  Me
  Myself
Not-Self Words (used in both IATs)
  It
  That

Appendix B: Vocal Characteristic Questionnaire

Please complete the following ratings for the voice clip compared to <u>same-gendered individuals</u>. Be sure to pay attention to the <u>qualities of the person's voice</u>, **not** the semantic content.

<u>Pitch-related Questions</u>
1. **Overall**, how would you describe the **pitch (e.g., low vs. high)** of this person's voice?

1	2	3	4	5	6
Extremely Deep, Low-pitched Voice	Quite Low-Pitched	Somewhat Low-pitched	Somewhat High-pitched	Quite High-pitched	Extremely High-pitched Voice

2. How **variable in pitch** was this person's voice?

1	2	3	4	5	6
Not at all Variable (monotone)	A Bit Variable	Somewhat Variable	Quite Variable	Very Variable	Extremely Variable (intonated)

3. To what extent did the person end the statement (e.g., sentence) with an **upward or rising intonation**?

1	2	3	4	5	6
Not at all Rising	A Bit Rising	Somewhat Rising	Quite Rising	Very Rising	Extremely Rising

4. To what extent did the person end the statement (e.g., sentence) with a **downward or falling intonation**?

1	2	3	4	5	6
Not at all Falling	A Bit Falling	Somewhat Falling	Quite Falling	Very Falling	Extremely Falling

<u>Amplitude-related Questions</u>
5. **Overall**, how would you describe the **volume (e.g., soft vs. loud)** of this person's voice?

1	2	3	4	5	6
Extremely Soft (Barely Audible)	Quite Soft	Somewhat Soft	Somewhat Loud	Quite Loud	Extremely Loud

6. How much did the person's **volume (soft vs. loud) change**?

1	2	3	4	5	6
Not at all Variable (either consistently quiet or loud)	A Bit Variable	Somewhat Variable	Quite Variable	Very Variable	Extremely Variable (changed a lot between quiet and loud)

7. To what extent did the person **trail off (e.g., fade out) at the end of each sentence**?

1	2	3	4	5	6
Didn't trail off at all	Trailed off a Bit	Trailed off Somewhat	Trailed off Quite a Lot	Trailed off Very Much	Trailed off Extremely

8. To what extent did the person **increase in volume (e.g., crescendo) at the end of each sentence**?

1	2	3	4	5	6
Didn't increase at all	Increased a Bit	Increased Somewhat	Increased Quite a Lot	Increased Very Much	Increased Extremely

9. To what extent did the person **accentuate or emphasize** particular words?

1	2	3	4	5	6
Not at all Emphatic	A Bit Emphatic	Somewhat Emphatic	Quite Emphatic	Very Emphatic	Extremely Emphatic

Resonance and Voice-quality Questions

10. How **full-sounding** was the person's voice?

1	2	3	4	5	6
Not at all Full-sounding	A Bit Full-sounding	Somewhat Full-sounding	Quite Full-sounding	Very Full-sounding	Extremely Full-sounding

11. How **child-like** was the person's voice?

1	2	3	4	5	6
Not at all Child-like	A Bit Child-like	Somewhat Child-like	Quite Child-like	Very Child-like	Extremely Child-like

12. How **nasal** was the person's voice?

1	2	3	4	5	6
Not at all Nasal	A Bit Nasal	Somewhat Nasal	Quite Nasal	Very Nasal	Extremely Nasal

13. How **hoarse** was the person's voice?

1	2	3	4	5	6
Not at all Hoarse	A Bit Hoarse	Somewhat Hoarse	Quite Hoarse	Very Hoarse	Extremely Hoarse

14. How **rough-sounding** was the person's voice?

1	2	3	4	5	6
Not at all Rough	A Bit Rough	Somewhat Rough	Quite Rough	Very Rough	Extremely Rough

15. How **raspy** was the person's voice?

1	2	3	4	5	6
Not at all Raspy	A Bit Raspy	Somewhat Raspy	Quite Raspy	Very Raspy	Extremely Raspy

16. How **clear-sounding** was the person's voice?

1	2	3	4	5	6
Not at all Clear	A Bit Clear	Somewhat Clear	Quite Clear	Very Clear	Extremely Clear

Speech Rate and Fluency Questions

17. How **fast-paced** was the person's voice?

1	2	3	4	5	6
Extremely Slow-Paced	Quite Slow-Paced	Somewhat Slow-Paced	Somewhat Fast-Paced	Quite Fast-Paced	Extremely Fast-Paced

