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Behavioral and Psychophysiological Correlates of Conversation

A dissertation submitted in partial satisfaction of the

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by

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ABSTRACT OF THE DISSERTATION

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Professor John H. Schumann, Chair

This dissertation investigates psychophysiological mechanisms co-occurring with selected behaviors in conversation, namely turn-taking, silences, pauses, disagreements, and word searches. The main hypothesis of this work is that certain interactional behaviors are modulated by a feedback system embedded in the psychological and physiological individual characteristics of the actors engaged in a conversation. It is based on the assumption that the human autonomic nervous system plays a role in framing and informing social engagement behaviors.

The goals of the study presented here were: (i) to correlate individual psychological characteristics and changes in physiological states to certain conversational behaviors, (ii) to expand the theoretical scope of what comprises embodied cognition to include neurobiological descriptors, and (iii) to present a transdisciplinary methodology for psychophysiological studies of conversation analysis and social engagement behaviors.

Here, conversation analysis was the methodology utilized to study not only speech acts like assessments, word searches, disagreements, requests, among others, but also their sequential

organization, participants' epistemic stances, co-construction of meaning, embedded gestures, and facial expressions that occurred during 28 video-recorded 20-minute-long conversations. In addition, this work has shown that across this dataset, individuals react and respond to contextual cues and demands differently, even across the same type of behavior. Given that psychophysiological variables underlie social behavior, participants' individual differences in personality traits and states, as well as their physiological predispositions and behavioral tendencies were measured and correlated to the elicited conversational behaviors. Inter-subject differences were also correlated to context, and so were intra-subject differences within tokens of the same behavior.

Thus, this dissertation shows that there are correlations between participants' psychophysiological traits and their conversational behaviors. These sources of additional data can help especially in the study of group behaviors, since there is a more distributed responsibility to maintain the conversation than in dyadic interactions.

The dissertation of Bahiyyih Hardacre Cerqueira is approved.

David Shapiro

Charles Goodwin

Marjorie Goodwin

John H. Schumann, Committee Chair

University of California, Los Angeles

2015

DEDICATION

I dedicate this dissertation to my parents, who have always had great faith in the role of education in the betterment of society, and have taught me to (i) push my limits further, (ii) set my goals higher, and (iii) strive to become the best person I can be. I also would like to thank my dear sister for her contagious cheerfulness and unconditional love, support, and friendship.

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BIOGRAPHICAL SKETCH

Bahiyyih Hardacre Cerqueira holds a Master's in Applied Linguistics and teaching English as a Second or Foreign Language from the University of California, Los Angeles, and is finishing her doctoral program in Applied Linguistics in the same institution. She also graduated from the Center for Culture, Brain, and Development training program, sponsored by the Foundation for Psychocultural Research. She has been awarded with the Eugene-Cota Robles Fellowship, the Graduate Research Mentorship, the Graduate Summer Research Mentorship, and the Evelyn Hatch award for three consecutive years. She has also been awarded with research grants from the Foundation for Psychocultural Research for two consecutive years, and was the study coordinator of a research project funded by the Transdisciplinary Seed Grant from the UCLA Vice Chancellor for Research. Among other academic achievements, she has published a book chapter and peer reviewed articles, has presented at over seventeen conferences in her field during her graduate studies, was the coordinator for the Test of Oral Proficiency at UCLA, and is the Editor-in-Chief of *Issues in Applied Linguistics*. Her main research interests are: the neurobiology of language, learning, memory, and social behaviors; interactional instinct; linguistic anthropology; and language and human evolution.

Chapter 1: Introduction

Areas of Concern

The research presented in this dissertation is concerned with the investigation of relationships between psychological and physiological processes in individuals carrying out a conversation in groups of two and three. The major aim is to examine the role of the human autonomic nervous system in framing and informing social engagement behaviors. The overarching theory underlying this project was the interest in an expanded neurobiological perspective of embodied cognition and embodied talk occurring in mundane social interactions.

In order to achieve this goal, research subjects participated in a simple guided conversation task while being video-recorded, and while their physiological responses were being recorded. In addition, well-established psychological surveys were used before and after the conversation session, along with online tracking of baseline physiological changes during resting, reading, and question-and-answer dyadic dialogue. The main objective was to examine significant correlations between coded social engagement behaviors and participants' changes in heart rate and skin conductance during the conversation.

Significance of the Problem

The role of co-participants' behaviors during conversation has been widely investigated in terms of facial expressions, gestures, prominence, gaze, and other biosemiotic resources visually and aurally available to conversationalists. If, however, behavior is informed by such visual and auditory cues, this information should be linked to motor and autonomic systems. Significant changes in heart rate and skin conductance are expected to correlate with conversational behaviors.

In order to pair social engagement behaviors with psychophysiological responses, analysis of the content of conversation should be taken into account. Systematic conversation analysis categorizes the language used during certain behaviors, along with the construction of turns, the placement of silences and pauses, and other behaviors. Conversation analysis allows the study of behavior by examining the language, body activity, and situational contexts in which conversation takes place. This research is innovative as it adds to the scope of conversation analysis the physiological data of the talk during interaction.

This research aims at shedding light on possible neurobiological correlates of conversational activity in order to establish a link between conversational behavior and its physiological responses. Areas that are investigated are turn-taking, disagreements, word searches, and pauses and silences. These areas correspond to possible disruptions of baseline breathing patterns, bursts of oxygen required for lengthier turns, and trigger locations of emotion regulation. If confirmed, these conversational moments may help researchers quantify the contribution the autonomic system offers to the maintenance of an ongoing conversation.

A significant byproduct of this study is the creation of a reasonably straight forward methodology for correlating video-recorded data and physiological data in order to describe the role of the responsive human body during communicative exchanges. Studies of discourse analysis using this methodology may help add a new layer of interpretation of the term ’embodiment’ in the social sciences and humanities, ‘the embodiment of talk.’

The type of research described here applies transdisciplinary research methods to the study of contextualized and socially oriented use of language, namely that of social psychophysiology (Cacioppo, Petty, & Tassinari, 1989; Shapiro & Crider, 1969) and discourse analysis (Garfinkel, 1967). Whereas social psychology represents a metatheoretical orientation in which there is a joint consideration of the inherent biopsychosocial nature of mentation and behavior, discourse analysis assumes that all human action and human institutions rest upon the primordial fact that persons are able to make shared sense of their circumstances and act on the shared sense they make. From this merged approach, a gesture that is interpreted by all conversational partners as a request to take the floor, for example, might correlate with some degree of physiological changes. This gesture might increase heart rate as much as speakership, or getting ready to take the floor. And so will highly emotional topics, anxiety, laughter, and caffeinated drinks. The role of the physiological and sensory systems of the human body in the social world is undeniable, and our psychological perceptions, biases, stimulus appraisals, and visceral reactions are very much intertwined with the next action in any given interaction as are addressees' words, gestures and facial expressions. Therefore, they should be accounted for when describing what participants' bodily displays during a face-to-face communicative exchange truly entail.

Research Questions and Hypothesis

The research reported in this dissertation evaluates changes in heart rate and skin conductance to determine how they relate with certain conversational behaviors based on concepts and methods of physiological and emotional regulation. The main hypothesis is that changes in heart rate and skin conductance precede, coincide with, or follow pivotal moments of the conversation:

1. Do individual scores obtained in the psychological surveys used in this study correlate with the following coded behavior?

A. Turn-taking

B. Silences and pauses

C. Disagreements

D. Word searches

2. Do changes in heart rate and skin conductance reliably precede, or coincide with the following key conversational actions?

A. Turn-taking

B. Silences and pauses

C. Disagreements

D. Word searches

3. Does extrapolated heart rate variability correlate with the following coded behavior?

A. Turn-taking

B. Silences and pauses

C. Disagreements

D. Word searches

Given that the four coded behaviors listed in each of the research questions above are a common theme, the subsequent data chapters are organized around them. The first data chapter is about Turn-taking, the second about Silences and Pauses, the third about Disagreements, and the fourth about Word Searches. Each of these chapters discusses observations of data behavior in three main domains, namely psychological scores, changes in heart rate and skin conductance before and after target behaviors, and heart rate variability during the conversation.

Chapter 2: Literature Review

This chapter lays out all the relevant literature review concerning this project. It starts from a quick overview of conversation analysis, then it gives a description of how the literature portrays embodiment, intentionality and consciousness, then it discusses somatic markers, followed by the polyvagal theory, heart rate variability, emotional regulation, and social engagement behaviors.

Conversation Analysis

Conversation Analysis (CA)allows the examination of talk-in-interaction, the primordial site of human sociality, asking "why that now" for each and every utterance by reference to the sequence in progress (Schegloff, 1993; Schegloff, 2007, p. 249). Its origin lies in sociology, as the concept of conversational uses of language is the fundamental locus of social organizations (Heritage, 1984b). The central domain of data analyzed through CA concerns everyday, mundane conversations. However, a growing number of empirical studies apply conversation analytic techniques to institutional data, such as emergency calls (Whalen & Zimmerman, 1987), legal settings (Atkinson & Drew, 1979; .Maynard, 1984), and pedagogical settings (Koshik, 2005; Lerner, 1995). As CA focuses on talk-in-interaction in various contexts, it intersects with applied linguistics research concerned with the examination of native and non-native talk, language pedagogy, and intercultural communication. In particular, a growing number of studies in Second Language Acquisition have adopted core CA concepts (including investigations into turn-taking, sequential organization, and repair), and have used CA as a method to study non-native discourse (Brouwer, 2003, 2004; Carroll, 2004, 2005; He, 2004; Hosoda, 2000; Kasper, 2004; Kurhila, 2001, 2006; Markee, 2004; Wagner, 1996; Wong, 2000, 2004). As many researchers in the field of Second Language Acquisition (SLA) view language as a social phenomenon that is acquired and used interactively, CA tools have been useful in the investigation of language learners' interactional practices as they are seen as active participants of a larger discourse within this framework (Firth & Wagner, 1997; Gardner & Wagner, 2004; Kasper, 2004; Wong, 2000). In addition, although CA generally investigates naturally occurring conversations as a social action in both ordinary and institutional settings, an increasing number of studies in language use have incorporated these techniques with experimental data as well (Heritage, 1997; Richards & Seedhouse, 2005; Schegloff, Koshik, Jacoby, & Olsher, 2002; Wagner, 1996).

Embodiment, Intentionality, and Consciousness

It is evident that by relying on the observable action within a given interactional framework, research on embodiment has been able to make assumptions about the participants' relationships in terms of epistemic status, stance, underlying meanings, intentions, and agendas during a given interaction. Even though participants do not have direct access to other participants' abstract thoughts, much of the content from such thoughts and intentions find their way out of interactants' brains into the immediately accessible medium. This is because eye movements, feet fidgeting, and head, hands, arms, and legs positioning can express a participant's stance and attitude towards the content of the talk, either when they are producing the talk themselves, or when they are its recipient. It is through these bodily displays that co-participants display their intentionality, by positioning themselves in certain ways to project and frame incoming actions, talk, or thoughts.

Merleau-Ponty (1963) situated *intentionality* on the level of the body. In his book *The Structure of Behavior*, he argues that the original and initial form of intentionality is locomotion (i.e., body motility). According to him, intentionality is not the "servant of consciousness" and he believed that intentionality originates in the body and through a meaningful relation to the environment. In *Phenomenology of Perception*, Merleau-Ponty (1945) argues that "the body is essentially an expressive space" and we move our body not as things moving in space, but through a power of locomotion which extends motor intention to limbs (as seen in translated version by Colin Smith, 1958, p. 169). In addition, he argues that our bodies are not merely expressive areas in our environment, but the "origin of the rest," and that it is the expressive movement itself that causes our bodies to exist as things under our hands and eyes and to how we perceive them as such. Turvey (1986) uses a different approach to describe intentionality. He describes this term in a perceiving-acting approach, where intentional beings display a certain directedness toward objects or towards their immediate surroundings, by placing their limbs in certain goal-oriented ways.

However, Jordan (2003) argues intentionality is the pre-specification of motor output. In congruence with this view, Jordan argues that *consciousness* is defined as a post-stimulus, attention-driven input phenomenon. Jordan adds that consciousness is just as intentional as action. He proposes a dynamic systems approach to study consciousness and intentionality that embodies the two, avoiding the 'epiphenomenalism' derived from a disembodied approach, providing a means of integrating cognitive science with the natural sciences that take into account the embodiment of undergoing actions.

Regardless of how intentionality is defined in the literature, whether it is treated as a crude "pre-specification of motor output" or as a "body expressive space," the perception of human behavior during a given interaction by its co-participants places the body as a biosemiotic resource of shared referential knowledge. Among other things, a shared referential knowledge includes the mutual understanding of how gestures, facial expressions, movements, enactments, and physical orientation of co-participants to each other or to objects in the interaction accessible by visual or aural observation fit in a given framework. In addition, as pointed out by Yokoyama (1986), "sharing of information is a prerequisite for discourse," including the knowledge of a linguistic code as that of a speech community, and various semiotic and biosemiotic systems (p.24).

Biosemiotic resources include the use of sign processes and sign relations between and within bodies (Favareau, 2010). Douglas (1982) denotes the body as a system of ‘natural symbols’ that reproduce the complexities of our social world. Therefore, it constitutes the way in which communication, meaning, and action are constituted and done within face-to-face interaction. The participants’ shared three-dimensional referential environment, and a multi-layered co-construction of meaning happens by means of talk and the body mutually constituting our continuing decodification of the events in progress. In this sense, there is a moment-by-moment building of both action and its understanding through the intertwining of both talk with its language structure and embodied resources. Through interaction, different participants can contribute different materials to the emerging structure of the action in progress, and through this process, the action itself can undergo continuous processes of change. Goodwin (2000) explains that “talk and gesture mutually elaborate each other within (1) a larger sequence of action and (2) an embodied participation framework constituted through mutual orientation between speaker and addressee” (p. 1499).

Nevertheless, the scope of studies of talk-in-interaction are still bound by the limits of visually and aurally accessible information. However, the internal bodily regulation contributes to the ongoing interaction with equally relevant influential resources, informed by the autonomic nervous system, the endocrine system, and the control mechanisms for musculo-skeletal activity. Therefore, in order to fully understand the mechanics of social behavior, one must also take into account the physiological functioning of such embodied minds.

The *embodied mind* thesis holds the notion that the nature of the human mind is greatly determined by the limits and shape of the human body. In congruence with this concept, Lakoff (1999) claims that the human mind is embodied, and he argues that almost all of human cognition, up through the most abstract reasoning, depends on and makes use of the sensorimotor system and emotions. Furthermore, the study of *embodied cognition* is based on the tenet that all aspects of cognition are shaped by aspects of the body, from mental constructs to human performance on cognitive tasks. Such aspects of the body include a perceptual system of the situated environments built into the body and the brain. Furthermore, Gibbs (2005) describes *embodiment of cognition* as the process of understanding the role of our own body in its everyday environment. Thus, in Gibbs's version of embodied perception, the subject's conscious experience of his or her own physical activities plays an especially important role in structuring his or her cognitive processing. The definitions that Lakoff and Gibbs propose suggest that psychophysiological aspects of embodiment are part of human condition and behavior, but much of the work within cognitive science does not take multiparty social interaction as a primary site for analysis. Such a view could be perceived as limited in scope and therefore problematic.

The Somatic Marker and Conversation Analysis

The usefulness of concepts such as *cognition* and *embodied mind* to studies of social interaction is the understanding that participants' mental semiotic resources partly rely on their bodies as reference during language production and communication, during social interaction and decision-making (Borghi & Cimatti, 2010; Damasio, 1994, Schumann, 1999). Decisions during communicative exchanges rely on online internal and external cues. External cues available in an ongoing interaction include the observation of the behavior of others, as well as the conversationalist's own behavior. Schegloff argues that such activities are part of "doing conversational behavior" (Schegloff, 1972, in *Notes on a Conversational Practice: Formulating Place*). Examples of such activities are distribution of turns, evidence that messages are getting through, devices for attracting, retaining, and displaying attention, participant identification, and forms of dealing with trouble in the talk. Heritage (2003) defines social organization as a "syntax of action that inhabits the practices and behaviors that make up human social interaction" (p.2). He adds that conversational behavior is framed by a social organization that is culturally specific. Goodwin & Heritage (1990) claim that it is through such processes of social interaction that all shared meaning, mutual understanding, and the coordination of human conduct are jointly achieved (p.283). Fiske (2004) adds that another binding characteristic of conversational behavior is its context, because not only does it limit the semiotic resources available to the interactants, but it also constrains appropriacy and operational relationship modes. Finally, Streeck, Goodwin, and LeBaron (2011) define the role of context as being the factor that frames behavior.

Goffman acknowledged that sociological work requires some assumptions about human psychology and embodiment. More specifically, Goffman alludes to “an inevitable psychobiological element” (Goffman, 1983) in face-to-face interaction because emotion, cognition, and muscular effort are intrinsic to its accomplishment for the following four reasons:

> … first, in interaction the expressiveness of the person is the medium through which information about the individual — status, mood, intentions, competence, etc. — is conveyed to others; second, information about the individual is conveyed in interaction through expressive messages; third, expressions conveyed in interaction provide a flow of information rich in qualifiers, and each individual is accessible to the ordinary (or ‘naked’) senses of all the others present, and they to him/her; fourth, the fact of co-presence facilitates opportunities for feedback, which can make the monitoring process complex. (Goffman, 1983, p. 3)

All in all, human social interaction is subserved by a complex adaptive system comprised of multi-layered semiotic resources for its successful accomplishment. Synchronically paired with talk is the participants’ interpretation of cues from the environment and other interlocutors. In conversation analysis, utterances are examined in their contextual sequences, taking into account occurring lengthenings, intonation, pitch, stress, silences and pauses, and the degree of overlap with other interlocutors’ talk, among a number of other segmental and suprasegmental features. A major issue in studies of such phenomena is the fact that such exchanges are very sensitive and reactive to the content of the talk, to facial expressions, pitch, stress, and other equally important non-verbal behavior of our co-interactants, crucial factors in the maintenance of participants’ social behavior. Such interplay of perception and behavior is regulated by stored affect, which is mediated by a mechanism that involves the ventromedial prefrontal cortex, called somatic markers.

Damasio's (1994) work places a great emphasis on embodiment in social interactions. He claims that "Nature appears to have built the apparatus of rationality not just on top of the apparatus of biological regulation, but also *from* it and *with* it" (p. 128). He also believes that emotions are vital to the higher reaches of distinctively human intelligence, and that emotions do not 'get in the way of' rational thinking, but are actually essential to rationality. He sees emotions as cognitive representations of body states that are part of a homeostatic mechanism by which the internal milieu is monitored and controlled, and by which behavior of the whole organism is influenced. When individuals make decisions, they must assess the incentive value of the choices available to them, using cognitive and emotional processes. However, when the individuals face complex and conflicting choices, they may be unable to decide using only cognitive processes, which may become overloaded. In such cases, somatic markers can help individuals make a decision.

There are times that decision making is not entirely based on unbiased and rationally thought-out reasoning processes. Often times quick decisions are influenced by previously encountered experiences that generate stored somatic markers, which may outweigh higher function cognitive processes. Somatic markers are associations between reinforcing stimuli that induce associated physiological affective states. Within the brain, somatic markers are thought to be processed in the ventromedial prefrontal cortex (VMPFC; a subsection of the orbitomedial prefrontal cortex). These somatic marker associations can recur during decision-making and bias our cognitive processing. When we have to make complex and uncertain decisions, the somatic markers created by the relevant stimuli are summed to produce a net somatic state. This overall state directs and biases our decision of how to act. This influence on our decision-making process may occur covertly, via the brainstem and ventral striatum, or overtly, engaging higher cortical cognitive processing. Damasio (1994) proposes that somatic markers direct attention towards more advantageous options, simplifying the decision process.

Damasio's (1994) *somatic marker* mechanism posits that perceptions interact with emotions, and such perceptions are biased and vary across individuals. Similarly, Schumann (1994) describes a *stimulus appraisal system*, where perceptions of a given reality are informed by the individuals' sensory systems and are modulated by the brain, relying on previous experiences. Damasio (1994) also points out that normal individuals confronting a stimulus situation get feedback from their autonomic nervous system, endocrine system, and musculoskeletal system. This feedback from the body constitutes an emotion that is perceived by the brain as a feeling. The feeling (positive or negative) helps individuals choose among possible courses of action (Damasio 1994, as seen in Schumann 1999). Hence, for every response option contemplated, a somatic state is generated, including sensations from the viscera, internal milieu, and the skeletal and smooth muscles.

Because the amygdala and VMPFC are thought to be essential components of this hypothesized mechanism, damage to either structure will disrupt their proposed action in mediating the development and action of somatic markers. To illustrate the effects that damage to VMPFC can have on social interactions, Damasio (2003) in *Descartes' Error: Emotion, Reason, and the Human Brain*, describes to one of his patients:

> I had been advised early in life that sound decisions came from a cool head... I had grown up accustomed to thinking that the mechanisms of reason existed in a separate province of the mind, where emotion should not be allowed to intrude… But now I had before my eyes the coolest, least emotional, intelligent human being one might imagine, and yet his practical reason was so impaired that it produced, in the wanderings of daily life, a succession of mistakes, a perpetual violation of what would be considered socially appropriate and personally advantageous. (Introduction)

This quote shows us that decision-making void of emotional input derived by damage to the ventromedial pre-frontal cortex creates impaired reasoning when it comes to decisions pertaining to appropriate social engagement behaviors. This is evidence that culturally-bound affect has a crucial role in guiding socially appropriate behaviors, which warrants research in conversation analysis that takes into this regulation. For example, during conversational interactions with strangers, polite turn-taking should minimize overlaps and avoid face-threatening contexts. If that is the case, the monitoring of a successful ongoing conversation requires that participants attune to the timing of turn contraction units, and mitigate disagreements. If these underlying behaviors are indeed taking place, corresponding emotional regulation should be observable and measurable. Literature in psychophysiology has successfully linked changes in heart rate and skin conductance to certain behaviors and emotions (Cacioppo, Petty, & Tassinari, 1989), and this line of reasoning comprises the major theoretical framework of this study. The idea that decisions are informed by somatic markers, which are in turn informed by sensations generated from the autonomic system allows for the consideration of Porges's (2001) *polyvagal theory* as a possible theoretical bridge for studies of social behavior.

The Polyvagal Theory

Porges's (2001, 2003) *polyvagal perspective* explores paradigms on the role of autonomic function in the regulation of affective states and social behavior (Grippo, Lamb, Carter, & Porges, 2007; Porges, 2001, 2003). Porges (2009) explains that we get cues from our social environment in order to decide whether or not it is safe to socially engage. He proposes *neuroception* as a plausible mechanism mediating both the expression and the disruption of positive social behavior, emotion regulation, and visceral homeostasis. Such responses can be measured by tracking bodily changes that are influenced by the sympathetic and parasympathetic nervous system. Examples are pupil dilation, palmar skin conductance, and heart rate.

Measures of autonomic regulation have been shown to index motivation and arousal, and this fact has a vast utility in the realms of social sciences. Skin conductance indicates electrical conductance of the skin. As sweat glands are controlled by the sympathetic nervous system, skin conductance is used as an indication of psychological and physiological arousal. Heart rate is a common physiological measure of human emotion, but its changes may be due to various psychological and neurophysiological processes (Cacioppo, Klein, Bernston, & Hatfield, 1993). For instance, Shapiro and Leiderman (1967), referring to published and also unpublished studies, showed that the mere presence of two other persons, during a pre-experimental rest period does not lead to higher levels of electrodermal activity compared to resting alone. But they support the fact that arousal can be either increased, or decreased depending on the nature of the group task, in small group activities. Variables within the activity will depend on the participant's attitude to the topic, the mutual attitudes of the interacting individuals, the degree to which the individual participates in the task, and the composition of roles within the group, even if those are not openly assigned. In addition, how we respond to a social environment depends on how we read and interpret its cues. For instance, if we pair seemingly homogenous participants and initially engage them in the same topic of conversation, no matter how many pairs we put together, every conversation will be different. This is due to the fact that each individual has had different life experiences that generated different appraisals that inform their social engagement behaviors.

The generation of such appraisals and somatic markers that color interactants' perceptions of the surrounding environment mold culturally appropriate social engagement behaviors. Lee et al (2009) suggest that the human brain evolved to interact with other human brains, being highly socially oriented, a theoretical standpoint that includes further concepts such as *theory of mind* and *mirror neurons*. Similarly, Christiansen and Chater (2010) propose that:

> …language has adapted through gradual processes of cultural evolution to be easy to learn, to produce and understand. Thus, the structure of human language must inevitably be shaped around human learning and processing biases deriving from the structure of our thought processes, perceptuomotor factors, cognitive limitations, and pragmatic constraints. Language is easy for us to learn and use, not because our brains embody knowledge of language, but because language has adapted to our brains. (p.490)

When we use language to interact and communicate with others, this communication is not done by only one participant delivering a turn-at-a-time in a sequential manner; communication is constructed simultaneously by all the involved parties, in a collaborative manner, and it evolves through this collaboration. This communicative interaction emerges from the ongoing talk and participants' bodily and facial displays. Such displays have underlying emotional meanings that frame the conversation. Therefore, the analysis of a fuller spectrum of this interactional structure requires the investigation of neurophysiological adaptive responsivity to the conversation among interactants. Research by Damasio (1994) gives support to this kind of investigation as it suggests that individuals confronting any situation get feedback from their autonomic nervous systems, endocrine systems, and musculoskeletal systems before displaying a response. In this response, feedback from the body provides a basis for how we respond during conversation, and it helps us make social and personal decisions. In ordinary conversational interaction, these decisions face us on a moment-to-moment basis and are informed by the immediate environment, in which the content of the interaction, or what was being said, is emerging through the ongoing calibration and interaction between speaker and hearer. This process encompasses both the interlocutors' talk and their bodies as meaningful canvases for display of action, and sources of experiential knowledge and feedback. Then, it is our understanding that social interactions require an online, two-way, multi-party, second-by-second adaptive process with neurobiological underpinnings.

Therefore, in conversational interaction we are constantly making judgments about interlocutors' evolving intentions, emotions, beliefs, and behaviors, enabling the interaction to be built through interpretants' participation. Participants' judgments rely on appraisals of the environment, interlocutors, and content of the conversation. Individuals develop such appraisals from monitoring and evaluating one or various occurrence(s) of an event by examining different basic components such as time, expectation, probability, and predictability (Grandjean, Sandler, & Scherer, 2005). Additionally, Schumann's (1999) Stimulus Appraisal System suggests that we form and appraise events according to their novelty (i.e., conformity or discrepancy with what is expected), pleasantness, and how they might challenge our ability to cope with the situation. In addition, we assess our interlocutor's state of mind and behavior according to whether they foster our goals and enhance our self and social image (Dornyei, 2010). On the basis of these appraisals, we may respond to the evolving interaction in a courteous or aggressive manner, or in a dominant or submissive manner, by manipulating prosody, grammar, and lexicon accordingly, fostering our goals and agendas (Schumann, 1999).

Turn-taking and decision-making in ordinary conversation is far from straightforward, and its analysis should not rely only on the observation of body language, appraisals, emotional expressivity, and talk. There are features that characterize participants' stance and agendas embedded in turn constructions, silences, or tokens of news receipt or disagreements, among many others. For example, Sacks, Schegloff, and Jefferson (1974) suggest that the analysis of turn-taking systems can be done in several ways, and must take into account the distribution of talk, distribution of silences, sequences in which the talk shifted from one to another and how it was retained, etc. On top of these various elements of turn-taking systems, however, behaviors that take place during ordinary conversation are reflected in measures of peripheral nervous system activity, because it coordinates the responsivity and regulation of our body's homeostasis during any given social interaction. Ultimately, it is the central nervous system that mediates homeostasis. It responds to internal and external stimuli, and any deviation from the body's normal state. For example, if core body temperature drops too low, the brain sends a message to the blood vessels to constrict and keep warm blood flowing in the core of the body. Similarly, excess body heat triggers perspiration. More specifically, the body's homeostasis-related functions are controlled by the pituitary gland, hypothalamus. The pituitary gland is linked to all the efferent neurons in the peripheral nervous system.

Major components in the maintenance of homeostasis are the central nervous system (CNS) and the peripheral nervous system (PNS). The CNS is the part of the nervous system that comprises of the brain and spinal cord. The PNS is the part of the nervous system that consists of the nerves and ganglia outside of the brain and spinal cord, including the twelve cranial nerves.

The main function of the PNS is to connect the CNS to the limbs and organs, essentially serving as a communication relay going back and forth between the brain and the extremities. One of the cranial nerves that allow such communication is the *vagus nerve*, also called *pneumogastric* or *cranial nerve X* (see Figure 1). The vagus nerve conveys sensory information about the state of the body's organs to the central nerve system. When the signal reaches the brain, it travels along efferent nerves to the muscles or glands to respond to a stimulus.

The PNS is divided into the somatic nervous system and the autonomic nervous system (ANS). Together, these two systems are directly responsible for homeostasis. The ANS comprises the sympathetic nervous system and the parasympathetic nervous system. Where the former produces epinephrine that gears the body to respond to an emergency by increasing heart rate, breathing, or energy transfer to muscles, for example, the latter produces acetylcholine that calms the body, lowering heart rate, breathing and playing a part in digestion. This is because acetylcholine has functions both in the peripheral nervous system and in the central nervous system as a neuromodulator. In cardiac tissue, acetylcholine neurotransmission has an inhibitory effect, which lowers heart rate. However, acetylcholine also behaves as an excitatory neurotransmitter at neuromuscular junctions in skeletal muscle. The secretion of adrenaline contributes to the shut down all non-vital functions for the duration of the situation. Bodily reactions to exciting stimuli from our environment are triggered by the sympathetic system, which is later regulated by the parasympathetic system (see Figure 2), a phenomenon called by Stephen Porges (2003) as 'Vagal Brake'. These mutually regulating systems react to stimuli generated externally in the environment which are assessed by the central nervous system, triggering subsequent behavioral and physiological adaptations.

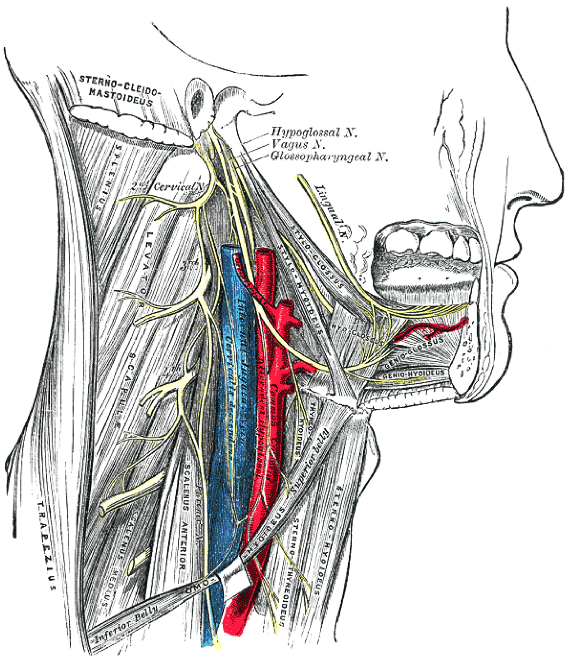

Figure 1. The Xth cranial nerve

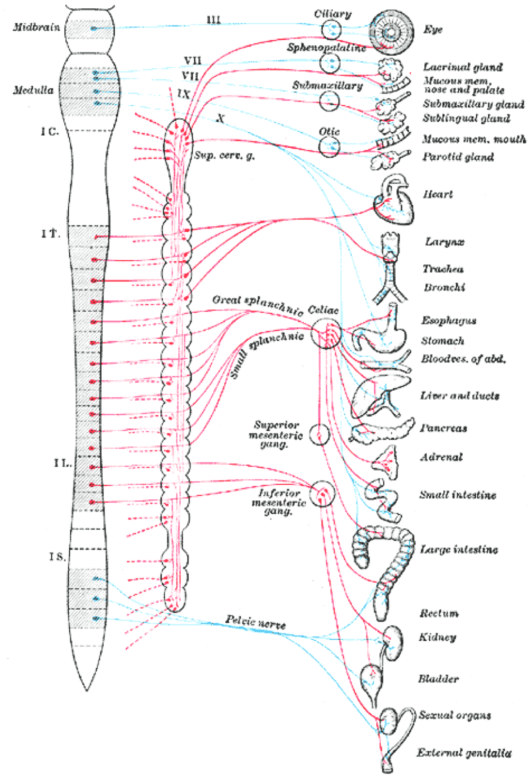

Figure 2. The autonomic nervous system

In most normal individuals, the nervous system evaluates risk and matches neurophysiological state with the actual risk of the environment. When the environment is appraised as safe, the defensive limbic structures are inhibited, enabling social engagement and calming visceral states. According to Porges's (2007) polyvagal theory, social communication can be expressed efficiently through the social engagement system only when the defensive circuits are inhibited. This means that if a certain environment or addressee is perceived as hostile and life-threatening, it is unlikely that subjects will choose to engage in social behaviors with each other at that moment. However, it does not necessarily mean that negative emotions will not arise from the interaction once it is established, as negative emotions are intrinsic part of any relationship or interaction as much as positive emotions are, even with members of our 'safe' circle. Porges theorizes that human brains operate guided by a system he calls *Neuroception*. According to him, neuroception represents a neural process that enables us to engage in social behaviors by distinguishing safe from dangerous contexts. He proposes that this is a plausible mechanism mediating both the expression and the disruption of positive social behavior, emotion regulation, and visceral homeostasis. He adds that neuroception might be triggered by feature detectors involving areas of temporal cortex that communicate with the central nucleus of the amygdala and the periaqueductal gray, since limbic reactivity is modulated by temporal cortex responses to the perceived intention of voices, faces, and hand movements. Thus, the neuroception of familiar individuals and individuals with appropriately prosodic voices and warm, expressive faces translates into a social interaction promoting a sense of safety, further promoting the social engagement system.

Porges's social engagement system consists of a somatomotor component (solid blocks in Figure 3) and a visceromotor component (dashed blocks in Figure 3). The somatomotor component involves special visceral efferent pathways that regulate the striated muscles of the face and head, while the visceromotor component involves the myelinated vagus that regulates the heart and bronchi (Porges, 2007). This social communication system involves the myelinated vagus, which serves to foster calm behavioral states by inhibiting sympathetic influences to the heart and dampening the hypothalamic-pituitary-adrenal (HPA) axis. The mobilization system is dependent on the functioning of the sympathetic nervous system. The most phylogenetically primitive component, the immobilization system, is dependent on the unmyelinated vagus, which is shared with most vertebrates. With increased neural complexity resulting from phylogenetic development, the organism's behavioral and affective repertoire is enriched. The three circuits can be conceptualized as dynamic, providing adaptive responses to safe or dangerous events and contexts.

Via evolution, the human nervous system retained three neural circuits, which are in a phylogenetically organized hierarchy. In this hierarchy of adaptive responses, the newest circuit is used first; if that circuit fails to provide safety, the older circuits are recruited sequentially (Porges, 2007). A face-heart connection evolved as source nuclei of vagal pathways shifted ventrally from the older dorsal motor nucleus to the nucleus ambiguus. This resulted in an anatomical and neurophysiological linkage between neural regulation of the heart via the myelinated vagus and the special visceral efferent pathways that regulate the striated muscles of the face and head, forming an integrated social engagement system. This social engagement system mediates all our social interactions, whether or not they are perceived as 'safe' or 'life-threatening'. Interactants' decisions on what to say when they next take a turn in the ongoing conversation does not rely exclusively on the current context of the talk, but on the manner in which speech is produced, including pitch, prosody, speed, facial expressions, gestures, bodily displays, epistemic status displays, gaze, and mutual orientations to shared physical and abstract environment.

Functionally, when the social environment is perceived as safe, two important features are expressed. First, bodily state is regulated in an efficient manner to promote growth and restoration (that is, visceral homeostasis). This is done through an increase in the influence of mammalian myelinated vagal motor pathways on the cardiac pacemaker that slows the heart, inhibits the fight-or-flight mechanisms of the sympathetic nervous system, dampens the stress response system of the HPA axis (e.g.: cortisol), and reduces inflammation by modulating immune reactions (e.g.: cytokines). Second, through the process of evolution, the brainstem nuclei that regulate the myelinated vagus became integrated with the nuclei that regulate the muscles of the face and head. This link results in the bidirectional coupling between spontaneous social engagement behaviors and bodily states. Specifically, an integrated social engagement system emerged in mammals when the neural regulation of visceral states that promote growth and restoration (via the myelinated vagus) was linked neuroanatomically and neurophysiologically with the neural regulation of the muscles controlling eye gaze, facial expression, listening, and prosody (Porges, 2011).

Heart Rate Variability, Emotional Regulation, and Social Engagement Behaviors

Although the nature of emotions has been the subject of much debate, most theorists consider emotions to be multifaceted processes involving coordinated changes in peripheral and central physiology (Thayer & Siegle, 2002), behavior or behavioral tendencies, and cognitive processing. Emotions guide our decisions (Damasio, 2003, p. 144), provide a substrate for social interaction (Keltner & Kring, 1998), and facilitate responses to challenge (Tooby & Cosmides, 1990). Emotions that are expressed with sensitivity to the situational context in which they unfold, both in terms of timing/occurrence and magnitude, are more likely to facilitate adaptive responses. Emotions are matched to their context through various regulatory strategies implemented both during and after initial emotional expression (Gross, 1998). Indeed, the capacity to regulate emotion is vital to social functioning (Eisenberg, 2001) and maintaining mental health (Gross & Munoz, 1995).

The emotions that humans experience while interacting with their environment are associated with varying degrees of physiological arousal (Appelhans & Luecken, 2006, Levenson, 2003). A key system involved in the generation of this physiological arousal is the autonomic nervous system (ANS). The ANS is subdivided into an excitatory sympathetic nervous system (SNS) and an inhibitory parasympathetic nervous system (PNS) that often interact antagonistically to produce varying degrees of physiological arousal. During physical or psychological stress, activity of the SNS becomes dominant, producing physiological arousal to aid in adapting to the challenge. An increased pulse, or heart rate, is characteristic of this state of arousal. During periods of relative safety and stability, the PNS is dominant and maintains a lower degree of physiological arousal and a decreased heart rate. The ease with which an individual can transition between high and low arousal states is dependent on the ability of the ANS to rapidly vary heart rate.

Emotion regulation depends critically on an individual's ability to adjust physiological arousal on a momentary basis (Gross, 1998). A flexible ANS allows for rapid generation or modulation of physiological and emotional states in accordance with situational demands. In contrast, autonomic rigidity results in a lessened capacity to generate or alter physiological and emotional responses in synchrony with changes in the environment. Heart rate variability (HRV) is a measure of the continuous interplay between sympathetic and parasympathetic influences on heart rate that yields information about autonomic flexibility and thereby represents the capacity for regulated emotional responding (Appelhans & Luecken, 2006).

Heart rate variability. Heart rate variability (HRV) is a reliable reflection of the many physiological factors modulating the normal rhythm of the heart. In fact, they provide a powerful means of observing the interplay between the sympathetic and parasympathetic nervous systems. It shows that the structure generating the signal is not only simply linear, but it involves nonlinear contributions. Heart rate (HR) is a non-stationary signal; its variation may contain indicators of current disease, or warnings about impending cardiac diseases. The indicators may be present at all times or may occur at random—during certain intervals of the day. It might show in abnormalities found in voluminous data collected over several hours. Hence, HR variation analysis (instantaneous HR against time axis) has become a popular noninvasive tool for assessing the activities of the autonomic nervous system. Computer based analytical tools for in-depth study of data over daylong intervals can be very useful in diagnostics. Therefore, the HRV signal parameters, extracted and analyzed using computer software, are highly useful in diagnostics (Acharya et al, 2006, Akselrod, 2006, Appelhans & Luecken, 2006, Thayer & Siegle, 2002).

Moreover, HRV reflects the degree to which cardiac activity can be modulated to meet changing situational demands. Although HRV is influenced by numerous physiological and environmental factors, two are particularly prominent and of psychophysiological importance: the influence of the ANS on cardiac activity and ANS regulation by the central autonomic network (CAN). As mentioned before, the heart is innervated by the sympathetic and parasympathetic (vagal) branches of the ANS, which exert a regulatory influence on heart rate by influencing the activity of the primary pacemaker of the heart, the sinoatrial node. The sinoatrial node generates action potentials that course throughout the cardiac tissue, causing regions of the myocardium (heart muscle) to contract, forming what characterizes a heartbeat. Activation of sympathetic fibers has an excitatory influence on the firing rate of the sinoatrial node and, among other things, results in increased heart rate. In contrast, parasympathetic activation has an inhibitory influence on the pacemaking activity of the sinoatrial node and produces decreased heart rate.

Alternatively, it can be said that the two autonomic branches regulate the lengths of time between consecutive heartbeats, or the inter-beat intervals (RR, see Figure below), with faster heart rates corresponding to shorter inter-beat intervals and vice versa. The PNS and SNS act antagonistically to influence cardiac activity. For example, an increase in heart rate could arise from either increased sympathetic activity or decreased parasympathetic inhibition (vagal withdrawal). Although both autonomic branches exert a constant influence on heart rate, parasympathetic influence is predominant at rest and serves to maintain resting heart rate well below the intrinsic firing rate of the sinoatrial node (Appelhans & Luecken, 2006, Berntson et al., 1997).

Figure 3. Variation of Beat-to-Beat Intervals of the Heart Rate, also Known as RR Intervals

The two branches of the ANS rely on different signaling mechanisms with different temporal effects. Sympathetic influence on heart rate is mediated by neurotransmission of norepinephrine and possesses a slow course of action on cardiac function. That is, changes in heart rate due to sympathetic activation unfold rather slowly, with peak effect observed after about 4 s and return to baseline after about 20 s (Appelhans & Luecken, 2006). In contrast, parasympathetic regulation of the heart is mediated by acetylcholine neurotransmission and has a very short latency of response, with peak effect at about 0.5 s and return to baseline within 1 s (Appelhans & Luecken, 2006, Berntson et al., 1997; Pumprla, Howorka, Groves, Chester, & Nolan, 2002). The ability of the PNS to rapidly modulate cardiac activity allows for flexibility in responding to environmental demands with physiological and emotional arousal. Owing to the difference in their latencies of action, the oscillations in heart rate produced by the two autonomic branches occur at different speeds, or frequencies. This serves as the basis for the frequency based HRV analyses described below. Breathing air into the lungs temporarily gates off the influence of the parasympathetic influence on heart rate, producing a heart rate increase (Berntson, Cacioppo, & Quigley, 1993).