18. How **fluently** did the person speak (e.g., flowing vs. stumbling over words)?

1	2	3	4	5	6
Not at all Fluent	A Bit Fluent	Somewhat Fluent	Quite Fluent	Very Fluent	Extremely Fluent

19. How often did the person **pause**?

1	2	3	4	5	6
Didn't Pause at All	Paused Once or Twice	Paused a few times	Paused Quite Often	Paused Very Often	Paused Extremely Often

20. How often did the person **mumble**?

1	2	3	4	5	6
Didn't Mumble at all	Mumbled once or twice	Mumbled a few times	Mumbled Quite Often	Mumbled Very Often	Mumbled Extremely Often

Other Questions

21. To what extent would this person's voice make a good **movie narrator or radio announcer**?

1	2	3	4	5	6
Extremely Poor Candidate	Quite a Poor Candidate	Somewhat Poor Candidate	Somewhat Good Candidate	Quite a Good Candidate	Extremely Good Candidate

22. How **pleasant-sounding** was the person's voice?

1	2	3	4	5	6
Not at all Pleasant	A Bit Pleasant	Somewhat Pleasant	Quite Pleasant	Very Pleasant	Extremely Pleasant

23. How **whiney** did this person sound?

1	2	3	4	5	6
Not at all Whiney	A Bit Whiney	Somewhat Whiney	Quite Whiney	Very Whiney	Extremely Whiney

24. To what extent did the person have a **melodic** voice (e.g., engaging intonation)?

1	2	3	4	5	6
Not at all Melodic	A Bit Melodic	Somewhat Melodic	Quite Melodic	Very Melodic	Extremely Melodic

Table 1

Inter-rater reliability of aurally coded paralinguistic behaviours

	Men	Women
<u>Behaviour</u>	<u>Inter-rater Reliability</u>	<u>Inter-rater Reliability</u>
Pitch Mean	.88	.91
Pitch Variability	.86	.85
Rising Intonation	.92	.93
Falling Intonation	.82	.82
Volume Mean	.95	.92
Volume Variability	.80	.82
Trail Off	.84	.82
Crescendo	.50	.79
Emphasis	.87	.86
Full-Sounding	.87	.87
Child-Like	.63	.89
Nasal	.76	.76
Hoarse	.79	.80
Rough	.84	.77
Raspy	.75	.83
Clear	.84	.83
Fast-Paced	.85	.86
Fluent	.85	.86
Pausing	.81	.80
Mumbling	.88	.91
Radio Announcer	.88	.90
Pleasant	.82	.80
Whiney	.80	.83
Melodic	.83	.80

Table 2

Inter-rater reliability of nonverbal behaviours

	Men	Women
Behaviour	Inter-rater Reliability	Inter-rater Reliability
Head Recline	.91	.89
Trunk Orientation	.80	.86
Trunk Lean	.84	.91
Left Arm Height	.97	.97
Right Arm Height	.97	.98
Left Arm Extension	.96	.97
Right Arm Extension	.90	.97
Arm Wrap	.95	.95
Nods	.96	.95
Shakes	.91	.90
Smiles	.97	.98
Self Manipulation	.80	.60
Object Manipulation	.96	.97
Gaze	.99	.98
Gestures	.95	.98

Table 3

Disattenuated correlations for dominance perceptions

<u>Nonverbal</u>	
Gesture	.42
<u>Aurally Coded Paralinguistic</u>	
Pitch Variability	.29
Pitch Falling	.28
Volume	.57
Volume Variability	.30
Emphasis	.52
Trail Off	-.41
Full-Sounding	.54
Child-Like	-.35
Whiney	-.20
Fast-Paced	.45
Fluent	.60
Pausing	-.36
Mumbling	-.59
<u>Computer-derived Paralinguistic</u>	
Pitch Variability (F0 SD)	.27
Volume Mean (dB Mean)	.50
Volume Variability (dB SD)	.31
Resonance (Formant Dispersion)	.35 for men, .01 (*ns*) for women

Note: All correlations are significant at $p < .01$, except where noted with *ns*.

Table 4

Disattenuated correlations for affiliation perceptions

Nonverbal	
Nods	.15 *(ns)* for men, .42 for women
Smiles	.39
Gaze	.26
Gesture	.21
Aurally Coded Paralinguistic	
Pitch Variability (F0 SD)	.21

Note: All correlations are significant at *p* < .01, except where noted with *ns*.

Table 5

Disattenuated correlations for dominance expression

Aurally Coded Paralinguistic	
Volume	.28
Full-sounding	.32
Child-like	-.35
Fast-Paced	.25
Fluent	.24
Computer-derived Paralinguistic	
Volume Mean (dB Mean)	.31

Note: All correlations are significant at *p* < .01.

Table 6

Disattenuated correlations for affiliation expression

<u>Nonverbal</u>	
Smiles	.04 *(ns)* for men, .36 for women
<u>Aurally Coded Paralinguistic</u>	
Child-like	-.24
Whiney	.40 for men, .05 *(ns)* for women

Note: All correlations are significant at $p < .01$, except where noted with *ns*. Correlations in brackets are presented for women when there was a significant gender difference.

Table 7

Exploratory factor analysis of aurally coded paralinguistic behaviours

	Male		Female	
Vocal Characteristic	Factor 1	Factor 2	Factor 1	Factor 2
Volume	**.83**	-.20	**.57**	-.48
Volume Variability	**.64**	.41	**.73**	.29
Emphasis	**.83**	.19	**.78**	-.12
Crescendo	**.33**	.21	**.43**	-.06
Pitch Variability	**.76**	.38	**.87**	.32
Pitch Falling	**.50**	.01	**.42**	-.10
Pausing	**-.47**	.03	**-.47**	-.11
Fast-Paced	**.59**	-.12	**.67**	-.01
Fluent	**.72**	-.23	**.59**	-.34
Pitch Mean	.33	**.75**	.38	**.72**
Child-Like	.04	**.74**	.15	**.86**
Full-Sounding	.52	**-.62**	.26	**-.81**
Whiney	-.13	**.36**	-.04	**.41**
Trails Off	-.36	.29	.08	.55
Hoarse	-.25	-.08	-.45	-.30
Nasal	-.01	.26	-.13	.11
Pitch Rising	.10	.25	.13	.23
Mumbling	-.68	.14	-.24	.53

Note. Principal Axis Factoring, Promax Rotation. Inter-factor correlation in men is -.29 and in women is -.38.

Table 8

Disattenuated correlations between vocal expressivity/vocal immaturity subscales and computer-derived paralinguistic cues

	Pitch Mean (F0 Mean)	Pitch Variability (F0 SD)	Volume Mean (dB Mean)	Volume Variability (dB SD)	Resonance (Formant Dispersion)
Vocal Expressivity	.29	.66	.76	.48	.49 for men .18(*ns*) for women
Vocal Immaturity	.42	.20	-.53	-.28	-.34

Note: If $r = .20$, p $< .05$
If $|.21| < r < /.30|$, p $< .01$
If $|.31| < r < |.76|$, p $< .001$
ns = not statistically significant

.

Table 9

Exploratory factor analysis of nonverbal behaviour in men

Behaviour	Factor 1	Factor 2	Factor 3
Gaze	**.60**	.21	.41
Head Recline	**.62**	-.06	.00
Trunk Lean	**-.73**	.06	.34
Head Nods	.04	**.26**	.12
Head Shakes	-.21	**.83**	-.06
Smiles	.37	**.51**	-.13
Arm Wrap	-.10	.32	**-.38**
Trunk Orientation	-.27	.11	**.52**
Gestures	.10	-.04	**.25**
Self-Manipulation	-.11	-.03	**.34**

Note. Principal Axis Factoring, Promax Rotation. Highest factor loadings for each item in bold.

Intercorrelation between F1 and F2 is .27; F1 and F3 is .44; F2 and F3 is .14.
Eigenvalues for the three factors are 2.25, 1.57, and 1.36, respectively.

Table 10

Exploratory factor analysis of nonverbal behaviour in women

Behaviour	Factor 1	Factor 2
Gaze	**.90**	-.02
Head Recline	**.55**	-.03
Head Nods	**.57**	-.08
Head Shakes	**.37**	-.09
Smiles	**.51**	.16
Trunk Lean	-.16	**.45**
Arm Wrap	.08	**-.44**
Trunk Orientation	.09	**.82**
Gestures	.11	**.32**
Self-Manipulation	.16	.06

Note. Principal Axis Factoring, Promax Rotation. Highest factor loadings for each item in bold.