Breathing air out of the lungs reinstates parasympathetic influence on heart rate, resulting in a heart rate decrease. This rhythmic oscillation in heart rate produced by called respiratory sinus arrhythmia (Appelhans & Luecken, 2006, Bernardi, Porta, Gabutti, Spicuzza, & Sleight, 2001; Berntson et al., 1993). As only cardiac parasympathetic activity possesses a latency of action rapid enough to covary with respiration, respiratory sinus arrhythmia is a phenomenon known to be entirely mediated by the PNS. In fact, a large majority of parasympathetically mediated variation in heart rate is produced by respiratory sinus arrhythmia (Berntson et al., 1997), and many researchers have reported the magnitude of respiratory sinus arrhythmia as an index of parasympathetically mediated HRV (Appelhans & Luecken, 2006). Historically, researchers assumed that the magnitude of respiratory sinus arrhythmia could serve as a linear index of "vagal tone," or the electrochemical activity of the vagus nerve (Grossman, Stemmler, & Meinhardt, 1990; Saul & Cohen, 1994). However, this view has been challenged (Pyetan & Akselrod, 2003), and strictly speaking, respiratory sinus arrhythmia is an estimate of parasympathetically mediated HRV rather than of vagal tone (Appelhans & Luecken, 2006).

The autonomic influences on heart rate are regulated remotely by the distributed network of brain areas composing the CAN (Benarroch, 1993). The CAN supports regulated emotional responding by flexibly adjusting physiological arousal in accordance with changing situational demands. Thus, the CAN is critically involved in integrating physiological responses in the services of emotional expression, responding to environmental demands, goal-directed behavior, and homeostatic regulation. The neuroanatomical composition of the CAN includes cortical (medial prefrontal and insular cortices), limbic (anterior cingulate cortex, hypothalamus, central nucleus of the amygdala, bed nucleus of the stria terminalis), and brainstem (periaquaductal gray matter, ventrolateral medulla, parabrachial nucleus, nucleus of the solitary tract) regions. The CAN receives input from visceral afferents regarding the physiological conditions inside the body and input from sensory processing areas in the brain regarding the external sensory environment (Appelhans & Luecken, 2006, Benarroch, 1993). This input allows the CAN to dynamically adjust physiological arousal, including arousal associated with emotional expression and regulation, in response to changes in internal and external conditions. The output of the CAN is transmitted to the sinoatrial node (and many other organs) through the SNS and PNS and directly influences heart rate. Therefore, HRV reflects the moment-to-moment output of the CAN and, by proxy, an individual's capacity to generate regulated physiological responses in the context of emotional expression (Thayer & Lane, 2000; Thayer & Siegle, 2002).

All in all, changes in cardiovascular reactivity have been used as a psychophysiological marker of various emotional states in both children and adults. Recent decades have seen increasing use of heart rate variability as a non-invasive marker of cardiac autonomic function and of central processes involved in autonomic function regulation. Developmental research has linked cardiac vagal tone to an individual's responsivity to environmental challenges and a decrease in vagal component of heart rate variability may reflect deficiencies in emotional regulatory system. Studies with children and adolescents suggest that attenuated cardiac vagal function is seen in various pathophysiological conditions characterized by emotional dysregulation. Thus, alteration in cardiac vagal modulation may be the common mechanism underpinning the association between negative affective states and emotional dysregulation. Therefore, HRV represents one of the most promising autonomic activity markers. HRV has become the conventionally accepted term to describe variations of both instantaneous heart rate and inter-beat intervals (RR). In order to describe oscillation in consecutive cardiac cycles, other terms have been used in the literature; for example, cycle length variability, heart period variability, RR variability and RR interval tachogram, and they more appropriately emphasize the fact that it is the interval between consecutive beats that is being analyzed rather than the heart rate per se. HRV frequency-domain analyses contributed to the understanding of the autonomic background of RR interval fluctuations in the heart rate record. With the availability of new, digital, high frequency, 24-hour multi-channel electrocardiographic recorders, HRV has the potential to provide additional valuable insight into physiological and pathological conditions.

Psychophysiological theories of heart rate variability. Two major theories causally relate the autonomic flexibility represented by HRV with regulated emotional responding. Porges's (1997, 2001) polyvagal theory is based within a evolutionary framework, which understands aspects of human functioning in terms of acquired, genetically based characteristics that are presumed to have aided in survival and/or reproduction throughout human phylogenetic history. As mentioned earlier, the polyvagal theory posits that the human ANS evolved in three stages, each characterized by the acquisition of an autonomic structure that plays a unique role in social processes. First acquired was the dorsal vagal complex, a slow-responding, unmyelinated vagus nerve that supports simple immobilization (e.g., freezing) in response to threat. This "vegetative vagus" slows heart rate through tonic inhibition of sinoatrial node activity. The capacity for active mobilization responses (e.g., fight or flight) became supported with the subsequent acquisition of the SNS. Most recently acquired was the ventral vagal complex, consisting of a fast-acting, myelinated vagus that can rapidly withdraw and reinstate its inhibitory influence on sinoatrial node activity. A key premise of the polyvagal theory is that the ventral vagal complex has afferent fibers terminating in the nuclei of the facial and trigeminal nerves and includes portions of cranial nerves that mediate facial expression, head turning, vocalization, listening, and other socially relevant behaviors. The connection of the ventral vagal complex and these cranial nerves provides a mechanism by which cardiac states can be coordinated with social behaviors (Porges, 1997, 2001).

The polyvagal theory states that the ability of the ventral vagal complex to rapidly withdraw its inhibitory influence allows humans to rapidly engage and disengage with their environment without the metabolic cost of activating the slower responding SNS. The dynamic nature of many social processes (e.g., nonverbal communication, romantic courtship; see Porges, 1998) requires this rapid management of metabolic resources. Only when ventral vagal complex withdrawal is insufficient to meet demands are other autonomic subsystems enlisted. In this respect, the polyvagal theory emphasizes the relation of respiratory sinus arrhythmia (which purportedly indexes ventral vagal complex activity; Porges, 2001) and the regulation of the emotional processes underlying social behavior.

Thayer and Lane (2000) outlined a model of neurovisceral integration, which relates emotional responding with HRV through a dynamical systems perspective. Within the dynamical systems framework, large-scale patterns (e.g., fluctuations in bird populations) are considered to be products of a number of smaller scale interacting forces (e.g., food supply, presence of predators) that influence one another in nonlinear fashions (see Gleick, 1987). According to the model of neurovisceral integration, the array of behavioral, cognitive, and physiological processes involved in emotion are considered to be subsystems of a larger, self-organizing system. Specific emotion states emerge from interactions among these lower level elements along the lines of certain control parameters. The model of neurovisceral integration cites a growing body of literature suggesting the dimensions of valence (aversive vs. appetitive) and arousal represent the control parameters that guide the organization of emotional responses.

More important, the model of neurovisceral integration views the CAN as the neurophysiological command center governing cognitive, behavioral, and physiological elements into regulated emotion states (Hagemann, Waldstein, & Thayer, 2003; Thayer & Lane, 2000). The CAN does this by inhibiting other potential responses. This inhibition requires reciprocal communication among system components (e.g., feedback loops), sensitivity to the initial conditions of the system, and the existence of multiple pathways to a response (e.g., combinations of sympathetic and parasympathetic activity), all elements of a neuroviscerally integrated dynamical system (Thayer & Seigle, 2002). Such inhibition is thought to be mediated synaptically in the brain and vagally in the periphery (Thayer & Friedman, 2002). From this perspective, HRV can be considered a proxy for the CAN's ability to regulate the timing and magnitude of an emotional response through inhibition in accordance with contextual factors.

Both theories presented above are similar in that they specify a critical role for parasympathetically mediated inhibition of autonomic arousal in emotional expression and regulation, and maintain that HRV measures are informative about individuals' capacity for this aspect of regulated emotional responding. However, these theories differ in a few of their premises. For example, the model of neurovisceral integration is premised on neuroanatomical links between the ANS and brain regions associated with emotional processing (e.g., cortical and limbic areas of the CAN), whereas the polyvagal theory largely rests on the neural connections between the vagus nerve and other cranial nerves that control peripheral structures involved in the behavioral expression of emotion (e.g., the muscles of the face and head). Attending to different neuroanatomical substrates has led to divergent extensions of each theory, mostly to affective dysfunction for the model of neurovisceral integration and to social and developmental processes for the polyvagal theory. Integrating our understanding of the neuroanatomical components from both models should help researchers generate more intricate hypotheses about the interaction of autonomic, cognitive, and behavioral aspects of emotional expression and regulation.

Emotional regulation and heart rate variability. Porges et al (1993), in a series of studies in infants and children, showed that vagal tone as measured by HRV is an index of emotion and attentional regulation. He shows that low vagal tone is associated with poor affect regulation, decreased responsivity to stimuli, and increased vulnerability to stress in infancy and childhood. For example, infants with difficulties in decreasing vagal tone during a social/ attention task at 9 months of age had significantly greater behavioral problems at 3 years of age. Kagan et al (1988) have described the construct of behavioral inhibition, a temperamental attribute in children, which they showed to be related to later development of anxiety disorders. For example, they present a study that shows that there was a greater shift towards low frequency power in HRV under cognitive stress in behaviorally inhibited children. Inhibited and uninhibited children also differed on other physiological indices such as salivary cortisol levels, norepinephrine levels and pupillary size at both baseline and in response to cognitive stress. These findings suggest that heightened sympathetic activity with involvement of neural circuits in the limbic system might be the basis for behavioral inhibition. Others have noted an excessive vagal reactivity to various environmental challenges among children who are temperamentally shy and angrily reactive. In contrast, vagal tone is positively correlated with children's social engagement, with teacher reports of social competence and expression of empathy towards others in distress. Higher vagal tone also appears to protect children who are exposed to marital discord and hostility from developing behavioral problems (Katz & Gottman, 1995). Porges (1993) has proposed that development of appropriate social behavior is dependent on the ability to regulate cardiac vagal tone, and cardiac vagal tone mirrors an individual's response and adaptivity to environmental challenges and demands, based on the observation that vagally mediated component of HRV reflects adaptivity (maladaptivity) to environmental challenges and indexes ability (inability) to modulate affect responses.

Physiological components of heart rate variability. Although cardiac automaticity is intrinsic to various pacemaker tissues, heart rate and rhythm are largely under the control of the autonomic nervous system. The parasympathetic influence on heart rate is mediated via release of acetylcholine by the vagus nerve. Muscarinic acetylcholine receptors respond to this release mostly by an increase in cell membrane K + conductance. Acetylcholine also inhibits the hyperpolarization-activated 'pacemaker' current. The sympathetic influence on heart rate is mediated by release of epinephrine and norepinephrine. Activation of adrenergic receptors results in cyclic AMP mediated phosphorilation of membrane proteins. The end result is an acceleration of the slow diastolic depolarization. Under resting conditions, vagal tone prevails and variations in heart period are largely dependent on vagal modulation. The vagal and sympathetic activity constantly interact. As the sinus node is rich in acetylcholinesterase, the effect of any vagal impulse is brief because the acetylcholine is rapidly hydrolyzed. Parasympathetic influences exceed sympathetic effects via two independent mechanisms: a cholinergically induced reduction of norepinephrine released in response to sympathetic activity, and a cholinergic attenuation of the response to a adrenergic stimulus (Thayer et al, 2012).

Many factors like age, level of physical activity, exercise, medications, sleep-wake cycle, respiratory activity, heart rate and posture influence the measurement of HRV. Power spectral analysis of HRV has been used extensively as a non-invasive tool to study the cardiac autonomic nervous system ever since Akselrod et al (2006) characterized the autonomic basis of the observed peaks in the heart rate power spectrum. Power spectral analysis of heart rate variability reveals three spectral components: the very low (VLF) (≤ 0.04 Hz), low (LF) (0.04-0.15 Hz) and high frequency (HF) components (0.15-0.4Hz). There is considerable evidence to suggest that the HF power is largely a function of parasympathetic influences to the heart. The LF power may not solely reflect sympathetic activity but is used, most often normalized for total power, as a representative index of sympathetic influences to the heart. The low frequency / high frequency (LF/HF) power ratio has been used by several investigators as a marker of sympathovagal balance although the use of this index has been debated in recent years.

Components of heart rate variability. The inter-beat (RR) interval variations present during resting conditions represent a fine tuning of the beat-to-beat control mechanisms. Vagal afferent stimulation leads to reflex excitation of vagal efferent activity and inhibition of sympathetic efferent activity. The opposite reflex effects are mediated by the stimulation of sympathetic afferent activity. Efferent vagal activity also appears to be under 'tonic' restraint by cardiac afferent sympathetic activity. Efferent sympathetic and vagal activities directed to the sinus node are characterized by discharge largely synchronous with each cardiac cycle which can be modulated by central (e.g. vasomotor and respiratory centers) and peripheral (e.g. oscillation in arterial pressure and respiratory movements) oscillators. These oscillators generate rhythmic fluctuations in efferent neural discharge which manifest as short and long-term oscillation in the heart period.

Analysis of these rhythms may permit inferences on the state and function of (a) the central oscillators, (b) the sympathetic and vagal efferent activity, (c) humoral factors, and (d) the sinus node. An understanding of the modulatory effects of neural mechanisms on the sinus node has been enhanced by spectral analysis of HRV. The efferent vagal activity is a major contributor to the HF component, as seen in clinical and experimental observations of autonomic maneuvers such as electrical vagal stimulation, muscarinic receptor blockade, and vagotomy (Cacioppo, Tassinary, & Berntson, 2000).

More controversial is the interpretation of the LF component which is considered by some as a marker of sympathetic modulation (especially when expressing it in normalized units) and by others as a parameter that includes both sympathetic and vagal influences. This discrepancy is due to the fact that in some conditions, associated with sympathetic excitation, a decrease in the absolute power of the LF component is observed. It is important to recall that during sympathetic activation the resulting tachycardia is usually accompanied by a marked reduction in total power, whereas the reverse occurs during vagal activation. When the spectral components are expressed in absolute units (ms2), the changes in total power influence LF and HF in the same direction and prevent the appreciation of the fractional distribution of the energy. This explains why in supine subjects under controlled respiration atropine reduces both LF and HF and why during exercise LF is markedly reduced.

Spectral analysis of 24-hour recordings shows that in normal subjects LF and HF expressed in normalized units exhibit a circadian pattern and reciprocal fluctuations, with higher values of LF in the daytime and of HF at night (Cacioppo, Tassinary, & Berntson, 2000). These patterns become undetectable when a single spectrum of the entire 24-h period is used or when spectra of subsequent shorter segments are averaged. In long-term recordings, the HF and LF components account for approximately 5% of total power. Although the ultra ow frequency (ULF) and VLF components account for the remaining 95% of total power, their physiological correlates are still unknown. LF and HF can increase under different conditions. An increased LF (expressed in normalized units) is observed during standing, mental stress and moderate exercise in healthy subjects, and during moderate hypotension, physical activity and occlusion of a coronary artery or common carotid arteries in conscious dogs. Conversely, an increase in HF is induced by controlled respiration, cold stimulation of the face and rotational stimuli.

Disagreement exists in respect to the LF component. Some studies suggest that LF, when expressed in normalized units, is a quantitative marker for sympathetic modulations, other studies view LF as reflecting both sympathetic and vagal activity. Consequently, the LF/HF ratio is considered by some investigators to mirror sympathovagal balance or to reflect sympathetic modulations. Physiological interpretation of lower frequency components of HRV (that is of the VLF and ULF components) warrants further elucidation. It is important to note that HRV measures fluctuations in autonomic inputs to the heart rather than the mean level of autonomic inputs. Thus both autonomic withdrawal and a saturatingly high level of sympathetic input leads to diminished HRV.

There are two main approaches to the analysis of HRV: time-domain and frequency-domain analysis. Time-domain indices (i.e., mean, standard deviation (SD), standard deviation of normal RR intervals (SDNN), standard deviation of averaged normal RR intervals (SDANN)) are derived from simple statistical calculations based on inter-beat intervals (RR intervals). These indices are sensitive to transients and trends in the sample of heartbeats, and as such provide estimates of overall and beat-to-beat variability (Karmakar et al, 2011). Frequency-domain analysis, which is based on the power spectral density of the heart rate time series, highlights the issue of the underlying rhythms of the mechanisms controlling heart rate (HR) and identified three major spectral peaks (high frequency (HF: 0.15-0.4 Hz), low frequency (LF: 0.04-0.15 Hz) and very low frequency (VLF: below 0.04 Hz)) in the adult HR spectrum.

Time domain methods. Variations in heart rate may be evaluated by a number of methods. Perhaps the simplest to perform are the time domain measures. With these methods either the heart rate at any point in time or the intervals between successive normal complexes are determined. In a continuous electrocardiographic (ECG) record, each QRS complex is detected (see *figure* 4), and the so-called normal-to-normal (NN) intervals (that is all intervals between adjacent QRS complexes resulting from sinus node depolarizations), or the instantaneous heart rate is determined. The QRS complex is a name for the combination of three of the graphical deflections seen on a typical ECG. It is usually the central and most visually obvious part of the tracing. It corresponds to the depolarization of the right and left ventricles of the human heart (see Figure). Simple time-domain variables that can be calculated include the mean NN interval, the mean heart rate, the difference between the longest and shortest NN interval, the difference between night and day heart rate, etc. Other time-domain measurements that can be used are variations in instantaneous heart rate secondary to respiration, tilt, *Valsalva maneuver*, or secondary to phenylephrine infusion. These differences can be described as either differences in heart rate or cycle length (Kleiger, Stein, Bosner, & Rottman, 1995)

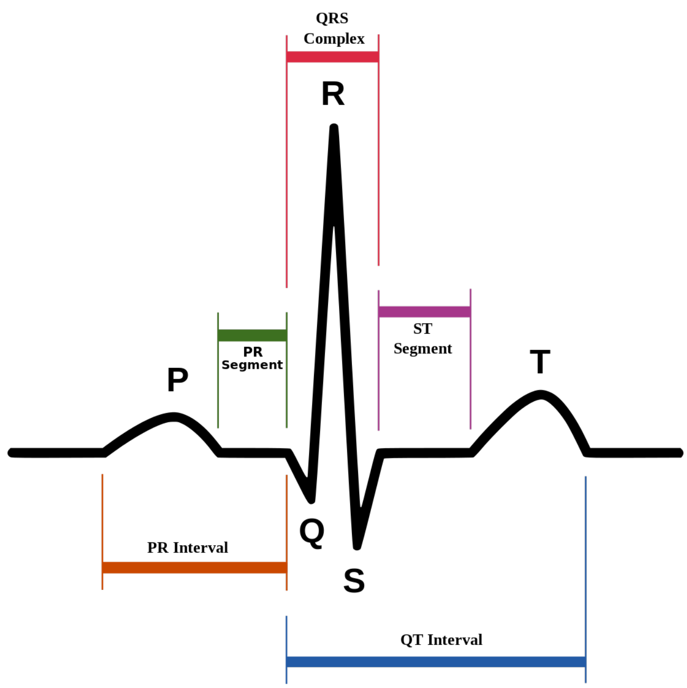

Figure 4. Schematic representation of a normal ECG, displaying position of the QRS Complex.

Statistical methods. From a series of instantaneous heart rates or cycle intervals, particularly those recorded over longer periods, traditionally 24h, more complex statistical time-domain measures can be calculated. These may be divided into two classes, (a) those derived from direct measurements of the NN intervals or instantaneous heart rate, and (b) those derived from the differences between NN intervals. These variables may be derived from analysis of the total electrocardiographic recording or may be calculated using smaller segments of the recording period. The latter method allows comparison of HRV to be made during varying activities, e.g. rest, sleep, etc.

SDNN: Standard deviation of the NN interval. The simplest variable to calculate is the standard deviation of the NN interval (SDNN), i.e. the square root of variance. Since variance is mathematically equal to total power of spectral analysis, SDNN reflects all the cyclic components responsible for variability in the period of recording. In many studies, SDNN is calculated over a 24-h period and thus encompasses both short-term high frequency variations, as well as the lowest frequency components seen in a 24-h period (Kleiger, Stein, Bosner, & Rottman, 1995). As the period of monitoring decreases, SDNN estimates shorter and shorter cycle lengths. It should also be noted that the total variance of HRV increases with the length of analyzed recording. Thus, on arbitrarily selected ECGs, SDNN is not a well-defined statistical quantity because of its dependence on the length of recording period. Thus, in practice, it is inappropriate to compare SDNN measures obtained from recordings of different durations. However, durations of the recordings used to determine SDNN values (and similarly other HRV measures) should be standardized. Hence, either short-term 5-min recordings or nominal 24 h long-term recordings seem to be appropriate options.

RMSSD: Root mean square differences of successive RR interval differences. Root Mean Square of the Successive Differences (RMSSD) is one of a few time-domain tools used to assess heart rate variability, the successive differences being neighboring RR intervals. This measurement of short-term variation estimate high frequency variations in heart rate and thus are highly correlated.

Poincaré Plots SD1 & SD2. A poincaré plot is one of the popular time domain HRV analysis techniques which is used both for short term (i.e. 5 to 30 minutes) or long term (ie. 24

hours) analyses. A poincaré plot is a visual presentation of time series signal to recognize the hidden patterns. It is also a quantitative technique in the sense that it has various parameters (e.g.: short-term variability (SD1) and long-term variability (SD2)) to quantify the information from the plot. The Poincaré plot of HRV signal is constructed by plotting consecutive points of RR interval time series (i.e., lag-1 plot). It is a representation of HRV signal on phase space or Cartesian plane (Liebovitch & Scheurle, 2000), which is commonly used to asses the dynamics of the HRV (Tulppo, et al 1996, Tulppo, et al, 1998, Toichi et al, 1997) signal, describe the sympathetic and parasympathetic modulation of heart rate (Brennan, Palaniswami, & Kamen, 2002).

Final considerations for time domain values. Since many of the measures correlate closely with others, the following four are recommended for time-domain HRV assessment: SDNN (estimate of overall HRV); HRV triangular index (estimate of overall HRV); SDANN (estimate of long-term components of HRV; NN is used in place of RR to emphasize the fact that the processed beats are "normal" beats), and RMSSD (estimate of short-term components of HRV). Having two estimates of the overall HRV are recommended because the HRV triangular index permits only casual pre-processing of the ECG signal. The RMSSD method is preferred to pNN50 and NN50 because it has better statistical properties (NN50 is the number of pairs of successive NNs that differ by more than 50 ms, while pNN50 is the proportion of NN50 divided by total number of NNs). The methods expressing overall HRV and its long- and short-term components cannot replace each other (Kleiger, Stein, Bosner, & Rottman, 1995). The method selected should correspond to the aim of each study. Finally, a distinction should be made between measures derived from direct measurements of NN intervals or instantaneous heart rate, and from the differences between NN intervals. It is inappropriate to compare time-domain measures, especially those expressing overall HRV, obtained from recordings of different durations.

Frequency domain methods. Various spectral methods for the analysis of the tachogram have been applied since the late 1960s. Power spectral density (PSD) analysis provides the basic information of how power (i.e. variance) distributes as a function of frequency. Independent of the method employed, only an estimate of the true PSD of the signals can be obtained by proper mathematical algorithms. Methods for the calculation of PSD may be generally classified as non-parametric and parametric. In most instances, both methods provide comparable results. The advantages of the non-parametric methods are: (a) the simplicity of the algorithm employed (Fast Fourier Transform, or FFT, in most of the cases) and (b) the high processing speed, while the advantages of parametric methods are: (a) smoother spectral components which can be distinguished independently of preselected frequency bands, (b) easy post-processing of the spectrum with an automatic calculation of low and high frequency power components and easy identification of the central frequency of each component, and (c) an accurate estimation of PSD even on a small number of samples on which the signal is supposed to maintain stationarity. The basic disadvantage of parametric methods is the need to verify the suitability of the chosen model and its complexity (i.e. the order of the model) (Cacioppo, Tassinary, & Berntson, 2000).

Spectral components: Short-term recordings. Three main spectral components are distinguished in a spectrum calculated from short-term recordings of 2 to 5 min: very low frequency (VLF), low frequency (LF), and high frequency (HF) components. The distribution of the power and the central frequency of LF and HF are not fixed but may vary in relation to changes in autonomic modulations of the heart period. The physiological explanation of the VLF component is much less defined and the existence of a specific physiological process attributable to these heart period changes might even be questioned. The non-harmonic component which does not have coherent properties and which is affected by algorithms of baseline or trend removal is commonly accepted as a major constituent of VLF. Thus, VLF assessed from short-term recordings (e.g. < 5 min) is a dubious measure and should be avoided when interpreting the power spectral density of short-term ECGs. Measurement of VLF, LF and HF power components is usually made in absolute values of power (ms2), but LF and HF may also be measured in normalized units (n.u.), which represent the relative value of each power component in proportion to the total power minus the VLF component. The representation of LF and HF in n.u. emphasizes the controlled and balanced behavior of the two branches of the autonomic nervous system. Moreover, normalization tends to minimize the effect on the values of LF and HF components of the changes in total power. (Cacioppo, Tassinary, & Berntson, 2000). Nevertheless, n.u. should always be quoted with absolute values of LF and HF power in order to describe in total the distribution of power in spectral components.

Spectral components: Long-term recordings. Spectral analysis may also be used to analyze the sequence of NN intervals in the entire 24-hour period. The result then includes an ultra-low frequency component (ULF), in addition to VLF, LF and HF components. The slope of the 24-h spectrum can also be assessed on a log-log scale by linear fitting the spectral values. Since the data in this project does not include long-term recordings, ULF does not apply. The problem of 'stationarity' is frequently discussed with long-term recordings. If mechanisms responsible for heart period modulations of a certain frequency remain unchanged during the whole period of recording, the corresponding frequency component of HRV may be used as a measure of these modulations. If the modulations are not stable, interpretation of the results of frequency analysis is less well defined. In particular, physiological mechanisms of heart period modulations responsible for LF and HF power components cannot be considered stationary during the 24-h period. Thus, spectral analysis performed in the entire 24-h period as well as spectral results obtained from shorter segments (e.g. 5 min) averaged over the entire 24-h period (the LF and HF results of these two computations are not different) provide averages of the modulations attributable to the LF and HF. Such averages obscure detailed information about autonomic modulation of RR intervals available in shorter recordings. It should be remembered that the components of HRV provide measurements of the degree of autonomic modulations rather than of the level of autonomic tone and averages of modulations do not represent an averaged level of tone.

Chapter 3: Research Methods

This section describes what equipment was used for recording and collection of data, research design, procedures used in all stages of data collection, a description of participants with their demographic distribution, and a brief overview of the psychological scales used in this particular project.

Equipment Used for Psychophysiological Data Collection

In order to collect physiological data during conversation of dyads and groups of 3 participants, minimally invasive measuring instruments were carefully considered. Ideally, the chosen equipment would yield high quality data, while allowing free and natural movement of study participants. This concern is based on the fact that most laboratory set ups for physiological data collection use wired electrodes that restrain the movement of participants being recorded. Another constraint is that psychophysiology lab set ups typically accommodate only one person at a time. Since this research aimed at monitoring heart rate and skin conductance of 2 to 3 people engaged in a conversation task simultaneously, the required lab set up had to consist of 3 sets of wireless pairs of transmitters and receivers. For example, the Polar RS-800-CX heart monitor, which is made for endurance training research in various sports, provides sufficiently reliable data, sampled at 1 millisecond intervals. However, this heart monitor only records heart rate. Since skin conductance is good measure of sympathetic activation and serves as a control of emotional regulation during the conversation activity, other research-specific physiological monitor manufacturers were considered.

Among those, Biopac Systems, a company that specializes in the recording of physiological data in lab settings for research and educational purposes, had recently launched the Bionomadix system, which uses a completely wireless set of physiological transmitters and receivers. When the electrodes are well placed, they allow for participants' freer movement with minimized noise and artifacts. This makes the Bionomadix system equipment widely used in movement and sport studies. But another striking difference between the Polar and the Biopac instruments is that Biopac has transmitters capable of reading, decoding, and transmitting data to paired receivers, ranging from respiration, muscle contrition, and eye tracking, to electroencephalography (EEG), electromyography (EMG), electrodermal activity (EDA, also known as 'skin conductance', abbreviated in this paper as "SC"), and electrocardiogram (ECG). Finally, it was a welcomed convenience that the University of California Los Angeles campus has a Psychophysiology Lab, whose facilities had been made available to this study. More importantly, this lab already had the main and most expensive component of the Biopic setup, namely the Biopac MP100 Data Acquisition System, a device that enables the communication of data between the transmitters-receivers and the computer.

Research Design

The project as a whole consisted of 2 different consecutive studies. The first one comprised tracking heart rate (HR) of dyads of non-native speakers during a conversation task, while the second one involved tracking electrodermal activity (EDA) and HR of a group of 3 English native speakers carrying out the same conversation task.

Study 1 (Pilot): Non-native speakers, using the Polar heart rate monitor RS800CX".

This study consisted of a video-recorded session with 2 volunteers at an office space in Rolfe Hall at the University of California Los Angeles. For this stage, two participants engaged in a conversation guided by a prompt question, while their HR is recorded with Polar RS800CX Heart Monitors. This heart monitor includes a watch which participants wear on their wrists and a chest band that they wear on their chests, under their clothes. The chest band reads participants' HR, and transmits data to the watch, which watch records it. The data are downloaded from the wristwatch to a computer through an infrared USB reader after each session. Study 1 was originally meant as a stand-alone project; however, with the design and development of the second study (Study 2, below), the first study became the pilot of the second study, and the data collected in the first stage were excluded from all final analyses. The reason behind this decision was that there were very relevant differences between the two studies in terms of design and procedures, as well as levels of anxiety derived from use of second language versus first language, or from the fact that participants varied in terms of familiarity with each other.

Study 2: Native speakers, using the Biopac Bionomadix System. The second part of the study took place at the Semel Institute for Neuroscience and Human Behavior at the University of California Los Angeles. This study involved three participants wearing the Biopac Bionomadix transmitters that sent readings to receivers wirelessly. These receivers communicate with a main interface and transcoder, which sends data to a computer attached to it. Each data reader is a transmitter that communicates with a specifically paired receiver. All the receivers are attached to the lab's Biopac MP100 system. Data are read online by Acqknowledge 3.9.1 software. This system collects participants' ECG and EDA online and simultaneously. The Bionomadix wireless system involves wearing a wrist module and electrodes attached to the right index and middle fingers for EDA, and a chest module with 3 electrodes on the chest, one of which is grounded, and two are placed on the participant's chest, being one electrode on each side of the heart. The prompt for the conversation activity for this project was "Talk about your favorite places in Los Angeles and decide together which one place you would recommend to out of town family members and friends."

The reason why the English nativeness of participants changed from the first group to the second was based on the fact that there have been no studies published about psychophysiological changes during conversation carried out by non-native speakers of a language. This poses the problem of not having a good control group of first language users with which the group of non-native speakers could be compared. This lack of information on usual correlations between conversational behavior and physiological changes would make it impossible to tell if there are any significant differences between these 2 groups, and given that there are studies on psychological factors influencing second-language speakers' willingness to communicate, it is safe to assume that non-native speakers' communicative behavior would entail higher degrees of anxiety and stress.

Finally, the data compiling and analyses sections presented in this dissertation focus on the data collected in Study 2. A total of 28 groups were recorded, out of which 4 groups were discarded and 24 groups were used. Out of these four discarded groups, two groups contained participants who knew each other, and two groups lacked a third participant, who was a no show on the day of the conversation task. Groups 1 and 15, which consisted of participants who knew each other, can be used in an exploratory manner in future studies, to investigate potential differences between social engagement behaviors among participants who know each other versus those who do not. Groups 12 and 22, which lacked a third participant, can be used in later studies to investigate potential differences in dynamics of social engagement behaviors between groups with 2 and 3 participants.

Procedures

In this section I describe the ways in which data were collected and were processed in order to be systematically analyzed. The data set consists of 28 groups, out of which 25 groups were used for a final analysis, and these groups were formed in various combinations of females and males (all females, all males, 1 female with 2 males, 2 females with 1 male). The dataset includes demographic information about participants, surveys of psychological traits and states, resting, reading and question-and-answer baselines, group resting baselines, the conversation task carried out by all groups, all of which were video-recorded.

Participants came to the lab twice. Each visit lasted 90 minutes. In the first visit, participants read and signed the consent form, then they were asked to answer a demographics survey and psychological questionnaires on SurveyGizmo.com. After they finished the surveys, ECG electrodes were placed on the chest, and EDA electrodes were placed on their right index and middle fingers, so that their physiological responses could be recorded during three baseline procedures.

When this part was finished, they were thanked for their participation on the first part of the study and left. In the second visit, once all three participants arrived at the lab, they were introduced to each other, and ECG and EDA electrodes were placed again on their chest and fingers, one participant and a time. When the electrodes, leads, and transmitters were all set up, tested and readjusted if necessary, the group resting baseline started, which lasted 10 minutes. This baseline task was followed by the conversation task, which lasted on average 15 minutes. When the time was up, participants were told they could stop the task, all the electrodes were removed, and participants were asked to fill out the exit surveys, followed by a debriefing session. More details about these procedures are below.

Recording location. The location where the sessions took place was a psychophysiology lab at the Semel Institute for Neuroscience and Human Behavior, at the University of California Los Angeles. This lab contains 2 rooms, one where the study coordinator and research assistants stay and monitor the progress of physiological recordings on the lab computers, and another room that is kept at a constant temperature, sound proofed, equipped with cameras and recording electrodes, transmitters and receivers.

Questionnaires. The first questionnaire participants were asked to answer was a quick demographics survey, which asked about their gender, age, educational background, and other standard questions that were relevant to this research. This survey was immediately followed by psychological surveys of trait characteristics related to emotions specifically relevant to this study. Participants filled out the surveys on the lab computers, through an online survey website called SurveyGizmo.com. The surveys used in this study were: Behavioral Inhibition/Behavioral

Activation Scale (BIS/BAS), Cognitive Disinhibition Scale (CDS), Personal Report of Communication Apprehension (PRCA-24), Social Interaction Anxiety Scale (SIAS), Loneliness Scale (LS), Positive and Negative Affect Scale (PANAS-X), Anxiety Scale (STAI), and Anger Scale (STAXI). These surveys inquired about participants' current emotional states (the 'state' questions), while other parts of them were meant to tap into their regular emotional regulation (e.g., questions about 'trait' characteristics). The sections of these surveys that ask about the subjects' personality traits were used on the first lab visit, whereas the parts that asked about participants' psychological state and group social behavior were used on the second lab visit. Participants were asked to fill out the exit survey immediately after the conversation task, on the second lab visit. The exit survey contained open-ended questions about how participants felt during the study, and invited them to leave comments and suggestions.

Baselines. Each person has a unique capacity to regulate their own social engagement behaviors and emotional responsivity. To make sure that we could more reliably interpret variations in participants' heart rate and skin conductance during the main conversation task, it was important to record baselines tasks for all participants. On the first visit, participants carried out the following baseline tasks: *resting*, *reading*, and *question-and-answer*. On the second session, they provided *group resting* baselines before they performed the conversation task.

Resting baseline. The first baseline task, the individual *resting* baseline, involved having participants sitting alone in a room, on a comfortable ambulatory armchair, and in a relaxed position for 10 minutes. This time is considered enough for participants to reach a relaxed state. They were told to try to relax and refrain from moving excessively, from checking their phones, from crossing their legs, and falling asleep.

Reading baseline. The second baseline task, the *reading* baseline, involved participants reading out loud a 2-page article from the New York Times on the topic of conversation.

Participants were asked to read at their normal pace, pitch, and rhythm, and they were told that they did not have a set time to read it, nor did they have to read all the text, meaning that they did not need to hurry through the reading. In normal speed, it was estimated that it would take about 6-7 minutes to read the entire article. The data obtained in this task were used to analyze the participant's regular pitch, intonation, voice projection and intensity, among other phonological features.

Question-and-answer baseline. The third baseline done on the first lab visit was the *question-and-answer* one, which aimed at verifying changes in heart rate and skin conductance due to the presence of a second person in the room; the mere presence of a second person (the interviewer) in the room is expected to alter the participant's physiological readings. Another goal was to have a measure of the timing of processing a question and formulating an answer, from easier questions like the participants' names and birthplaces, to open ended questions about how they feel about confrontations and taboo topics. The effort made to speak to another individual is also expected to alter physiological activity.

Group resting baseline. On the second lab visit, participants provided *group resting* baselines right before the actual conversation task, and this one lasted 10 minutes. They were asked to sit quietly on chairs in the same room they were going to carry out the conversation task, but not in a face-to-face formation. They were told to try to relax, close their eyes if it made them feel more comfortable to do so, and to avoid engaging with each other, refraining from talking, crossing their legs, checking their phones, standing up, and making eye contact. Due to the fact that all participants were aware of the presence of the 2 other people in the room with them, and that these were people they hadn't met before, it was highly likely that their group resting physiological readings would show increased arousal compared to their individual resting physiological baselines.

All in all, these four baselines taken during the first lab session should allow the identification of individual characteristics in the regulation of normal heart rate and skin conductance measures from actual responses to the external environment and interaction.

Seating arrangement. Participants were sat in a semi circle. Participant 1 sat on the left, participant 2 sat in the middle, and participant 3 sat on the right. They were assigned seats based on their numbers (#1, 2, or 3) so they were not allowed to sit where they wanted, and they were not allowed to move the chairs or change their positions.

Camera placement. Two cameras were placed in the room, in order to capture different angles based on seating arrangements and tasks. One camera was placed off-center, to the left of the front of the semicircle participant arrangement, while the other camera was place off-center, to the right (see *figure* 5).

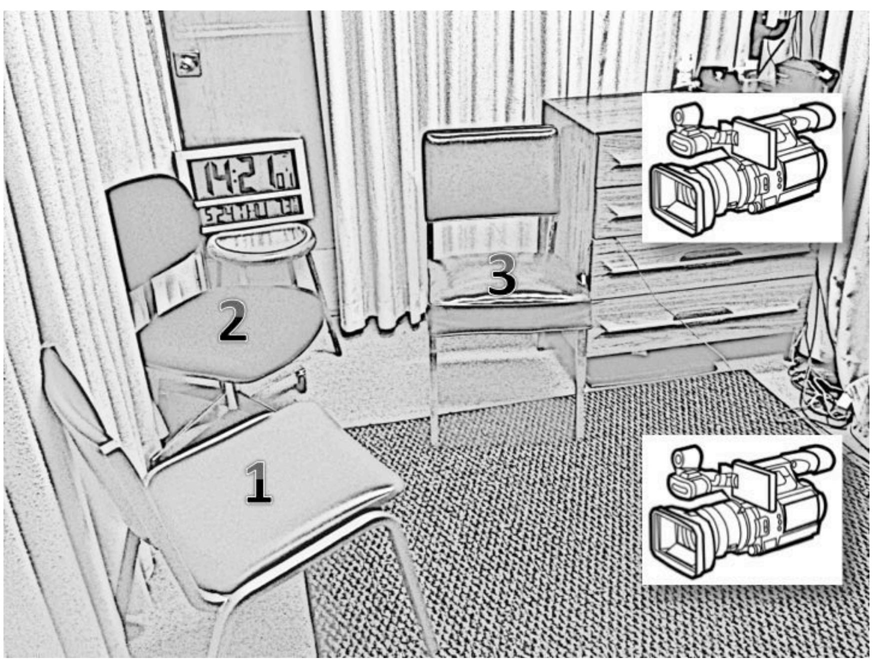

Figure 5. Placement of chairs and cameras in the psychophysiology lab for the conversation task.

Video and audio. Video recording was made by the placing of 1 or 2 cameras, depending on the task. During baselines only one camera was used, placed where we could see the participant, a LED light that indicated the start of the physiological recordings, and the door, so that it was possible to see when the study coordinator left the room or re-entered the room for each of the tasks. During the conversation task, two cameras were placed in different angles in order to capture all participants' faces, along with the led light attached to the Biopac main recording module. Both cameras had additional external microphones. The first camcorder was a High Definition Canon Vixia HF M40 camcorder, with a Canon WD-H43 Wide Angle Converter Lens. Attached to it was an Audio Technica ATR 6550 Condenser Shotgun microphone. The second camera was a Go Pro Hero 3 Silver Edition. Attached to this camera was a Polar Pro C1005 external microphone. The first camera recorded in the Canon native MTS video compressing format, while the Go Pro camera recorded in MP4. Both files were later converted to MOV in order to be compatible with the video coding and transcribing software InqScribe, as well as video players such as Quicktime Pro, and also to be in 30 frames per second format, which allowed for the later synchronization in Final Cut Pro. The synchronized visualization of both videos was done in both Final Cut Pro X and in ChronoViz 2.0.2, and precision of the synchronization was ensured through a visually accessible atomic clock. All videos were labeled, coded, dated and time-stamped in order to facilitate the syncing of audio-visual data with the separately collected physiological data, frame-by-frame.

Synchronizing data. ChronoViz was used to facilitate the visualization of heart rate and skin conductance for each of the participants of a group, and the syncing of audio and video. This software allows the visualization of the video along tiers for an audio wave file, for captions, and for various data displays synced along the same timeline, as well as transcription of their discourse. Therefore, this software created online visualization of data for all participants. This was possible because the data collected by the Polar monitors is downloaded to a software called Polar ProTrainer, which then allowed the export as comma separated values (CSV) files.

These files were opened in Excel, labeled, and visualized in ChronoViz. The advantage of using this software was the ability to import not only the CSV files data but also movie (MOV) video files, syncing all data through a common relative or absolute timeline. However, the Biopac study recorded data in Acknowledge 3.8 (files saved as ACQ files), with very high precision and rate (sampling at 1ms). The large volume of final data was extracted with Matlab, which is a superior and more robust engineering software. A code was written specifically for our needs. This was an efficient system that enabled the syncing of MOV and ACQ files with very good precision.

Data handling. After debriefing and thanking participants for helping with the project, all data files were saved and backed up, including the video and audio recordings, and the physiological data files, which were dated, labeled, and backed up to a password protected computer at the lab and on two password protected external hard drives. These data were later exported through Matlab to an Excel compatible format, which could be displayed in ChronoViz. It was then bookmarked, coded, and transcribed in InqScribe. The data exported through Matlab into Excel files allowed the visualization of the physiological recordings, making it easily manipulated. The Matlab code created for this project created 22 different Excel files for each group of participants, half of the data exported with heart rate data by beats and the other half with heart rate by seconds. Beat-by-beat data was required for the exapolation of HRV. Each group therefore had 2 files for the resting baseline (1 by beats, 1 by seconds), containing 3 different tabs, being one tab for each participant; 2 Excel files for the conversation task (1 by beats, 1 by seconds) also containing 3 different tabs, being one tab for each participant; and 6 files for each of the participants, with their individual resting, reading, question-and-answer baselines, both by beats and by seconds. Once it had been established what segments to look at, equivalent data were extracted from the Excel sheets, including 10 seconds lag before and after the segment to be analyzed; it was then plotted and visualized in ChronoViz for later multimodal analyses.