 Intercorrelation between F1 and F2 is .01.

 Eigenvalues for the two factors are 2.46 and 1.79, respectively.

Table 11

Disattenuated correlations between dyad members' nonverbal and paralinguistic behaviours

Dominance-Related Indices		Affiliation-Related Indices	
Nonverbal		Nonverbal	
Gestures	.23	Head Recline	.54
		Trunk Lean	.03
Aurally Coded Paralinguistic		Head Nods	.31
Pitch Mean	.15	Head Shakes	.10
Pitch Variability	.00	Smiles	.69
Pitch Falling	.14	Gaze	.79
Volume	.41		
Volume Variability	.17		
Emphasis	.28		
Full-Sounding	.41		
Child-Like	-.10		
Whiney	.27		
Fast-Paced	.41		
Fluent	.20		
Pausing	-.10		
Mumbling	.26		
Computer-derived Paralinguistic			
Pitch Mean	.27		
Pitch Variability	.21		
Volume Mean	.55		
Volume Variability	.30		
Resonance	.38		

Note. For $r > .25$, $p < .01$

Figure 1. Example Lens Model
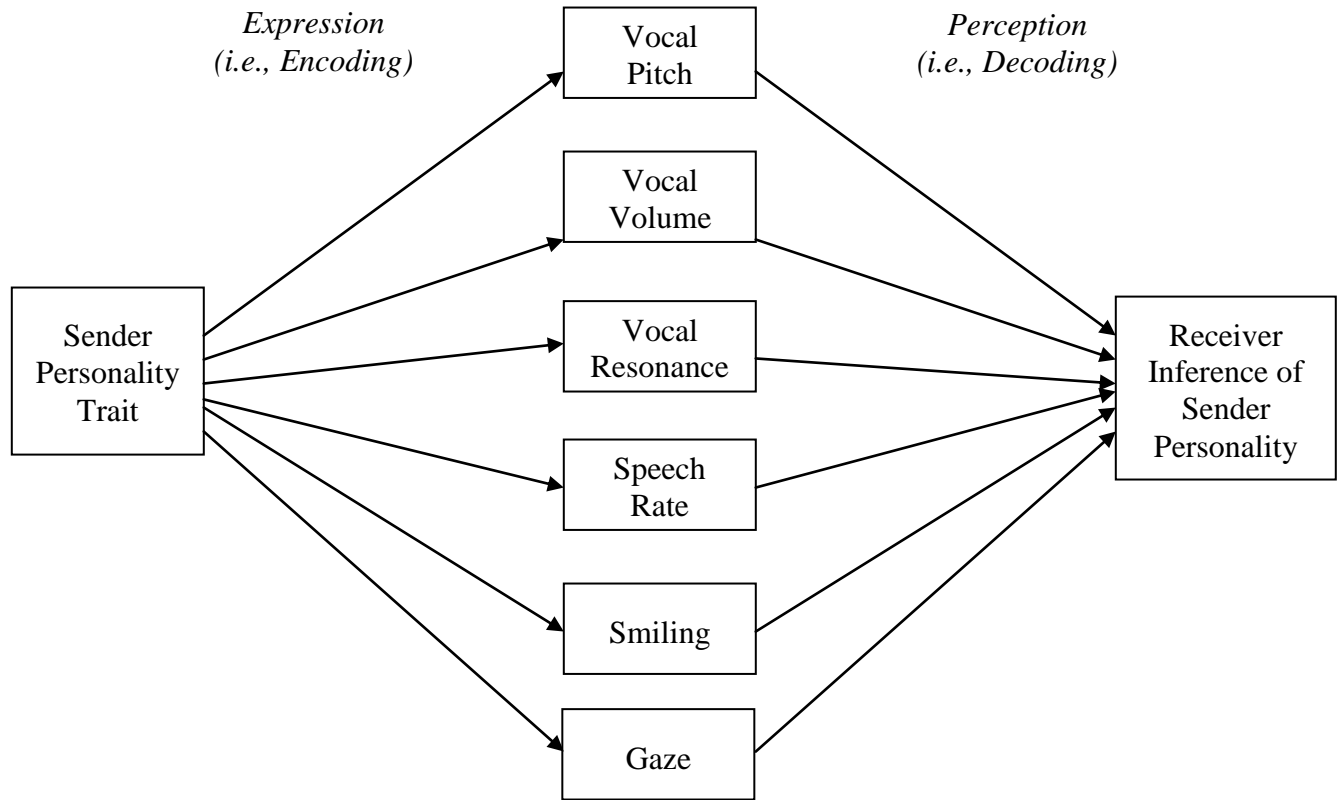
Figure 2. Interpersonal Circumplex
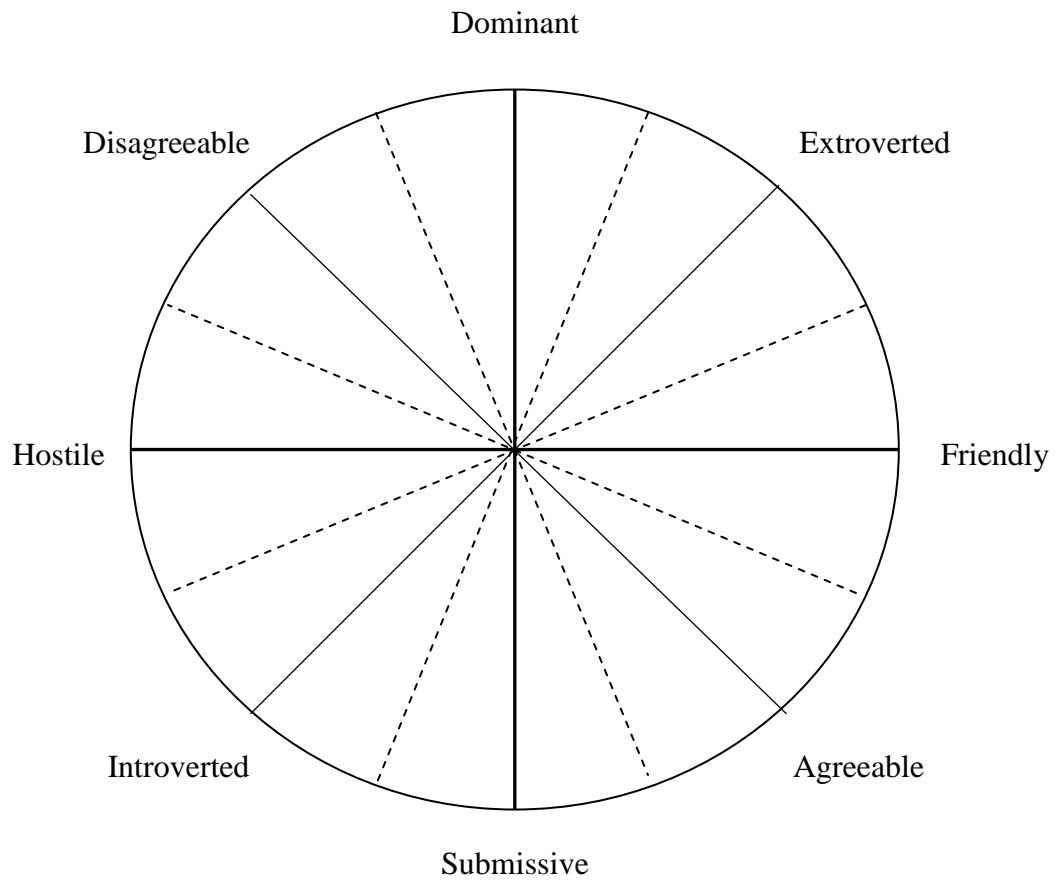
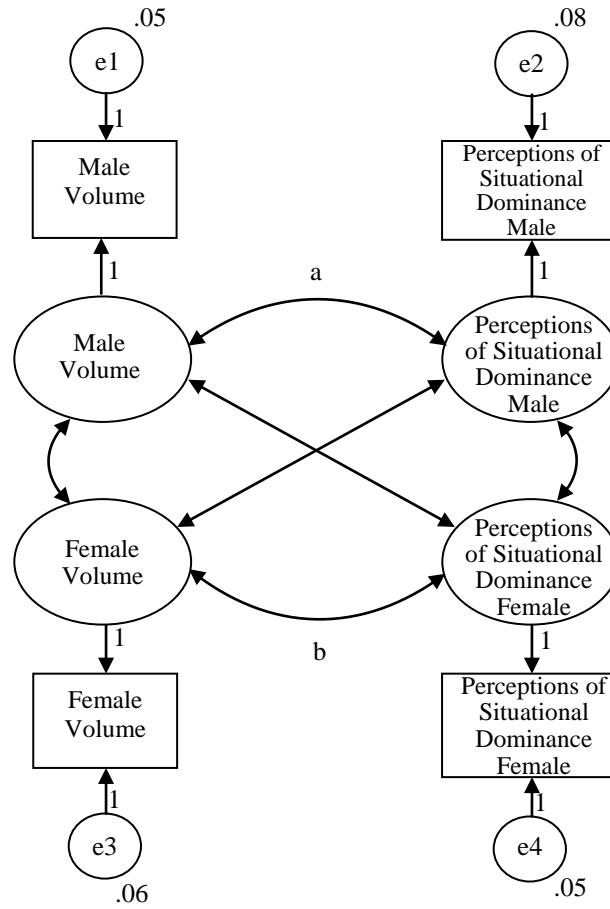*Figure 3.* Example of Disattenuated Covariance Model.

Figure 4. Predicting Perceptions of Situational Dominance (SBI) with Paralinguistic
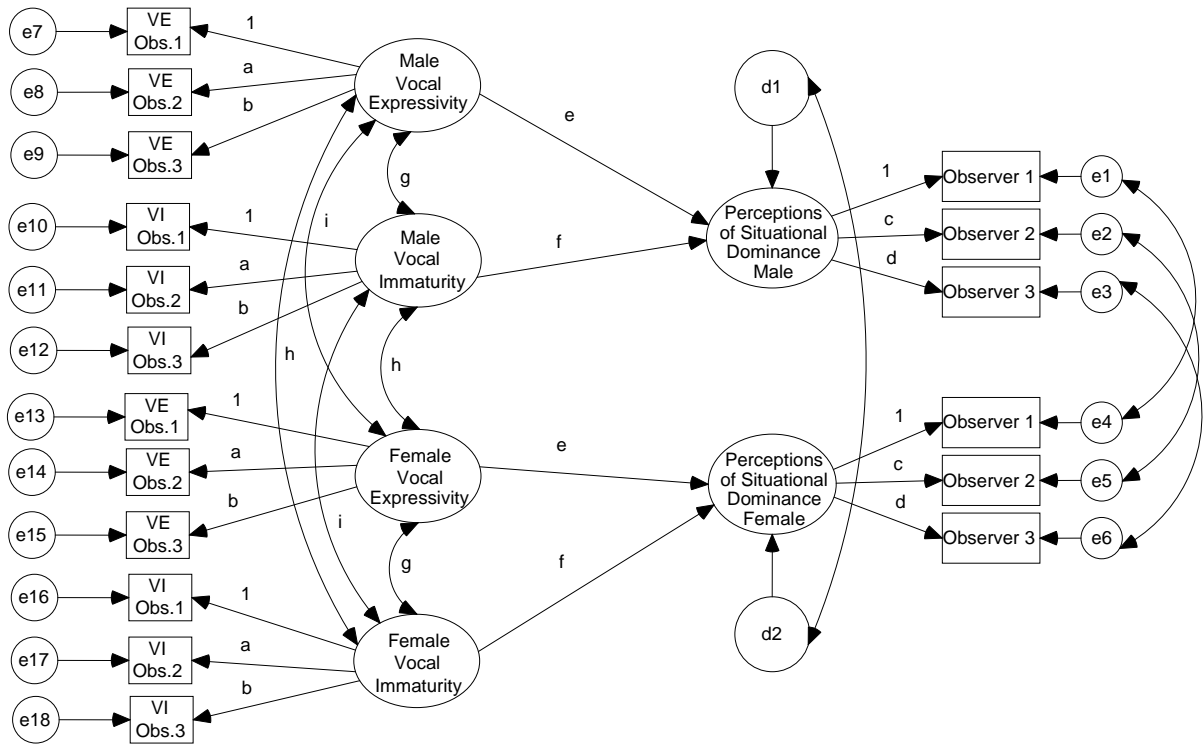
Factors – AMOS Input Diagram.