Physiological data processing. Raw heart rate data were extracted as an excel file from Acqknowledge (version 3.9, Biopac Systems, Inc.) using MATLAB (R2012a, Natick, Massachusetts, U.S.A) and imported into Kubios (version 2.1, 2012, Biosignal Analysis and Medical Imaging Group, University of Kuopio, Finland). All 5 and 10 minute resting, reading and question-and-answer samples were initially processed to remove potential artifacts. Artifact removal was confirmed via visual inspection after processing. Kubios was then used to calculate time, frequency, and non-linear HRV measures. Inter-beat intervals were calculated and transformed into beats per minute for mean heart rate. The two time-domain measures calculated using inter-beat intervals included the standard deviation of all RR intervals (SDNN) and the square root of the mean-squared differences between successive RR intervals (RMSSD). The frequency domain measures were calculated as absolute powers of the power spectrum density in the high frequency (HF; 0.15–0.4 Hz) and low frequency (LF; 0.04–0.15 Hz) bands using the Fast Fourier transform. The HF component of the power spectrum reflects parasympathetic activity, and the LF component reflects a mixture of vagal and sympathetic activity (Thayer et. al., 2012).

Coding. After the videos were watched several times, the areas coded were identified and bookmarked in InqScribe. Areas that were bookmarked and coded were further examined in order to be categorized systematically and explored for correlations between physiological data and conversational behaviors. Also through the use of this software, some of these segments were transcribed in order to allow for a microanalysis of the talk among participants. Segments that were located and coded for later analysis were *turn-taking*, *silences, pauses*, *disagreements*, and *word searches*.

For example, *disagreements* were coded in the following manner: every time there was a disagreement in the video-recorded group conversation, the video was marked twice using timestamps in InqScribe: the first timestamp marked the beginning of the turn in which the disagreement occurred, and a second timestamp marked the end of the disagreeing action. The initial time of each recording starts counting from 0:00:00 (hour:minute:frame), being the last 2 digits the frame in which the video was paused. The videos were recorded in 30 frames per second, thus each second contained 30 images, or 30 possible places to stop the video in order to analyze the visual behavior, or to catch the exact beginning or end of an action. In the lab sessions, a big atomic clock was placed within camera range to serve as a real-time reference to sync both the video and the data captured by the lab computers, during post-processing. This helped sync the coded behavior and the physiological data in the exported Excel sheets. However, it was vital to consider three additional factors: (1) because of the well-known lag of reaction of skin conductance and how it can be based on individual differences of autonomic regulation, it was necessary to look at 10 seconds before and 10 seconds after the labeled interaction; (2) the nature of the action was to be taken into account. Because disagreements are responses to a prior turn, the prior turn should be located and included in the observed segment so that we could understand its sequential organization; (3) the physiological responses of all three participants during the conversation were worthy of examination, since it is important to verify the physiological readings in the original proponent of the disagreeable turn, the actual responder/disagreer, and the 3rd interactant in the room, who could be neutral or decide to align with one of the other participant and therefore take a side. Overall, all the other codes were treated in a similar fashion, in the process of identification of areas of interest and extraction, so that appropriate segments of skin conductance and heart rate could be extracted from the Excel files, and synced with the video segments of interest.

Statistical analyses. Analyses were conducted in SPSS (version 22, International Business Machines Corporation) with significance set at $p<.05$. All correlational analyses were conducted with Pearson correlations, two-tailed. The correlation coefficient was interpreted as $r = .5$ large, r

= .3 medium, and r = .10 small. Single Pearson Correlations were used to compare all psychological constructs to coded behavior and physiological data. Tests were conducted to ensure that underlying assumptions for between-group analyses were not violated. Therefore, the Pearson Assumption was satisfied by running a descriptives test on the entire dataset, in order to test for normal distribution, looking at Kurtosis and Skewness.

Before testing for normal distribution, all values were changed into Standard Scores, or Z-scores, so that all data are comparable. In order to determine which data are stronger predictors of observed behavior, regression analyses were done for each of the following behaviors: turn-taking, silences, pauses, disagreements, and word searches. Another purpose of using regression analysis on such behaviors is that once the regression formulas have been established, the studied behaviors can be predicted.

Regression analysis. Regression analysis is a statistical technique for studying linear relationships. It begins by supposing a general form for the relationship, known as the regression model:

$$Y = \alpha + \beta_1 X_1 + ... + \beta_k X_k + \varepsilon$$

Y is the dependent variable, representing a quantity that varies from individual to individual throughout the population, and is the primary focus of interest. $X_1,..., X_k$ are the explanatory variables (the so-called "independent variables"), which also vary from one individual to the next, and are thought to be related to Y. Finally, ε is the residual term, which represents the composite effect of all other types of individual differences not explicitly identified in the model. Beside the model, the other input into a regression analysis is some relevant sample data, consisting of the observed values of the dependent and explanatory variables for a sample of members of the population. The primary result of a regression analysis is a set of estimates of the regression coefficients α, $\beta_1,\ldots,\beta_k$. These estimates are made by finding values for the coefficients that make the average residual 0, and the standard deviation of the residual term as small as possible. The result is summarized in the prediction equation:

$$Y_{pred} = a + b_1X_1 + \ldots + b_kX_k$$

At the end of each data chapter table and figures display the assumptions and results of the linear regression analyses. These tables and figures displayed below are evidence that these data allow the use of a regression model. If the data were not appropriate, we would not be able to run regression analysis. The depending variables chosen for regression analyses were: turn-taking, silences, pauses, disagreements, and word searches. For each of these target behaviors, independent variables were selected based on their correlation to the dependent variable, and lack of correlation to each other.

Participants

In both studies, volunteers were eligible to participate if they were between ages 18 and 60, right handed, could communicate in English, if they were not pregnant or breast feeding, and had no illness or condition that in the judgment of the staff made them unsuitable for inclusion. Psychological disorders and medication that affect heart rate also disqualified a prospective candidate. Lastly, participants were asked to refrain from caffeinated drinks for at least 2 hours prior to a lab session.

Study 1 (Pilot): Non-native speakers, using the Polar heart rate monitor RS800CX.

In this study, participants' ages ranged from 23 to 49. They consisted of 2 males and 8 females. Five of the dyads have a 1-male-1-female pairing, and the remaining three dyads have 2 females each. Participants were volunteers and therefore did not receive any incentives to participate in the study. They were graduate students at the University of California Los Angeles. The sessions were run in the afternoon between 2 and 6pm. They shared a common discussion prompt, which was meant to be a somewhat ordinary topic that would not elicit strong emotional responses. The conversation prompt required that they discuss what places in Los Angeles they would recommend to out of town family members and friends. These participants were non-native speakers of English.

Study 2: Native speakers using the Biopac Bionomadix System. In this study, participants' ages ranged from 18 to 30, excluding one outlier who was 60 years old. They consisted of 28 males and 49 females, and most of these participants were undergraduate students at the University of California Los Angeles. They did not know each other, which was a prerequisite to ensure consistent levels of stress derived from interacting with other participants. The location of the lab sessions for this study was an on-campus building, the *Semel Institute for Neuroscience and Human Behavior*. One of the main challenges in creating equal numbers of groupings of 3 participants of all possible gender combinations -- that is, 1 female and 2 males, 1 male and 2 females, 3 females, and 3 males -- was coordinating the availability of these participants. Hence, the distribution was not uniform, and there was a total of ten groups of all females, six groups of all males, eight groups of 1 male and 2 females, and four groups of 2 males and 1 female.

Demographic Distribution of Study Participants

All the data described in this section refer to Study 2, since Study 1 was treated as a Pilot and contained qualitative differences in terms of its design and procedures. In the second study, the total number of participants who came to the first lab session was 108, but only 78 participated in the second lab visit, which was the one in which participants had to perform a conversation task. So only these 78 participants were grouped and finished all the lab sessions, becoming part of the final dataset for this project. These participants were both men and women, mostly undergrads at the University of California, Los Angeles. Others were participants from the neighboring community who saw a flyer about this study and called in to participate. This section describes the demographic distribution of the participants in this study, and it is displayed by gender, age, educational background, race, employment status, psychiatric disorders, smoking habits, coffee intake, pregnancy, and menstrual cycle.

Gender. The dataset consisted of 61% females, and 39% males.

Age. As can be observed in *table* 1, participants' ages ranged from 18 to 39 years old.

Table 1

Percentage distribution of participants by age

Age	17 or younger	18-20 years old	21-29 years old	30-39 years old	40-49 years old	50-59 years old	60 or older
Distribution	0%	45%	49%	5%	0%	0%	1%

As can be observed in *table* 1 above, 45% of participants were between the ages of 18 and 20, 49% participants were between the ages of 21 and 29, 5% were between 30 and 39 years of age, and 1 participant was over the age of 60. There were no participants between the ages of 40 and 59.

Table 2

Age distribution by gender

Age	17 or younger	18-20	21-29	30-39	40-49	50-59	60 or older
Male	2	17	18	3	0	0	1
Female	0	28	31	2	0	0	0
Total	2	45	49	5	0	0	1

Within the 18-20 age range, 17 participants were male and 28 were female; within the age range of 21-29, 18 participants were male and 31 female; within the age range of 30-39, 3 participants were male, and 2 participants were female. The outlier in this category who was above the age of 60 was a male (see *table* 2).

Educational background. The distribution of participants' educational background reveals that 25 participants had at least high school or the equivalent, 49 participants had some college but no degree, 10 had an associate degree, 14 had a bachelor's degree, and 2 had a graduate degree (see *table* 3).

Table 3

Distribution of participants' educational background, also broken down by gender

Educational Background	Less than high school degree	High school degree or equivalent	Some college but no degree	Associate degree	Bachelor degree	Graduate degree
Yes	0	10	17	5	6	1
No	0	15	32	5	8	1
Total	0	25	49	10	14	2

Ethnicity. The distribution of ethnicity was the following: 27 of participants were white, 3 were African-American, 1 was Native Hawaiian, 41 was Asian descent, 14 was Hispanic descent, 13 was from multiple races, and 1 was from some other race (Iranian). *Table* 4 shows the race distribution in this dataset:

Table 4

Distribution of participants' ethnicity, broken down by gender

Ethnicity Distribution	White	Black or African-American	American Indian or Alaskan Native	Native Hawaiian or other Pacific Islander	Asian descent	Hispanic descent	From multiple races	Some other ethnicity (please specify)
Male	12	1	0	0	15	3	8	0
Female	15	2	0	1	26	11	5	1 (Iranian)
Total	27	3	0	1	41	14	13	1 (Iranian)

Employment status. The table below shows that in this study, 47 the participants were employed at the time, working from 1 to 38 hours a week, and 1 was employed working over 40 hours a week. Additionally, 20 of the participants were not employed and were looking for work, while 32 of them were not employed nor were they looking for work. None of the participants reported to be retired, disabled, and not able to work (see *table* 5).

Table 5

Distribution of participants' employment status, also broken down by gender

Employment Status	Employed, working 1-39 hours per week	Employed, working 40 or more hours per week	Not employed, looking for work	Not employed, NOT looking for work	Retired	Disabled, not able to work
Male	17	0	6	16	0	0
Female	30	1	14	16	0	0
Total	47	1	20	32	0	0

Psychiatric disorders. Although participants were screened and did not deem eligible to participate in the study if they had a history of psychiatric disorders, 2 participants said that they had been previously diagnosed with depression, bipolar disorder, bulimia/ anorexia, or some other psychiatric disorder. When questioned during the first lab session, they expressed the belief that they had been "cured" and that the diagnosis no longer applied to their current psychological health. As a precaution, however, those participants were not invited back to the second stage of the study, in which they would interact with other participants in a group conversation (see *table* 6).

Table 6

Distribution of participants' psychiatric disorders, also broken down by gender

Psychiatric Disorders	Yes	No
Male	1	38
Female	1	60
Total	2	98

Smoking habits. Although candidates who had the habit of smoking were also supposedly screened out, 3 out of 100 participants said that they smoked on a regular basis. When questioned during the first interview, one of them said that he smoked electronic cigarettes; the other 2 said they smoked too few cigarettes a week to think it would matter. As a precaution, they were not invited back to the second lab session (see *table* 7).

Table 7

Distribution of participants' smoking habits, also broken down by gender

Smoking Habits	Yes	No
Male	3	36
Female	0	61
Total	3	97

Coffee intake. Because coffee is well known to have an effect on heart rate, all participants were asked to abstain from drinking coffee at least 2 hours prior to coming to their lab appointments. Nonetheless, as a measure of control, they were asked about their coffee drinking habits. Out of 100 participants, 3 said they drank coffee twice a day, 14 said they drank it once a day, 20 said they drank coffee only a couple of times a week, 18% said they drank coffee once a week, while 21 said they drank coffee less than once a month. Finally, 24 participants said they had never drunk coffee (see *table* 8).

Table 8

Distribution of participants' coffee intake, also broken down by gender

Coffee Intake	Yes, at least twice a day	Yes, once a day	Yes, but only a couple of times during the week	Yes, once a week	Yes, but less than once a month	No
Male	2	3	5	8	8	13
Feale	1	11	15	10	13	11
Total	3	14	20	18	21	24

Pregnancy. Screening ensured that none of the female participants were pregnant, for if they were, they would not be eligible to partake in the study. Consistently, nobody indicated in the initial demographics survey that they were pregnant at the time.

Menstrual cycle. Because a woman's menstrual cycle has a direct effect on her behavior and heart rate, we asked participants to tell us when they last had their menstrual cycle. Keeping in mind that 60% of the participants were female, 14% said they had their last cycle less than a week prior, while 4% said they had it the week before, 10% said they had their last cycle between 1-2 weeks before, 12% said it had taken place 2-3 weeks before, 16% had it 3-4 weeks before, and 4% had their last menstrual cycle over 4 weeks prior to that first lab meeting. *Table* 9 illustrates the distribution:

Table 9

Distribution of participants' menstrual cycle

Menstrual Cycle	Less than a week ago	A week ago	Between 1-2 weeks ago	Between 2-3 weeks ago	Between 3-4 weeks ago	Over 4 weeks ago	Other
	14	4	10	12	16	4	1

Psychological Surveys

In this section, the surveys used in Study 2 are detailed. They were chosen based on their relevance in studies of social behavior, and also because they were likely to correlate with participants' performance during the conversation. Even though these are individual measures and can only provide scores of individual personality traits and states, differences in interactions and emotional regulation during the conversation task is partly influenced by participants' intrinsic characteristics. The surveys used in this study were: Behavioral activation system and behavioral inhibition system (BIS/BAS), Cognitive disinhibition scale (CDS), Center for epidemiological studies depression scale (CES-D), Loneliness scale (LS), Positive and negative affect schedule (PANAS-X), Personal report of communication apprehension (PRCA-24), Revised cheek and buss shyness scale (RCBS), Social interaction anxiety scale (SIAS), State-trait anxiety inventory for adults (STAI), and State-trait anger expression inventory (STAXI).

BIS/BAS: Behavioral inhibition system and behavioral activation system. The behavioral approach system (BAS) is believed to regulate appetitive motives, in which the goal is to move toward something desired, while the behavioral avoidance (or inhibition) system (BIS) is said to regulate aversive motives, in which the goal is to move away from something unpleasant.

Working initially with animals, physiological psychologists have identified two distinct neurological structures and systems – the behavioral inhibition system (BIS) and the behavioral activation system (BAS). The BIS is sensitive to signals of possible negative consequences and inhibits behavior that may lead to undesirable outcomes. In contrast, the BAS is sensitive to cues for rewarding consequences, and facilitates the initiations of behavior that can gain positive consequences. Thus, the BIS is presumed to regulate avoidance behavior, while BAS controls approach behavior. For example, a *success-seeker* would score high on BAS and low on BIS, while a *failure avoider* would score low on BAS and high on BIS. It is possible to score low on both the BAS and the BIS, indicating low motivation to achieve positive consequences or avoid negative consequences.

BIS/BAS

Each item of this questionnaire is a statement that a person may either agree with or disagree with. For each item, indicate how much you agree or disagree with what the item says. Please respond to all the items; do not leave any blank. Choose only one response to each statement. Please be as accurate and honest as you can be. Respond to each item as if it were the only item. That is, don't worry about being "consistent" in your responses. Choose from the following four response options:

1 = very true for me
2 = somewhat true for me
3 = somewhat false for me
4 = very false for me

1. A person's family is the most important thing in life.
2. Even if something bad is about to happen to me, I rarely experience fear or nervousness.
3. I go out of my way to get things I want.
4. When I'm doing well at something I love to keep at it.
5. I'm always willing to try something new if I think it will be fun.
6. How I dress is important to me.
7. When I get something I want, I feel excited and energized.
8. Criticism or scolding hurts me quite a bit.
9. When I want something I usually go all-out to get it.
10. I will often do things for no other reason than that they might be fun.
11. It's hard for me to find the time to do things such as get a haircut.
12. If I see a chance to get something I want I move on it right away.
13. I feel pretty worried or upset when I think or know somebody is angry at me.
14. When I see an opportunity for something I like I get excited right away.
15. I often act on the spur of the moment.
16. If I think something unpleasant is going to happen I usually get pretty "worked up."
17. I often wonder why people act the way they do.
18. When good things happen to me, it affects me strongly.
19. I feel worried when I think I have done poorly at something important.
20. I crave excitement and new sensations.
21. When I go after something I use a "no holds barred" approach.
22. I have very few fears compared to my friends.
23. It would excite me to win a contest.
24. I worry about making mistakes.

CDS: Cognitive disinhibition scale. The Cognitive Disinhibition Scale (CDS; Vartanian & Martindale, 2001) is an 18-item questionnaire developed as a self-report measure of cognition theoretically linked to creativity. The CDS is a two-factor scale that assesses cognitive immersion and flexibility. Each item is rated on a scale ranging from -3 to +3. The average score on the CDS in the present sample was 1 8.10 (SD = 1 1.10). The Coefficient Alpha for the CDS in the present study was .73, which is consistent with previous research (Vartanian & Martindale, 2001).

Please inspect the following questionnaire carefully and ensure that you understand how the rating system works. Then, indicate your degree of agreement with each statement by writing the appropriate number in the box to the right of the statement.

-3______-2______-1______0______1______2______3

Strongly disagree — Neutral — Strongly agree

1	Once a thought has entered my mind, it almost always leads to others.	
2	Little events here and there trigger all sorts of ideas in me.	
3	I don't have an active imagination.	
4	I can really immerse myself in an interesting idea.	
5	I appreciate the free-floating nature of thought.	
6	My frame of mind is constantly in a problem-solving mode.	
7	I never have difficulties making decisions.	
8	My attention is completely focused when I watch a program on TV.	
9	My thoughts wander off when I'm a passenger in the bus or in a car.	
10	It is useless to apply a concept to a completely new area.	
11	Ideas that are not carefully analyzed are worthless.	
12	I perceive a categorical difference between conscious and unconscious thought.	
13	Good art has a tendency to energize the imagination.	
14	I never allow myself to cultivate any irrational thoughts.	
15	New ideas have a way of completely capturing my attention.	
16	Insights into problems only occur during moments of careful consideration.	
17	Scientific and nonscientific concepts are categorically different.	
18	I have a narrow range of interests.	

CES-D: Center for epidemiological studies depression scale. The CES-D scale is a short self-report scale designed to measure depressive symptomatology in the general population. The items of the scale are symptoms associated with depression, which have been used in previously validated longer scales. The Center for Epidemiological Studies Depression Scale was developed for use in studies of the epidemiology of depressive symptomology in the general population. It was designed to measure current level of depression, with emphasis on the affective component, depressed mood.

<u>During the past week:</u>

1. I was bothered by things that usually don't bother me.
2. I did not feel like eating; my appetite was poor.
3. I felt that I could not shake off the blues even with help from my family or friends.
4. I felt that I was just as good as other people.
5. I had trouble keeping my mind on what I was doing.
6. I felt depressed.
7. I felt that everything I did was an effort.
8. I felt hopeful about the future.
9. I thought my life had been a failure.
10. I felt fearful.
11. My sleep was restless.
12. I was happy.
13. I talked less than usual.
14. I felt lonely.
15. People were unfriendly.
16. I enjoyed life.
17. I had crying spells.
18. I felt sad.
19. I felt that people dislike me.
20. I could not get "going."

LS: Loneliness scale. Humans are social animals. In fact, our desire for social connections seems so strong that some authors have suggested that humans have a basic need to belong (Baumeister & Leary 1995). Social relationships subtly embrace us in the warmth of self-affirmation, the whispers of encouragement, and the meaningfulness of belonging. They are fundamental to our emotional fulfillment, behavioral adjustment, and cognitive function. Disruption or absence of stable social relationships alter our mental states and biology like few other events (Hughes, Waite, Hawkley, & Cacioppo 2004).

There is now substantial evidence that loneliness is a core part of a constellation of socio-emotional states including self-esteem, mood, anxiety, anger, optimism, fear of negative evaluation, shyness, social skills, social support, dysphoria, and sociability (see, e.g., Berscheid and Reis 1998; Shaver and Brennan 1991). Feelings of loneliness are not synonymous with being alone but instead involve feelings of isolation, feelings of disconnectedness, and feelings of not belonging. These feelings in turn are thought to reflect the discrepancy between one's desired and one's actual relationships (Peplau and Perlman 1982). The scale has three items and a simplified set of response categories but appears to measure overall loneliness quite well.

Three-Item Loneliness Scale

Lead-in and questions are read to respondent.

The next questions are about how you feel about different aspects of your life. For each one, tell me how often you feel that way.

Question	*Hardly Ever*	*Some of the Time*	*Often*
First, how often do you feel that you lack companionship: Hardly ever, some of the time, or often?	1	2	3
How often do you feel left out: Hardly ever, some of the time, or often?	1	2	3
How often do you feel isolated from others? (Is it hardly ever, some of the time, or often?)	1	2	3

PANAS-X: Positive and negative affect schedule. The Positive and Negative Affect Schedule (PANAS) comprises two mood scales, one that measures positive affect and the other which measures negative affect. Used as a psychometric scale, the PANAS can show relations between positive and negative affect with personality stats and traits. Ten descriptors are used for each PA scale and NA to define their meanings. Participants in the PANAS are required to respond to a 20-item test using 5-point scale that ranges from "very slightly or not at all" (1) to "extremely" (5).

Table 1 *Sample* PANAS-X *Protocol Illustrating "Past Few Weeks" Time Instructions*

This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate <u>to what extent you have felt this way during the past few weeks</u>. Use the following scale to record your answers:

1	2	3	4	5
very slightly or not at all	a little	moderately	quite a bit	extremely

______ cheerful	______ sad	______ active	______ angry at self
______ disgusted	______ calm	______ guilty	______ enthusiastic
______ attentive	______ afraid	______ joyful	______ downhearted
______ bashful	______ tired	______ nervous	______ sheepish
______ sluggish	______ amazed	______ lonely	______ distressed
______ daring	______ shaky	______ sleepy	______ blameworthy
______ surprised	______ happy	______ excited	______ determined
______ strong	______ timid	______ hostile	______ frightened
______ scornful	______ alone	______ proud	______ astonished
______ relaxed	______ alert	______ jittery	______ interested
______ irritable	______ upset	______ lively	______ loathing
______ delighted	______ angry	______ ashamed	______ confident
______ inspired	______ bold	______ at ease	______ energetic
______ fearless	______ blue	______ scared	______ concentrating
______ disgusted with self	______ shy	______ drowsy	______ dissatisfied with self

PRCA-24: Personal report of communication apprehension. The PRCA-24 is the instrument that is most widely used to measure communication apprehension. It is preferable above all earlier versions of the instrument (PRCA, PRCA10, PRCA-24B, etc.). It is highly reliable (alpha regularly >.90) and has very high predictive validity. It permits one to obtain sub-scores on the contexts of public speaking, dyadic interaction, small groups, and large groups. However, these scores are substantially less reliable than the total PRCA-24 scores-because of the reduced number of items.

Communication apprehension describes “an individual’s level of fear or anxiety associated with either real or anticipated communication with another person or persons” (McCroskey, 1977, p. 78). Generally, an individual ranks high, moderate, or low in communication apprehension. An individual who is high on communication apprehension almost always feels apprehensive about communicating with other people whereas an individual who is low in communication apprehension hardly ever feels apprehensive about communicating with other people. An individual who is moderate in communication apprehension falls somewhere between being highly fearful and not being fearful at all, and tends to be more flexible in dealing with communication apprehension on a daily basis.

According to James McCroskey (1984), communication apprehension can emerge in four forms: trait, context-based, audience-based, and situational. Trait apprehension refers to a relatively enduring level of apprehension across a variety of situations. People who are high in trait communication apprehension feel anxious about communicating across all situations. Whether communication involves talking during a job interview, participating in a class discussion, or giving a public speech in the community, a person with high trait communication apprehension usually will experience anxiety and apprehension. On the other hand, a person who is low in trait communication apprehension will feel comfortable in most situations and not experience any discomfort or anxiety.

Context-based apprehension, a form of apprehension tied to a specific context (i.e., small group, meetings, interpersonal, public speaking), is based on the idea that people sometimes feel comfortable talking in one context and anxious in another. Some people feel completely comfortable talking to almost anyone face-to-face but experience a great deal of anxiety when giving a public speech. Other people may experience no anxiety when giving a formal presentation in front of a crowd but a great deal of apprehension when attempting to communicate in a small group. Audience-based apprehension is linked to communicating with a specific audience. Some people, though low in trait communication apprehension, may experience apprehension when it comes to communicating, for example, with their superiors at work. A person may experience situational apprehension when communicating with a given person in a particular situation. Note that almost everyone will experience situational apprehension at one time or another.

A person with communication apprehension will experience internal anxiety and discomfort (McCroskey & Beatty, 1998), which may or may not manifest itself in external signs of nervousness or apprehensiveness about communicating with others. These external signs include the physiological (e.g., sweating, increased heart rate, blushing) and the interactive. Based on the research conducted on communication apprehension, McCroskey, Daly, and Sorensen (1976) compiled a profile of the highly apprehensive person and the minimally apprehensive person. For instance, highly communication-apprehensive individuals often act aloof, prefer to work alone, get easily annoyed, withdraw, and dislike interaction whereas minimally communication apprehensive individuals are calm, self-assured, ego-involved, decisive, and relaxed. Though not exhaustive, this profile provides an idea about feeling, thought, and behavior differences in highly and minimally communication apprehensive individuals.

It is important to consider, though, that if an individual exhibits high communication apprehension, he or she will not necessarily be quiet. Some highly communication-apprehensive individuals talk too much from nervousness, and some minimally communication-apprehensive individuals hardly talk at all because they simply are not interested in communicating.

Personal Report of Communication Apprehension (PRCA-24)

DIRECTIONS: This instrument is composed of twenty-four statements concerning feelings about communicating with other people. Please indicate the degree to which each statement applies to you by marking whether you **strongly agree (1-SA), agree (2-A), undecided (3-U), disagree (4-D), or strongly disagree (5-SD).**

Work quickly; record your first impression.

Question	Response				
1. I dislike participating in group discussions.	1 - SA	2 - A	3 - U	4 - D	5 - SD
2. Generally, I am comfortable while participating in group discussions.	1 - SA	2 - A	3 - U	4 - D	5 – SD
3. I am tense and nervous while participating in group discussions.	1 - SA	2 - A	3 - U	4 - D	5 - SD
4. I like to get involved in group discussions.	1 - SA	2 - A	3 - U	4 - D	5 - SD
5. Engaging in a group discussion with new people makes me tense and nervous.	1 - SA	2 - A	3 - U	4 - D	5 - SD
6. I am calm and relaxed while participating in group discussions.	1 - SA	2 - A	3 - U	4 - D	5 - SD
7. Generally, I am nervous when I have to participate in a meeting.	1 - SA	2 - A	3 - U	4 - D	5 - SD
8. Usually I am calm and relaxed while participating in meetings.	1 - SA	2 - A	3 - U	4 - D	5 - SD
9. I am very calm and relaxed when I am called upon to express an opinion at a meeting.	1 - SA	2 - A	3 - U	4 - D	5 - SD
10. I am afraid to express myself at meetings.	1 - SA	2 - A	3 - U	4 - D	5 - SD
11. Communicating at meetings usually makes me uncomfortable.	1 - SA	2 - A	3 - U	4 - D	5 - SD
12. I am very relaxed when answering questions at a meeting.	1 - SA	2 - A	3 - U	4 - D	5 - SD
13. While participating in a conversation with a new acquaintance, I feel very nervous.	1 - SA	2 - A	3 - U	4 - D	5 - SD
14. I have no fear of speaking up in conversations.	1 - SA	2 - A	3 - U	4 - D	5 - SD
15. Ordinarily I am very tense and nervous in conversations.	1 - SA	2 - A	3 - U	4 - D	5 - SD
16. Ordinarily I am very calm and relaxed in conversations.	1 - SA	2 - A	3 - U	4 - D	5 - SD
17. While conversing with a new acquaintance, I feel very relaxed.	1 - SA	2 - A	3 - U	4 - D	5 - SD
18. I'm afraid to speak up in conversations.	1 - SA	2 - A	3 - U	4 - D	5 - SD
19. I have no fear of giving a speech.	1 - SA	2 - A	3 - U	4 - D	5 - SD
20. Certain parts of my body feel very tense and rigid while giving a speech.	1 - SA	2 - A	3 - U	4 - D	5 - SD
21. I feel relaxed while giving a speech.	1 - SA	2 - A	3 - U	4 - D	5 - SD
22. My thoughts become confused and jumbled when I am giving a speech.	1 - SA	2 - A	3 - U	4 - D	5 - SD
23. I face the prospect of giving a speech with confidence.	1 - SA	2 - A	3 - U	4 - D	5 - SD
24. While giving a speech, I get so nervous I forget facts I really know.	1 - SA	2 - A	3 - U	4 - D	5 - SD

RCBS: Revised Cheek and Buss shyness scale. Shyness has been conceptualized and defined in a number of ways, mostly being regarded as belonging to a particular category. One such category views shyness as a subjective experience which is exhibited as nervousness and apprehension in interpersonal encounters (Bas, 2010; Buss, 1980; Leary & Schlenker, 1981; Zimbardo, 1977). Buss (1980), for instance, defined shyness as an inhibition of expected social behaviour, together with feelings of tension and awkwardness. This line of definitions can be said to regard shyness as a social phenomenon, and a form of social anxiety.

Shyness has long been described as a character trait, an attitude, or a state of inhibition (Durmuş, 2007). Researchers investigating shyness have attempted to develop objective definitions of this human experience. For example, shyness has been defined as discomfort, inhibition, and awkwardness in social situations, particularly in situations with unfamiliar people (Buss, 1985) or as a tendency to avoid social interaction and to fail to participate appropriately in social situations (Durmuş, 2007; Pilkonis, 1977; Schölmerich, Broberg & Lamb, 2000).

The Revised Cheek and Buss Shyness Scale (RCBS) is one of the most commonly employed measures of dispositional shyness (Cheek & Briggs, 1990). The original Cheek and Buss Shyness Scale (Cheek & Buss, 1981) contained 9 items. The development of the revised form aimed at improving the psychometric properties of the original scale. The revision resulted in a 13-item revised version of the original scale. There are also two other revised versions of the scale, one with 14 and the other with 20 items; however 13-item RCBS was of interest for the present study, given that it has been accepted as the most prominent measure in shyness research (Leary, 1991). The RCBS was found to be internally consistent (coefficient alpha = .90), and 45-day test-retest reliability coefficient was r = .88 (Cheek & Briggs, 1990). Considerable support was also reported for the validity of the scale. The convergent validity was supported via strong correlations with Social Avoidance and Distress Scale (Watson & Friend, 1969, r = .77), and Social Reticence Scale (Jones et al., 1986, r = .79). The scale also correlated with the original 9-

item version (r = .96). Leary (1986) recommended the use of RCBS as an appropriate measure of shyness due to its inclusion of both behavioral and physiological factors.

Items from the Revised Cheek and Buss Shyness Scale
[Table 11.1 on page 322 of Cheek & Briggs, 1990]

1. I feel tense when I'm with people I don't know well.
2. I am socially somewhat awkward.
3. I do not find it difficult to ask other people for information.
4. I am often uncomfortable at parties and other social functions.
5. When in a group of people, I have trouble thinking of the right things to talk about.
6. It does not take me long to overcome my shyness in new situations.
7. It is hard for me to act natural when I am meeting new people.
8. I feel nervous when speaking to someone in authority.
9. I have no doubts about my social competence.
10. I have trouble looking someone right in the eye.
11. I feel inhibited in social situations.
12. I do not find it hard to talk to strangers.
13. I am more shy with members of the opposite sex.
14. During conversations with new acquaintances I worry about saying something dumb.

Note. The response format ranges from 1 = very uncharacteristic or untrue to 5 = very characteristic or true. Items 3, 6, 9, and 12 are reverse-scored. Item 14 is a revised wording of one of the original 9 items that was not included in the 13-item version. The average item mean is 2.55.

SIAS: Social interaction anxiety scale. The Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998), which measures anxiety regarding social interactions in dyads and groups, is one of the more often-used contemporary self-report measures of social anxiety. Many empirical studies (see Heimberg & Turk, 2002) have demonstrated its excellent reliability and construct validity.

SIAS

1. I get nervous if I have to speak with someone in authority (teacher, boss, etc.)
2. I have difficulty making eye contact with others
3. I become tense if I have to talk about myself or my feelings
4. I find difficulty mixing comfortably with the people I work with
5. I tense up if I meet an acquaintance in the street
6. When mixing socially I am uncomfortable
7. I feel tense if I am alone with just one other person
8. I am at ease meeting people at parties, etc.
9. I have difficulty talking with other people
10. I find it easy to think of things to talk about
11. I worry about expressing myself in case I appear awkward
12. I find it difficult to disagree with another's point of view
13. I have difficulty talking to attractive persons of the opposite sex
14. I find myself worrying that I won't know what to say in social situations
15. I am nervous mixing with people I don't know well
16. I feel I'll say something embarrassing when talking
17. When mixing in a group I find myself worrying I will be ignored
18. I am tense mixing in a group
19. I am unsure whether to greet someone I know only slightly

SPS

1. I become anxious if I have to write in front of other people
2. I become self-conscious when using public toilets
3. I can suddenly become aware of my own voice and of others listening to me
4. I get nervous that people are staring at me as I walk down the street
5. I fear I may blush when I am with others
6. I feel self-conscious if I have to enter a room where others are already seated
7. I worry about shaking or trembling when I'm watched by other people
8. I would get tense if I had to sit facing other people on a bus or a train
9. I get panicky that others might see me to be faint, sick, or ill
10. I would find it difficult to drink something if in a group of people
11. It would make me feel self-conscious to eat in front of a stranger at a restaurant
12. I am worried people will think my behavior odd
13. I would get tense if I had to carry a tray across a crowded cafeteria
14. I worry I'll lose control of myself in front of other people
15. I worry I might do something to attract the attention of others
16. When in an elevator I am tense if people look at me
17. I can feel conspicuous standing in a queue
18. I get tense when I speak in front of other people
19. I worry my head will shake or nod in front of others
20. I feel awkward and tense if I know people are watching me

STAI: State-trait anxiety inventory for adults. Description of Measure: The State-Trait Anxiety Inventory (STAI) is a commonly used measure of trait and state anxiety (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). It can be used in clinical settings to diagnose anxiety and to distinguish it from depressive syndromes. It also is often used in research as an indicator of caregiver distress. Form Y, its most popular version, has 20 items for assessing trait anxiety and 20 for state anxiety. State anxiety items include: "I am tense; I am worried" and "I feel calm; I feel secure." Trait anxiety items include: "I worry too much over something that really doesn't matter" and "I am content; I am a steady person." All items are rated on a 4-point scale (e.g., from "Almost Never" to "Almost Always"). Higher scores indicate greater anxiety. The STAI is appropriate for those who have at least a sixth-grade reading level.

Internal consistency coefficients for the scale have ranged from .86 to .95; test-retest reliability coefficients have ranged from .65 to .75 over a 2-month interval (Spielberger et al., 1983). Test-retest coefficients for this measure in the present study ranged from .69 to .89. Considerable evidence attests to the construct and concurrent validity of the scale (Spielberger, 1989).

Self Evaluation Questionnaire
STAI Form Y-1

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel *right now*, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	Not At All	**Some-what**	**Moderately So**	**Very Much So**
1. I feel calm	1	2	3	4
2. I feel secure	1	2	3	4
3. I am tense	1	2	3	4
4. I feel strained	1	2	3	4
5. I feel at ease	1	2	3	4
6. I feel upset	1	2	3	4
7. I am presently worrying over possible misfortunes	1	2	3	4
8. I feel satisfied	1	2	3	4
9. I feel frightened	1	2	3	4
10. I feel comfortable	1	2	3	4
11. I feel self-confident	1	2	3	4
12. I feel nervous	1	2	3	4
13. I feel jittery	1	2	3	4
14. I feel indecisive	1	2	3	4
15. I am relaxed	1	2	3	4
16. I feel content	1	2	3	4
17. I am worried	1	2	3	4
18. I feel confused	1	2	3	4
19. I feel steady	1	2	3	4
20. I feel pleasant	1	2	3	4

STAXI: State-trait anger expression inventory. The State-Trait Anger Expression Inventory-2 (STAXI-2) assesses various areas of anger and the traits of experiencing anger. A common use for the STAXI is to collect information for people with anger issues and for creating treatment plans. Participants are asked to respond to 57 items using a 4-point scale ("Not at all" to "Very much so"). Approximately 12 to 15 minutes is required for completion. STAXI is the revised edition which had only included 44-items.

The State-Trait Anger Expression Inventory is a well-known instrument and it has relatively high reliability and validity. In the authors test manuals, the psychometric properties included high alpha coefficients for internal reliability for all subscales except for the Trait Anger Scale/Angry Reaction (0.73-0.76). There is extensive showing of validity for the original versions of STAXI but none for the current edition. Concurrent validity of the original STAXI strongly correlates with the Multiphasic Inventory (Hostility and Over Hostility Scales), Buss-Durkee Hostility Inventory, and the Eysenck Questionnaire (Psychoticism and Neuroticism).

Part 1 Directions

A number of statements that people use to describe themselves are given below. Read each statement and then circle the number which indicates how you feel *right now*. There are no right or wrong answers. Do not spend too much time on any one statement. Mark the answer that *best* describes your *present feelings*.

Not at all 1	Somewhat 2	Moderately so 3	Very much so 4

How I Feel Right Now

1.	I feel furious	1	2	3	4
2.	I feel irritated	1	2	3	4
3.	I feel angry	1	2	3	4
4.	I feel like yelling at somebody	1	2	3	4
5.	I feel like breaking things	1	2	3	4
6.	I am mad	1	2	3	4
7.	I feel like banging on the table	1	2	3	4
8.	I feel like hitting someone	1	2	3	4
9.	I feel like swearing	1	2	3	4
10.	I feel annoyed	1	2	3	4
11.	I feel like kicking somebody	1	2	3	4
12.	I feel like cursing out loud	1	2	3	4
13.	I feel like screaming	1	2	3	4
14.	I feel like pounding somebody	1	2	3	4
15.	I feel like shouting	1	2	3	4

Part 2 Directions

Read each of the following statements that people have used to describe themselves, and then circle the appropriate number to indicate how you *generally* feel or react. There are no right or wrong answers. Do not spend too much time on any one statement. Circle the answer that *best* describes how you *generally* feel or react.

Almost never 1	Sometimes 2	Often 3	Almost always 4

How I Generally Feel

16.	I am quick tempered	1	2	3	4
17.	I have a fiery temper	1	2	3	4
18.	I am a hotheaded person	1	2	3	4
19	I get angry when I'm slowed down by others' mistakes	1	2	3	4
20.	I feel annoyed when I am not given recognition for doing good work	1	2	3	4
21.	I fly off the handle	1	2	3	4
22.	When I get mad, I say nasty things	1	2	3	4
23.	It makes me furious when I am criticized in front of others	1	2	3	4
24.	When I get frustrated, I feel like hitting someone	1	2	3	4
25.	I feel infuriated when I do a good job and get a poor evaluation	1	2	3	4

Part 3 Directions

Everyone feels angry or furious from time to time, but people differ in the ways that they react when they are angry. A number of statements are listed below which people use to describe their reactions when they feel *angry* or *furious*. Read each statement and then circle the approximate number to indicate how *often* you *generally* react or behave in the manner described when you are feeling angry of furious. There are no right or wrong answers. Do not spend too much time on any one statement.

Almost never 1	Sometimes 2	Often 3	Almost always 4

How I Generally React or Behave When Angry or Furious…

26.	I control my temper	1	2	3	4
27.	I express my anger	1	2	3	4
28.	I take a deep breath and relax	1	2	3	4
29.	I keep things in	1	2	3	4
30.	I am patient with others	1	2	3	4
31.	If someone annoys me, I'm apt to tell him or her how I feel	1	2	3	4
32.	I try to calm myself as soon as possible	1	2	3	4
33.	I pout or sulk	1	2	3	4
34.	I control my urge to express my angry feelings	1	2	3	4
35.	I lose my temper	1	2	3	4
36.	I try to simmer down	1	2	3	4
37.	I withdraw from people	1	2	3	4
38.	I keep my cool	1	2	3	4
39.	I make sarcastic remarks to others	1	2	3	4
40.	I try to soothe my angry feelings	1	2	3	4
41.	I boil inside, but I don't show it	1	2	3	4
42.	I control my behavior	1	2	3	4
43.	I do things like slam doors	1	2	3	4
44.	I endeavor to become calm again	1	2	3	4

45.	I tend to harbor grudges that I don't tell anyone about.........	1	2	3	4
46.	I can stop myself from losing my temper.............................	1	2	3	4
47.	I argue with others..	1	2	3	4
48.	I reduce my anger as soon as possible...............................	1	2	3	4
49.	I am secretly quite critical of others....................................	1	2	3	4
50.	I try to be tolerant and understanding.................................	1	2	3	4
51.	I strike out at whatever infuriates me..................................	1	2	3	4
52.	I do something relaxing to calm down.................................	1	2	3	4
53.	I am angrier than I am willing to admit................................	1	2	3	4
54.	I control my angry feelings..	1	2	3	4
55.	I say nasty things..	1	2	3	4
56.	I try to relax..	1	2	3	4
57.	I'm irritated a great deal more than people are aware of......	1	2	3	4

In sum, the total number of surveys used in this study was ten, as follows: Behavioral activation system and behavioral inhibition system (BIS/BAS), Cognitive disinhibition scale (CDS), Center for epidemiological studies depression scale (CES-D), Loneliness scale (LS), Positive and negative affect schedule (PANAS-X), Personal report of communication apprehension (PRCA-24), Revised cheek and buss shyness scale (RCBS), Social interaction anxiety scale (SIAS), State-trait anxiety inventory for adults (STAI), and State-trait anger expression inventory (STAXI). They were selected with the help of the study's principal investigator, and based on studies found in the literature of social engagement behaviors and communicative performance.