Figure 5. Predicting Perceptions of Situational Dominance (SBI) with Paralinguistic Factors.
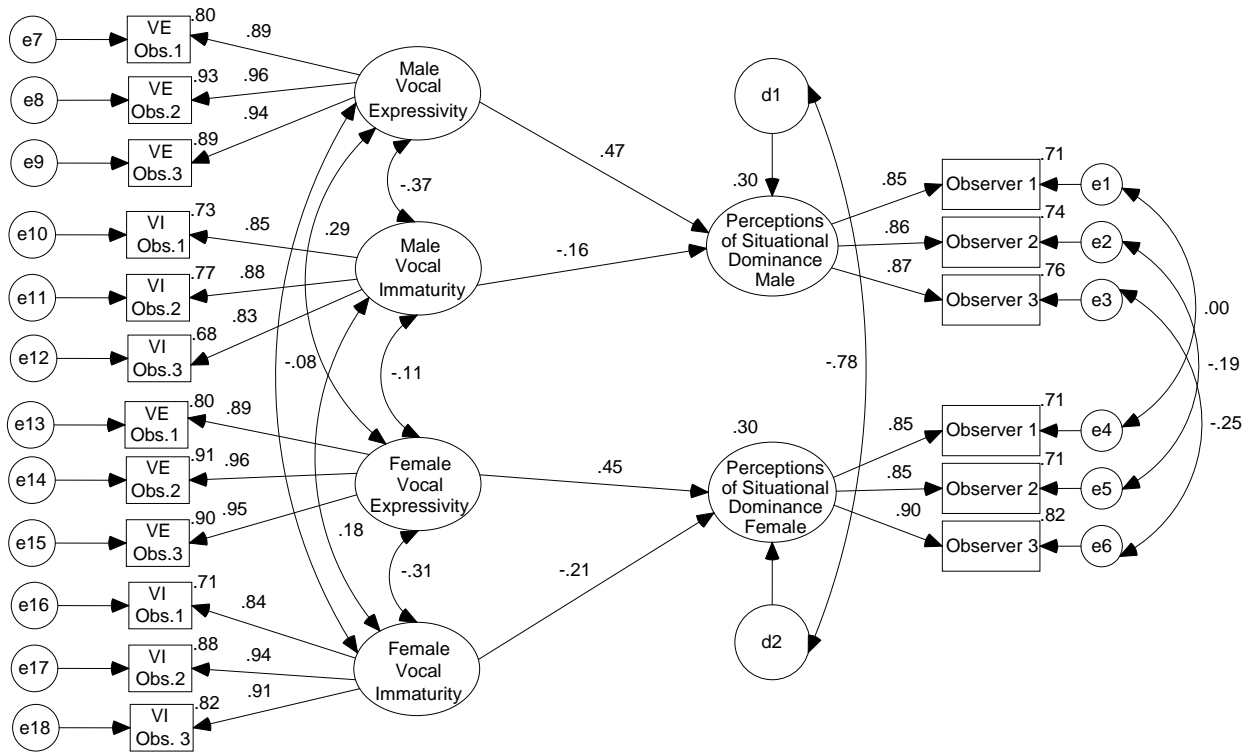
Figure 6. Predicting Perceptions of Situational Affiliation (SBI) with Paralinguistic Factors.