Chapter 4: Turn-Taking

Crucial to understanding the nature and origins of human language is understanding how it is used in both social and cultural contexts. Language is learned through repeated and prolonged exposure to informal conversation, and through successful attempts to produce communicative interactions with other people. Most actions of human conduct are carried out paired with talk, and the organization of this talk consists of speaking turns (Lerner, 2004). A fundamental part of the infrastructure for conversation is turn-taking, or the collective understanding of who is to speak next and when (Sacks, Schegloff, & Jefferson, 1974). The practice of turn-taking revolves around the distribution of chances to participate in an ongoing conversation. Actions organized through speaking turns shape how speakers compose their contributions, where they position those contributions in the ongoing interaction, and when they get to participate.

Conversation is managed locally by the participants, turn by turn, in terms of who speaks when, for how long, and about what. Given its seemingly chaotic nature, conversation proceeds remarkably smoothly. Typically, conversational partners take turns, with one person being treated by co-participants as having the right and also the obligation to speak (while co-participants have the right and obligation to attend to the speaker), and then smoothly relinquishing that status as another person begins talking. Thus, in most cases of conversation, speech is exchanged nearly continuously by speakers taking turns, with minimal gaps in the talk and minimal overlaps.

Simultaneous talk and silences occur in conversation, but such events are themselves organized relative to turn-taking. Sometimes, this involves competition for the turn, as when two potential speakers start simultaneously, the previous speaker adds to an already completed utterance, or a listener directly interrupts in an attempt to take over the turn (French & Local, 1983; Schegloff, 2000). Such overlaps are typically brief, usually settled by one party's dropping out. Other cases of simultaneous talk are treated as non-problematic by participants. These include collaborative turn completions (Lerner, 1991, 1996) and recognition point interruptions

(Jefferson, 1973, 1984), in which a listener begins speaking to indicate comprehension or affiliation, and back-channeling, in which brief interjections (e.g., “yeah” or “wow”) occur that are not treated by either party as an attempt to take the turn. There are even situations in which choral co-production can properly occur, such as mutual greetings when guests arrive at a party (Lerner, 2002).

Finally, silences in combination with adjacent turns can be treated by listeners as a positive action on the part of the current turn-holder (see, e.g., Heritage, 1984, pp. 273–274). For example, a direct question transfers the turn immediately to the recipient (Sacks, Schegloff, & Jefferson’s [1974] model), and for this reason, a pause before the question is answered may be interpreted by others as an act on the part of the recipient, reflecting mental work load (D’Urso & Zammuner, 1990) or honesty or comfort level (Fox Tree, 2002). On the other hand, when the recipient of a request or invitation pauses before answering, this may be heard as portending some kind of awkwardness, such as a denial of the request or refusal of the invitation, whereas conversely, a lack of a pause can be interpreted as rudeness (Heritage, 1984, p. 268). The point to note in all these cases is that participants treat simultaneous talk and silences in ways that depend on the position and connect of the talk, but disruptive of smooth turn-taking.

The features of turn-taking described above are universal. This means that they hold across cultures and social classes, despite differences in the specifics of the verbal and nonverbal regulators employed (Caspers, 1998; Hafez, 1991; Kjaerbeck, 1998; La France, 1974; Lee et al, 2009; Lerner & Takagi, 1999; Murata, 1994; Robbins, Devoe, & Wiener, 1978; Sidnell, 2001; Streeck, 1996; Tanaka, 2000a, 2000b). Wilson and Wilson (2005) describe a conversation style known as the collaborative floor, in which the turn-taking norms of the one-at-a-time floor do not hold (e.g., Coates, 1994, 1997). No culture or group has been found in which the fundamental features of turn-taking are absent. This is true even when the physical substrate of conversation is radically different from that of ordinary speech, as in the cases of sign language used by the deaf (e.g., Coates & Sutton-Spence, 2001) and tactile sign language used by the deaf-blind (Mesch, 2000, 2001). Finally, turn-taking emerges early in human development, manifested in the structure of babies' vocal and bodily interactions with caregivers (Beebe, Alson, Jaffe, Feldstein, & Crown, 1988; Bloom, Russell, & Wassenberg, 1987; Crown, Feldstein, Jasnow, Beebe, & Jaffe, 2002; Elias, Hayes, & Broerse, 1986; Holmlund, 1995; Jasnow & Feldstein, 1986; Keller, Schlmerich, & Eibl-Eibesfeldt, 1988; Masataka, 1993, 1995; Rutter & Durkin, 1987; Stevenson, Ver Hoeve, Roach, & Leavitt, 1986). Taken together, these findings point to the grounding of turn-taking in fundamental human cognitive processes. As Sidnell (2001) has argued, turn-taking in conversation may constitute a species-specific biological adaptation.

In order to achieve a seamless exchange of turns, getting one's timing right is a key feature in speaking. When producing and comprehending speech in conversation, participants come under a range of psychological and performance pressures, requiring both speed and temporal accuracy. In the flow of interaction, a number of simultaneous tasks are required, such as perceiving and processing the speech of others, formulating utterances in advance, simultaneously monitoring the internal speech timing relative to the other participants, monitoring the content of speech and correcting problems if detected, monitoring others' responses to delivered utterances and correcting problems if detected, and producing and comprehending hand gestures and other bodily actions linked to the speech, among other cognitive tasks. Among this rich and urgent flow of perceptual information and motor activity, not only do co-participants work to produce utterances that are well-formed and that achieve the purposes they are designed to achieve (e.g. eliciting information, or searching for a word), but they are also working to ensure that the timing and content of their speech production are aligned as seamlessly as possible with those of their interlocutors.

Utterances are formulated to fit into sequences of social interaction, and such sequences are characterized by the orderly and finely timed transition of interlocutors between speaker/hearer roles. The production of an irrelevant utterance, or one whose deployment is less than impeccably timed, risks making an 'unusual' contribution, which in turn may cause your interlocutor to infer messages that were not intended (e.g. speaker is getting impatient, or speaker is becoming hesitant). This constant 'threat to face' (Brown & Levinson 1978) means that there is much at stake in getting the timing of speech production just right. In their influential and widely cited treatment of turn-taking, Sacks, Schegloff, and Jefferson (1974) point out that to achieve the precise timing that enables co-participants to do no-gap-no-overlap turn transitions, they must anticipate in advance the precise moment at which the current speaker's utterance is going to come to a completion point. This allows others to set the wheels of speech production in motion well before the 'in point' arrives, and in turn keep exactly one person talking at all times.

For the reasons listed above, the unyielding imperative of participants in a conversation is to minimize both the amount of speech produced in overlap (i.e., avoid having two or more people speaking at the same time) and the amount of silence between successive turns. A generally accepted working assumption in studies of conversation is that the one-speaker-at-a-time rule is operative in all informal conversational settings. It is important to understand that to propose such a rule is not to propose that all talk actually proceeds one speaker at a time. There are constant departures from the rule (overlaps, gaps, and so forth, as is made explicit in the Sacks et al. 1974 model; cf. Schegloff 2000:47–48, n. 1), and these departures can be exploited for functional effect, since they are indeed treated by interactants as departures.

Thus, the existence of organized turn-taking is something that the data of conversation have made obvious. It is customary that one party talks at a time, that speakers change, and that the size of turns and ordering of turns vary; however, transitions are finely coordinated, and techniques are used for turns status and allocation of turns and speakership. Sacks, Schegloff, Jefferson (1974) pointed out that conversations are consistently organized in the following manner:

> (1) speaker-change recurs or at least occurs; (2) [...] one party talks at a time; (3) occurrences of more than one speaker at a time are common, but brief; (4) transitions (from one turn to the next) with no gap and no overlap are common; (5) turn order is not fixed but varies; (6) turn size is not fixed, but varies; (7) length of conversation is not specified in advance; (8) what parties say is not specified in advance; (9) relative distribution of turns is not specified in advance; (10) number of parties can vary; (11) talk

> can be continuous or discontinuous; (12) turn-allocation techniques are […] used. A current speaker may select a next speaker (as when he addresses a question to another party); or parties may self-select in starting to talk; (13) various turn-construction units are employed; e.g., turns can be […] one word long, or […] sentential in length; (14) repair mechanisms exist for dealing with turn-taking errors and violations; e.g., if two parties find themselves talking at the same time, one of them will stop prematurely, thus repairing the trouble. (p. 701)

Research on turn-taking has examined cues used in recognizing opportunities for turn transition (Kendon, 1967), the time course of a turn in an exchange (Chapple, 1939), and the timing of turn transitions (Duncan, 1977). In English conversation, speakers do not necessarily wait for pauses to begin their turn, but they avoid gaps and overlaps. To achieve this they use grammar, prosody, and pragmatics to project when they can start a next turn, suggesting that turn-taking is specifically organized to achieve this close timing.

Besides observing cues in the current speaker's behavior for accurate projection of the end of a turn in order to keep the conversation going, recipients (who are in fact active participants, doing 'attentive listening') may have varying degrees of willingness to participate during the ongoing conversation. Nevertheless, in a dyadic formation, participants may not be able to refuse taking the floor next, since conversational actions require that their adjacent pairs be produced by the other participating actor. This obligatory fulfillment of collaborative completion of actions starts to involve self-selection or other-selection of next turn speaker once a group of conversationalists contains three participants or more. The current speaker may choose to select the next speaker by addressing a request, comment, or question to one of the recipients, therefore selecting that person to take the floor next, or when the current speaker does not specifically select the next speaker, the floor remains open until one of the recipients — or possibly the current speaker — picks it up. At this moment, if a recipient is not interested in taking the floor next, he or she might display avoidance behavior. This is normally accomplished by not making eye contact with the current speaker at the end of a turn, or during a transition relevant point. The decision to communicate with co-participants during a conversation relies not only on the participants' awareness of conversation norms such as turn-taking, alignments, uptakes, assessments, face preservation, epistemic status, among others, but also on psychophysiological state and traits. A number of psychological traits can be crucial in constraining or fostering conversational behavior. For example, participants' willingness to communicate (McCroskey, 1992) derives from a combination of personality traits, interpersonal and intrapersonal psychological factors, and environmental factors. Conveniently, some of these contributing psychological factors can be measured through well-established scales of psychological characteristics. Examples of such scales that are relevant to the study of normative social behavior are the Revised Cheek and Buss Shyness Scale (RCBS), Personal Report of Communication Apprehension (PRCA), and the Social Interaction Anxiety Scale (SIAS), Cognitive Disinhibition Scale (CDS), among others. In this study, some of these scales correlated positively or negatively to the number of turns each participant took, and to the total length of floor each participant took.

Psychological Scores, Physiological Values, and Coded Behavior

In order to investigate the existence of correlations between participants' individual scores on the psychological surveys used in this study and their turn-taking behavior during the conversation, Pearson Single Correlation was used to investigate the variables *total of seconds in all turns* (TURNS LENGTH) held by participants, and *total number of turns* (TURNS NUMBER) taken by participants. In other words, TURNS LENGTH refers to how many seconds in total each participant had in the entire recorded conversation task, and TURNS NUMBER refers to the number of times each participant took the conversational floor.

The surveys used for the correlation found here were: Behavioral activation system and behavioral inhibition system (BIS/BAS), Cognitive disinhibition scale (CDS), Center for epidemiological studies depression scale (CES-D), Loneliness scale (LS), Positive and negative affect schedule (PANAS-X), Personal report of communication apprehension (PRCA-24), Revised cheek and buss shyness scale (RCBS), Social interaction anxiety scale (SIAS), State-trait anxiety inventory for adults (STAI), and State-trait anger expression inventory (STAXI).

All correlational analyses were conducted with Single Pearson Correlations, two-tailed. The correlation coefficient was interpreted as r =.5 large, r = .3 medium, and r= .10 small. These Single Pearson Correlations were used to compare all psychological constructs to the total number of turns and total length of turns in the conversation, and participants' physiological data during the conversation. Tests were conducted to ensure that underlying assumptions for between-group analyses were not violated. The Pearson Assumption was satisfied by running a descriptives test on the entire dataset, in order to test for normal distribution, looking at Kurtosis and Skewness. Before testing for normal distribution, all values were changed into Standard Scores, or Z-scores, so that all data were comparable. Paired Sample T-Tests were performed in order to check for significant difference between pairs. T-Test significance was set at $p<0.5$ and Means of Pre and Post heart rate and skin conductance were examined.

Procedures and Results

Steps for coding turns, extracting HR and SC data, and syncing both. The method of coding behavior, location and extraction of HR and SC averages, and merging data onto a centralized excel data sheet is described below step-by-step:

Step 1. Video recordings were watched and coded by research assistants that had undertaken in-lab training specifically for this task. They marked all turns, along with who had the turns, and if the turn was taken with an overlap. Codes marked both beginnings and ends of turns, so the length of a turn was derived from this information.

Step 2. Coding was checked by 3 separate research assistants to make sure the timing of all codes was right, and that all *turns* were appropriately caught and labeled.

Step 3. All *turn-taking* codes were transferred to the spreadsheet containing the heart rate and skin conductance data that was recorded during the video recorded conversation. The transfer relied on time stamps on the video and on the data sheet.

Step 4. The code transfer task was also checked by 3 separate research assistants in order to make sure all codes were correctly placed on the physiology spreadsheet.

Step 5. An excel formula was created and used for each and every code, in order to look for the target codes, and then read the data 10 seconds before and 10 seconds after each code, calculate the mean of the previous 10 seconds, and for the 10 seconds that followed, and paste the values elsewhere on the same sheet. The formula looked at the heart rate and skin conductance data for all three participants, for each instance of *turn-taking*.

Step 6. All the means were gathered on a separate spreadsheet. They were pasted back-to-back, in order to find the overall "Pre Mean" and "Post Mean" averages for all *turns* in the 24 group conversations.

Step 7. These values were plotted within excel in order to generate visual graph containing the differences between Pre and Post *turn-taking* data. In those plots, the Y-axis is the heart rate or skin conductance value, and the X-axis is the corresponding number of cases found for each target behavior, which in this case was *turn-taking*.

Step 8. Descriptive statistics analysis was performed on the data in order to verify a normal distribution of the *turn-taking* data, looking at skewness and kurtosis. Skewness and kurtosis had to be between -1 and +1 for the values to have normal distribution.

Step 9. Paired T-Tests were performed in order to check if the differences between the Pre-Post heart rate and Pre-Post skin conductance data were significant. Significant differences between Pre and Post values would have to be (<.05).

Steps for preparing data for correlations. In order to look for correlations among participants' psychological scores, target behaviors, heart rate, skin conductance, and heart rate variability values, a Pearson Single Correlation was performed after a series of steps, as follows:

Step 1. Participants' answers to psychological questionnaires were scored following the procedures listed in the corresponding scoring manuals.

Step 2. All data relative to participants' scores, quantification of target behaviors per participant, heart rate and skin conductance averages, and heart rate variability values were transferred to an excel sheet. This data sheet contained all data collected for Study 2, displayed by participant, and by group.

Step 3. This data sheet containing all data displayed by participant and by group was imported into SPSS.

Step 4. To prepare the data for a Pearson Correlation analysis, all data was converted to standard scores, or Z scores.

Step 5. The data were checked for normal distribution, looking at skewness and kurtosis. Skewness and kurtosis had to be between -1 and +1 for the values to have normal distribution.

Step 6. Pearson Correlation analysis was performed, and the correlations between *turn-taking,* other behaviors, and psychological scores (see *table* 10 and 11).

Step 7. For the purpose of conducting regression analysis, independent variables showing high correlation with the dependent variable but not among each other were saught.

Correlation results. The correlation coefficient was interpreted as r =.5 large, r = .3 medium, and r= .10 small. As can be observed in the table below, coded behaviors and certain surveys showed strong and medium correlations to the number of seconds participants talked in total during the conversation (TURNS LENGTH), and to the number of turns they took (TURNS NUMBER).

Table 10

Single Pearson Correlations Between Scores on Psychological Surveys and Coded Conversational Behaviors – first half

PSYCH SURVEYS X BEHAVIOR	1	2	3	4	5	6	7	8	9	10	11	12	13
1. TURNS - LENGTH	1												
2. TURNS - NUMBER	.469**	1											
3. DISAGREEMENT	.205	.224	1										
4. SILENCE	.013	.004	-.167	1									
5. PAUSE	.513**	.142	.083	.221	1								
6. WORD SEARCH	.302**	.081	.123	.150	.527**	1							
7. BAS DRIVE	.161	.245*	.257*	-.010	.010	.041	1						
8. BAS FUN SEEKING	-.141	-.063	.106	-.207	-.126	.056	.293*	1					
9. BAS REW RESP	-.049	.144	.110	-.089	-.203	-.025	.408**	.243*	1				
10. BIS	-.127	-.015	-.164	.065	-.012	-.091	-.162	-.170	.236*	1			
11. CDS	-.074	-.079	.022	.000	-.047	.064	.087	.252*	.115	-.265*	1		
12. CES-D	.318**	.189	.006	.062	.336**	.081	-.019	-.054	.257*	.277*	-.021	1	
13. LS	.113	.074	.031	-.207	.121	-.042	-.198	.105	-.013	.366**	-.102	.469**	1
14. PANAS NEGATIVE	.016	-.108	-.136	.040	-.011	-.081	.090	.094	.089	.066	.079	.182	.041
15. PANAS POSITIVE	.087	-.060	-.061	-.002	-.020	-.039	.128	.263	.088	-.192	.156	-.092	-.224
16. PRCA GR DISC	-.333**	-.216	-.194	.234*	-.060	.020	-.235*	-.232	-.082	.406**	-.051	.081	.179
17. PRCA MEETINGS	-.141	-.149	-.124	.155	-.022	.092	-.228	-.080	.004	.351**	-.144	.190*	.329**
18. PRCA INT CONV	-.389**	-.134	-.272*	.076	-.105	.047	-.390	-.104	-.115	.451**	-.030	.129	.305**
19. PRCA PUB SPEAK	-.279*	-.079	-.249*	-.068	-.098	-.010	-.191	.076	.265*	.317**	-.113	.171	.197
20. RCBS	-.294*	-.087	-.217	.072	.023	.075	-.521**	-.206	-.212	.444**	-.217	.098	.406**
21. SIAS	-.223	-.007	-.265*	-.053	-.129	-.149	-.209	-.160	.019	.393**	-.253	.332**	.427**
22. STAI-Y2	.016	-.018	-.246*	.018	.164	-.057	-.274*	-.268	-.036	.596**	-.269*	.471**	.611**
23. STAXI T-ANGER	-.037	.058	.249*	.038	-.078	-.215	.213	.025	.194	.245*	-.103	.312**	.199
24. STAXI AC OUT	-.112	-.171	.127	.037	.066	.157	.040	.181	-.054	-.049	.159	-.007	-.097
25. STAXI AC IN	.022	-.025	.323**	-.145	.039	.176	.295**	.363**	-089	-.135	.202	-.015	-.032
26. STAXI INDEX	.000	.005	-.201	.058	-.026	-.159	-.157	-.239	.031	.268*	-.200	.199	.219

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Table 11

Single Pearson Correlations Between Scores on Psychological Surveys and Coded Conversational Behaviors – second half

PSYCH SURVEYS X BEHAVIOR	14	15	16	17	18	19	20	21	22	23	24	25	26
1. TURNS - LENGTH													
2. TURNS - NUMBER													
3. DISAGREEMENT													
4. SILENCE													
5. PAUSE													
6. WORD SEARCH													
7. BAS DRIVE													
8. BAS FUN SEEKING													
9. BAS REW RESP													
10. BIS													
11. CDS													
12. CES-D													
13. LS													
14. PANAS NEGATIVE	1												
15. PANAS POSITIVE	.807**	1											
16. PRCA GR DISC	.054	-.131	1										
17. PRCA MEETINGS	.150	-.091	.650**	1									
18. PRCA INT CONV	.039	-.180	.672**	.548**	1								
19. PRCA PUB SPEAK	-.042	-.213	.444**	.361**	.409**	1							
20. RCBS	-.077	-.242	.646**	.481**	.791**	.376**	1						
21. SIAS	.057	-.224	.489**	.597**	.638**	.406**	.641**	1					
22. STAI-Y2	.082	-.282	.394**	.430**	.407**	.428**	.485**	.563**	1				
23. STAXI T-ANGER	.118	-.075	.161	.180	.042	.137	.081	.267*	.267*	1			
24. STAXI AC OUT	.100	.094	-.011	-.118	.059	-.126	-.092	-.315**	-.234*	-.285*	1		
25. STAXI AC IN	.152	.128	-.246*	-.263*	-.208	-.135	-.277	-.415**	-.325	-.229	.630**	1	
26. STAXI INDEX	-.030	-.158	.336**	.320**	.174	.289*	.299**	.477**	.485**	.398**	-.783**	-.791**	1

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

TURNS LENGTH x Coded Behaviors. The number of seconds during which participants held the floor (TURNS LENGTH) is highly correlated to the number of turns participants took (TURNS NUMBER) (r=.469, p<0.01). It is also highly correlated to *Pause* (r=.513, p<0.01). It also has a medium correlation to *Word Searches* (WD SCH) (r=.302, p<0.01).

TURNS LENGTH x Psychological Scores. As can be observed in the table above, there was a medium correlation between TURNS LENGTH and *Depression* scores (CES.D) (r=.318, p<.01); it had a moderate negative correlation with *Communication Apprehension (PRCA) Group Discussion* (r=-.333, p<0.01), a moderate negative correlation with *Communication Apprehension (PRCA) Interpersonal Conversation* and (r= -.389, p<.01), a moderate negative correlation with *PRCA Public Speaking* (r=-.279, p<0.05). There was a weak positive correlation between number of turns taken and CES.D Drive (r=.313, N=77, p<.006), there was a medium negative correlation with *Shyness* (RCBS) (r= -.294, p<0.05), and a somewhat weaker negative correlation with Social Anxiety (SIAS) (r=-.223). All remaining scales showed weak to very weak correlations.

TURNS NUMBER x Coded Behaviors. The number of turns participants took in total showed a moderate to weak correlation with Disagreements (r=.224). It shows weak correlations to the other coded behaviors.

TURNS NUMBER x Psychological Scores. The number of turns participants took shows moderate correlation to Behavioral Activation (BAS Drive) (r=.245, p<0.05), and medium to weak negative correlation to *Communication Apprehension* (PRCA) *Group Discussion* (r=-.216). This category shows weak correlation to all other psychological scales.

Additional Pearson correlations between *turn-taking* and physiological data are displayed in *tables* 12 and 13.

Table 12

Single Pearson Correlations Between Heart Rate Variability During Group Task and Coded Conversational Behaviors – first half

CONVERSATION HRV X BEHAVIOR:	1	2	3	4	5	6	7	8	9	10	11	12
1. TURNS - LENGTH	1											
2. TURNS - NUMBER	.469**	1										
3. DISAGREEMENT	.205	.224	1									
4. SILENCE	.013	.004	-.167	1								
5. PAUSE	.513**	.142	.083	.221	1							
6. WORD SEARCH	.302**	.081	.123	.150	.527**	1						
7. SDNN	.031	-.006	.279*	.026	.013	.112	1					
8. RMSSD	.052	.089	.265*	-.052	-.007	.089	.894**	1				
9. SD1	.032	.082	.247*	-.086	-.011	.073	.857**	.958**	1			
10. SD2	-.017	.004	.295*	-.010	.017	.100	.951**	.808**	.819**	1		
11. LF/HF	.213	-.037	.118	-.013	.149	.156	-.243*	-.347**	-.362**	-.169	1	
12. TP	.053	.118	.269*	-.056	-.043	.017	.804**	.803**	.834**	.793**	-.194	1
13. NP HF	-.110	.067	.158	-.159	-.108	-.065	.418**	.557**	.613**	.405**	-.707**	.571**
14. NP LF	.053	.010	-.047	.037	.115	.120	-.416**	-.556	-.463**	-.176	.745**	-.443
15. RP HF	-.015	.139	.107	-.153	-.064	-.036	.404**	.573**	.634**	.340**	-.532**	.651**
16. RP LF	.319**	.105	-.021	-.077	.178	.139	-.198	-.189	-.115	-.107	.584**	-.168
17. RP VLF	-.277*	-.156	.014	.078	-.100	-.039	-.161	-.294*	-.298**	.007	-.022	-.297**
18. AP HF	-.035	.106	.182	-.095	-.083	.002	.579**	.675**	.698**	.509**	-.323**	.856**
19. AP LF	.256*	.136	.226	-.032	.055	.052	.621**	.570**	.630**	.656**	.149	.751**
20. AP VLF	-.027	.018	.267*	.039	-.045	-.007	.801**	.668**	.663**	.864**	-.174	.759**
21. PF HF	-.080	-.077	.075	-.155	-.014	.059	.029	.170	.257*	.140	-.162	.242*
22. PF LF	.056	-.007	.167	-.129	-.051	.052	-.043	-.068	.004	.047	.349**	.011
23. PF VLF	.206	-.087	-.002	-.122	.100	.168	.068	.023	.090	.085	.384	.078

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Table 13

Single Pearson Correlations Between Heart Rate Variability During Group Task and Coded Conversational Behaviors – second half

CONVERSATION HRV X BEHAVIOR:	13	14	15	16	17	18	19	20	21	22	23
1. TURNS - LENGTH											
2. TURNS - NUMBER											
3. DISAGREEMENT											
4. SILENCE											
5. PAUSE											
6. WORD SEARCH											
7. SDNN											
8. RMSSD											
9. SD1											
10. SD2											
11. LF/HF											
12. TP											
13. NP HF	1										
14. NP LF	-.756**	1									
15. RP HF	.891**	-.709**	1								
16. RP LF	-.485**	.632**	-.213	1							
17. RP VLF	-.104	.285*	-.477**	-.484**	1						
18. AP HF	.721**	-.619**	.854**	-.278*	-.376**	1					
19. AP LF	.114	-.027	.261*	.304**	-.414**	.385**	1				
20. AP VLF	.337**	-.215	.174	-.325**	.228*	.422**	.587**	1			
21. PF HF	.508**	-.191	.442**	-.082	.002	.298**	.066	.136	1		
22. PF LF	-.166	.348	-.030	.544**	-.276*	-.050	.234*	-.132	.046	1	
23. PF VLF	-.221	.236	-.017	.558**	-.466**	-.010	.351**	-.125	-.005	.373**	1

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

TURNS LENGTH x Heart Rate Variability. Based on this table, it can be observed that TURNS LENGTH is moderately correlated with the HRV values LF/HF (r=.213), RP LF (r=.319, p<0.01), and AP LF (r=.256). In addition, it shows moderate negative correlation with RP VLF (r=-.277, p<0.05).

TURNS NUMBER x Heart Rate Variability. The number of turns participants took in general is only weakly correlated to HRV values. No significant correlations were found for this category.

Regression Analysis

Typically, a regression analysis is done for one of two purposes: in order to predict the value of the dependent variable for individuals for whom some information concerning the explanatory variables is available, or in order to estimate the effect of some explanatory variable on the dependent variable.

Turns Number. This conversational behavior did not produce independently correlated variables that would allow a regression analysis, as the assumptions for all possible independently correlated variables were not satisfied.

Turns Length. TURNS LENGTH is the dependent variable in this case, and this variable represents how many seconds in total each participant had during their entire group conversation. The independent variables selected for this regression were based on their correlation to the dependent variable, and on lack of correlation to each other. The identified independent variables are in *table* 14.

Table 14 *Dependent and Independent Variables for Regression Analysis of Turns Length*				
Dependent Variable:	Independent Variable:	Independent Variable:	Independent Variable:	Independent Variable:
TURNS LENGTH	PAUSE	CES-D	PRCA-24 INT CONV	HRV RP LF GCN

Figure 6 and *tables* 15, 16, and 17 demonstrate that the assumptions of linear regression analysis were verified, making sure that the variables selected allow the use of a regression model.

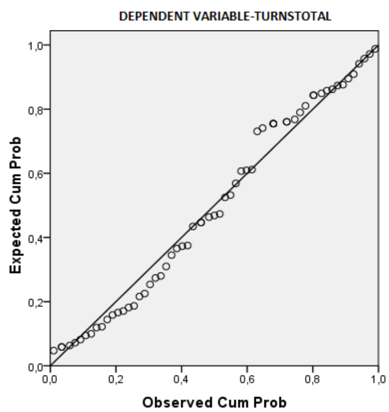

Figure 6. Linearity assumption for TURNS LENGTH

Table 15 *Normality assumption of variables*			
	N	Skewness	Kurtosis
TURNS LENGTH	61	.130	-.920
PAUSE	61	.970	-.037
CES-D	61	.395	.364
PRCA INT CONV	61	.311	-.302
HRV RP LF GCN	61	-.160	-.102

Skewness and Kurtosis values must be between -1 and +1 in order to satisfy the normality assumption of this dataset. In this case, all of the skewness and kurtosis values are between -1 and +1, so this assumption was satisfied.

Table 16

Multi-colinearity assumption between variables

	N	Tolerance	VIF (variance inflation factor)	CI (condition index)
TURNS LENGTH	61			1.000
PAUSE	61	.967	1.035	1.160
CES-D	61	.958	1.044	1.428
PRCA INT CONV	61	.881	1.135	1.675
HRV RP LF GCN	61	.880	1.136	2.199

According to Field (2005) and Mertler and Vannatta (2005), to avoid multi-colinearity problems between independent variables, tolerance values must be higher than 0.10. In addition, variance inflation factor values must be lower than 10, and condition indexes must be lower than 30. Here, all of the tolerance values are higher than 0.10, and all of the variance inflation factor values are lower than 10. Finally, all condition indexes are lower than 30. This means that there are no multi-colinearity problems between the selected independent variables.

Table 17

Results of regression analysis for TURNS LENGTH

Variable	B	β	t	p	Partial	Part
CONSTANT	.228		1.878	.066		
PAUSE	1.023	.465	4.543	.000*	.519	.457
CES-D	.193	.172	1.674	.100	.218	.169
PRCA INT CONV	-.323	-.318	-2.967	.004*	-.369	-.299
HRV RP LF GCN	.132	.144	1.346	.184	.177	.136

Notes. * *p* values are significant
** *p* values are not significant

Finally, below are the variables that comprise the regression model defined for TURNS LENGTH.

R= 0.657; R^2=0.432, F=10.659; sd=4.56; p=0.000*

TURNS LENGTH = 0.228+1.023*(PAUSE)+0.193*(CES-D)-0.323*(PRCA INT CONV) +0.132*(HRV RP LF GCN)

The *p* values marked with a (*) in the tables are significant, which means that they have that there is a significant correlation between the value and the dependent variable. This also shows that the independent variables can predict the dependent variable. These equations are significant because their p value are (<.05). If these values were higher than .05, we would not be able to use those equations to predict the targeted behavior. Therefore, these equations let you insert values for the independent variables in order to predict the dependent variable.

This equation is significant because its *p* value is (<.05). If this value were higher than .05, it would not be possible to use this equation to predict the targeted behavior. Therefore, this equation allows the insertion of values for the independent variables in order to predict the dependent variable.

Summary and Conclusion

In conversation analysis, researchers frequently look at a transcript of a recorded natural interaction in search of contextual and sequential clues for participants' decision to take or hold the floor. Moreover, the timing for taking the floor, number of overlaps, gestures, facial expressions, gaze orientation, and prosody are among the resources that participants can manipulate in order to signal to each other they are keeping the floor longer, are going to relinquish it, or are about to take over. These resources are visual and aural, and also available to conversation analysts with access to a videorecording of the interaction. But there are other non-visual or aural resources that can not only mold conversationalists' behavior to a certain degree, but that are also measurable and recordable by instruments. These resources are personal reports of psychological traits and states and physiological data.

This chapter has shown that there is a correlation between participants' psychological predispositions and their actual behavior, which in this case was *turn-taking.* These sources of additional data can help especially in the interpretation of group conversations, since there is a more distributed responsibility to maintain the conversation going, minimize overlaps, and avoid long silences. For example, it is very likely that a person with the highest score of communication apprehension or shyness would have the floor less if the other participants have higher scores in interpersonal conversation.

For the sake of performing a discriminatory analysis, the conversational behavior category *turn-taking* was subdivided into *length of floor held* (TURNS LENGTH) and *number of turns taken* (TURNS NUMBER). A number of psychological constructs that have a direct impact on social and communicative behavior were used to help interpret the dynamics of the interactions under a stable setting and context, namely a social study held at a psychophysiology lab at UCLA, with participants who do not know each other, and who are given a discussion task to generate conversation.

In terms of what could be observed regarding the usefulness of psychological scales in the study of turn-taking behavior, it was pointed out here that certain psychological individual differences in personality traits and states were highly correlated with the conversational behaviors of *length of floor held* and *number of turns taken.* More specifically, the psychological constructs that most highly correlate with *length of floor held* were Communication Apprehension Group Discussion (PRCA, negatively correlated), Depression (CES-D, positively correlated) and Communication Apprehension Interpersonal Conversation (PRCA, negatively correlated). On the other hand, the psychological construct that most highly correlated with *number of turns taken* was Behavioral Approach (BAS). Given that this psychological construct represent variables that drive social behavior, it can be argued that participants with higher scores on this scale had the motivation necessary to keep engaged in the conversation and work toward its continuous maintenance.

In addition, the *length of floor held* per participant and the *number of turns taken* were moderately correlated, but not highly. This correlation was r=469 ($p<0.05$). This might be explained by the fact that participants who held the floor the most would also take more turns back. . The *length of floor held* also correlated with pauses and word searches, while *number of turns taken* did not correlate with any other behavior. This fact is also reasonable since the longer one keeps the floor, the higher the chances there will be intra-turn pauses and word searches, while just taking consecutive turns does not imply that they are long enough for other conversational behaviors to occur.

In terms of how measures of heart rate variability (HRV) informed this research, the data displayed in this chapter have shown that the *length of floor held* moderately correlated with LF-HRV and with LF/HF ratio; and the *number of turns taken* weakly correlated with both LH-HRV and HF-HRV, indicating that both sympathetic and parasympathetic systems were involved in the transitions of turns behavior, but maintaining the floor increased levels of stress. This is because higher values of high frequency HRV have been shown to be associated with parasympathetic activation and pro-social behavior, while higher low frequencies have been shown to be associated with sympathetic activity. Therefore, low-frequency-high-frequency (LF/HF) ratio represents parasympathetic-sympathetic autonomic influences.

Finally, by identifying which variables were correlated with *length of floor held* and *number of turns taken* but that were independent and non-correlated to each other, it was possible to create a regression model that allows conversation analysts to predict conversational behaviors, or at least how likely any given individual would be to produce a certain type of conversational behavior. Such a model ideally takes into account various dimensions of individual psychological and physiological differences in the sought behavior. What was found here was that the *number of turns taken* did not hold significant enough correlations with any of the variables produced in this research in order to pass regression analysis assumption tests. However, the *length of floor held* did. Four variables were selected for this regression, namely: Pauses, Depression, Interpersonal Conversation, and LF-HRV collected during the conversation task. This means that provided a researcher has access to these data, how long a participant is likely to hold the floor can be anticipated.

Chapter 5: Silences and Pauses

Silence can be as loud and meaningful as words. Depending on how it is used, or where it is placed in a given sequence organization of a turn construction unit, it can mean potential trouble at talk, avoidance of a face threatening act, a preemptive sign of a restart, among other context-specific interpretations. However, in naturally occurring speech, humans tend to reduce the possible duration of a silence by using it as a transition relevance place. Pauses, however, are constrained by the ongoing speech of the current turn, although they can be construed as a possible transition relevance place as well.

Based on empirical study of tape recordings of naturally occurring interaction, Sacks et al. (1974) outlined a model that captures the intuition that silence is a great deal more than an absence of speech. Findings from qualitative conversation analytic research have demonstrated that when silence follows certain speech acts (e.g. invitations or requests) it is indicative of possible trouble in the interaction (e.g. invitation about to be declined or request denied) (Davidson, 1984; Pomerantz, 1984). This "trouble" surrounding silence is empirically available through speakers' routine practice of producing "subsequent versions'' (Davidson, 1984, p. 104) of their requests or invitations following silence. To serve as illustration of this point, the following is a simplified transcription of an actual conversation in which such an activity occurs (based on Davidson, 1984, p. 104).

```
A:   Well did you want me to just pick you- get into Robinson's so you  could
buy a little pair of slippers?
     (silence)
A:   I mean or can I get you something?
```

Essentially, the silence following the proposal or request occasions the speaker's review of prior talk to find some way to make it more clear, understandable, or perhaps acceptable to the listener. With this and other examples, Davidson (1984) demonstrates how speakers faced with silence at a place where response is expected, reformulate their talk to display that they understand their hearer to be reluctant, not hearing, or for some other reason slow to respond. This detection of trouble by the speaker is thus attuned to what is not said, to the lack of uptake after particular types of speech acts that require response. Silence is within the realm of formal linguistic cues, and it must be understood in the context of surrounding talk, both in terms of social actions occasioned by preceding talk and prosodic features of that talk (Heldner & Edlund, 2010).

Previous research suggests that a silence duration of approximately 1 second is oriented to by speakers as troubles-indicative (Jefferson, 1989). However, in an exhaustive examination of 289 pages of transcription (in which silences had been subjectively timed), Jefferson (1989) identified 170 interactional sequences where the silences indicated some problematic moment. Sixty-two percent of these troubles-indicative silences (n = 106) were between 900 and 1200 ms. Silences longer than that were generally filled in some way (i.e., with non-verbal activity such as scanning documents or writing something down).

Although evidence suggests 1 second as a rough metric, it is evident that troubles-indicative silences occur in all lengths in natural conversation. In fact, Davidson's (1984) research concerning reformulation of a speech act following silence has instances of much smaller gaps. Although these were timed subjectively, relative to the speed of the surrounding talk, it is nonetheless clear that silence is a sequentially relevant and dynamic phenomenon in conversation.

This insight has been examined from a cognitive perspective by researchers working within the "Feeling of Knowing'' paradigm (Hart, 1965; Smith and Clark, 1993) or the "Feeling of Another's Knowing'' paradigm (as identified by Brennan and Williams, 1995). These approaches have examined delaying of response (as well as other prosodic cues, fillers, and lexical hedges) in terms of the production and detection of uncertainty. Latency to respond is conceptualized as an inability to find an answer (Glucksberg and Mccloskey, 1981); the outward appearance of this searching-monitoring process (Nelson, 1993) is thus characterized as "uncertainty.'' Swerts and Krahmer (2005) take this research a step further by combining audio and visual cues so that facial expressions are also examined as signaling uncertainty.

What these efforts have yet to make explicit is that uncertainty must be more broadly construed; affective orientations such as "unwilling" or "uninterested'' or "not in agreement'' are interpersonally relevant shadings of uncertainty, and could become manifest in the context of speech acts where requests and opinions are at stake. The uncertainty in these cases is not necessarily about "not knowing'' or "unable to retrieve,'' but instead concerns so the context of utterances other than those which embody factual searches. Furthermore, when delay has been examined, the pauses are categorized subjectively ("long'' and "short'' by Brennan and Williams, 1995, p. 389 ; "present'' or "absent'' in Swerts and Krahmer, 2005, p. 84). What this means is that delay is being treated as a general cue, which fits with insights from early descriptive studies, but the lack of precision in measurements makes it hard to compare findings across studies or to apply findings in environments where greater exactness is required (for example, in speech processing domains).

Finally, despite the general sense that latency of response is related to uncertainty or even deception (see Anderson, 1999 , for an overview) silence has also been shown to signal thoughtfulness (Burgoon et al., 1995). As Levinson (1983) points out, it is unwise to view silence as meaning only one thing. As described by Davidson (1984) and Pomerantz (1984) , silence takes on meaning in the context of the structure of the interaction so far.

Another consideration in the study of silence is how different words can be used interchangeably in various research papers. Silences can also be categorized in terms of length and placement during an ongoing dialogue. For example, Sacks et. al. (1974) distinguished between three kinds of acoustic silences in conversations: pauses, gaps, and lapses. This classification was based on what preceded and followed a silence in a conversation, and on the perceived length of the silence. A pause, in this account, refers to a silence within a turn; a gap refers to a shorter silence between turns or at a possible completion point (i.e. at a transition-relevance place, or TRP); and a lapse refers to a longer (or extended) silence between turns. However, this classification is complicated by the fact that the right context of the silence was also taken into account. For example, a silence followed by more speech by the same speaker would always be classified as a pause; also if it occurred at a TRP. Although this situation is not mentioned by Sacks, it seems fair to assume that any silence followed by a speaker change would be classified as a gap or a lapse also when it did not occur at a TRP. Hence, gaps and lapses could in practice only occur when there was a speaker change.

There is also the possibility of speaker changes involving overlaps or no-gap-no-overlaps, which were the terms used by Sacks et. al. (1974). In addition to gaps, it seems that just about any three-way combination of (i) inter/between, (ii) turn/speaker, and (iii) silences/ pauses/ intervals/ transitions has been used for concepts similar to gaps and duration of gaps at some point in time (e.g. Bull, 1996; Roberts, Francis, & Morgan, 2006; Bosch, Oostdijk, & Boves, 2005; Bosch, Oostdijk, & de Ruiter, 2004b). Other closely related terms include (positive) response times (Norwine & Murphy, 1938), alternation silences (Brady, 1968), switching pauses (Jaffe & Feldstein, 1970), (positive) switch time or switch pauses (Sellen, 1995), transition pauses (Walker & Trimboli,1982), (positive) floor transfer offsets (de Ruiter et. al., 2006), or just silent or unfilled pauses (e.g. Campione & Veronis, 2002; Duncan, 1972; Maclay & Osgood, 1959; McInnes & Attwater, 2004; Weilhammer & Rabold, 2003).

Pauses and overlaps do not seem to have as many names, but the alternative terms for overlaps or durations of overlaps include, at least, double talking and (negative) response times (Norwine & Murphy, 1938), double talk and interruptions (Brady, 1968), simultaneous speech (Jaffe & Feldstein, 1970), (negative) switch time or switch overlaps (Sellen, 1995), and (negative) floor transfer offsets (de Ruiter et. al., 2006). On the other hand, there are apparently two ways of treating gaps and overlaps in the previous literature. Either gaps and overlaps are treated as entirely different phenomena, or they are conceptualized as two sides of a single continuous metric (with negative values for overlaps, and positive values for gaps) that measures the relationship between one person ending a stretch of speech and another starting one (de Ruiter et. al., 2006; Norwine & Murphy, 1938; Sellen, 1995).

Finally, pauses (in the sense of silences or durations of silences within the speech of one speaker) have also been called "resumption times" (Norwine & Murphy, 1938) and the slightly expanded version within-speaker pauses. On a side note, while many of these terms superficially appear to presuppose the existence of turns or a conversational 'floor,' studies involving larger scale distribution analyses of such durations have typically defined their terms operationally in terms of stretches of speech ending in a speaker change, rather than stretches of speech ending in a transition-relevance place (cf. Bosch et. al., 2005).

An important consideration when analyzing pause, gap and overlap distributions is the factors known to influence those intervals. For gaps, it has been suggested that increased stress (induced in an interview situation designed to elicit information of an intimate and embarrassing nature) is associated with markedly shorter gaps (Jaffe & Feldstein, 1970). Similarly, competitive conversations, for example conversations involving arguments, have significantly shorter gaps than cooperative conversations, such as friendly chats (Trimboli & Walker, 1984). There have also been reports that gap durations tend to increase with cognitive load (see e.g. in Cappella,1979).

In the present study, the term Silence is used for gaps and lapses that occurred between speakers turns, whereas the term Pause is used for instances of silence within a same turn. For the analysis of participants' physiological changes during these events, the length of silences and pauses was broken down into 1-second intervals, ranging from 1 to 15 seconds. The frequency and length of silences and pauses was quantified and correlated with psychological scores in order to determine if psychological traits have any weight over the number and length of silences and pauses utilized during a 20-minute conversation, and also over observed physiological changes.

Psychological Scores, Physiological Values, and Coded Behavior

In order to investigate correlations between psychological scores and *silences* and *pauses*, statistical analyses were conducted in SPSS with significance set at $p<.05$. The surveys used for this correlation were: Behavioral activation system and behavioral inhibition system (BIS/BAS), Cognitive disinhibition scale (CDS), Center for epidemiological studies depression scale (CES-D), Loneliness scale (LS), Positive and negative affect schedule (PANAS-X), Personal report of communication apprehension (PRCA-24), Revised cheek and buss shyness scale (RCBS), Social interaction anxiety scale (SIAS), State-trait anxiety inventory for adults (STAI), and State-trait anger expression inventory (STAXI).

All correlational analyses were conducted with Single Pearson Correlations, two-tailed. The correlation coefficient was interpreted as r =.5 large, r = .3 medium, and r= .10 small. Single Pearson Correlations were used to compare all psychological constructs to *silences* and *pauses* and participants' physiological data during the conversation. Tests were conducted to ensure that underlying assumptions for between-group analyses were not violated. The Pearson Assumption was satisfied by running a descriptives test on the entire dataset, in order to test for normal distribution, looking at Kurtosis and Skewness. Before testing for normal distribution, all values were changed into Standard Scores, or Z-scores, so that all data were comparable. Paired Sample T-Tests were performed in order to check for significant difference between pairs. T-Test significance was set at $p<0.5$ and Means of Pre and Post heart rate and skin conductance were examined.

Procedures and Results

Coding turns, extracting HR and SC data, and syncing both. The method of coding behavior, location and extraction of HR and SC averages, and merging data onto a centralized excel data sheet is described below step-by-step:

Step 1. Video recordings were watched and coded by research assistants that had undertaken in-lab training specifically for this task. They looked for all instances of intraturn pauses that were 1 second or longer, and interturn silences that were 1 second or longer.

Step 2. Coding was checked by 3 separate research assistants to make sure the timing of all codes was right, and that all instances of silences and pauses were appropriately caught and labeled.

Step 3. All silences and pauses codes were transferred to the spreadsheet containing the heart rate and skin conductance data that was recorded during the video recorded conversation. The transfer relied on time stamps on the video and on the data sheet.

Step 4. The code transfer task was also checked by 3 separate research assistants in order to make sure all codes were correctly placed on the physiology spreadsheet.

Step 5. An excel formula was created and used for each and every code, in order to look for the target codes, and then read the data 10 seconds before and 10 seconds after each code, calculate the mean of the previous 10 seconds, and for the 10 seconds that followed, and paste the values elsewhere on the same sheet. The formula looked at the heart rate and skin conductance data for all three participants, for each instance of target behavior.

Step 6. All the means were gathered on a separate spreadsheet. They were pasted back-to-back, in order to find the overall "Pre Mean" and "Post Mean" averages for all silences and pauses in the 24 conversations.

Step 7. These values were plotted within excel in order to generate a visual graph containing the differences between Pre and Post silence and pause data. In those plots (see *figures* 7 and 8 below) the Y-axis is the heart rate or skin conductance value, and the X-axis is the corresponding number of cases found for each target behavior, which in this case was silences and pauses.

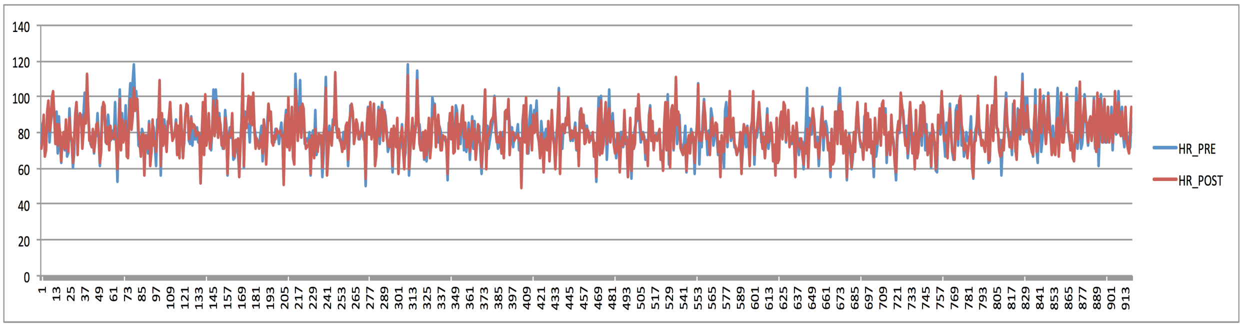

Figure 7. Pre and post average heart rate values for silences by number of cases

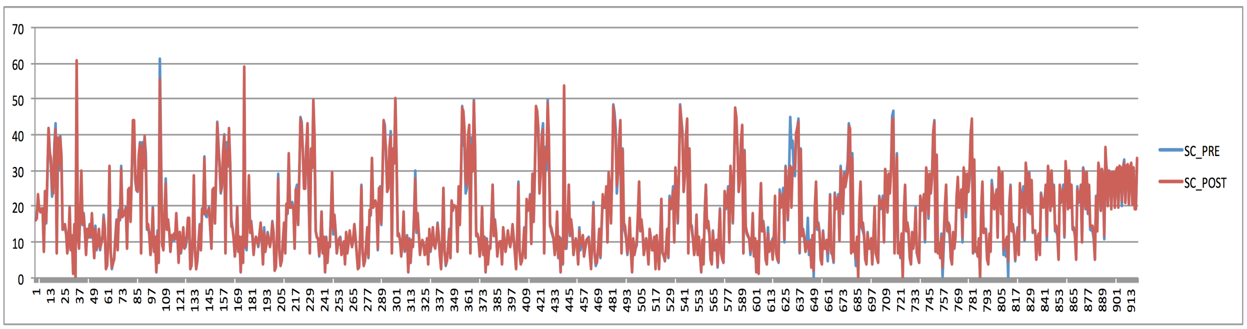

Figure 8. Pre and post average skin conductance values for silences by number of cases

In *figures* 7 and 8 it can be observed that there were very small changes surrounding the investigated behavior. In order to find out if these small changes were statistically significant, and paired T-test was performed (step 9).

Step 8. Descriptive statistics analysis was performed on the data in order to verify a normal distribution of the silence and pause data, looking at skewness and kurtosis. Skewness and kurtosis had to be between -1 and +1 for the values to have normal distribution.

Step 9. Paired T-Tests were performed in order to check if the differences between the Pre-Post heart rate and Pre-Post skin conductance data were significant. Significant differences between Pre and Post values would have to be (<.05).

Table 18 *Descriptive Statistics for Silences Pre and Post HR and SC*					
	N	Skewness		Kurtosis	
	Statistic	Statistic	Standard Error	Statistic	Standard Error
SILENCEHRPRE	919	.269	.081	.349	.161
SILENCEHRPOST	919	.243	.081	.100	.161
SILENCESCPRE	919	.918	.081	.294	.161
SILENCESCPOST	919	.924	.081	.317	.161
Valid N (list wise)	919				

From the table above it can be observed that the date show a normal distribution since values fall between -1 and 1.

Table 19 *Paired Samples Statistics for Silences Pre and Post Means*					
		Mean	N	Std Deviation	Std Error
Pair 1	SILENCEHRPRE	79.89	919	11.02	.363
	SILENCEHRPOST	79.69	919	10.85	.358
Pair 2	SILENCESCPRE	17.37	919	11.23	.370
	SILENCESCPOST	17.44	919	11.21	.370

As can be observed from *tables* 18 and 19, the values for SILENCEHRPRE and SILENCEHRPOST do not show a significant difference. There is also no significant difference between the pairs SILENCESCPRE and SILENCESCPOST. In addition, the means of the paired variables show that *pre* heart rate was higher than *post* heart rate, whereas *pre* skin conductance in comparison to its pair, *post* skin conductance was slightly lower.

Based on these results, paired sample statistics for pre and post heart rate and skin conductance for *pauses* was not performed, given what constitutes a *pause*. A *pause* falls within turn, and because of its nature, it is not expected to generate a very different change in heart rate and skin conductance from the results found for *silences*.

Table 20

Paired Samples Correlations for Silences Pre and Post Means

		N	Correlation	Sig.
Pair 1	SILENCEHRPRE & SILENCEHRPOST	919	.882	.000
Pair 2	SILENCESCPRE & SILENCESCPOST	919	.994	.000

The correlation values observed in the table above show that SILENCEHRPRE and SILENCEHRPOST are highly correlated (r=.882, p=.000). The same can be observed for SILENCESCPRE and SILENCESCPOST (r=.994, p=.000).

Table 21

Paired Samples T-Test for Silences Pre and Post Means

		Paired Differences					t	df	sig.
					95% Confidence Interval of the Difference				
		Mean	Std Deviation	Std Error	Lower	Upper			
Pair 1	SILENCEHRPRE & SILENCEHRPOST	.201	5.32	.175	-.143	.546	1.148	918	.251
Pair 2	SILENCESCPRE & SILENCESCPOST	-.063	1.27	.042	-.146	.018	-1.521	918	.129

Tables 20 and 21 shows the results of the T-test performed on the *silence* pre and post means data. It can be observed that the difference of means taken between each of these pairs is not significant, given that the significant values (Sig.) are higher than (.05).

Preparing data for correlations. In order to look for correlations among participants' psychological scores, target behaviors, heart rate, skin conductance, and heart rate variability values, a Pearson Single Correlation was performed after a series of steps, as follows:

Step 1. Participants' answers to psychological questionnaires were scored following the procedures listed in the corresponding scoring manuals.

Step 2. All data relative to participants' scores, quantification of target behaviors per participant, heart rate and skin conductance averages, and heart rate variability values were transferred to an excel sheet. This data sheet contained all data collected for Study 2, displayed by participant, and by group.

Step 3. This data sheet containing all data displayed by participant and by group was imported into SPSS.

Step 4. To prepare the data for a Pearson Single Correlation analysis, all data was converted to standard scores, or Z scores.

Step 5. The data were checked for normal distribution, looking at skewness and kurtosis. Skewness and kurtosis had to be between -1 and +1 for the values to have normal distribution.

Step 6. Pearson Single Correlation analysis was performed, and the correlations between *silences* and *pauses,* other behaviors, and psychological scores (see *tables* 10 and 11, presented again in this section).

Correlation results. The correlation coefficient was interpreted as r =.5 large, r = .3 medium, and r= .10 small. As can be observed in the table below, coded behaviors and certain surveys showed strong and medium correlations to the number of silence and pauses.

Table 10

Single Pearson Correlations Between Scores on Psychological Surveys and Coded Conversational Behaviors – first half

PSYCH SURVEYS X BEHAVIOR	1	2	3	4	5	6	7	8	9	10	11	12	13
1. TURNS - LENGTH	1												
2. TURNS - NUMBER	.469**	1											
3. DISAGREEMENT	.205	.224	1										
4. SILENCE	.013	.004	-.167	1									
5. PAUSE	.513**	.142	.083	.221	1								
6. WORD SEARCH	.302**	.081	.123	.150	.527**	1							
7. BAS DRIVE	.161	.245*	.257*	-.010	.010	.041	1						
8. BAS FUN SEEKING	-.141	-.063	.106	-.207	-.126	.056	.293*	1					
9. BAS REW RESP	-.049	.144	.110	-.089	-.203	-.025	.408**	.243*	1				
10. BIS	-.127	-.015	-.164	.065	-.012	-.091	-.162	-.170	.236*	1			
11. CDS	-.074	-.079	.022	.000	-.047	.064	.087	.252*	.115	-.265*	1		
12. CES-D	.318**	.189	.006	.062	.336**	.081	-.019	-.054	.257*	.277*	-.021	1	
13. LS	.113	.074	.031	-.207	.121	-.042	-.198	.105	-.013	.366**	-.102	.469**	1
14. PANAS NEGATIVE	.016	-.108	-.136	.040	-.011	-.081	.090	.094	.089	.066	.079	.182	.041
15. PANAS POSITIVE	.087	-.060	-.061	-.002	-.020	-.039	.128	.263	.088	-.192	.156	-.092	-.224
16. PRCA GR DISC	-.333**	-.216	-.194	.234*	-.060	.020	-.235*	-.232	-.082	.406**	-.051	.081	.179
17. PRCA MEETINGS	-.141	-.149	-.124	.155	-.022	.092	-.228	-.080	.004	.351**	-.144	.190*	.329**
18. PRCA INT CONV	-.389**	-.134	-.272*	.076	-.105	.047	-.390	-.104	-.115	.451**	-.030	.129	.305**
19. PRCA PUB SPEAK	-.279*	-.079	-.249*	-.068	-.098	-.010	-.191	.076	.265*	.317**	-.113	.171	.197
20. RCBS	-.294*	-.087	-.217	.072	.023	.075	-.521**	-.206	-.212	.444**	-.217	.098	.406**
21. SIAS	-.223	-.007	-.265*	-.053	-.129	-.149	-.209	-.160	.019	.393**	-.253	.332**	.427**
22. STAI-Y2	.016	-.018	-.246*	.018	.164	-.057	-.274*	-.268	-.036	.596**	-.269*	.471**	.611**
23. STAXI T-ANGER	-.037	.058	.249*	.038	-.078	-.215	.213	.025	.194	.245*	-.103	.312**	.199
24. STAXI AC OUT	-.112	-.171	.127	.037	.066	.157	.040	.181	-.054	-.049	.159	-.007	-.097
25. STAXI AC IN	.022	-.025	.323**	-.145	.039	.176	.295**	.363**	-089	-.135	.202	-.015	-.032
26. STAXI INDEX	.000	.005	-.201	.058	-.026	-.159	-.157	-.239	.031	.268*	-.200	.199	.219

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Table 11

Single Pearson Correlations Between Scores on Psychological Surveys and Coded Conversational Behaviors – second half

PSYCH SURVEYS X BEHAVIOR	14	15	16	17	18	19	20	21	22	23	24	25	26
1. TURNS - LENGTH													
2. TURNS - NUMBER													
3. DISAGREEMENT													
4. SILENCE													
5. PAUSE													
6. WORD SEARCH													
7. BAS DRIVE													
8. BAS FUN SEEKING													
9. BAS REW RESP													
10. BIS													
11. CDS													
12. CES-D													
13. LS													
14. PANAS NEGATIVE	1												
15. PANAS POSITIVE	.807**	1											
16. PRCA GR DISC	.054	-.131	1										
17. PRCA MEETINGS	.150	-.091	.650**	1									
18. PRCA INT CONV	.039	-.180	.672**	.548**	1								
19. PRCA PUB SPEAK	-.042	-.213	.444**	.361**	.409**	1							
20. RCBS	-.077	-.242	.646**	.481**	.791**	.376**	1						
21. SIAS	.057	-.224	.489**	.597**	.638**	.406**	.641**	1					
22. STAI-Y2	.082	-.282	.394**	.430**	.407**	.428**	.485**	.563**	1				
23. STAXI T-ANGER	.118	-.075	.161	.180	.042	.137	.081	.267*	.267*	1			
24. STAXI AC OUT	.100	.094	-.011	-.118	.059	-.126	-.092	-.315**	-.234*	-.285*	1		
25. STAXI AC IN	.152	.128	-.246*	-.263*	-.208	-.135	-.277	-.415**	-.325	-.229	.630**	1	
26. STAXI INDEX	-.030	-.158	.336**	.320**	.174	.289*	.299**	.477**	.485**	.398**	-.783**	-.791**	1

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Silence x Coded Behavior. The number of silences in the conversations moderately correlates with Pauses (r=.221), and a weak correlation to the other behaviors.

Silence x Psychological Scores. The number of silences in the conversations shows a moderate negative correlation to *Behavioral Activation* (BAS) *Fun Seeking* (r=-.207) and to *Loneliness* (LS) (r=-.207). Finally, it also shows a moderate to weak positive correlation to *Communication Apprehension* (PRCA) *Group Discussion* (r=.234, $p<0.05$).

Pause x Coded Behavior. The number of pauses during the conversations highly correlates to *Word Searches* (WD SCH) (r=.527, $p<0.01$). It does not correlate with any of the other coded behaviors.

Pause x Psychological Scores. Pauses are moderately correlated to *Depression* CES-D (r=.336, $p<0.01$), and moderately to weakly negatively correlated to *Behavioral Activation* (BAS) *Reward Responsiveness* (r=-.203).

In addition, the Pearson Correlation between *silences* and *pauses,* other behaviors, and physiological data are displayed in *tables* 12 and 13, presented again here.

Table 12

Single Pearson Correlations Between Heart Rate Variability During Group Task and Coded Conversational Behaviors – first half

CONVERSATION HRV X BEHAVIOR:	1	2	3	4	5	6	7	8	9	10	11	12
1. TURNS - LENGTH	1											
2. TURNS - NUMBER	.469**	1										
3. DISAGREEMENT	.205	.224	1									
4. SILENCE	.013	.004	-.167	1								
5. PAUSE	.513**	.142	.083	.221	1							
6. WORD SEARCH	.302**	.081	.123	.150	.527**	1						
7. SDNN	.031	-.006	.279*	.026	.013	.112	1					
8. RMSSD	.052	.089	.265*	-.052	-.007	.089	.894**	1				
9. SD1	.032	.082	.247*	-.086	-.011	.073	.857**	.958**	1			
10. SD2	-.017	.004	.295*	-.010	.017	.100	.951**	.808**	.819**	1		
11. LF/HF	.213	-.037	.118	-.013	.149	.156	-.243*	-.347**	-.362**	-.169	1	
12. TP	.053	.118	.269*	-.056	-.043	.017	.804**	.803**	.834**	.793**	-.194	1
13. NP HF	-.110	.067	.158	-.159	-.108	-.065	.418**	.557**	.613**	.405**	-.707**	.571**
14. NP LF	.053	.010	-.047	.037	.115	.120	-.416**	-.556	-.463**	-.176	.745**	-.443
15. RP HF	-.015	.139	.107	-.153	-.064	-.036	.404**	.573**	.634**	.340**	-.532**	.651**
16. RP LF	.319**	.105	-.021	-.077	.178	.139	-.198	-.189	-.115	-.107	.584**	-.168
17. RP VLF	-.277*	-.156	.014	.078	-.100	-.039	-.161	-.294*	-.298**	.007	-.022	-.297**
18. AP HF	-.035	.106	.182	-.095	-.083	.002	.579**	.675**	.698**	.509**	-.323**	.856**
19. AP LF	.256*	.136	.226	-.032	.055	.052	.621**	.570**	.630**	.656**	.149	.751**
20. AP VLF	-.027	.018	.267*	.039	-.045	-.007	.801**	.668**	.663**	.864**	-.174	.759**
21. PF HF	-.080	-.077	.075	-.155	-.014	.059	.029	.170	.257*	.140	-.162	.242*
22. PF LF	.056	-.007	.167	-.129	-.051	.052	-.043	-.068	.004	.047	.349**	.011
23. PF VLF	.206	-.087	-.002	-.122	.100	.168	.068	.023	.090	.085	.384	.078

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Table 13

Single Pearson Correlations Between Heart Rate Variability During Group Task and Coded Conversational Behaviors – second half

CONVERSATION HRV X BEHAVIOR:	13	14	15	16	17	18	19	20	21	22	23
1. TURNS - LENGTH											
2. TURNS - NUMBER											
3. DISAGREEMENT											
4. SILENCE											
5. PAUSE											
6. WORD SEARCH											
7. SDNN											
8. RMSSD											
9. SD1											
10. SD2											
11. LF/HF											
12. TP											
13. NP HF	1										
14. NP LF	-.756**	1									
15. RP HF	.891**	-.709**	1								
16. RP LF	-.485**	.632**	-.213	1							
17. RP VLF	-.104	.285*	-.477**	-.484**	1						
18. AP HF	.721**	-.619**	.854**	-.278*	-.376**	1					
19. AP LF	.114	-.027	.261*	.304**	-.414**	.385**	1				
20. AP VLF	.337**	-.215	.174	-.325**	.228*	.422**	.587**	1			
21. PF HF	.508**	-.191	.442**	-.082	.002	.298**	.066	.136	1		
22. PF LF	-.166	.348	-.030	.544**	-.276*	-.050	.234*	-.132	.046	1	
23. PF VLF	-.221	.236	-.017	.558**	-.466**	-.010	.351**	-.125	-.005	.373**	1

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Silence x Heart Rate Variability. It can be concluded from the table above that Silence only weakly correlates to HRV values.

Pause x Heart Rate Variability. It can be concluded from the table above that Pause only weakly correlates to HRV values.

Regression Analysis

For the purpose of conducting regression analysis, independent variables showing high correlation with the dependent variable but not among each other were identified. They are displayed in *table* 22.

Table 22

Dependent and Independent Variables for Regression Analysis of Silences and Pauses

Dependent variable: SILENCE	No independently correlated were variables found	
Dependent variable: PAUSE	Independent variable: WORD SEARCH	Independent variable: CES-D

It was not possible to identify candidate independent variables for a regression analysis on *Silence* to be performed. A regression model requires independent variables that show high correlation with the dependent variable but not among each other. Since there were no variables with significant correlations to *Silence*, a regression formula for this behavior was not attainable. On the other hand, it was possible to create a linear regression model for *Pause* using the independent variables *Word Search* and *Depression* (CES-D).

Pause is the dependent variable in this case, and this variable represents how many seconds in total each participant had during their entire group conversation. The independent variables selected for this regression were based on their correlation to the dependent variable, and on lack of correlation to each other.

Figure 9 and *tables* 23, 24, and 25 demonstrate that the assumptions of linear regression analysis were verified, making sure that this valuables selected allow the use of a regression model.

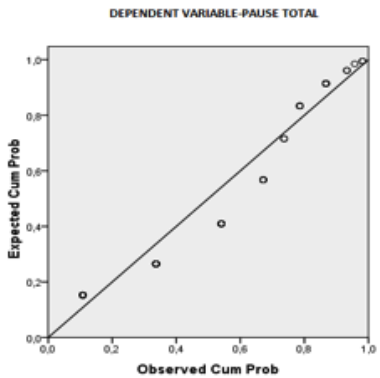

Figure 9. Linearity assumption of PAUSE

Table 23

Normality Assumption of Variables

	N	Skewness	Kurtosis
PAUSE	61	.970	-.037
CES-D	61	.395	.364
WORD SEARCH	61	.793	-.346

Skewness and Kurtosis values must be between -1 and +1 in order to satisfy the normality assumption of this dataset. In this case, all of the skewness and kurtosis values are between -1 and +1, so this assumption was satisfied.

Table 24

Multi-Colinearity Assumption Between Variables

	N	Tolerance	VIF (variance inflation factor)	CI (condition index)
PAUSE	61			1.000
WORD SEARCH	61	.998	1.002	1.350
CES-D	61	.998	1.002	1.819

According to Field (2005) and Mertler and Vannatta (2005), to avoid multi-colinearity problems between independent variables, tolerance values must be higher than 0.10. In addition, variance inflation factor values must be lower than 10, and condition indexes must be lower than 30. Here, all of the tolerance values are higher than 0.10, and all of the variance inflation factor values are lower than 10. Finally, all condition indexes are lower than 30. This means that there are no multi-colinearity problems between the selected independent variables.

Table 25

Results of Regression Analysis for Pauses

Variable	B	β	t	p	Partial	Part
CONSTANT	-.235		-3.893	.000		
WORD SEARCH	.287	.369	3.064	.003*	.373	.369
CES-D	.070	.138	1.147	.256**	.149	.138

Notes. * *p* values are significant
** *p* values are not significant

Finally, below are the variables that comprise the regression model defined for PAUSE.

R= 0.400; R^2=0.160; F=5.522; sd=2.58; p=0.006*

PAUSE = -0.235+0.287*(WORD SEARCH)+0.070*(CES-D)

The *p* values marked with a (*) in the tables are significant, which means that they show that there is a significant correlation between the value and the dependent variable. This also shows that the independent variables can predict the dependent variable. These equations are significant because their p value are (<.05). If these values were higher than .05, we would not be able to use those equations to predict the targeted behavior. Therefore, these equations let you insert values for the independent variables in order to predict the dependent variable.

This equation is significant because its *p* value is ($<.05$). If this value were higher than .05, it would not be possible to use this equation to predict the targeted behavior. Therefore, this equation allows the insertion of values for the independent variables in order to predict the dependent variable.

Summary and Conclusion

In conversation analysis, an inter-turn *silence* or an intra-turn *pause* can be loaded in terms of contextual meaning. Without their surrounding contexts, like their sequential organization, or their embedded action, a discourse analyst cannot make any assumptions about how conversationalists use or respond to those gaps in talk. But having acknowledged this fact, there are additional sources of information that can be explored in order to investigate why some people will make greater use of *silences* and *pauses* while others will not. These sources of information pertain to the domain of individual psychological and physiological differences.

There are 2 types of data that can be used in this endeavor. The first is the use of personal reports of psychological constructs, and the second is the recording of resting and active heart rate, which can generate heart rate variability data, and skin conductance. These two dimensions of description can help researchers investigate trends in behavior that might go beyond the immediate context of talk-in-interaction.

In terms of psychological constructs, I have demonstrated that whole-group inter-turn *silences* moderately correlated with the construct of communication apprehension for group discussion, which means that higher scores of this type of communication anxiety is connected to higher occurrences of *silences* during a conversation. *Silences* also showed a moderate negative correlation with behavioral approach for fun seeking and loneliness. These personality traits might represent some of the driving forces that could potentially decrease the number of *silences* in a given conversation. This is because the higher the motivation to seek fun in a given conversational activity, the lower the number of *silence* will be utilized; and the higher the levels of loneliness participants may have, the lower the number of *silences*, which will lead to a higher amount of continuous talk. In addition, *silences* also showed a weak negative correlation with anger and a weak positive correlation with communication apprehension for meetings.

Intra-turn *pauses*, on the other hand, correlated moderately with depression, general trait anxiety, and loneliness. It is possible that these three psychological traits might interfere with memory retrieval and thought processing, causing the speaker to pause his or her talk. *Pauses* also showed a weak negative correlation with behavioral approach for fun seeking, behavioral approach for fun reward response, which might indicate that higher scores in these constructs might increase uninterrupted stream of speech. However, the observed weak negative correlation with communication apprehension for interpersonal conversation, and social interaction anxiety might indicate that pauses are not caused by fear of communicating with other people, even if they are strangers.

In terms of physiological responses, *silences* weakly negatively correlated with high frequency HRV. HF-HRV has been shown to be associated with pro-social behaviors; therefore, a negative correlation with this construct might indicate that silences might be perceived as a breakdown of a medium of social behavior, more specifically the flow of a conversation. HF-HRV is thought to be representative of the parasympathetic system, so in this sense, this system is not majorly activated during *silences*.

Pauses weakly negatively correlated with both high frequency HRV and low frequency HRV. This fact might indicate that pauses are not strongly influenced by any one system in isolation, that is, the sympathetic or the parasympathetic system. In fact, pauses showed a positive correlation with HF/LF-HRV, further indicating that both systems are in balance and equally influencing this conversational behavior.

In terms of correlations with other behaviors, *silences* did not significantly correlate with any other behavior except weakly for *pauses*. *Pauses*, on the other hand, strongly correlated with word searches and length of turns. It also weakly correlated with number of turns. It is clear that the longer the turn, the more frequent the intra-turn pauses, and that word searches typically occur amidst pauses in a typical conversation.

Finally, by identifying which variables were correlated with *silences* and *pauses* but that were independent and non-correlated to each other, it was possible to create a regression model that will allow conversation analysts to predict conversational behaviors, or at least how likely any given individual would be to produce a certain type of conversational behavior. Such a model ideally takes into account various dimensions of individual psychological and physiological differences in the sought behavior. What was found here was that *silences* did not hold significant enough correlations with any of the variables produced in this research in order to pass regression analysis assumption tests. However, the *pauses* did. Two variables were selected for this regression, namely: word searches or number of turns, and depression. Because number of turns and word searches are correlated, only one of them should be used in the regression. Provided a researcher has access to these data, how long a participant is likely to produce intra-turn pauses can be anticipated.

Chapter 6: Disagreements

Disagreements in ordinary conversations with individuals who are well trained in displaying socially appropriate behaviors do not occur very often, especially during conversations with complete strangers. One learns very early that it is preferable to agree with others, and safer to avoid arguments and conflicts with others one is not familiar with because disagreeing with someone you do not know well can lead to unexpected turns in the conversation, including undesired emotional responses from the recipient being disagreed with. Potential negative responses can not only terminate the conversation, but also jeopardize future relations and exchanges with that person.

The term *disagreement* is often used in the socio-pragmatic literature as an overarching term that includes a range of actions, usually meaning the opposite of agreement, varying considerably in relation to its perceived effect on the ongoing interaction. Being so, its nature varies based on the context, setting, and who the recipients are. Therefore, the interpretation of disagreement depends on who one is with, what one disagrees about, the repercussions this may have on one's relationship with others, and the cultural norms which the interactants are bound to.

Anger & Locher (2012) describe disagreement as:

> a) expressing opposing views is an everyday phenomenon; b) certain practices are prone to contain disagreement so that this speech act is expected rather than the exception; for example, they are in fact a *sine qua non* in decision making and problem solving talk in either every day or professional contexts; other practices and contexts are less tolerant of the expression of disagreement; c) disagreeing cannot be seen as an a priori negative act; communities and groups of people have developed different norms over time which influence how disagreement is perceived and enacted; d) as in all language usage, the

> ways in which disagreement is expressed — and not only its occurrence per se — will have an impact on relational issues (face-aggravating, face-maintaining, face-enhancing); at the same time, expectations about how disagreement is valued in a particular practice will influence what forms participants choose. (p.1551)

The study of disagreements can be approach from a content perspective, i.e., what is being disagreed about, how it was linguistically delivered, and its relational perspective. From a content point of view, Kakava (1993) defines disagreement as "an oppositional stance (verbal or non-verbal) to an antecedent verbal (or non-verbal) action'' (p.36). Hence, disagreement stands in relation to a previously taken position and is in opposition rather than in agreement with it. Theoretically, any point of view could be followed by an act of disagreement expressed by another party. However, any view on the speech act of disagreeing would be incomplete without its embedded context (Gumperz, 1992), and how this speech activity is part of wider discourses. For example, there are activities that call for disagreement (for example, business meetings and debates) and others where the conversation floor is not open or shared, and expressing disagreement would not typically be expected (for example, ritualized religious ceremonies and formal presentations). This is because there are activities where the interactants are on an equal footing to express different points of views, while in others there are constraints which the interactants need to negotiate and challenge.

Another way to approach an analysis of disagreement is through focusing on form, or the ways in which disagreement is expressed. Disagreements can vary in terms of being direct or explicit, to mitigated or implied to overt. There can be also partial disagreements (Pomerantz, 1984). These forms of disagreement can then be studied in their situated context through the lens of interpersonal pragmatics (Locher & Graham, 2010). This relational view allows us to focus not only on the content of the disagreement, the interactional order of the exchange, and the linguistic forms in which disagreement is rendered, but also on how disagreement is used to negotiate relationships through relational work (Locher & Watts, 2005), observing how disagreement is enacted and achieved and what the effects of the different renditions might be on the maintenance of the conversation.

Disagreement constitutes a rich area in the study of interpersonal interaction as it entails opposing views and its enactment does pose a challenge for the interactants if they intend to ‘‘get one’s point across without seeming self-righteous or being injurious’’ (Locher, 2004, p.94). This challenge is characterized by interpersonal concerns, having to do with issues of politeness, impoliteness, and appropriateness, and with issues of identity construction more generally, appearing as a person who can make a point or stand up for his or her opinion and the factual matter over which the dispute takes place. Kotthoff’s (1993) found that people might move from mitigated to straightforward disagreement during an emerging disagreement episode. Kotthoff argues that within the same interaction, there might be a frame shift from the expectation to mitigate and to save the addressee’s face, to the expectation that a continued mitigation might be face-threatening to the person who disagrees.

Some literature also reports on practices in which disagreement, typically related to confrontation and conflict, is evaluated as having negative effects. For example, Pomerantz (1984) associates disagreement with the notion of preference from a conversation analytic perspective — with agreement typically being the preferred act (Levinson, 1983). However, the oppositional stance of disagreement need not be seen as on opposite sides of a scale, being either negatively or positively marked. Work on oral (dis)agreement has also shown that it may be the norm for the participants in a given context (Tannen, 1998), and Schiffrin's (1984) work on ‘sociable argument’ referring to exchanges “with the form of argument, but without the serious substance of argument’’ (p.331) is a good illustration of this. Tannen and Kakava’s (1992) research has provided further evidence of how disagreement can be used to create intimacy and Georgakopoulou (2001) has observed that “the occurrence of disagreements does not seem to pose a threat to the participants’ relation” (p.1897). In high stakes contexts, such as the workplace, disagreement has often been construed negatively in business scholarship but also in popular literature providing advice on ‘how to’ handle disagreement (Scott, 2008). In this context disagreement is represented as an act to be skillfully managed or avoided because of adverse consequences on team cohesiveness and employees' relationships. In addition, Rahim (2011) suggests that disagreement at work can be a prelude to conflict directly associated with negotiation of power between the interactants.

On the other hand, disagreement has proven to be appropriate and beneficial (Tjosvold, 2008) and may not necessarily result in damaging the interlocutors' rapport. Research on business negotiation and problem solving (Gray, 2001) suggests that disagreement is an inherent and unmarked part of the process as the interactants negotiate and challenge opposing views in the workplace (Angouri & Bargiela-Chiappini, 2011). These important findings do not deny the fact that there are indeed conflictual contexts, where expressing different points of view is not always associated with positive connotations. Muntigl and Turnbull's (1998) work on opposing views in conflict talk shows that the content and the enactment of disagreement is of major significance in how the speakers' utterances are perceived by the interactants.

The rich body of work on stylistic variation has highlighted factors influencing the speakers' interactional choices particularly in relation to their backgrounds, experiences and expectations. As disagreement is not an *a priori* negatively marked action, variation in 'how it is done' points to the importance of context, local norms and practices regarding what is acceptable, allowed or preferred in a given interaction. Furthermore, the enactment of disagreement has also been associated with its embedded culture. For example, Paramasivam (2007) in a study on negotiations between Malay and Japanese speakers argued that culture is related to the ways in which people tolerate or handle diverging opinions in interaction. From this point of view, disagreement or conflict resolution has been associated with notions such as 'concern for self' vs. 'concern for others' (Gabrielidis et al., 1997) corresponding to notions of individualism and collectivism (Hall, 1966; Triandis, 1995). Although generalizations on culture that seem to apply to large (national, social or other) groups, presented as homogenous, can be limiting and limited (Angouri & Glynos, 2009), this work has foregrounded variation in what people understand as disagreement and subsequently variation in the strategies used to either enact or handle it.

Myers (2004) suggests that disagreement has acquired a bad reputation, being regarded as a "kind of failure between interactants" (p.112). According to Pomerantz (1984) disagreement is dispreferred because "disagreeing with one another is uncomfortable, unpleasant, difficult, risking threat, insult or offense," whereas agreeing with one another is "comfortable, supportive, reinforcing, and perhaps sociable, since it demonstrates that interlocutors are like-minded" (p.77). Sacks (1974) notes that disagreeing is not a matter of individual preference but rather "an aspect of a formal apparatus, a possible property of the system" (p.65). Additionally, Sacks suggests that the preference for agreement may stem from social expectations when he says "it is not that somebody or everybody psychologically does not like to disagree, but they may not like to disagree because they are supposed to not like to disagree; they are supposed to try to agree perhaps'' (p.69). In other words, interlocutors design their utterances not according to personal preference but so that they will elicit agreement (Levinson, 1983). This means that even though the concept of preference in conversation analytic terms is conceptualized and analyzed as a structural phenomenon, it is not entirely devoid of social considerations. Atkinson and Heritage (1984) make social considerations explicit when they state that the institutionalized design features of preferred/dispreferred actions are oriented to maximizing cooperation and to minimizing conflict in interactions. This perspective was reinforced in later research (Clayman, 2012; Heritage & Raymond, 2012; Raymond & Heritage, 2006) that links preference with the promotion of solidarity and affiliation and dispreference with the weakening of solidarity and disaffiliation. Such views imply or explicitly state face considerations (Atkinson & Heritage, 1984; Brown and Levinson, 1987; Lerner, 1996); in particular, the need to avoid face-threatening acts and ultimately conflict in interactions.

Finally, Sifianou (2012) defines disagreement as "the expression of a view that differs from that expressed by another speaker" (p.1554). She explains that disagreements can be perceived and constructed as face-threatening as well as face-enhancing. From this perspective, disagreement can be a sign of intimacy and sociability as well as conflict and impoliteness, and should therefore be labelled as both “ambiguous and polysemous” (Tannen, 1994, p.222). Sifianou adds that the intricate negotiations of face needs to take into account politeness issues and potential for conflict, and that researchers should construe disagreement more broadly since it might in fact lie outside the observed data stretch that is available for analysis. This discussion raises important methodological questions for the study of the ‘here and now’ of talk in relation to the participants’ previous discourse histories. In combination with the knowledge of the personal traits and relational histories of the interactants, this more global understanding of the speech event is fundamental for a better understanding of the function of disagreement.

Psychological Scores, Physiological Values, and Coded Behavior

In order to investigate correlations between psychological scores and *disagreements*, statistical analyses were conducted in SPSS with significance set at $p<.05$. The surveys used for this correlation were: Behavioral activation system and behavioral inhibition system (BIS/BAS), Cognitive disinhibition scale (CDS), Center for epidemiological studies depression scale (CES-D), Loneliness scale (LS), Positive and negative affect schedule (PANAS-X), Personal report of communication apprehension (PRCA-24), Revised cheek and buss shyness scale (RCBS), Social interaction anxiety scale (SIAS), State-trait anxiety inventory for adults (STAI), and State-trait anger expression inventory (STAXI).

All correlational analyses were conducted with Pearson correlations, two-tailed. The correlation coefficient was interpreted as r =.5 large, r = .3 medium, and r= .10 small. Single Pearson Correlations were used to compare all psychological constructs to the total number of *disagreements* in the conversation, and participants’ physiological data during the conversation. Tests were conducted to ensure that underlying assumptions for between-group analyses were not violated. The Pearson Assumption was satisfied by running a descriptives test on the entire dataset, in order to test for normal distribution, looking at Kurtosis and Skewness. Before testing for normal distribution, all values were changed into Standard Scores, or Z-scores, so that all data were comparable. Paired Sample T-Tests were performed in order to check for significant difference between pairs. T-Test significance was set at $p<0.5$ and Means of Pre and Post heart rate and skin conductance were examined.

Procedures and Results

Steps for coding turns, extracting HR and SC data, and syncing both. The method of coding behavior, location and extraction of HR and SC averages, and merging data onto a centralized excel data sheet is described below step-by-step:

Step 1. Video recordings were watched and coded by research assistants that had undertaken in-lab training specifically for this task. They looked for all instances of *disagreements* that were 1 second or longer.

Step 2. Coding was checked by 3 separate research assistants to make sure the timing of all codes was right, and that all instances of *disagreements* were appropriately caught and labeled.

Step 3. All *disagreement* codes were transferred to the spreadsheet containing the heart rate and skin conductance data that was recorded during the video recorded conversation. The transfer relied on time stamps on the video and on the data sheet.

Step 4. The code transfer task was also checked by 3 separate research assistants in order to make sure all codes were correctly placed on the physiology spreadsheet.

Step 5. An excel formula was created and used for each and every code, in order to look for the target codes, and then read the data 10 seconds before and 10 seconds after each code, calculate the mean of the previous 10 seconds, and for the 10 seconds that followed, and paste the values elsewhere on the same sheet. The formula looked at the heart rate and skin conductance data for all three participants, for each instance of *disagreement*.

Step 6. All the means were gathered on a separate spreadsheet. They were pasted back-to-back, in order to find the overall "Pre Mean" and "Post Mean" averages for all *disagreements* in the 24 conversations.

Step 7. These values were plotted within excel in order to generate visual graph containing the differences between Pre and Post *disagreements* data. In these plots (see the *figures* 10 and 11 below) the Y-axis is the heart rate or skin conductance value, and the X-axis is the corresponding number of cases found for each target behavior, which in this case were *disagreements*.