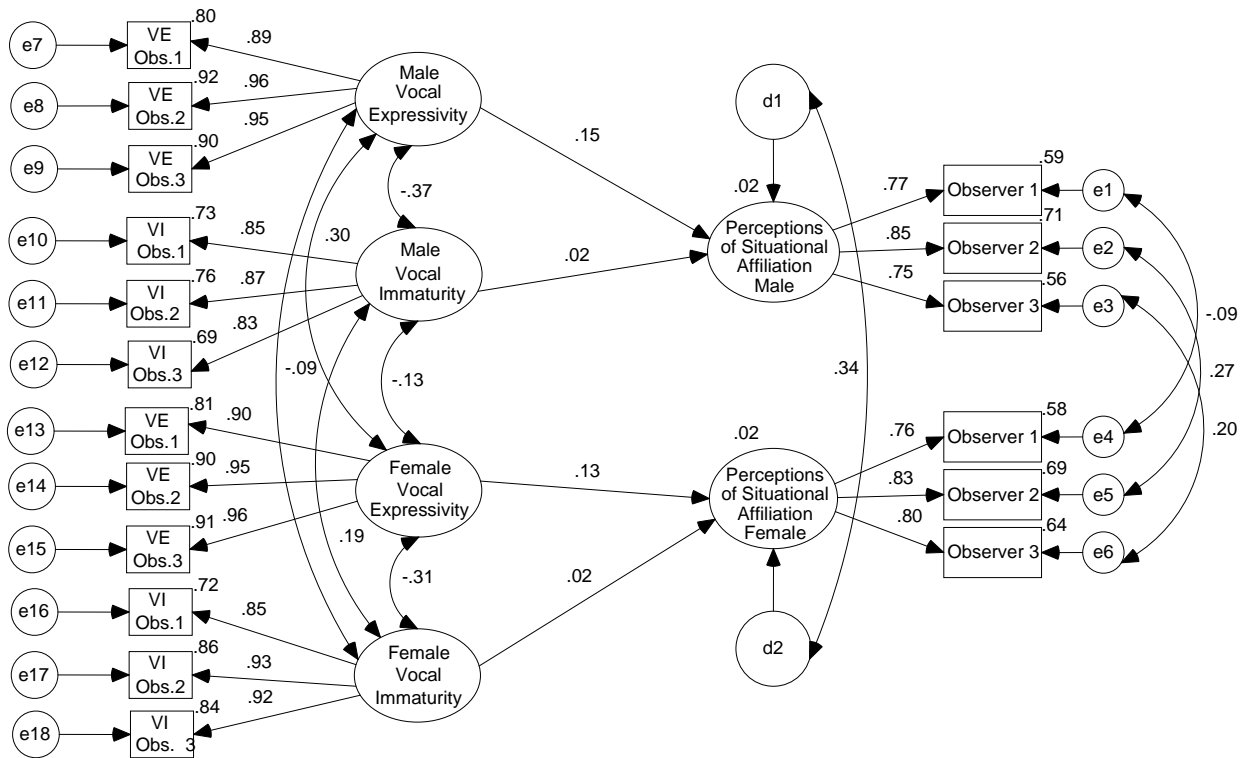
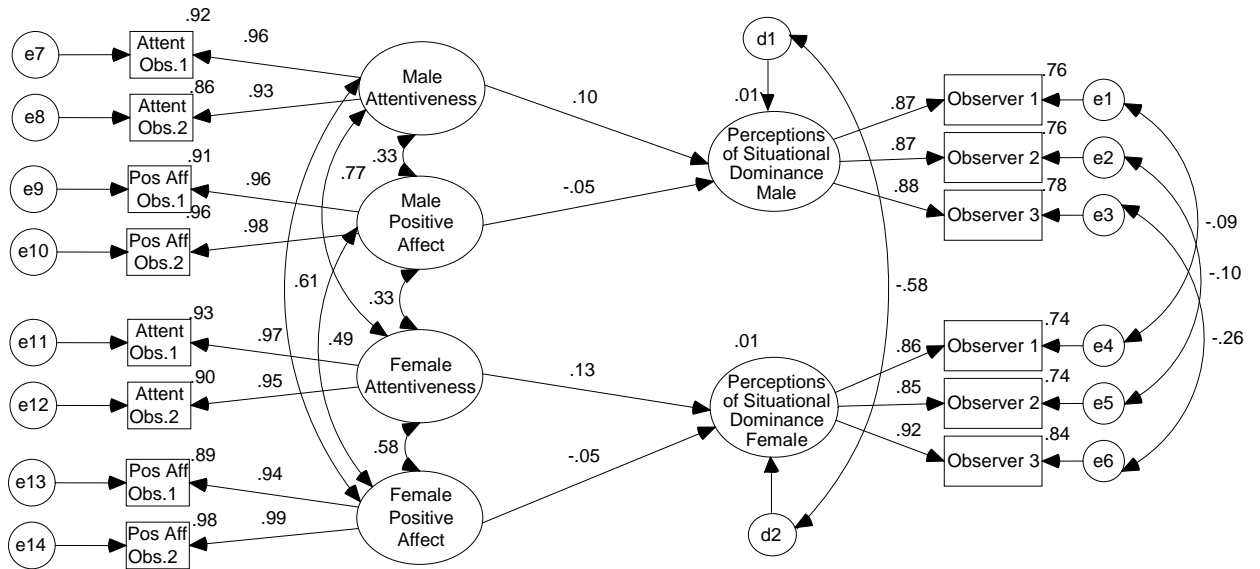*Figure 7.* Predicting Perceptions of Situational Dominance (SBI) with Nonverbal Factors.

Figure 8. Predicting Perceptions of Situational Affiliation (SBI) with Nonverbal Factors.