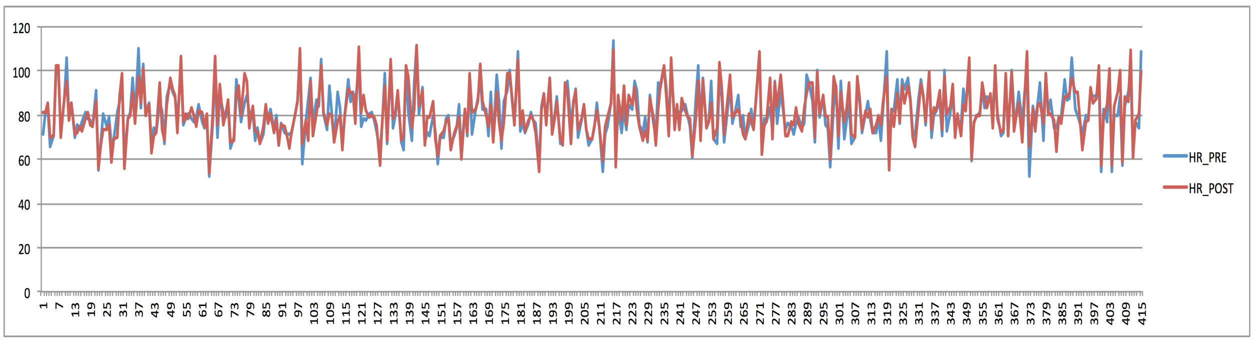

Figure 10. Pre and post average heart rate values for disagreements by number of cases

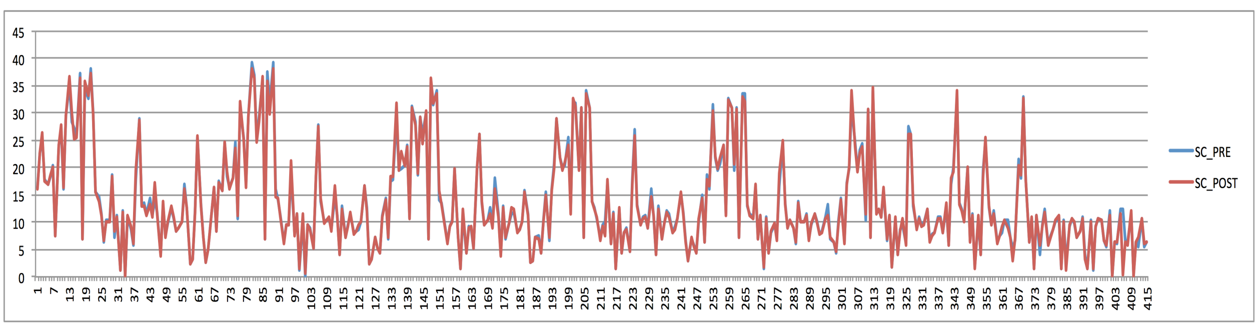

Figure 11. Pre and post average skin conductance values for silences by number of cases

In *figures* 10 and 11, it can be observed that there were very small changes surrounding the investigated behavior. In order to find out if these small changes were statistically significant, and paired T-test was performed (step 9).

Step 8. Descriptive statistics analysis was performed on the data in order to verify a normal distribution of the *disagreements* data, looking at skewness and kurtosis. Skewness and kurtosis had to be between -1 and +1 for the values to have normal distribution.

Step 9. Paired T-Tests were performed in order to check if the differences between the Pre-Post heart rate and Pre-Post skin conductance data were significant. Significant differences between Pre and Post values would have to be (<.05).

Table 26

Descriptive Statistics for Disagreements Pre and Post HR and SC

	Skewness	Kurtosis
DISAGREEHRPRE	.258	.023
DISAGREEHRPOST	.305	-.066
DISAGREESCPRE	1.064	.462
DISAGREESCPOST	1.045	.405

Based on *table* 26, it can be observed that the data show a normal distribution since values fall between -1 and 1. The Skewness values for DISAGREESCPRE (1.045) and POST (1.045) are significantly higher than 1, and therefore do not present a challenge to this data's normal distribution characteristics.

Table 27

Paired Samples Statistics for Disagreements Pre and Post Means

		Mean	N	Std Deviation	Std Error
Pair 1	DISAGREEHRPRE	81.00	415	11.28	.553
	DISAGREEHRPOST	81.11	415	11.33	.556
Pair 2	DISAGREESCPRE	13.63	415	8.59	.422
	DISAGREESCPOST	13.57	415	8.61	.423

As can be observed from *table* 27, the values for DISAGREEHRPRE and DISAGREEHRPOST show a significant difference. There is also a significant difference between the pairs DISAGREESCPRE and DISAGREESCPOST. However, the means of the paired variables show that not only pre heart rate was higher than post heart rate, but so was pre skin conductance in comparison to post skin conductance.

Table 28

Paired Samples Correlations for Disagreements Pre and Post Means

		N	Correlation	Sig.
Pair 1	DISAGREEHRPRE & DISAGREEHRPOST	415	.905	.000
Pair 2	DISAGREESCPRE & DISAGREESCPOST	415	.995	.000

The correlation values observed in *table* 28 show that DISAGREEHRPRE and DISAGREEHRPOST are highly correlated (r=.905, p=.000). The same can be observed for DISAGREESCPRE and DISAGREESCPOST (r=.995, p=.000).

Table 29

Paired Samples T-Test for Disagreements Pre and Post Means

		Paired Differences					t	df	sig.
					95% Confidence Interval of the Difference				
		Mean	Std Deviation	Std Error	Lower	Upper			
Pair 1	DISAGREEHRPRE & DISAGREEHRPOST	-.103	4.935	-.579	-.579	.372	-.426	414	.670
Pair 2	DISAGREESCPRE & DISAGREESCPOST	.062	.893	-.044	-.024	.148	1.407	414	.160

Table 29 shows the results of the T-test performed on the *disagreement* pre and post means data. It can be observed that the difference of means taken between each of these pairs is not significant, given that the significant values (Sig.) are higher than (.05).

Preparing data for correlations. In order to look for correlations among participants' psychological scores, target behaviors, heart rate, skin conductance, and heart rate variability values, a Pearson Single Correlation was performed after a series of steps, as follows:

Step 1. Participants' answers to psychological questionnaires were scored following the procedures listed in the corresponding scoring manuals.

Step 2. All data relative to participants' scores, quantification of target behaviors per participant, heart rate and skin conductance averages, and heart rate variability values were transferred to an excel sheet. This data sheet contained all data collected for Study 2, displayed by participant, and by group.

Step 3. This data sheet containing all data displayed by participant and by group was imported into SPSS.

Step 4. To prepare the data for a Pearson Single Correlation analysis, all data was converted to standard scores, or Z scores.

Step 5. The data were checked for normal distribution, looking at skewness and kurtosis. Skewness and kurtosis had to be between -1 and +1 for the values to have normal distribution.

Step 6. Pearson Single Correlation analysis was performed, and the correlations between *disagreements* and psychological scores and coded behaviors are found (see *tables* 10 and 11, presented again in this section).

Correlation results. The correlation coefficient was interpreted as r =.5 large, r = .3 medium, and r= .10 small. As can be observed in the table below, coded behaviors and certain surveys showed strong and medium correlations to the number of disagreements.

Table 10

Single Pearson Correlations Between Scores on Psychological Surveys and Coded Conversational Behaviors – first half

PSYCH SURVEYS X BEHAVIOR	1	2	3	4	5	6	7	8	9	10	11	12	13
1. TURNS - LENGTH	1												
2. TURNS - NUMBER	.469**	1											
3. DISAGREEMENT	.205	.224	1										
4. SILENCE	.013	.004	-.167	1									
5. PAUSE	.513**	.142	.083	.221	1								
6. WORD SEARCH	.302**	.081	.123	.150	.527**	1							
7. BAS DRIVE	.161	.245*	.257*	-.010	.010	.041	1						
8. BAS FUN SEEKING	-.141	-.063	.106	-.207	-.126	.056	.293*	1					
9. BAS REW RESP	-.049	.144	.110	-.089	-.203	-.025	.408**	.243*	1				
10. BIS	-.127	-.015	-.164	.065	-.012	-.091	-.162	-.170	.236*	1			
11. CDS	-.074	-.079	.022	.000	-.047	.064	.087	.252*	.115	-.265*	1		
12. CES-D	.318**	.189	.006	.062	.336**	.081	-.019	-.054	.257*	.277*	-.021	1	
13. LS	.113	.074	.031	-.207	.121	-.042	-.198	.105	-.013	.366**	-.102	.469**	1
14. PANAS NEGATIVE	.016	-.108	-.136	.040	-.011	-.081	.090	.094	.089	.066	.079	.182	.041
15. PANAS POSITIVE	.087	-.060	-.061	-.002	-.020	-.039	.128	.263	.088	-.192	.156	-.092	-.224
16. PRCA GR DISC	-.333**	-.216	-.194	.234*	-.060	.020	-.235*	-.232	-.082	.406**	-.051	.081	.179
17. PRCA MEETINGS	-.141	-.149	-.124	.155	-.022	.092	-.228	-.080	.004	.351**	-.144	.190*	.329**
18. PRCA INT CONV	-.389**	-.134	-.272*	.076	-.105	.047	-.390	-.104	-.115	.451**	-.030	.129	.305**
19. PRCA PUB SPEAK	-.279*	-.079	-.249*	-.068	-.098	-.010	-.191	.076	.265*	.317**	-.113	.171	.197
20. RCBS	-.294*	-.087	-.217	.072	.023	.075	-.521**	-.206	-.212	.444**	-.217	.098	.406**
21. SIAS	-.223	-.007	-.265*	-.053	-.129	-.149	-.209	-.160	.019	.393**	-.253	.332**	.427**
22. STAI-Y2	.016	-.018	-.246*	.018	.164	-.057	-.274*	-.268	-.036	.596**	-.269*	.471**	.611**
23. STAXI T-ANGER	-.037	.058	.249*	.038	-.078	-.215	.213	.025	.194	.245*	-.103	.312**	.199
24. STAXI AC OUT	-.112	-.171	.127	.037	.066	.157	.040	.181	-.054	-.049	.159	-.007	-.097
25. STAXI AC IN	.022	-.025	.323**	-.145	.039	.176	.295**	.363**	-089	-.135	.202	-.015	-.032
26. STAXI INDEX	.000	.005	-.201	.058	-.026	-.159	-.157	-.239	.031	.268*	-.200	.199	.219

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Table 11

Single Pearson Correlations Between Scores on Psychological Surveys and Coded Conversational Behaviors – second half

PSYCH SURVEYS X BEHAVIOR	14	15	16	17	18	19	20	21	22	23	24	25	26
1. TURNS - LENGTH													
2. TURNS - NUMBER													
3. DISAGREEMENT													
4. SILENCE													
5. PAUSE													
6. WORD SEARCH													
7. BAS DRIVE													
8. BAS FUN SEEKING													
9. BAS REW RESP													
10. BIS													
11. CDS													
12. CES-D													
13. LS													
14. PANAS NEGATIVE	1												
15. PANAS POSITIVE	.807**	1											
16. PRCA GR DISC	.054	-.131	1										
17. PRCA MEETINGS	.150	-.091	.650**	1									
18. PRCA INT CONV	.039	-.180	.672**	.548**	1								
19. PRCA PUB SPEAK	-.042	-.213	.444**	.361**	.409**	1							
20. RCBS	-.077	-.242	.646**	.481**	.791**	.376**	1						
21. SIAS	.057	-.224	.489**	.597**	.638**	.406**	.641**	1					
22. STAI-Y2	.082	-.282	.394**	.430**	.407**	.428**	.485**	.563**	1				
23. STAXI T-ANGER	.118	-.075	.161	.180	.042	.137	.081	.267*	.267*	1			
24. STAXI AC OUT	.100	.094	-.011	-.118	.059	-.126	-.092	-.315**	-.234*	-.285*	1		
25. STAXI AC IN	.152	.128	-.246*	-.263*	-.208	-.135	-.277	-.415**	-.325	-.229	.630**	1	
26. STAXI INDEX	-.030	-.158	.336**	.320**	.174	.289*	.299**	.477**	.485**	.398**	-.783**	-.791**	1

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Disagreement x Coded Behaviors. Based on the table above, it can be observed that *Disagreement* only has weak correlations, or none at all, with other coded behaviors.

Disagreement x Psychological Scores. Disagreements are moderately correlated to *Behavioral Activation* (BAS DRIVE) ($r=.257$, $p<0.05$), moderately negatively correlated to *Communication Apprehension Interpersonal Conversation* (PRCA INT CONV) ($r=-.272$, $p<0.05$), *Communication Apprehension Public Speaking* (PRCA PUB SPEAK) ($r=-.249$, $p<0.05$), *Shyness* (RCBS) ($r=-.217$), *Social Anxiety* (SIAS) ($r=-.265$, $p<0.05$), *Trait Anxiety* (STAI Y2) ($r=-.246$, $p<0.05$), and to Anger Expression Index (STAXI INDEX) ($r=-.201$), moderately positively correlated to Anger Trait (STAXI T-ANGER) ($r=.249$, $p<0.05$), and to *Anger Control-In* (STAXI AC IN) ($r=.323$, $p<0.01$).

In addition, the correlations between *disagreements* and physiological data are displayed on *table*s 12 and 13, presented again here.

Table 12

Single Pearson Correlations Between Heart Rate Variability During Group Task and Coded Conversational Behaviors – first half

CONVERSATION HRV X BEHAVIOR:	1	2	3	4	5	6	7	8	9	10	11	12
1. TURNS - LENGTH	1											
2. TURNS - NUMBER	.469**	1										
3. DISAGREEMENT	.205	.224	1									
4. SILENCE	.013	.004	-.167	1								
5. PAUSE	.513**	.142	.083	.221	1							
6. WORD SEARCH	.302**	.081	.123	.150	.527**	1						
7. SDNN	.031	-.006	.279*	.026	.013	.112	1					
8. RMSSD	.052	.089	.265*	-.052	-.007	.089	.894**	1				
9. SD1	.032	.082	.247*	-.086	-.011	.073	.857**	.958**	1			
10. SD2	-.017	.004	.295*	-.010	.017	.100	.951**	.808**	.819**	1		
11. LF/HF	.213	-.037	.118	-.013	.149	.156	-.243*	-.347**	-.362**	-.169	1	
12. TP	.053	.118	.269*	-.056	-.043	.017	.804**	.803**	.834**	.793**	-.194	1
13. NP HF	-.110	.067	.158	-.159	-.108	-.065	.418**	.557**	.613**	.405**	-.707**	.571**
14. NP LF	.053	.010	-.047	.037	.115	.120	-.416**	-.556	-.463**	-.176	.745**	-.443
15. RP HF	-.015	.139	.107	-.153	-.064	-.036	.404**	.573**	.634**	.340**	-.532**	.651**
16. RP LF	.319**	.105	-.021	-.077	.178	.139	-.198	-.189	-.115	-.107	.584**	-.168
17. RP VLF	-.277*	-.156	.014	.078	-.100	-.039	-.161	-.294*	-.298**	.007	-.022	-.297**
18. AP HF	-.035	.106	.182	-.095	-.083	.002	.579**	.675**	.698**	.509**	-.323**	.856**
19. AP LF	.256*	.136	.226	-.032	.055	.052	.621**	.570**	.630**	.656**	.149	.751**
20. AP VLF	-.027	.018	.267*	.039	-.045	-.007	.801**	.668**	.663**	.864**	-.174	.759**
21. PF HF	-.080	-.077	.075	-.155	-.014	.059	.029	.170	.257*	.140	-.162	.242*
22. PF LF	.056	-.007	.167	-.129	-.051	.052	-.043	-.068	.004	.047	.349**	.011
23. PF VLF	.206	-.087	-.002	-.122	.100	.168	.068	.023	.090	.085	.384	.078

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Table 13

Single Pearson Correlations Between Heart Rate Variability During Group Task and Coded Conversational Behaviors – second half

CONVERSATION HRV X BEHAVIOR:	13	14	15	16	17	18	19	20	21	22	23
1. TURNS - LENGTH											
2. TURNS - NUMBER											
3. DISAGREEMENT											
4. SILENCE											
5. PAUSE											
6. WORD SEARCH											
7. SDNN											
8. RMSSD											
9. SD1											
10. SD2											
11. LF/HF											
12. TP											
13. NP HF	1										
14. NP LF	-.756**	1									
15. RP HF	.891**	-.709**	1								
16. RP LF	-.485**	.632**	-.213	1							
17. RP VLF	-.104	.285*	-.477**	-.484**	1						
18. AP HF	.721**	-.619**	.854**	-.278*	-.376**	1					
19. AP LF	.114	-.027	.261*	.304**	-.414**	.385**	1				
20. AP VLF	.337**	-.215	.174	-.325**	.228*	.422**	.587**	1			
21. PF HF	.508**	-.191	.442**	-.082	.002	.298**	.066	.136	1		
22. PF LF	-.166	.348	-.030	.544**	-.276*	-.050	.234*	-.132	.046	1	
23. PF VLF	-.221	.236	-.017	.558**	-.466**	-.010	.351**	-.125	-.005	.373**	1

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Disagreement x Heart Rate Variability. According to the table above, *disagreement* seems to have medium correlation to the *Standard Deviation of Normal Inter-beat Intervals* (SDNN) (r=.279, $p<0.05$), to the *Root Mean Square of Successive Differences* (RMSSD) (r=.265, $p<0.05$), *Standard Deviation of Short Term Variability* (SD1) (r=.247, $p<0.05$), *Standard Deviation of Long Term Variability* (SD2) (r=.295, $p<0.05$), *Total Power of Spectral Analysis* (TP) (r=.269, $p<0.05$), *Absolute Power of Low Frequency* (AP LF) (r=.226), and *Absolute Power of Very Low Frequency* (AP VLF) (r=.267, $p<0.05$).

Regression Analysis

For the purpose of conducting regression analysis, independent variables showing high correlation with the dependent variable but not among each other were identified.
In the case of *disagreements* being the desired dependent variable, BAS Drive, PRCA, STAXI, and the Heart Rate Variability Standard Deviation of the Poincare Plot value "SD2" were identified as suitable independent variables because they showed a good degree of correlation to the independent variable and no correlation among themselves.

Table 30

Dependent and Independent Variables for Regression Analysis of Disagreement

Dependent Variable:	Independent Variable:	Independent Variable:	Independent Variable:	Independent Variable:
DISAGREEMENT	BAS DRIVE	PRCA-24 INTERPERSONAL CONVERSATIONS	STAXI AC IN	HRV SD2 GCN

Figure 12 and *tables* 31, 32, and 33 demonstrate that the assumptions of linear regression analysis were verified, making sure that this valuables selected allow the use of a regression model.

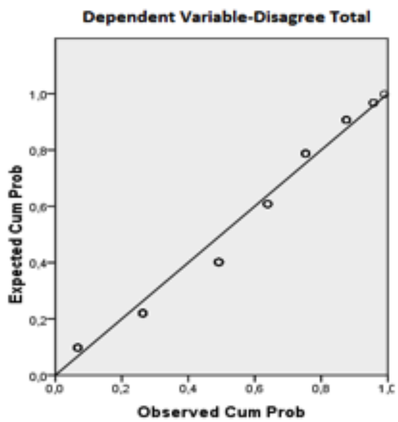

Figure 12. Linearity assumption of DISAGREEMENT

Table 31

Normality Assumption Of Dependent Variables Of Disagreement

	N	Skewness	Kurtosis
PRCA INTERPERSONAL CONVERSATION	61	.311	-.302
BAS DRIVE	61	.459	-.035
STAXI AC IN	61	-.274	-.959
HRV SD2 GCN	61	-.161	.481
DISAGREEMENT	61	.661	-.259

Skewness and Kurtosis values must be between -1 and +1 in order to satisfy the normality assumption of this dataset. In this case, all of the skewness and kurtosis values are between -1 and +1, so this assumption was satisfied.

Table 32

Multi-Colinearity Assumption Between Variables

	N	Tolerance	Variance inflation factor	Condition index
DISAGREEMENT				1.000
BAS DRIVE	61	.795	1.258	1.231
PRCA INTERPERSONAL CONV	61	.858	1.166	1.299
STAXI AC IN	61	.878	1.139	1.436
HRV SD2 GCN	61	.999	1.001	1.646

According to Field (2005) and Mertler and Vannatta (2005), to avoid multi-colinearity problems between independent variables, tolerance values must be higher than 0.10. In addition, variance inflation factor values must be lower than 10, and condition indexes must be lower than 30. Here, all of the tolerance values are higher than 0.10, and all of the variance inflation factor values are lower than 10. Finally, all condition indexes are lower than 30. This means that there are no multi-colinearity problems between the selected independent variables.

Table 33

Results Of Regression Analysis For Disagreement

Variable	B	β	t	p	Partial	Part
CONSTANT	-.035		-.307	.760**		
BAS DRIVE	.090	.101	.716	.477**	.095	.090
PRCA INTERPERSONAL CONVERSATION	-.127	-.131	-.966	.338**	-.128	-.121
STAXI AC IN	.186	.208	1.551	.126**	.203	.195
SD2 GCN	.137	.121	.963	.340**	.128	.121

Note. * *p* values are significant
** *p* values are not significant

Finally, below are the variables that comprise the regression model defined for disagreements:

R= 0.344; R^2=0.119; F=1.885; sd=4;56; p=0.126**

DISAGREEMENT=-0.035+0.090*(BAS DRIVE)-0.127*(PRCA INTERPERSONAL CONVERSATIONS)+0.186*(STAXI AC IN)+0.137*(HRV SD2 GCN)

Summary and Conclusion

In this research, *disagreements* were located and coded when one or two participants in the video recorded conversations were 'not doing agreement' after another participant performed an assessment or an assertion. These *disagreements* were not usually overtly dismissive of the prior talk, but changes in pre-post heart rate and skin conductance means depended not only on individuals' personality and physiological characteristics, but also on the context of the *disagreement*. In addition, such physiological changes, when observed, could occur to the doer or the recipient of the *disagreement*; in other words, to the *disagreer* or to the *disagreed with*.

This chapter attempted to show that the number of occurrences of disagreements in any given interaction could be related to the individual characteristics of the participants in a group. In addition, through a regression analysis of independently correlated variables, this chapter also brought together which psychological and physiological variables could predict a likely number of disagreements when those elements are put together. The variables utilized for the investigation of correlational influences on disagreement were other conversational behaviors, participants' scores on personal reports of psychological predispositions, and means and averages of physiological data, namely heart rate, skin conductance, and extrapolated heart rate variability.

In terms of other observed conversational behaviors that showed any correlation with disagreement, the number of turns and the length of turns showed positive moderate correlation. This is acceptable given that the higher the occurrences of ongoing turns, the higher the likelihood of occurrences of disagreements as well; and the same applies to the length of turns, so the longer the turns are, the greater the likelihood of disagreements. Moreover, word searches showed a weak positive correlation to disagreement, and silences showed a weak negative correlation.

In terms of psychological scores, behavioral approach drive and trait anger showed moderate positive correlation with disagreements. The first, behavioral approach drive might be related to the fact that a motivation to take turns, since it was the scale most highly correlated to number of turns taken, and disagreements have already been shown to have correlated to this behavior. So it is possible that doing a disagreement is related to wanting to keep the conversation going, and taking an additional turn in order to interject and perform a disagreement. The second scale that moderately correlated with disagreements, trait anger, might suggest that the performance of this conversational behavior might be related to some level of interactional aggression, which is not necessarily a negative thing. If one is too afraid to hurt someone's feelings even with the slightest opposing comment, one would never dare to perform a disagreement, specially with people who are strangers, as was the case of the participants in this study. Additionally, disagreements showed a moderate negative correlation with two dimensions of communication apprehension, namely interpersonal conversation and public speaking, and also with shyness, social interaction anxiety, and general trait anxiety. This fact is interesting because these constructs seem to be ones that would indeed prevent disagreements. If one is too shy, anxious, and afraid of carrying out conversations and speaking out loud, one would also be less likely not only to speak at all, but specially to perform a disagreement. Finally, disagreements also showed a weak negative correlation to behavioral inhibition, negative affect and communication apprehension for group discussion and meetings. For the reasons just discussed, if one is inhibited, afraid of communicating in group discussion or in group meetings, or if one has high scores of negative affect, it is very likely that this person will be less prone to displaying conversational behaviors, including performing disagreements, which apparently requires a more extraverted approach (based on this behavior's higher correlation to behavioral approach drive).

In terms of physiological markers such as heart rate variability, no strong correlations were found; but there were some moderate and weak positive correlations. Disagreements had a moderate positive correlation with SDNN, RSSD, SD1, SD2, and low frequencies. This indicates that it is correlated with some level of elevated stress state. It also had a weak positive correlation to all dimensions of high frequencies (LF/HF, NP HF, RP HF, AP HF), and one low frequency (PF LF). While the low frequency shows some correlation with stress, the high frequency values show that participants must be more pro-social and pro-conversation in order to perform this conversational behavior. This fact had already been demonstrated by the psychological scores discussed in the previous paragraph, and it is now confirmed with these physiological markers.

Chapter 7: Word Search

Word searching is a phenomenon that occurs in many types of interactions including those between native, non-native, child, and adult speakers of a language within mono-linguistic and cross-linguistic settings. Research in conversation analysis examines word searches as part of repair sequences. Within such framework, the notion of repair includes the courses of conduct that address problems of speaking, hearing, or understanding talk (Schegloff, Jefferson, & Sacks, 1977). Such repair is a co-constructed action that occurs through the coordination of turns-at-talk, embodiments, and environments on a moment-by-moment basis among the participants (Goodwin, 1979; Goodwin, 1990; Heritage, 1984a; Sacks, Schegloff, & Jefferson, 1974; Schegloff, 2007).

A repair sequence constitutes a sequence of actions in which participants initiate and solve (or fail to solve) a problem in the talk, and the actions 'supersede' other actions in progress (e.g. a next turn constructional unit in a turn, a next turn in a sequence, an element of story-telling, etc.) (Schegloff, 1997, 2000). Repair may be initiated either by the speaker of the problematic talk (self-initiated repair) or by the other speaker (other-initiated repair). The repair may then be carried out by the speaker of the problematic talk (self-repair) or by the other speaker (other-repair). Schegloff et al. (1977) found a preference for self-initiation self-repair over other-initiation other-repair. They also found that the occurrence of other-repair is highly constrained in terms of their local sequential environment. For example, other-repair appears regularly just after understanding checks and verbal invitations of other-repair, which exhibit an orientation to its dispreferred status.

Word searches are prevalent in various kinds of interaction, and thus have been examined in a variety of disciplines with distinct perspectives. From a conversation analytical perspective, a word search sequence is considered one of the primary sequences that demonstrate an adjacency pair through which an action is accomplished as a basic unit of social organization (Sacks, 1992). An adjacency pair is a sequence of two utterances in which a first pair part requires a relevant second pair part that displays the recipient's understanding of the current turn (Schegloff & Sacks, 1973; Schegloff, 2007). For example, greeting-greeting, question-answer, or offer-acceptance/decline all constitute adjacency pairs. What is at issue is not the grammatical form, but the action initiated by the first pair part and accomplished in the adjacency pair sequence. Sacks (1992a) demonstrates this point by presenting examples of when a speaker pauses within the course of a sentence to search for a word, at which point the recipient attempts to complete the sentence by proffering the word that is looked for. Here is an example provided by Sacks (1992a, p. 321):

```
Ken:        He looked like he was coming in here for uh…
Al:         kicks.
Louise:     guidance. heh
```

What this example shows is how both recipients, Al and Louise, respond to the action of searching for a word that is initiated by the speaker, Ken. More specifically, Al provides a candidate answer, which is repaired by Louise. As a result, the speaker and the recipients collaborate in producing a grammatically complete sentence. With the illustration of such collaborative production of new sentences, Sacks (1992a, 1992b) challenges the idea that a sentence is a basic unit of social organization. Instead, he proposes that the distribution of adjacency pairs through which actions are implemented keeps participants attentive to the ongoing talk. Based on the understanding that an adjacency pair is a fundamental unit of social organization, Schegloff et al. (1977) note that a word search activity falls in the domain of repair, and show how repair refers to a broader range of actions than the terms such as a correction or a replacement might suggest. The study showed that self-initiations use various non-lexical speech perturbations such as cut-offs, sound stretches, and uh's, whereas other-initiations use turn-constructional devices including question words and partial repeats of the trouble-source turn in order to project the following repair initiation. Reporting the highly constrained occurrence of other-repair, the authors suggest that the frequent use of other-repair may be relevant to 'not-yet-competent' speakers, as is the case of non-native speakers, and suggest other-repair as a vehicle for socialization (p. 381).

Drawing upon the research of Schegloff et al. (1977), Wong (1994), in her study of Native-Speaker-Non-Native-Speaker (NS-NNS) interaction, investigated the use of *yeah* in same-turn repair and delayed next-turn repair initiation. She found that delayed next-turn repair frequently occurs in NS-NNS interaction, and *yeah* is sequentially positioned at the moment of solution in repair. Examining the details of talk, she demonstrated how NNSs' (in)competence in the target language becomes interactionally relevant in NS-NNS communication.

Hosoda (2000) also employed conversation analysis to examine naturally occurring NS-NNS conversations in Japanese and confirmed the preference for self-initiation in repair. Her study aimed to provide a closer examination of the nature of other-repair in NS-NNS interaction. She looked at word search sequences, among other-repair sequences, and found that non-verbal behavior as well as verbal behavior effectively initiates other-repair. Embodied cues such as gaze and body orientation combined with verbal indications of sound stretches, fillers, and question markers are used to invite help from NSs in finding a word. Hosoda further explains that NSs and NNSs tend to use certain different verbal resources to self-initiate other-repair. For example, NSs exclusively used the Japanese demonstrative pronoun as one way of holding a place for a noun or noun phrase that is searched for. She concludes by saying that paying close attention to participants' verbal and non-verbal behaviors is necessary in research of the use of word search in NS-NNS conversations as NNSs often request conversational help from NSs using both vocal and non-vocal resources.

The importance of studying the use of non-verbal resources is further demonstrated by Goodwin and Goodwin (1986). In this paper they analyze a word search activity focusing on its organization for non-verbal phenomena and co-participation frameworks. They examine word search sequences in detail and show that gestures, including gaze shifts and a distinctive thinking face, occurred at particular points in talk, after the self-interruption of a turn constructional unit. The placement of such visual phenomena was demonstrated to be consequential for the recipient to recognize the ongoing activity and act upon it. For example, gazing toward a recipient within a word search often establishes the relevance of the recipient's escalated involvement in the activity. They argue that gesture within a particular word search activity results in visible changes in the co-participation status of participants. The authors pose that word searches, as activities, provide organization for a range of vocal and non-vocal actions, and participants attend to them as it is clear that both types of action are part of the ongoing framework of the ongoing negotiated interaction. A word search is, therefore, a visible activity that takes place outside of the current speaker's head, and co-participants can not only recognize it, but also participate in it, if and when appropriate.

It is possible to verify that recipients are aware of the ongoing self-initiation of repair because at this point they turn their gaze to the current speaker. Goodwin and Goodwin (1986) claim that this gaze toward a speaker who is involved in a word search enables recipients to display awareness that the activity is still going on while allowing the speaker to produce the word being sought. Nevertheless, the authors also propose that not all word searches are clear and straight-forward. There is evidence that speakers might show they lack a word without proposing a search for it. So even though a word might be posed as unavailable, the search for it will not be pursued.

Moreover, Goodwin and Goodwin (1996) discuss another resource that allows recipients to know that a word search is underway, without having to be in the speaker's head. They refer to Sacks et al's (1974) definition of a basic conversational unit, or turn-construction unit, and that it allows a projection of the unit-type underway, or near its completion. They say that usually in a word search a turn construction unit is interrupted after it starts and before it has been completed. This is a clearly observed perturbation in the current talk, marked by non-lexical perturbations as well, such as pauses, sound stretches, and the production of elongations and fillers such as 'uh's' which will mark the initiation of a possible repair. The clearly unavailability of a word prevents the continuation of the talk in progress. In such cases, achieving an outcome to the search becomes relevant, as is the production of additional talk, ranging from commenting on their involvement in the search to their epistemic status regarding relevant knowledge to provide such outcome.

Most importantly, Goodwin and Goodwin (1996) discuss the involvement of non-vocal phenomena such as gestures in the repair activity. They propose that during a word search speakers frequently gaze away from their recipients. Since not all gaze withdrawals correlate with word search initiations, it is important to note that the production of a 'thinking face' and perturbations in the talk produce a stereotypic word search behavior that is recognizable by recipients. Such behaviors could be perceived as simple avoidance of distracting visual information so that the speaker may allocate cognitive resources to the task at hand. But evidence that they are effective is in the adjacent action being that of word production or reason for its unavailability. Finally, the authors conclude by saying that the organization of gestures are only relevant within activities from which they emerge, and that these very same activities can not be fully understood merely based on their linguistic and sequential organizations.

Another area that needs to be further examined is the existence of different types of word searches. Hosoda (2006) discusses the case of 'vocabulary checking' as a possible subcategory. This paper shows that native speakers do not deploy these methods to initiate other repair on everyday vocabulary items. The 'vocabulary check' occasionally found in the NS-NNS conversations may be taken as a form of request for confirmation. In responding to a request for confirmation, one responds with either agreement or correction. This author suggests that responding to a request for confirmation on content matters is not a repair in the sense that it does not address any problems of the speaker's speaking or the hearer's understanding or hearing. A request for confirmation occurs when a current speaker considers that the information is within the 'territory' of the recipient (Kamio 1994, 1997a, 1997b). According to Kamio, information is within the territory of a person when: (a) the information is obtained through the person's internal or direct experience; (b) the information embodies detailed knowledge which falls into the person's professional or other expertise; or (c) the information is about persons, facts, and things close to the person. While a request for confirmation usually focuses on content or factual matters, 'vocabulary checks' deal with the language of the interaction. Unlike a request for confirmation on a content matter and a response to it, a 'vocabulary check' and its response constitute a repair sequence in the sense that it addresses a problem of the speaker's speech production.

As discussed above, a request for confirmation occurs when a speaker considers that the information resides in the domain of a hearer. Thus, non-native speakers may assume that information on the language of the interaction itself resides in the domain of the native speaker and thus, when they encounter problems with speaking the language, they occasionally request confirmation on a linguistic item they produce. In other words, by checking everyday vocabulary items, the non-native speakers themselves, at that moment, although it is not necessarily beyond them to complete the repair sequence, orient to themselves as a 'novice' in the language spoken in the interaction while they treat their interlocutors, at that moment, as a language expert. The complementary orientation to novice and expert status through the practice of 'vocabulary checking' explains why vocabulary checks are such rare occurrences in native-speaker conversations. This may be due to the fact that native speakers have no reason to assume that their interlocutors were any more expert in the language of ordinary conversation than they were themselves; even when they have problems of speaking, they do not typically resort to this overt way to solicit help on the language items they produce.

Buckwalter (2001) reports a study in word search repair sequences used in dyadic conversations between Spanish second language speakers. She classifies the types of word search she has observed in her data as *lexical, grammar,* and *pronunciation*. She shows that in her data all three categories of repair were often self-initiated self-repair, while self-initiated other-repair was less frequent. When it did occur, other participants did not offer assistance immediately, allowing for enough time for self-repair to lapse, or until it was requested. Finally, she also points to the fact that other-initiated other-repair was more common than other-initiated self repair but usually not used to indicate errors in the other speaker's turn, but to indicate non-understanding of a lexical item. Speakers in this case used circumlocution or visual cues to both communicate the originally intended meaning. She shows that intraturn pauses were found to indicate either the presence of a trouble source or planning. More specifically, pauses were typically present when the speaker was involved in a word search, but only when the pause was accompanied by other indicators could it be determined for certain that a word search was underway. The author shows that even though native speakers tend to use self-directed speech when searching for a word (which probably also serves the social function of maintaining the control of the floor while thinking), as in the following example from Schegloff et al (1977, p.363).

```
Clacia:  B't a-another one then went school
         with me wa:s a girl na:med
         uh. (0.7) 'W't th' hell wz er name.
         'Karen. Right.
         Karen.
```

Based on a different research paradigm, studies relying on SLA theories consider a word search as a type of interactional practice through which language learners require assistance from their peers, teachers, and NSs. A large body of research on native and non-native interaction stems from the study of communication strategies and negotiation of meaning (Faerch & Kasper, 1983; Gass & Selinker, 1994; Larsen-Freeman, 1980). Faerch and Kasper (1983) examined language learners' interlanguage and use of communication strategies. Although their study did not examine word search activities specifically, their study showed that, in general, learners utilized communication strategies when faced with problems in planning and producing utterances. Learners attempted to solve such problems by using compensatory communication strategies such as interlingual transfer, code switching, paraphrasing, and restructuring. As a continuation of Faerch and Kasper, Kasper and Kellerman (1997) investigated learners' lexical problem-solving strategies. The researchers provided examples of relevant communicative strategies for situations in which speakers do not have lexical resources, cannot recall the resources, or cannot use them due to contextual constraints. The study suggested that word searches indicate learners' lexical deficiencies that are compensated for by the deployment of communication strategies.

From a slightly different perspective, Gass and Selinker (1994) reviewed many studies that looked at non-native discourse in light of negotiation of meaning (pp. 259-309). They reported that findings from various studies, including Gass and Varonis (1985) and Long (1983), showed how participants negotiated the meaning of utterances to maintain equal footing of both parties. Participants often questioned particular utterances or requested conversational help from one another when faced with difficulties in comprehending their interlocutor's lexical choice. Gass and Selinker noted that negotiation of meaning through confirmation checks, comprehension checks, and clarification requests occurred more frequently in conversations involving NNSs compared to the conversations solely among NSs. In relation to the negotiation of meaning process, Schwartz (1980) examined word searches within other-repair sequences. She stated that word searches are constructed in ways in which speakers confer with hearers to negotiate connecting a word with its meaning. Speakers use a variety of verbal strategies (such as providing synonyms, definitions, and examples) and non-verbal strategies (including changing eye gaze, posture, and hand rotation). She described cases where not only speakers but also hearers began word searches of their own as a way to demonstrate how the search was built on an interactive process (pp. 144-145).

Overall, many studies discuss word searches as part of repair activities in native discourse but only a few studies have focused on word searches in native and non-native interaction (Brouwer, 2003; Hosoda, 2000; Kurhila, 2006; Wong, 1994). Word searches in non-native discourse require a thorough examination as they carry significant interactional import. Since the scope of words being searched in native and non-native interaction mainly includes content words, failures in word searches are likely to engender major communicative problems such as communication delays and breakdowns (Brouwer, 2003; Kurhila, 2006). With these different perspectives in mind, the present study examines how NSs and NNSs of English construct their action at different junctures of word search activities using both verbal and non-verbal resources. That is, the study examines the interactional work through which a distributed responsibility of participants for sequential coherence, meaning, and events is co-constructed (Jacoby & Ochs, 1995). A word search as a repair activity to solve an interactional problem is examined. In addition, the internal organization of a word search to build intersubjectivity among interlocutors is discussed in detail. Intersubjectivity is achieved by "a set of practices by which actions and stances could be composed in a fashion which displayed grounding in, and orientation to, 'knowledge held in common'" (Schegloff, 1992b, p. 1298). Searching for a word is therefore a practice through which participants build shared understandings and assumptions within and through interaction.

Psychological Scores, Physiological Values, and Coded Behavior

In order to investigate correlations between psychological scores and *word searches*, statistical analyses were conducted in SPSS with significance set at p<.05. The surveys used for this correlation were: Behavioral activation system and behavioral inhibition system (BIS/BAS), Cognitive disinhibition scale (CDS), Center for epidemiological studies depression scale (CES-D), Loneliness scale (LS), Positive and negative affect schedule (PANAS-X), Personal report of communication apprehension (PRCA-24), Revised cheek and buss shyness scale (RCBS), Social interaction anxiety scale (SIAS), State-trait anxiety inventory for adults (STAI), and State-trait anger expression inventory (STAXI).

All correlational analyses were conducted with Pearson correlations, two-tailed. The correlation coefficient was interpreted as *r* =.5 large, *r* = .3 medium, and *r*= .10 small. Single Pearson Correlations were used to compare all psychological constructs to the total number of *word searches* during the conversation, and participants' physiological data during the conversation. Tests were conducted to ensure that underlying assumptions for between-group analyses were not violated. The Pearson Assumption was satisfied by running a descriptives test on the entire dataset, in order to test for normal distribution, looking at Kurtosis and Skewness. Before testing for normal distribution, all values were changed into Standard Scores, or Z-scores, so that all data were comparable. Paired Sample T-Tests were performed in order to check for significant difference between pairs. T-Test significance was set at p<0.5 and Means of Pre and Post heart rate and skin conductance were examined.

Procedures and Results

Steps for coding turns, extracting HR and SC data, and syncing both. The method of coding behavior, location and extraction of HR and SC averages, and merging data onto a centralized excel data sheet is described below step-by-step:

Step 1. Video recordings were watched and coded by research assistants that had undertaken in-lab training specifically for this task. They looked for all instances of *word searches* that were 1 second or longer.

Step 2. Coding was checked by 3 separate research assistants to make sure the timing of all codes was right, and that all instances of *word searches* were appropriately caught and labeled.

Step 3. All *word searches* were transferred to the spreadsheet containing the heart rate and skin conductance data that was recorded during the video recorded conversation. The transfer relied on time stamps on the video and on the data sheet.

Step 4. The code transfer task was also checked by 3 separate research assistants in order to make sure all codes were correctly placed on the physiology spreadsheet.

Step 5. An excel formula was created and used for each and every code, in order to look for the target codes, and then read the data 10 seconds before and 10 seconds after each code, calculate the mean of the previous 10 seconds, and for the 10 seconds that followed, and paste the values elsewhere on the same sheet. The formula looked at the heart rate and skin conductance data for all three participants, for each instance of *word searches*.

Step 6. All the means were gathered on a separate spreadsheet. They were pasted back-to-back, in order to find the overall "Pre Mean" and "Post Mean" averages for all *word searches* in the 24 conversations.

Step 7. These values were plotted within excel in order to generate visual graph containing the differences between Pre and Post *word searches* data. In those plots (see *figures* 13 and 14 below) the Y-axis is the heart rate or skin conductance value, and the X-axis is the corresponding number of cases found for each target behavior, which in this case was *word searches*.

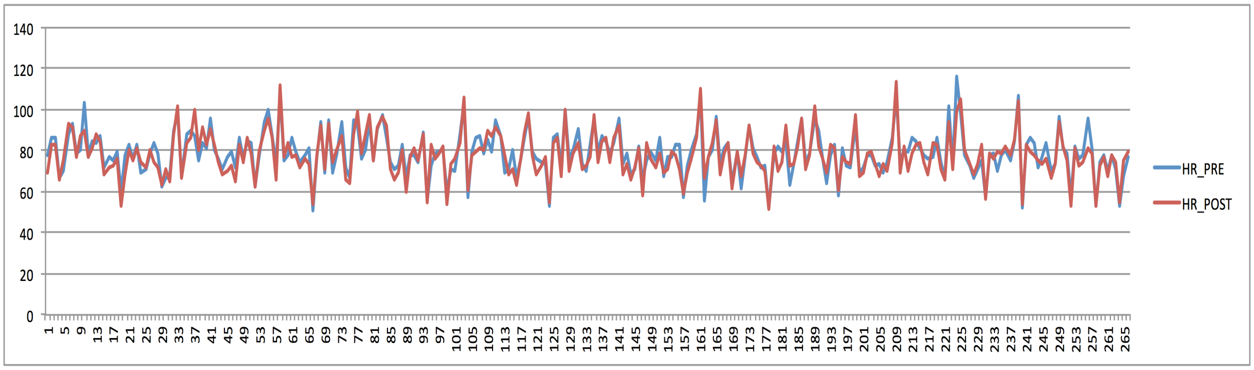

Figure 13. Pre and post average heart rate values for word searches by number of cases

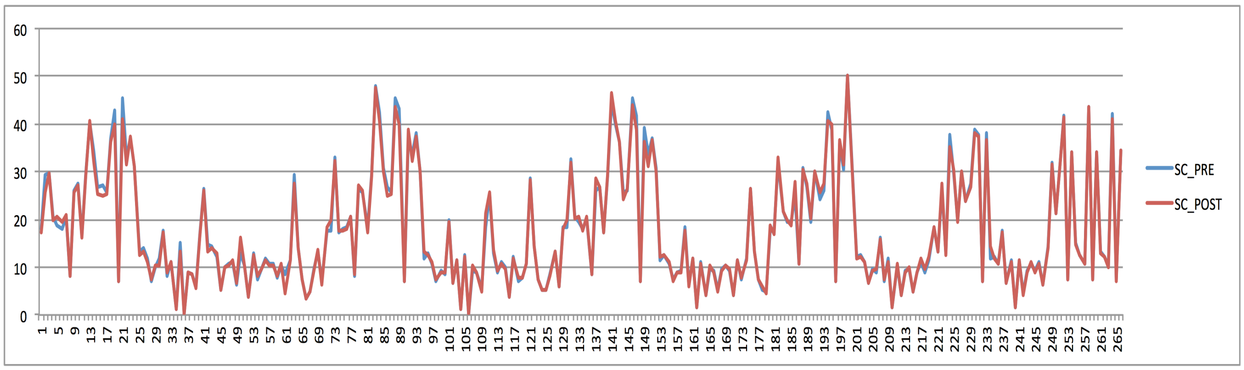

Figure 14. Pre and post average skin conductance values for word searches by number of cases

In *figures* 13 and 14, it can be observed that there were very small changes surrounding the investigated behavior. In order to find out if these small changes were statistically significant, and paired T-test was performed (step 9).

Step 8. Descriptive statistics analysis was performed on the data in order to verify a normal distribution of the *word searches* data, looking at skewness and kurtosis. Skewness and kurtosis had to be between -1 and +1 for the values to have normal distribution.

Step 9. Paired T-Tests were performed in order to check if the differences between the Pre-Post heart rate and Pre-Post skin conductance data were significant. Significant differences between Pre and Post values would have to be (<.05).

Table 34 *Descriptive Statistics for Word Searches Pre and Post HR and SC*					
	N	Skewness		Kurtosis	
	Statistic	Statistic	Standard Error	Statistic	Standard Error
WORDHRPRE	266	.188	.149	.791	.298
WORDHRPOST	266	.342	.149	.767	.298
WORDSCPRE	266	.817	.149	-.375	.298
WORDSCPOST	266	.778	.149	-.435	.298
Valid N (list wise)	266				

From *table* 34 it can be observed that the date show a normal distribution since values fall between -1 and 1.

Table 35 *Paired Samples Statistics for Word Searches Pre and Post Means*					
		Mean	N	Std Deviation	Std Error
Pair 1	WORDHRPRE	78.91	266	10.76	.659
	WORDHRPOST	77.94	266	10.90	.668
Pair 2	WORDSCPRE	17.79	266	11.63	.713
	WORDSCPOST	17.65	266	11.40	.699

As can be observed from *table* 35, the values for WORDHRPRE and WORDHRPOST show a significant difference. There is also a significant difference between the pairs WORDSCPRE and WORDSCPOST. However, the means of the paired variables show that not only pre heart rate was higher than post heart rate, but so was pre skin conductance in comparison to its pair, post skin conductance.

Table 36 *Paired Samples Correlations for Word Searches Pre and Post Means*				
		N	Correlation	Sig.
Pair 1	WORDHRPRE & WORDHRPOST	266	.910	.000
Pair 2	WORDSCPRE & WORDSCPOST	266	.997	.000

The correlation values observed in *table* 36 show that WORDHRPRE and WORDHRPOST are highly correlated (r=.910, p=.000). The same can be observed for WORDSCPRE and WORDSCPOST (r=997, p=.000).

Table 37

Paired Samples T-Test for Word Searches Pre and Post Means

		Paired Differences					t	df	sig.
					95% Confidence Interval of the Difference				
		Mean	Std Deviation	Std Error	Lower	Upper			
Pair 1	WORDHRPRE & WORDHRPOST	.970	4.597	.281	.415	1.525	3.442	265	.001
Pair 2	WORDSCPRE & WORDSCPOST	.141	.949	.058	.026	.256	2.430	265	.016

Table 37 shows the results of the T-test performed on the *word search* pre and post means data. It can be observed that the difference of means taken between each of these pairs is significant, given that the significant values (Sig.) are lower than (.05).

Preparing data for correlations. In order to look for correlations among participants' psychological scores, target behaviors, heart rate, skin conductance, and heart rate variability values, a Pearson Single Correlation was performed after a series of steps, as follows:

Step 1. Participants' answers to psychological questionnaires were scored following the procedures listed in the corresponding scoring manuals.

Step 2. All data relative to participants' scores, quantification of target behaviors per participant, heart rate and skin conductance averages, and heart rate variability values were transferred to an excel sheet. This data sheet contained all data collected for Study 2, displayed by participant, and by group.

Step 3. This data sheet containing all data displayed by participant and by group was imported into SPSS.

Step 4. To prepare the data for a Pearson Single Correlation analysis, all data was converted to standard scores, or Z scores.

Step 5. The data were checked for normal distribution, looking at skewness and kurtosis. Skewness and kurtosis had to be between -1 and +1 for the values to have normal distribution.

Step 6. Pearson Single Correlation analysis was performed, and the correlations between *word searches* and psychological scores were found.

Correlation results. The correlation coefficient was interpreted as r =.5 large, r = .3 medium, and r= .10 small. As can be observed in the table below, coded behaviors and certain surveys showed strong and medium correlations to the amount of *word searches* (see *tables* 10 and 11, presented again in this section).

Table 10

Single Pearson Correlations Between Scores on Psychological Surveys and Coded Conversational Behaviors – first half

PSYCH SURVEYS X BEHAVIOR	1	2	3	4	5	6	7	8	9	10	11	12	13
1. TURNS - LENGTH	1												
2. TURNS - NUMBER	.469**	1											
3. DISAGREEMENT	.205	.224	1										
4. SILENCE	.013	.004	-.167	1									
5. PAUSE	.513**	.142	.083	.221	1								
6. WORD SEARCH	.302**	.081	.123	.150	.527**	1							
7. BAS DRIVE	.161	.245*	.257*	-.010	.010	.041	1						
8. BAS FUN SEEKING	-.141	-.063	.106	-.207	-.126	.056	.293*	1					
9. BAS REW RESP	-.049	.144	.110	-.089	-.203	-.025	.408**	.243*	1				
10. BIS	-.127	-.015	-.164	.065	-.012	-.091	-.162	-.170	.236*	1			
11. CDS	-.074	-.079	.022	.000	-.047	.064	.087	.252*	.115	-.265*	1		
12. CES-D	.318**	.189	.006	.062	.336**	.081	-.019	-.054	.257*	.277*	-.021	1	
13. LS	.113	.074	.031	-.207	.121	-.042	-.198	.105	-.013	.366**	-.102	.469**	1
14. PANAS NEGATIVE	.016	-.108	-.136	.040	-.011	-.081	.090	.094	.089	.066	.079	.182	.041
15. PANAS POSITIVE	.087	-.060	-.061	-.002	-.020	-.039	.128	.263	.088	-.192	.156	-.092	-.224
16. PRCA GR DISC	-.333**	-.216	-.194	.234*	-.060	.020	-.235*	-.232	-.082	.406**	-.051	.081	.179
17. PRCA MEETINGS	-.141	-.149	-.124	.155	-.022	.092	-.228	-.080	.004	.351**	-.144	.190*	.329**
18. PRCA INT CONV	-.389**	-.134	-.272*	.076	-.105	.047	-.390	-.104	-.115	.451**	-.030	.129	.305**
19. PRCA PUB SPEAK	-.279*	-.079	-.249*	-.068	-.098	-.010	-.191	.076	.265*	.317**	-.113	.171	.197
20. RCBS	-.294*	-.087	-.217	.072	.023	.075	-.521**	-.206	-.212	.444**	-.217	.098	.406**
21. SIAS	-.223	-.007	-.265*	-.053	-.129	-.149	-.209	-.160	.019	.393**	-.253	.332**	.427**
22. STAI-Y2	.016	-.018	-.246*	.018	.164	-.057	-.274*	-.268	-.036	.596**	-.269*	.471**	.611**
23. STAXI T-ANGER	-.037	.058	.249*	.038	-.078	-.215	.213	.025	.194	.245*	-.103	.312**	.199
24. STAXI AC OUT	-.112	-.171	.127	.037	.066	.157	.040	.181	-.054	-.049	.159	-.007	-.097
25. STAXI AC IN	.022	-.025	.323**	-.145	.039	.176	.295**	.363**	-089	-.135	.202	-.015	-.032
26. STAXI INDEX	.000	.005	-.201	.058	-.026	-.159	-.157	-.239	.031	.268*	-.200	.199	.219

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Table 11

Single Pearson Correlations Between Scores on Psychological Surveys and Coded Conversational Behaviors – second half

PSYCH SURVEYS X BEHAVIOR	14	15	16	17	18	19	20	21	22	23	24	25	26
1. TURNS - LENGTH													
2. TURNS - NUMBER													
3. DISAGREEMENT													
4. SILENCE													
5. PAUSE													
6. WORD SEARCH													
7. BAS DRIVE													
8. BAS FUN SEEKING													
9. BAS REW RESP													
10. BIS													
11. CDS													
12. CES-D													
13. LS													
14. PANAS NEGATIVE	1												
15. PANAS POSITIVE	.807**	1											
16. PRCA GR DISC	.054	-.131	1										
17. PRCA MEETINGS	.150	-.091	.650**	1									
18. PRCA INT CONV	.039	-.180	.672**	.548**	1								
19. PRCA PUB SPEAK	-.042	-.213	.444**	.361**	.409**	1							
20. RCBS	-.077	-.242	.646**	.481**	.791**	.376**	1						
21. SIAS	.057	-.224	.489**	.597**	.638**	.406**	.641**	1					
22. STAI-Y2	.082	-.282	.394**	.430**	.407**	.428**	.485**	.563**	1				
23. STAXI T-ANGER	.118	-.075	.161	.180	.042	.137	.081	.267*	.267*	1			
24. STAXI AC OUT	.100	.094	-.011	-.118	.059	-.126	-.092	-.315**	-.234*	-.285*	1		
25. STAXI AC IN	.152	.128	-.246*	-.263*	-.208	-.135	-.277	-.415**	-.325	-.229	.630**	1	
26. STAXI INDEX	-.030	-.158	.336**	.320**	.174	.289*	.299**	.477**	.485**	.398**	-.783**	-.791**	1

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Word Search x Coded Behavior. The category *word search* showed moderate correlation to the total *Number of Seconds* participants had the floor (TURNS SEC) ($r=.302$, $p<0.01$), and high correlation to Pauses ($r=.527$, $p<0.01$).

Word Search x Psychological Scores. Pauses only showed weak to no correlations to psychological scores. The highest of the weak correlations was to Trait Anger (STAXI T-ANGER) ($r=-.215$). The remaining correlations were not significant.

In addition, the Pearson correlations between *word searches* and physiological data are displayed on *tables* 12 and 13, presented again here.

Table 12

Single Pearson Correlations Between Heart Rate Variability During Group Task and Coded Conversational Behaviors – first half

CONVERSATION HRV X BEHAVIOR:	1	2	3	4	5	6	7	8	9	10	11	12
1. TURNS - LENGTH	1											
2. TURNS - NUMBER	.469**	1										
3. DISAGREEMENT	.205	.224	1									
4. SILENCE	.013	.004	-.167	1								
5. PAUSE	.513**	.142	.083	.221	1							
6. WORD SEARCH	.302**	.081	.123	.150	.527**	1						
7. SDNN	.031	-.006	.279*	.026	.013	.112	1					
8. RMSSD	.052	.089	.265*	-.052	-.007	.089	.894**	1				
9. SD1	.032	.082	.247*	-.086	-.011	.073	.857**	.958**	1			
10. SD2	-.017	.004	.295*	-.010	.017	.100	.951**	.808**	.819**	1		
11. LF/HF	.213	-.037	.118	-.013	.149	.156	-.243*	-.347**	-.362**	-.169	1	
12. TP	.053	.118	.269*	-.056	-.043	.017	.804**	.803**	.834**	.793**	-.194	1
13. NP HF	-.110	.067	.158	-.159	-.108	-.065	.418**	.557**	.613**	.405**	-.707**	.571**
14. NP LF	.053	.010	-.047	.037	.115	.120	-.416**	-.556	-.463**	-.176	.745**	-.443
15. RP HF	-.015	.139	.107	-.153	-.064	-.036	.404**	.573**	.634**	.340**	-.532**	.651**
16. RP LF	.319**	.105	-.021	-.077	.178	.139	-.198	-.189	-.115	-.107	.584**	-.168
17. RP VLF	-.277*	-.156	.014	.078	-.100	-.039	-.161	-.294*	-.298**	.007	-.022	-.297**
18. AP HF	-.035	.106	.182	-.095	-.083	.002	.579**	.675**	.698**	.509**	-.323**	.856**
19. AP LF	.256*	.136	.226	-.032	.055	.052	.621**	.570**	.630**	.656**	.149	.751**
20. AP VLF	-.027	.018	.267*	.039	-.045	-.007	.801**	.668**	.663**	.864**	-.174	.759**
21. PF HF	-.080	-.077	.075	-.155	-.014	.059	.029	.170	.257*	.140	-.162	.242*
22. PF LF	.056	-.007	.167	-.129	-.051	.052	-.043	-.068	.004	.047	.349**	.011
23. PF VLF	.206	-.087	-.002	-.122	.100	.168	.068	.023	.090	.085	.384	.078

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Table 13

Single Pearson Correlations Between Heart Rate Variability During Group Task and Coded Conversational Behaviors – second half

CONVERSATION HRV X BEHAVIOR:	13	14	15	16	17	18	19	20	21	22	23
1. TURNS - LENGTH											
2. TURNS - NUMBER											
3. DISAGREEMENT											
4. SILENCE											
5. PAUSE											
6. WORD SEARCH											
7. SDNN											
8. RMSSD											
9. SD1											
10. SD2											
11. LF/HF											
12. TP											
13. NP HF	1										
14. NP LF	-.756**	1									
15. RP HF	.891**	-.709**	1								
16. RP LF	-.485**	.632**	-.213	1							
17. RP VLF	-.104	.285*	-.477**	-.484**	1						
18. AP HF	.721**	-.619**	.854**	-.278*	-.376**	1					
19. AP LF	.114	-.027	.261*	.304**	-.414**	.385**	1				
20. AP VLF	.337**	-.215	.174	-.325**	.228*	.422**	.587**	1			
21. PF HF	.508**	-.191	.442**	-.082	.002	.298**	.066	.136	1		
22. PF LF	-.166	.348	-.030	.544**	-.276*	-.050	.234*	-.132	.046	1	
23. PF VLF	-.221	.236	-.017	.558**	-.466**	-.010	.351**	-.125	-.005	.373**	1

Note. **Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Word Search x Heart Rate Variability. Word searches only showed weak to no correlations to all HRV values. No significant correlations were found.

Regression Analysis

For the purpose of conducting regression analysis, independent variables showing high correlation with the dependent variable but not among each other were required (see table below).

Table 38

Dependent and Independent Variables for Regression Analysis of Word Search

Dependent Variable	Independent Variable
WORD SEARCH	No independently correlated variables were found

Therefore, it was not possible to identify candidate independent variables for a regression analysis on *word search* to be performed. A regression model requires independent variables that show high correlation with the dependent variable but not among each other. Since there were no variables with significant correlations to *word searches*, a regression formula for this behavior was not attainable.

Summary and Conclusion

Word searching is a form of repair that often invites other participants' collaboration. It is often self-initiated, but if not self-repaired within a turn, it becomes an open invitation for other-repair. In addition, it is possible that other recipients might see this type of collaboration as an offer of assistance that will have physiological soothing effects.

In terms of other behaviors, *word searches* strongly correlated with pauses, indicating that pauses and *word searches* frequently occur together. *Word searches* showed a moderate positive correlation with length of turns, which seems to indicate that the longer the turn the higher the likelihood of *word search* occurrences.

In terms of psychological scales, *word searches* showed moderate negative correlation with trait anger, indicating that it is possible that because this conversational behavior involves taking a chance at a turn during the current speaker's turn, it requires the participant to have a somewhat aggressive behavior. This is further supported by the fact that *word searches* correlate negatively with social interaction anxiety scores, meaning that this type of anxiety paired with a lack of anger would prevent a recipient from taking the chance at helping someone else with a *word search*, risking offering an inadequate candidate answer. This behavior, therefore, seems to involve some level of risk-taking.

In this dataset, *word searches* did not show any strong correlations to any of the physiological measures. It did, however, show a weak positive correlation to the standard deviation of interbeat intervals, low-high frequency ratio, and all low frequencies. This indicates that this conversational behavior might require the suppression of the parasympathetic system, and activation of the sympathetic system. Searching for a word might be perceived as a stressor in the conversation, possibly because it would not allow the continuation of the ongoing stream of talk.

Chapter 8: Individual Differences in Group Interactions

In order to describe in more detail the factors that influence individuals' behaviors when interacting during a small group conversation, this chapter's goal is twofold: (i) to discuss the literature on individual differences in personality traits, and (ii) to present the data available for each of the three participants in Group 7 and Group 26 (Study 2). The behavior of the individuals in the groups selected for this preliminary qualitative analysis is discussed in terms of participants' psychophysiological traits and predispositions. Moreover, groups were chosen randomly from the pools of all-female and all-male groups, and were not selected based on the nature of participants' performance. Another purpose of this chapter is to discuss the potential psychological and physiological differences found among the participants within these particular groups are, and how they may be related to differences in their behavior during the conversation. Behavioral differences found among participants in this group are not thought to be universal or applicable to other groups' performance. This is because behaviors coded and quantified for each member of these groups are thought to be closely related to participants' psychological traits and heart rate variability, as demonstrated here.

It is safe to assume that people who share a similar upbringing are more similar to each other than those who do not. Additional similarities in behavior and personality traits can be based on shared linguistic and cultural backgrounds. In this study, participants share linguistic and cultural backgrounds in the sense that they are all native speakers of English, attend classes at the same university (with a few exceptions), live in the same city, and most of them fall between the age range of 18 to 29. Despite the fact that the demographic similarities found in this particular case may lead to a non-verbal consensus of shared knowledge and similar and consistent conversational behaviors, the usefulness of applying individual differences in one situation to predict individual differences in another situation is limited (Revelle, 1996). Nevertheless, a great amount of personality research relies on prediction and selection of behavior (Kanfer et al, 1995), and focuses on the study of individual differences in personality (Buss, 1989).

In general, the literature on personality can be organized into two distinct approaches: (i) cognitive vs. affective-temperamental, and (ii) descriptive vs. causal-explanation. The first approach distinguishes analyses of intellectual abilities from those of non-cognitive variables associated with affective reactions and behavior. Experimental analyses have shown systematic relationships between non-cognitive personality variables and cognitive performance. These relationships are moderated by a variety of situational manipulations that affect motivational states (Anderson, 1996; Matthews et. al., 1990; Revelle, 1996). Studies of individual differences in mood have extended the earlier work of Tellegen (1985), Russell (1979); Thayer (1989), and Watson & Tellegen (1985) on identifying the independent dimensions of mood and emotion that are associated with positive and negative affect. For example, extraversion is associated with measures of positive affect while neuroticism is associated with measures of negative affect (Meyer & Shack, 1989; Saucier 1992; Watson et. al., 1994).

The second approach found in the literature on personality deals with descriptive vs. causal explanations of individual differences. Causal theorists have emphasized the relationships of biological mechanisms of emotional reactivity with dimensions of individual differences and have followed two related paths: demonstrations of the genetic basis of particular traits, and explorations of particular biological mechanisms thought to be associated with individual differences in the major affective and cognitive traits (Buss, 1990). Among the mechanisms proposed are differences in relative activation of specific brain structures as well as differences in the relative amounts of specific neurotransmitters. Moreover, some causal explanations for individual differences have been proposed in terms of evolutionary theory (MacDonald, 1992).

Studies of the biological substrates of personality are related to Eysenck's (1990) theories of approach and reward, inhibition and punishment, and aggression and flight. All three constructs have been the basis for descriptive as well as non-biological theories of motivation and learning (Atkinson 1960; Dollard & Miller 1950). Unifying recent biological work is an emphasis on these three interrelated biological and behavioral systems as sources of individual differences in affective reactions and interpersonal behavior. Central constructs of Eysenck’s biological theory of introversion-extraversion and stability-neuroticism were cortical arousal and limbic activation (Eysenck, 1967). Arousal was originally postulated as reflecting activation of the Ascending Reticular Activating System (ARAS) and the associated cortical-reticular loop. Activation reflected limbic activity of the hippocampus, amygdala, singulum, septum, and hypothalamus. Introverts were thought to have higher levels of resting arousal than did extraverts. With the assumption that some intermediate level of arousal was preferred, the stimulus seeking behavior of extraverts was explained as a compensation for a lower resting level. With the recognition that ARAS arousal was too broad a concept, Eysenck subsequently modified his theory to include a limbic arousal system, the monoamine oxidase system, and the pituitary-adrenocortical system (1990). He suggested that the apparent diversity of multiple arousal mechanisms “may not prevent the systems from operating in a relatively unified fashion.” (p 249). He associates subjective arousal with Thayer’s (1989) measures of energetic arousal (feelings of energy, vigor, and pep). Extraversion and feelings of energetic arousal are both associated with approach behavior and with positive affect following reward or cues for reward.

More specifically, the Behavioral Activation System (BAS, Fowles, 1988) activates approach behaviors in response to cues for reward or non-punishment. It may be associated neurophysiologically with the motor programming system. "The key components are the basal ganglia (the dorsal and ventral striatum, and dorsal and ventral pallidum); the dopaminergic fibers that ascend from the mesencephalon (substantia nigra and nucleus A 10 in the ventral tegmental area) to innervate the basal ganglia; thalamic nuclei closely linked to the basal ganglia; and similarly, neocortical areas (motor, sensorimotor, and prefrontal cortex) closely linked to the basal ganglia." (Gray, 1994, p. 41). Dopamine is said to play an essential moderating role in the functioning of the BAS (Depue & Iacono, 1989), but the full relationship of dopaminergic activation and reward is less clear (Wise & Rompre, 1989). The cluster of approach traits of extraversion (Eysenck, 1990), impulsivity (Barratt, 1996; Gray 1994; Zinbarg & Revelle, 1989), novelty seeking (Cloninger, 1987), and positive affectivity (Depue & Iacono, 1989; Tellegen 1985) as well as the states resulting from approach or reward, energetic arousal (Thayer 1989), and positive affect (Watson et al, 1994) have been discussed in terms of the BAS.

If the BAS is the engine of behavior, the Behavioral Inhibition System (BIS) is the braking system. Signals of punishment, non-reward, novel stimuli, and innate fear stimuli lead to behavioral inhibition, an increment in tense arousal, and increased attention. The BIS may be considered both as a cognitive and physiological system (Fowles,1988; Gray, 1982). Cognitively, the role of the BIS is to compare the current state of the world with expectations, and to inhibit and modify behavior that leads to deviations from expectation. Physiologically, the comparator function of the BIS is associated with the septohippocampal system. Input to this system comes from the prefrontal cortex, and output flows through the noradrenergic fibers of the locus coeruleus, and serotonergic fibers from the median raphe (Gray, 1994). More detailed reviews of the neurophysiology of the BIS emphasize the role of serotonin (Clonginger, 1987; Depue & Iacono, 1989; Spoont, 1992) and the amygdala (Kagan, Arcus & Snidman, 1993).

Neurologically, the fight-or-flight system has been associated with the amygdala, the medial hypothalamus, and the central gray of the midbrain (Gray, 1994). Neurochemically, serotonin, gamma-aminobutyric acid, the endorphins, and testosterone have been implicated in aggression and hostility (Dabbs & Morris, 1990). In partial agreement with the dichotomization of affect into positive and negative systems are studies of the lateralization of emotionality that suggest an association between left frontal brain activation and approach-related positive affect and right frontal activation and inhibitory or withdrawal related behavior and negative affect (Davidson, 1993). Unfortunately, identification of particular biological systems with particular personality traits or psychopathological disorders tends to ignore the complexity of neural architecture. The brain has evolved to solve many different problems, and primitive systems are controlled by later, more complex systems (Derryberry & Tucker, 1992; MacLean, 1990).

But traits are not behavior; they are summary statements describing likelihood of and rates of change in behavior in response to particular situational cues. In addition to their relationship to the probability and latency of response, stable predispositions may be conceptualized in terms of differential sensitivities to situations and differential response biases. Intervening among traits, situations, and responses are momentary affective and cognitive states. Two affective dimensions that relate to stable personality traits are positive and negative affect (PANAS, Watson et al, 1994) or the related constructs of energetic and tense arousal (Thayer, 1989). For example, extraversion tends to be related to positive affect, and neuroticism with negative affect. These relationships, however, are not strong and interact predictably with the situation. Although these relationships are consistent with theories of traits and states, they are small enough to require assessing traits and states in order to study relationships with performance (Matthews, 1992b).

Further complicating the trait-state relationship is its dynamic nature. When free to choose situations, individuals sensitive to negative affect will try to avoid threatening situations. It is the emotionally stable individual who is more likely to participate voluntarily in activities that are likely to induce negative affect. Thus, it is necessary to distinguish between externally imposed and freely selected situations as well as within and between subject differences in the use of affective scales.

Traits as well as emotional states affect the detection, encoding, storage, retrieval and integration of information (Christianson, 1993). Trait and state effects may be seen at each of these conceptual stages (Revelle, 1996). For example, impulsivity interacts with time of day to affect energetic arousal, which in turn is related to the detection and storage of information (Anderson & Revelle, 1994; Revelle, 1996); anxiety shifts attention to threat related cues whereas depression biases memory towards depression-related material (Mathews, 1993; Mueller, 1992); and relations between anxiety and memory vary as a function of trait and state anxiety as well as implicit and explicit memory conditions (Eysenck & Mogg, 1993).

In addition, social learning theory explains consistent individual differences in behavior in terms of similarities in the supporting environment rather than in terms of an individual's characteristics. Consistency across situations reflects similarity of those situations rather than stable individual traits. Hence, behavior can be modified by changing the environmental cues. Some of the clearest evidence for the effect of the formative and sustaining environment in determining individual differences comes from behavioral genetic analyses. For example, the fact that identical twins are not perfectly concordant for extraversion, neuroticism, schizophrenia, or homosexuality demonstrates environmental effects. More importantly, the fact that identical twins growing up together seem to be no more similar than those growing up apart (Eaves et al, 1989; Tellegen et al, 1988) implies that the formative environment is not the set of experiences shared within a family, but is either unique to each individual or common to their culture. Although "interactionism" was claimed to be the new and improved way to study personality (Magnusson & Endler, 1976), most personality research has gone beyond the simple assertion that consistencies exist in the interactions of traits and situations. Theoretically driven trait theorists have long recognized that stable individual differences produce predictably different patterns of results in different situations. In fact, failure to change one's actions across situations is a sign of pathology, not adaptive behavior.

Therefore, a person is not just the simple combination of universals of human nature and specific values on several independent trait dimensions. A person is also a dynamic information processor whose unique memories and perceptual structures lead to a unique cognitive, affective, and behavioral signature. Structural studies of individual differences emphasize between subject correlational patterns of variables. But these structures are not the same as studying the coherent patterns of an individual over a lifetime, or even across different situations (York & John, 1992). What is important to people in the aggregate becomes coded into the language, including the multiple hypotheses one has about one's self, one's perceptions, thoughts, and actions. In this sense, self is the insider's view of personality and it shapes interpersonal behavior (Markus & Cross, 1990). As a fundamentally social construal (Banaji & Prentice, 1994), the "working self concept is influential in the shaping and controlling of intrapersonal behavior (self-relevant information processing, affect regulation; and motivational processes) and interpersonal processes, which include social perception, social comparison, and social interaction" (Markus & Cross, 1990, p. 578).

Thus, it is undeniable that individual differences in terms of gender, age, background, health, education, ethnicity, psychological traits, mood and affect, neurophysiology, neurochemistry, physiological predispositions, self construals, among many other factors, play a crucial role in the interactive complex dynamic system that comprise human interpersonal and interpersonal behaviors. Keeping in mind the considerations raised in the brief literature review above, the following sections focus on the different dimensions and characteristics of Groups 7 and 26 ranging from demographics to psychological scores on personality tests, changes in heart rate and skin conductance during tasks, and recordings of heart rate variability during tasks. This information taps into physiological and psychological differences among subjects, which accounts for differences in their conversational behaviors.

GROUP 7

Data Analysis I: Demographics, Psychophysiology, and Distribution of Tokens of Behavior

Several kinds of information about the participants in Group 7 are relevant for a more thorough understanding of their performance. Among the types of data available are demographic information, scores on psychological surveys, quantified target behavior, heart rate variability data, and pre and post target behaviors changes in heart rate and skin conductance. The following *table* provides demographic information of Group 7 participants:

Table 39 *Demographic information about participants in Group 7*					
Participant ID	Gender	Age Range	Educational Background	Race	Employed
BPCC036	Female	21-29	High school degree	Asian descent	Not employed, not looking for work
BPCC038	Female	18-20	High school degree	Asian descent	Employed, working 1-39 hours/ week
BPCC039	Female	18-20	High school degree	African American	Not employed, not looking for work

All subjects were female, college students. Two participants were between the ages 18 and 20, and the other was between the age of 21 and 29. Two participants were Asian descent, and the third was African American (see *table* 39). One participant worked, and the other two were not employed, nor were they looking for work. Besides demographic information, it is important to note health related data, as seen in *table* 40.

Table 40 *Health related information about participants in Group 7*					
Participant ID	Smoke	Psychiatric Disorders	Coffee Intake	Menstrual Cycle	Pregnant
BPCC036	No	No	Once a week	Over 4 weeks ago	No
BPCC038	No	No	Less than once a month	Less than a week ago	No
BPCC039	No	No	Less than once a month	Less than a week ago	No

As can be observed in *table* 40, none of the participants smoked, were diagnosed with psychiatric disorders, or were pregnant. Two participants said they drank coffee less than once a month, and one participant said she had coffee once a week. Two participants had their menstrual cycle less than a week before the session, while one said menstrual cycle had been over 4 weeks before that time.

Table 41

Distribution of target behaviors across participants in Group 7

Participant ID	TURNS LENGTH (SECONDS)	TURNS NUMBER	OVER-LAPS	SILENCE	PAUSE	DISAGREEMENTS	WORD SEARCH
BPCC036	146	35	37	16	0	1	0
BPCC038	515	80	42	16	5	1	2
BPCC039	572	67	52	16	4	1	3

Table 41 shows that participant BPPC036 had a significantly lower number or turns (35 in total) during the entire conversation in relation to participants BPCC038 and BPCC039 (80 and 67 turns respectively). This fact correlates with the fact that BPCC036 held the floor less (146 seconds) than the other two participants (515 and 572 seconds respectively) (see *figures* 15 and 16).

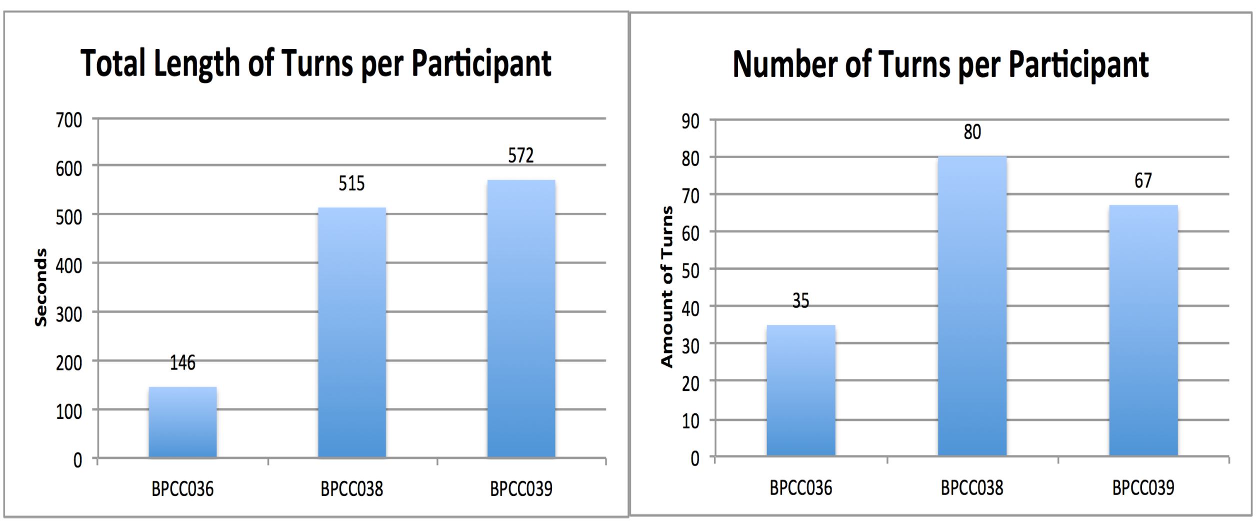

Figure 15. Total length of turns taken by each participant in seconds and number of turns each participant took during the conversation

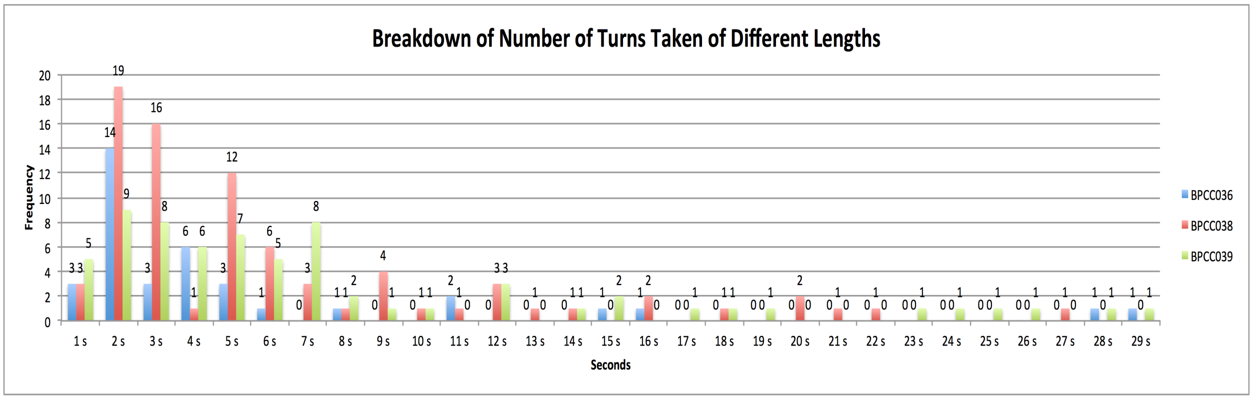

Figure 16. Breakdown of the number of turns of each length that each participant took

Interestingly, participant BPCC036 also had fewer *overlaps* (37 overlaps) than participants BPCC038 and BPCC039 (42 and 52 overlaps respectively), no *pauses* (0) as opposed to 5 and 4 pauses made by participants BPCC038 and BPCC039; in addition, BPCC036 made no attempt at *word searches* (0) as opposed to 2 and 3 word searches for participants BPCC038 and BPCC039 respectively. There are no significant differences in terms of numbers of *disagreements*, as each participant initiated 1 disagreement each (see *figure* 17).

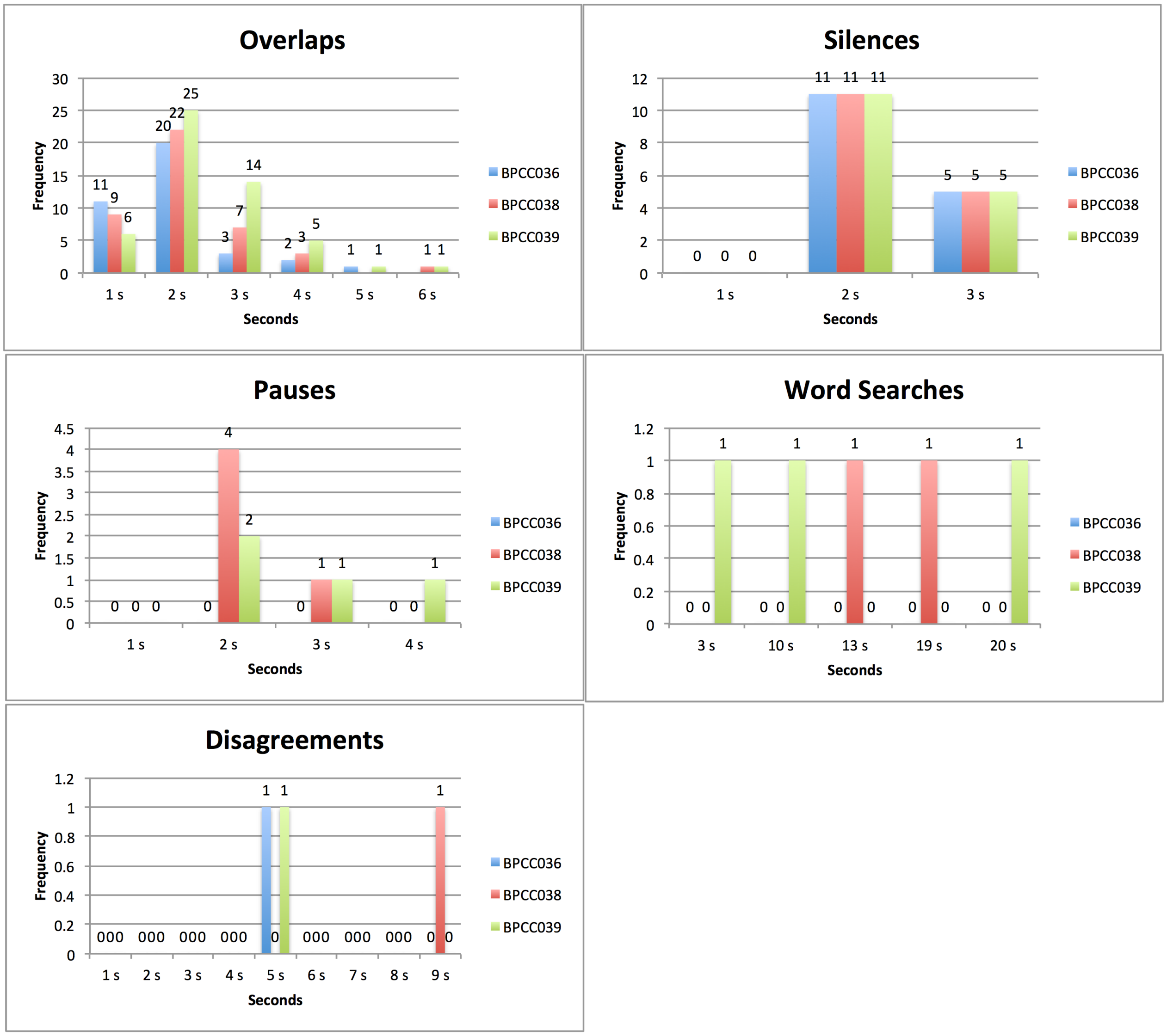

Figure 17. Breakdown of overlaps, silences, pauses, word searches, and disagreements during the conversation, per participant, displayed by frequency and length in seconds

Compared with others in the same group, participant BPCC036's behavior showed a smaller number of turns during the conversation task, less time holding the floor, fewer pauses, word searches, and overlaps. This seemingly introspective behavioral predisposition correlates with BPCC036's personality characteristics. Participant BPCC036's as well as participants

BPCC038's and BPCC039's scores on several scales of psychological traits and states are displayed on *table* 42 and *figure* 18 below.

Table 42

Group 7 participants' scores on psychological scales

Participant ID	BAS DRIVE	BAS FUN SEEKING	BAS REWARD RESPONSIVENESS	BIS	RCBS	CDS	CES-D
BPCC036	11	13	18	22	38	13	19
BPCC038	13	14	20	23	29	19	20
BPCC039	12	10	19	20	32	20	12
Participant ID	LS	PANAS POSITIVE AFFECT	PANAS NEGATIVE AFFECT	PRCA-24 OVERALL CA	PRCA-24 GROUP DISCUSSION	PRCA-24 INTERPERSONAL CONVERSATIONS	PRCA-24 PUBLIC SPEAKING
BPCC036	3	40	19	78	20	15	20
BPCC038	3	37	14	82	21	20	28
BPCC039	3	33	13	59	13	15	14
Participant ID	SIAS	STAI Y1	STAI Y2	STAXI_S-ANG	STAXI_T-ANG	STAXI_AC-O	STAXI AX INDEX
BPCC036	24	32	42	15	22	29	35
BPCC038	18	20	42	15	13	31	29
BPCC039	21	35	35	15	14	21	25

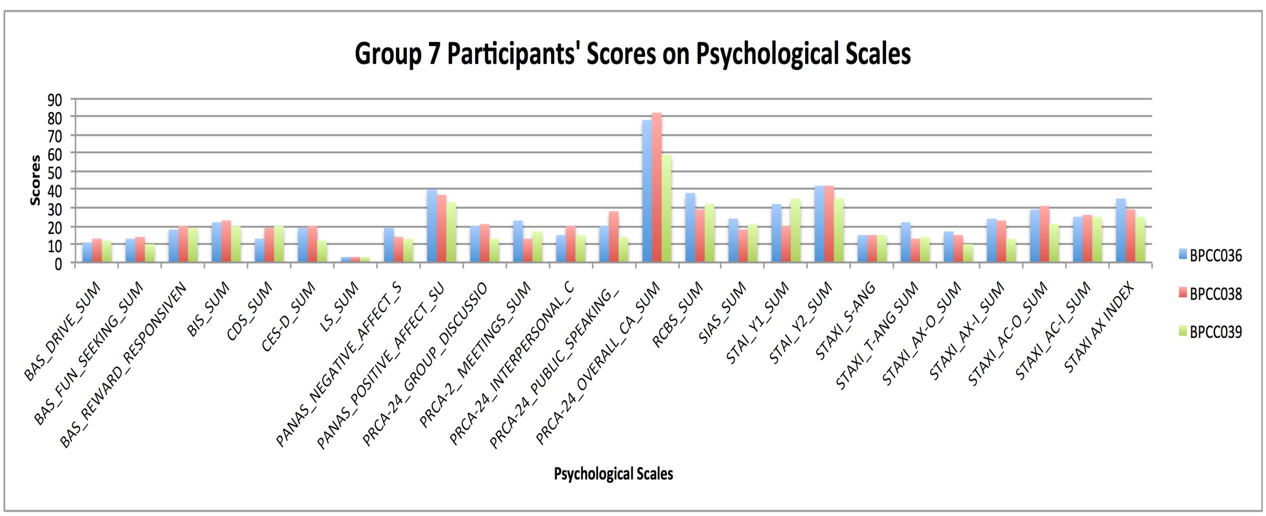

Figure 18. Graphic representation of Group 7 participants' scores on psychological scales

As can be seen in *tables* 28 and 29 and *figure* 18 above, BPCC036's behavioral characteristics reflect some of the scores in the psychological constructs. For example, BPCC036's score on BAS (believed to drive behavior when the goal is to move toward something desired) was lower (score: 11) than for the other participants (13 for BPCC038 and 12 for participant BPCC039); therefore, it can be argued that BPCC036 saw less reward or motivation in participating in the conversation task than the other participants did. This lower drive to participate is reflected on BPCC036's lower number of turns taken as well as on the reduced total number of turns in seconds. In addition, BPCC036's score on BIS, which is said to inhibit an individual away from non-rewarding or punishing situations, was 22, while BPCC038's score was 23, and BPCC039's score was 20. BPCC036's and BPCC038's scores on the BIS were higher than BPCC039's. These scores somewhat correspond to the distribution of number of turns among these two participants, since BPCC039 also had the highest number of seconds total in his turn. Moreover, BPCC036 had the lowest score on the Cognitive Disinhibition Scale (CDS): 13; whereas participants BPCC 038 and BPCC039 scored 19 and 20 respectively. Another scale that measures shyness is the RCBS (Revised Cheek and Buss Shyness scale). In this scale the scores are still consistent with the results from the already mentioned scales, and BPCC036 scored higher (38) than the other participants (BPCC038: 29; BPCC039:32). Still consistent with the above scores and BPCC036's behavior are the results in the Social Interaction Anxiety Scale (SIAS). While participant BPCC036 scored 24, participants BPCC038 and BPCC039 scored 18 and 21 respectively. The scores on the Depression Scale (CES-D) provide somewhat interesting data as well. BPCC036 and BPCC038 scored 19 and 20 respectively, and BPCC039 scored much lower, 12. The scores described so far are also consistent with the scores obtained from the Anger Scale (STAXI). In this scale, BPCC036 scored 35, while the participants who spoke the most, BPCC038, scored 29, and BPCC039, scored 25. Analyses of behavior in light of these psychological constructs are discussed in the following sections.

The correlations table below shows the surveys that more highly correlate with the studied behaviors. Noteworthy is are the scales CDS, which strongly correlates with all of the studied behaviors listed in the table below; PANAS Negative Affect and STAXI, which strongly negatively correlate with all of the studied behaviors. Given the reduced number of samples available for this Pearson Single Correlation analysis (n=3) these correlations have small statistical significance. However, these correlations help determine which psychological constructs might help explain differences in conversational performance (see *table* 43).

Table 43

Correlations between behaviors of participants in Group 7 and their scores on psychological surveys

	TURNS LENGTH	TURNS NUMBER	OVERLAP	PAUSE	WORD SEARCH
BAS DRIVE	0.798	0.972	0.327	0.945	0.655
BIS	-0.309	0.094	-0.786	.000	-0.500
CDS	0.999	0.914	0.836	0.948	0.980
CES-D	-0.507	-0.124	-0.901	-0.217	-0.676
PANAS NEGATIVE AFFECT	-0.999	-0.904	-0.849	-0.941	-0.984
PANAS POSITIV AFFECT	-0.886	-0.629	-0.994	-0.700	-0.963
PRCA GROUP DISC	-0.507	-0.124	-0.901	-0.217	-0.676
PRCA MEETING	-0.862	-0.992	-0.434	-0.976	-0.737
PRCA INTERPERSONAL CONV	0.389	0.723	-0.189	0.655	0.189
RCBS	-0.897	-0.999	-0.500	-0.990	-0.786
SIAS	-0.798	-0.972	-0.327	-0.945	-0.655
STAI Y1	-0.208	-0.579	0.371	-0.500	.000
STAI Y2	-0.603	-0.237	-0.945	-0.327	-0.756
STAXI	-0.960	-0.769	-0.954	-0.826	-0.997

Table 44 displays participants' measures of heart rate variability. According to the polyvagal theory, the autonomic nervous system functioning plays a key role in social behavior and emotion (Alvares et al, 2013). The theory predicts that psychiatric disorders of social dysfunction are associated with reduced heart rate variability, an index of autonomic control, as well as social inhibition and avoidance. Resting state heart rate variability may therefore be considered a marker for social approach-related motivation and capacity for social engagement (Geisler & Schroder-Abe, 2015). Additionally, heart rate variability may provide a useful biomarker to explain underlying difficulties with social approach, impaired stress regulation, and behavioral inhibition, especially in disorders associated with significant impairments in these domains. Individual differences in self-regulatory strength can be assessed by measuring vagal tone via high-frequency heart rate variability (HF-HRV) at rest (Geisler et al., 2013, 2010; Smith et al., 2011; Segerstrom & Solberg Nes, 2007). Biological theory and empirical research suggest that HRV, particularly its high frequency component, is an indicator of one's ability to effectively regulate one's emotions (Appelhans & Lucken, 2006; Denson et al., 2011). HF-HRV is linked to inhibitory activity in prefrontal neural structures and neural feedback mechanisms between the central nervous system and the autonomic nervous system. This central autonomic network is assumed to adjust physiological arousal to changing situational demands and thus to support goal-directed behavior and adaptation (Thayer et al., 2009).

Table 44

HRV values for the 3 participants in Group7, throughout all baselines and tasks

TASK	PARTICIPANT ID		
	BPCC036	BPCC038	BPCC039
Resting			
MHR	62.0	68.5	69.1
SDNN	53.5	57.2	85.6
RMSSD	42.2	51.2	49.8
HF (n.u)	28.0	85.6	46.1
LF (n.u.)	71.8	14.3	53.8
Reading			
MHR	70.6	77.2	72.6
SDNN	56.5	61.5	62.7
RMSSD	98.8	40.1	37.0
HF (n.u)	50.6	36.7	49.1
LF (n.u.)	49.2	63.3	50.8
Question-and-Answer			
MHR	69.0	79.0	75.6
SDNN	74.5	78.7	64.3
RMSSD	37.1	41.3	41.8
HF (n.u)	23.7	13.8	27.6
LF (n.u.)	76.2	86.2	72.3
Group Resting			
MHR	65.5	78.9	76.3
SDNN	71.5	58.1	56.0
RMSSD	85.0	44.1	45.1
HF (n.u)	76.3	60.3	38.3
LF (n.u.)	23.6	39.7	61.6
Group Conversation			
MHR	70.4	80.5	79.9
SDNN	66.2	86.1	64.4
RMSSD	51.1	68.8	37.0
HF (n.u)	39.6	28.0	18.1
LF (n.u.)	60.1	71.9	81.9

As can be observed in *table* 44, participant BPCC036, the same participant who had the fewest number of seconds and turns, fewer overlaps and pauses, and no word searches, consistently displays the lowest HRV values across all baselines and conversation tasks, while participants BPCC039, the most active and talkative participant during the conversation task, also displays higher HRV values. BPCC036's resting HF-HRV was 28, whereas BPCC038's and BPCC039's resting HF-HRV were 85.6 and 46.1 respectively.

Pre and Post Heart Rate and Skin Conductance for Silence. As can be observed in *table* 45 and *figure* 19, most silences are 2 or 3 seconds long. These are very common lengths of silence, and should not elicit overt changes in heart rate and skin conductance, or in anticipation of them. It is, however, as possibility that BPCC036's decreased variation in pre-post silence heart rate and skin conductance measures is correlated with the fact that this participant did not have the floor for most of the conversation, and therefore did not react as much as the other 2 participants. Given that a silence is a clear transition relevant point, there is a chance that BPCC036 was not pursuing opportunities to become the next speaker.

Table 45

Heart rate and skin conductance of participants in Group 7 during silences

	PRE SILENCE 1	PRE SILENCE 2	PRE SILENCE 3	PRE SILENCE 4	PRE SILENCE 5	PRE SILENCE 6	PRE SILENCE 7	PRE SILENCE 8
LENGTH OF SILENCE	3 SECONDS	2 SECONDS	3 SECONDS	2 SECONDS	2 SECONDS	3 SECONDS	2 SECONDS	2 SECONDS
HR BPCC036	68.52	71.31	74.99	76.64	72.17	69.29	66.58	65.85
SC BPCC036	22.87	24.8	23.63	27.26	25.01	23.78	24.46	23.71
HR BPCC038	88.74	81.66	92.85	75.12	72.69	75.6	86.65	79.15
SC BPCC038	25.26	24.04	25.6	25.77	25.27	25.26	30.43	29.38
HR BPCC039	73.53	79.11	84.09	79.67	75.99	85.46	79.54	75.25
SC BPCC039	37.42	34.28	35.46	36.09	36.31	36.52	40.01	39.17
	POST SILENCE 1	POST SILENCE 2	POST SILENCE 3	POST SILENCE 4	POST SILENCE 5	POST SILENCE 6	POST SILENCE 7	POST SILENCE 8
HR BPCC036	72.62	66.46	71.1	72.17	71.9	72.42	66.21	69.22
SC BPCC036	25.53	24.84	24.09	25.01	24.09	26.93	23.74	25.86
HR BPCC038	84.62	78.59	87.96	72.69	77.29	72.27	78.84	79.02
SC BPCC038	23.59	24.54	25.83	25.27	25.21	25.75	29.21	29.02
HR BPCC039	80.32	79.34	81.62	75.99	82.1	81.89	74.8	78.1
SC BPCC039	35.43	34.43	35.07	36.3	36.45	39.81	39.07	38.3

	PRE SILENCE 9	PRE SILENCE 10	PRE SILENCE 11	PRE SILENCE 12	PRE SILENCE 13	PRE SILENCE 14	PRE SILENCE 15
LENGTH OF SILENCE	3 SECONDS	2 SECONDS	2 SECONDS	3 SECONDS	2 SECONDS	2 SECONDS	2 SECONDS
HR BPCC036	70.73	67.54	73.53	72.31	63.63	68.17	66.95
SC BPCC036	24.23	24.01	29.97	26.73	24.09	24.27	24.1
HR BPCC038	75.051	71.99	79.1	75.87	77.92	73.12	72.13
SC BPCC038	28.06	28.26	28.39	31.96	30.27	27.82	27.82
HR BPCC039	83.92	73.38	81.21	76.34	75.55	79.02	79.81
SC BPCC039	40.17	38.93	39.2	42.99	45.14	41.08	40.55
	POST SILENCE 9	POST SILENCE 10	POST SILENCE 11	POST SILENCE 12	POST SILENCE 13	POST SILENCE 14	POST SILENCE 15
HR BPCC036	67.86	67.33	75.52	68.66	67.64	67.32	69.99
SC BPCC036	24.14	24.08	29.72	25.51	23.88	23.87	24.08
HR BPCC038	71.88	72.47	83.75	73.87	73.99	70.94	74.13
SC BPCC038	28.19	27.05	31.74	29.57	29.66	28.11	29.99
HR BPCC039	72.97	79.93	73.65	80.62	79.95	78.04	72.08
SC BPCC039	39.05	38.5	40.32	42.1	44.16	40.11	39.48

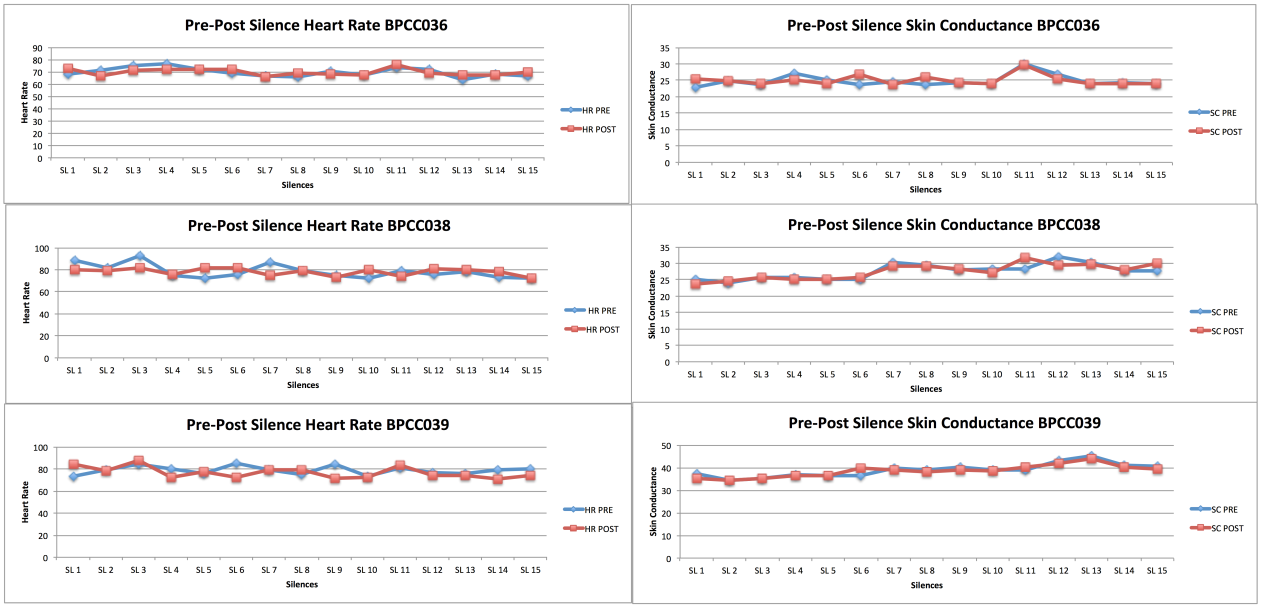

Figure 19. Pre and post silence heart rate and skin conductance for Group 7 participants

Pre and Post Heart Rate and Skin Conductance for Disagreements. *Table* 46 shows participants' heart rate (HR) and skin conductance (SC) data before and after the three instances of disagreements during the recorded conversation task. The values on the top labeled as PRE represent the average of the 10 seconds preceding the disagreement, while the values labeled POST are the averages of the 10 seconds following the observed disagreement, for each participant. It is important to note that there might be changes not only in the physiological responses of the person doing the disagreement, but also in the physiological responses of the person being disagreed with, as well as with the physiological responses of the third party who is just observing each of these particular interactions.

For example, as can be observed in *table* 46 and *figure* 20, in the first disagreement, participant BPCC036 disagrees with participant BPCC038. In this case, BPCC036's HR average increases from 73.80 to 74.55, while BPCC038's average HR decreases from 76.96 to 72.84. Nevertheless, BPCC036's SC decreases from 27.14 to 25.38, while BPCC038's skin conductance remains reasonably steady, moving from 25.83 to 25.54. The third participant in this interaction, BPCC039, displays a decrease in both HR and SC, as HR goes from 81.40 to 78.73, while SC goes from 37.19 to 36.52.

In the second instance, participant BPCC039 disagrees with participant BPCC038. In this case, BPCC039's HR average increases from 82.04 to 85.09, while BPCC038's average HR increases from 71.42 to 74.68. Nevertheless, BPCC039's SC remains fairly steady, going from 36.13 to 36.57, while BPCC038's average SC decreases from 29.25 to 28.34. The third participant in this interaction, BPCC036, displays a steady HR, which goes from 67.04 to 67.40, and SC, which goes from 25.40 to 24.75.

In the third instance of disagreement, participant BPCC038 disagrees with participant BPCC039. During this action, BPCC038's HR increases from 72.28 to 78.94, while SC also increases from 29.99 to 30.30. BPCC039's HR decreases from 81.14 to 78.77, while SC increases from 42.06 to 44.07. The third participant's (BPCC036) HR decreases from 68.19 to 66.38, while SC also decreases from 26.07 to 24.50.

Table 46

Heart rate and skin conductance of participants in Group 7 during disagreements

	PRE DISAGREEMENT 1 (1:2)	PRE DISAGREEMENT 2 (3:2)	PRE DISAGREEMENT 3 (2:3)
LENGTH OF DISAGREEMENT	5 SECONDS	5 SECONDS	9 SECONDS
HR BPCC036	73.80	67.04	68.19
SC BPCC036	27.14	25.40	26.07
HR BPCC038	76.96	71.42	72.28
SC BPCC038	25.84	29.25	29.99
HR BPCC039	81.40	82.04	81.14
SC BPCC039	37.19	36.13	42.06
	POST DISAGREEMENT 1 (1:2)	POST DISAGREEMENT 2 (3:2)	POST DISAGREEMENT 3 (2:3)
HR BPCC036	74.55	67.40	66.38
SC BPCC036	25.38	24.75	24.50
HR BPCC038	72.84	74.68	78.94
SC BPCC038	25.54	28.34	30.30
HR BPCC039	78.73	85.10	78.77
SC BPCC039	36.52	36.57	44.07

Note. The heart rate (HR) and skin conductance (SC) values in this table are averages of 10 seconds before the disagreement occurred (PRE) and 10 seconds after it was over (POST). In parenthesis who is disagreeing with whom is also annotated.

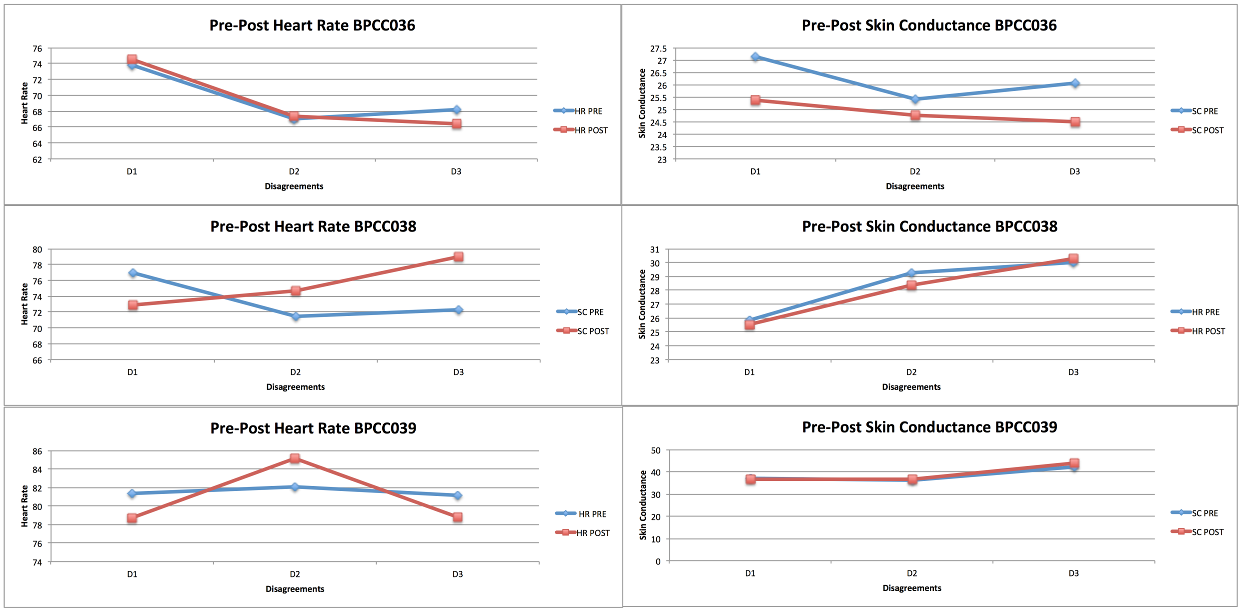

Figure 20. Pre and post disagreement heart rate and skin conductance for Group 7 participants

Pre and Post Heart Rate and Skin Conductance for Word Searches. *Table* 47 and *figure* 21 shows participants' heart rate (HR) and skin conductance (SC) data before and after five instances of word searches during the recorded conversation task. The values on the top labeled as PRE represent the average of the 10 seconds preceding the word search, while the values labeled POST are the averages of the 10 seconds following the observed word search, for each participant. It is important to note that there might be changes not only in the physiological responses of the person doing the word search, but also in the physiological responses of the people assisting in the search for a word, as well as with the physiological responses of the people who may just be listening. The word searches listed here are characterized by having one of the participants initiate a repair sequence. The word searches that occurred in this period ranged from 3 seconds to 37 seconds before they found a resolution. All the repair sequences were initiated by the current speaker.

Table 47

Heart rate and skin conductance of participants in Group 7 during word searches

	PRE WORD SEARCH 1 (BPCC038)	PRE WORD SEARCH 2 (BPCC039)	PRE WORD SEARCH 3 (BPCC039)	PRE WORD SEARCH 4 (BPCC038)	PRE WORD SEARCH 5 (BPCC039)
LENGTH OF WORD SEARCH	23 SECONDS	37 SECONDS	10 SECONDS	13 SECONDS	3 SECONDS
HR BPCC036	76.64	70.83	68.23	64.30	66.87
SC BPCC036	27.26	26.78	25.58	24.08	24.03
HR BPCC038	75.12	72.51	70.71	77.90	71.14
SC BPCC038	25.77	25.79	25.93	26.23	27.47
HR BPCC039	79.67	83.03	82.16	82.89	75.15
SC BPCC039	36.90	45.27	45.26	42.37	38.71
	POST WORD SEARCH 1 (2)	POST WORD SEARCH 2 (3)	POST WORD SEARCH 3 (3)	POST WORD SEARCH 4 (2)	POST WORD SEARCH 5 (3)
HR BPCC036	72.17	66.28	66.21	69.36	68.38
SC BPCC036	25.01	25.04	24.15	25.54	23.86
HR BPCC038	72.70	69.62	72.27	82.70	73.61
SC BPCC038	25.27	25.41	26.34	27.56	26.73
HR BPCC039	75.99	80.09	81.48	80.88	82.58
SC BPCC039	36.31	43.64	43.78	40.48	38.14

Note. The heart rate (HR) and skin conductance (SC) values in this table are averages of 10 seconds before the word search occurred (PRE) and 10 seconds after it was over (POST). In parenthesis who is searching for a word during that time is also annotated.

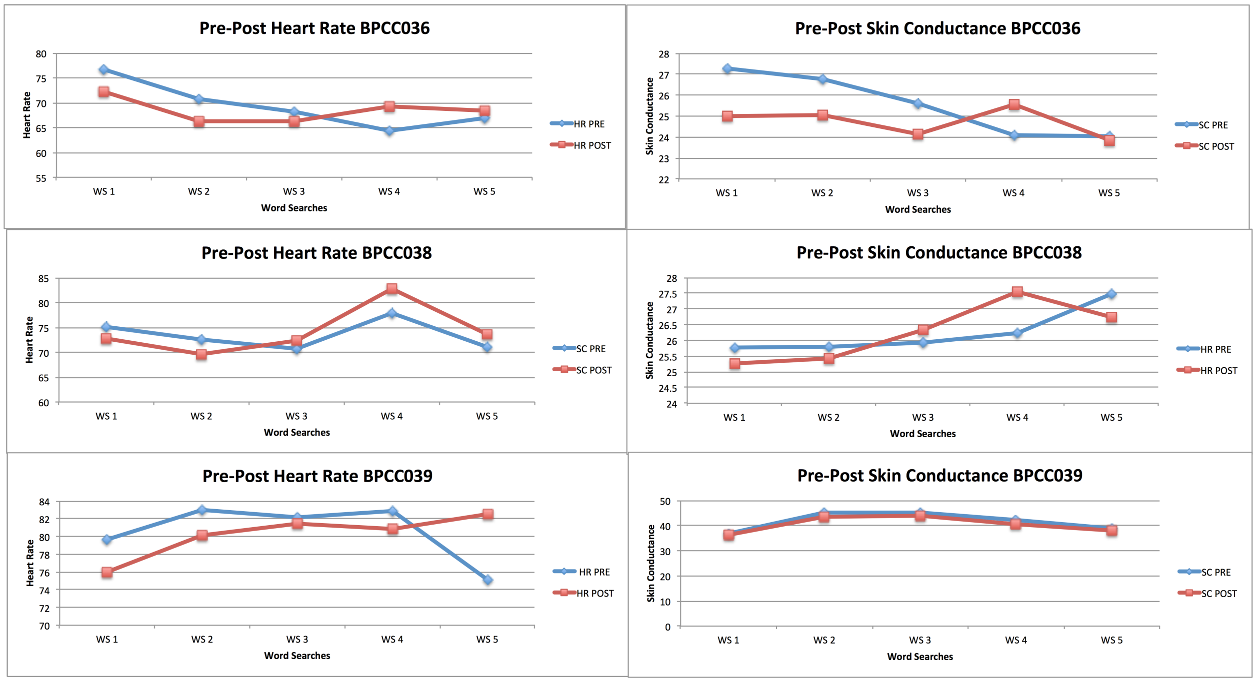

Figure 21. Pre and post word search heart rate and skin conductance for Group 7 participants

The first word search lasted 23 seconds in total, and it was initiated by participant BPCC038. This participant was initially assisted by participant BPCC036, and then by participant BPCC039, in this order. Therefore, it is safe to say that the listeners were actively involved in the search initiated by the speaker. By taking a look at the averages of all participants' HR and SC 10 seconds before (PRE) and 10 seconds after (POST) the word search action, we see that the main speaker, or BPCC038, had a decrease in HR from 75.12 to 72.70 and a fairly steady SC which went from 25.77 to 25.27. The participant who offered a candidate word first, BPCC036, had a decrease in HR from 76.64 to 72.17, and a decrease in SC from 27.26 to 25.01. Participant BPCC039, who offered a candidate answer second, had a HR decrease from 79.67 to 75.99 and an SC fairly steady, from 36.90 to 36.31. It is possible to hypothesize, based on this information, that helping the speaker performing a word search is perceived by helpers as ‘an act of kindness’, and the feeling derived from this help might be the reason why their heart rate goes down.

The next word search lasted 37 seconds, and was initiated by participant BPCC039. This word search was first assisted by BPCC036, and then assisted by BPCC038. The main speaker, BPCC039, had HR average decrease from 83.03 to 80.09, and SC average decrease from 45.27 to 43.64. The first assistant, BPCC036’s HR average decreased from 70.83 to 66.28, and SC average decreased from 26.78 to 25.04. The second assistant, had a HR average decrease from 72.51 to 69.62, and SC remained steady, going from 25.79 to 25.41.

The third word search lasted 10 seconds in total. It was initiated BPCC039, and had no uptake from the other participants. In this word search, BPCC039’s HR decreased from 68.23 to 66.21, SC from 25.58 to 24.15. The other two participants’ HR and SC behaved differently. BPCC036 saw an overall decrease, with HR going from 68.23 to 66.21 and SC going from 25.58 to 24.15, while BPCC038 saw an overall increase, with HR going from 70.71 to 72.27 and SC going from 25.93 to 26.34.

Just 5 seconds later in the conversation, participant BPCC038 initiates another word search. This word search was only assisted by BPCC039, toward the end or this repair sequence. The main speaker’s HR (BPCC038) increased from 77.90 to 82.70, and SC also increased from 26.23 to 27.56. The participant who helped at the end, BPCC039, had an HR decrease from 82.89 to 80.88, and SC decrease from 42.37 to 40.48.

The last word search of this conversation was initiated by BPCC039 and only lasted 3 seconds. The word search did not elicit any uptakes. BPCC039’s HR increased from 75.15 to 82.58, but SC remained fairly steady, going from 38.71 to 38.14. BPCC036’s HR also increased from 66.87 to 68.38, but SC saw a small decrease from 24.03 to 23.86. Finally, BPCC038's HR increased from 71.14 to 73.61 while SC remained fairly steady, going from 38.71 to 38.14.

Data Analysis II: Video Data and Transcripts for Group 7

In order to add contextual information in the analysis of physiological changes in regards to pre and post heart rate and skin conductance surrounding tokens of behavior, and to try to understand what might underlie up-regulation or down-regulation of heart rate and skin conductance for the same individual across similar tokens of behavior, the following examples are further discussed in detail.

Example 1: Silence and Word Search. Before the silence discussed in this example, BPCC038 (in the middle) asked BPCC039 (on the right) if she knew someone called "Emmy" (line 7). At this moment, there was a silence during which BPCC039 was expected to generate a response to BPCC038's request for information, for which she had to remember the name of a person (see image and transcript below).

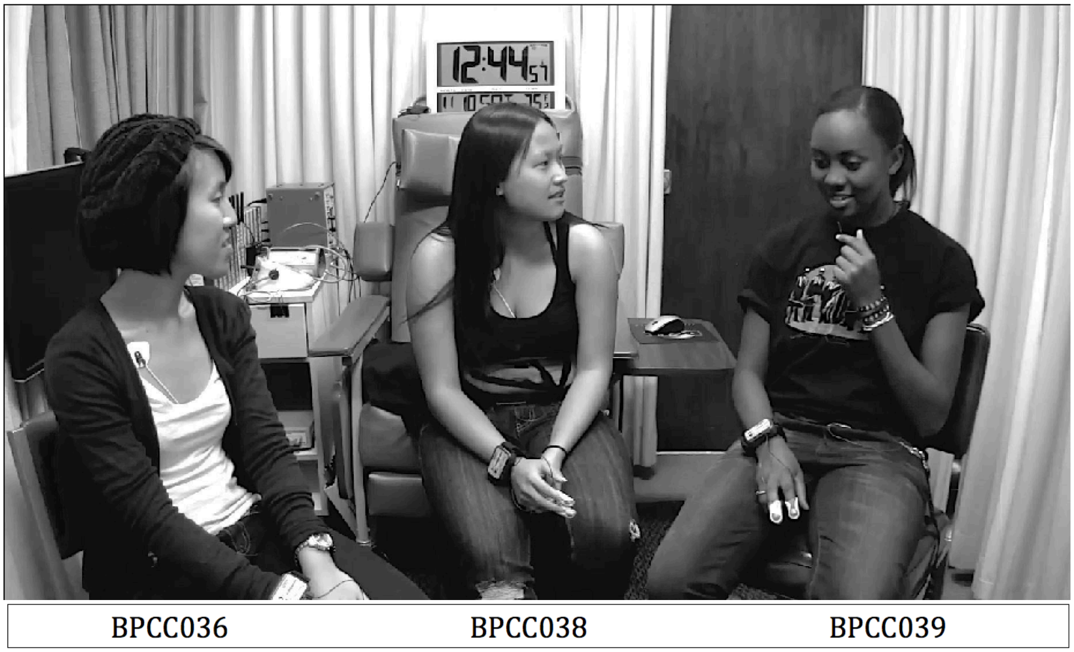

Figure 22. Framegrab of Silence 1 following a name search

Transcript [Silence 1: Emmy]

BPCC039: i'm friends with a lot of the flutes,
a:nd well piccolos included,
but yes [okay]
BPCC038: [oh did you] go to the party last [night?]
BPCC039: [t()] yeah
BPCC038: ohh, she was in our room um,
do you know emmy? she's an exchange student too
BPCC036: [oh]
BPCC038: [fro:m]
BPCC039: i know the nam- i've heard the name before
but i- i'm not putting a face
to it
(3.0)
BPCC039: [I’ve heard the name] though

```
15   BPCC038: [she was]
16            she was Asian and she was wearing a beige trenchcoat, (.)
17            i don't know if you've ever
18   BPCC039: um flu- flute? no
19   BPCC038: ss she a flute? actually yeah i think she is a flute
20   BPCC039: okay, i think so, i think s- i've heard the name,
21            i know I've heard the name, that name before
```

BPCC039's response (lines10 to 12) to a confirmation request by BPCC038 (line 7) is followed by a 3-second silence (line 13), during which BPCC036's pre-post HR and SC saw an increase. BPCC036 did not attempt to offer an answer, since the question was not directed at her, and because it was unlikely she knew who the other 2 participants were talking about. BPCC038's HR and SC saw a decrease, possibly indicating that during the silence she was waiting for a reply from BPCC039 and not about to restart talking, and BPCC039's HR increases since she was unable to confirm that she knew who BPCC038 was talking about. Only participant BPCC036 saw an increase in pre-post SC (from 22.87 to 25.53), while participants BPCC038's and BPCC039's SC decreased from 25.26 and 37.42 to 23.59 to 35.42, respectively. This might indicate that this silence was only specially stressful for BPCC036, but not to BPCC038 or BPCC039.

Example 2: Silence and Word Search. In this segment we see a collaborative word search in which a 2-second silence is inserted. The context of this word search is the discussion of a movie called "Memento," directed by Christopher Nolan, and whose lead actor is Guy Pearce. During this word search, while participants are displaying their effortful search for who "Guy Pearce" is, they all break eye contact and silence takes over.

BPCC036 BPCC038 BPCC039

Figure 23. Framegrab of Silence 5, following a name search

Transcript [Silence 5: Guy Pearce]

```
1    BPCC038: he's not- wait which one is he?
2    BPCC036: christian bale is batman
3    BPCC038: christian bale is [batman]
4    BPCC039:                   [bat- yeah] batman
5    BPCC038: guy pearce, what movie was he in?
6             (2.0)
7    BPCC038: he wasn't in- he's not [the james bond] is he?
8    BPCC039:                        [i don't know why ()]
9    BPCC036: no
10   BPCC038: no
11   BPCC039: that's the other the oth- guy, the other guy
12   BPCC036: that's [()]
```

```
13   BPCC038:        [the other british guy]
14   BPCC039: yeah yeah
15   BPCC038: guy pearce
16   BPCC036: well it's christopher nolan so you can't go wrong
17   BPCC039: yeah
18   BPCC036: yeah
19   BPCC038: do you guys watch any of his movies
20   BPCC039: yes
```

This word search was initiated by BPCC038 who didn't know who "Guy Pearce" was (line 1). In order to offer a proper response, the other participants tried to think of movies in which he took part. Evidence of that is the fact that in line 2, BPCC036 says "christian bale is batman" and also evidence is that in line 5 BPCC038 asks the other participants "guy pearce, what movie was he in?" The resolution comes from BPCC036 in line 16 when she says "well it's christopher nolan so you can't go wrong" referring to the director of the movie they are talking about. During this silence which follows a repair initiation, we can observe that the repair initiator's (BPCC038) HR increases from 72.69 to 77.29, but her SC remains steady, going from 25.27 to 25.21. BPCC039, who was the recipient of BPCC038's repair initiation by means of directed gaze in line 1, also sees a HR increase from 75.99 to 82.10. Her SC also remains steady, going from 36.31 to 36.45. BPCC036's HR, however, remains fairly steady, going from 72.17 to 71.90, with a slight SC decrease from 25.01 to 24.09. Here we see that both BPCC038 and BPCC039 have a significant rise in heart rate without an increase in skin conductance, which could indicate that although they did not consider this word search activity to be particularly stressful, it still involves increased cognitive effort, which could account for the increase in HR.

Example 3: Disagreement. Before this segment, participants were talking about various relatives of famous people who go to UCLA or that teach at this institution. At this point, they were talking about the younger brother of a then Los Angeles Lakers but now current Chicago Bulls basketball player, Pau Gasol. His younger brother, whom they are talking about, is Adria Gasol, who plays at the men's basketball team at UCLA.

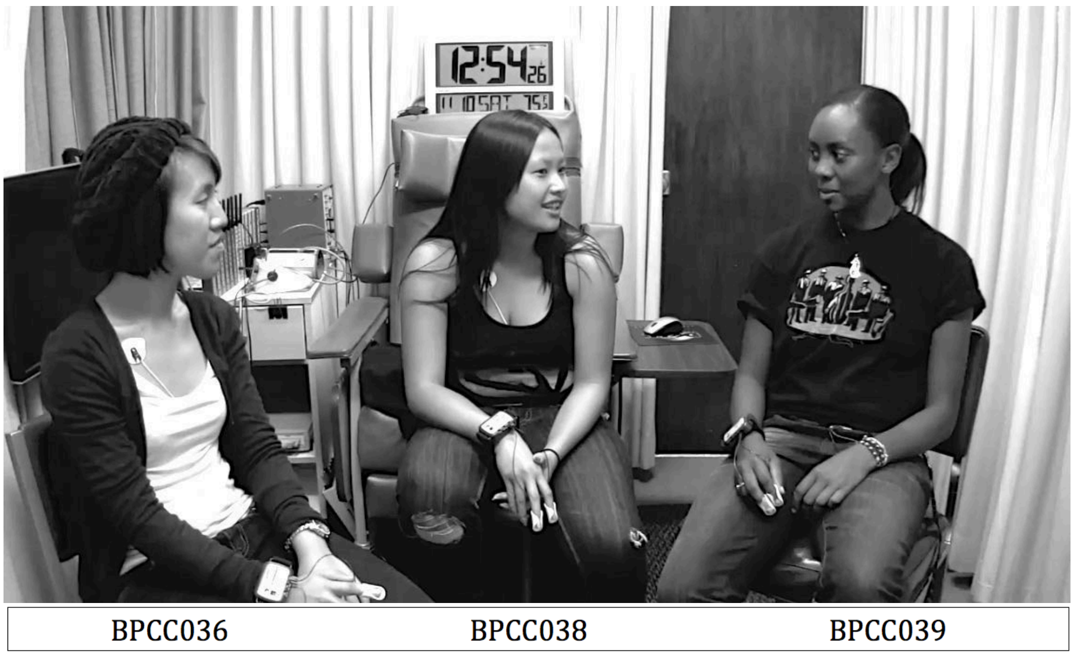

Figure 24. BPCC038 performs assessment of Gasol's physical appearance

Figure 25. BPCC039 disagrees with BPCC038's assessment of Gasol's physical appearance

Transcript [Disagreement 2: Gasol]

```
BPCC038: then p diddy's son goes here
BPCC039: yes (.) the gasol's younger brother
BPCC038: oh i saw him in the dining hall.
         i was egging my friend on like, go sit with him,
         and he's like, no:
BPCC039: ((laughter)) go, just make a new friend
BPCC038: exactly, he is so tall
BPCC039: i- did you guys go to the pauley like
         student spotlight opening thing last friday?
BPCC038: i actually slept and took a nap after work so no
BPCC039: i went because of the band and (.) and they called all the
         basketball players out and when they called gasol out
         it was the loudest like huhrr, but yeah he's really tall
```

```
14   BPCC038: he doesn't look like his older brother
15 ->BPCC039: i feel like he ki- well kind of does, i don't know.
16            i never- i don't
17            [keep up with lakers so i don't know]
18   BPCC038: [i think his older brother looks like] more of a caveman
19            like [he's not that attractive]
20   BPCC039:      [caveman from spain]
21            that's- that's funny, wait did you guys go to the basketball
22            game last night?
```

In line 14, BPCC038 says that she does not think that Adria Gasol looks like his older brother. In the first framegrab, BPCC039 and BPCC036 are both looking at BPCC038. However, in the second image we see that BPCC039 initiates a disagreement adding to additional clues to her incoming action, namely breaking eye contact with current speaker, overlap, and use of a higher pitch prosody in the beginning of her turns. Along with these non-verbal clues, in line 15, BPCC039 disagrees with BPCC038 saying that she thinks that the brothers do look alike. In line 18 BPCC038 gives a reason for her assessment of Adria Gasol's lack of resemblance to his older brother by saying that Pau Gasol looks like a caveman (line 18) and therefore not attractive (line 19). An analysis of participants' pre-post HR and SC tells us that while BPCC036's HR stay pretty steady (from 67.04 to 67.40), maybe because she is not assessing or participating in this disagreement, BPCC038's HR increases from 71.42 to 74.68, and BPCC039's HR increases from 82.04 to 85.10. This shows that the two participants doing the disagreement in this segment had an increase in heart rate, and that not only did the person who disagreed see the increase, but also the person being disagreed with saw the same phenomenon. The context of this disagreement is important. First, BPCC038 and BPCC039 do not reach a consensus or a final agreement. They have different opinions of Gasol. Second, the participants' different assessments are regarding a member of the other sex, and it does involve a physical description of him, which is very likely to increase their heart rate.

Example 4: Disagreement. In this segment, participants are talking about differences between the quarter and semester systems. Participant BPCC036 goes to a school on a semester system, while BPCC038 and BPCC039 go to a school on a quarter system. On a semester system there are 16 weeks, and finals week is on week 16, whereas on the quarter system there are 10 weeks, and final week is usually on the 11th week. In this particular segment of their conversation, BPCC039 makes a comment that although December starts with a whole week of class, Winter break is at least 4 weeks and one should not complain. But BPCC038 disagrees about the length of Winter break, saying it is 3 weeks long, given the Fall end date and Winter quarter start date. BPCC039 agrees with BPCC038 at the end.

Figure 26. BPCC039 makes an assessment about the length of Winter break

BPCC036 BPCC038 BPCC039

Figure 27. BPCC038 initiates repair by disagreeing about the length of Winter break

Transcript [Disagreement 3: Winter Break]

BPCC038: i know it just feels like yesterday it was zero week.
now it's [almost 7]
BPCC039: [yea] i have like a part of me's
still in that like oh no no it's just zero week like
oh no no [it's seventh] week
BPCC036: [yeah]
BPCC039: get on it like oh okay gotcha
BPCC036: and final's w- week 16?
BPCC038: u:m
BPCC039: technically week 11
BPCC036: o:h
BPCC038: yeah

BPCC039: [but]
BPCC036: [okay]
BPCC039: [yeah]
BPCC038: first week of december
BPCC039: yes. what a great way to start december.
but then it's followed by a nice you know four-week break
so i guess we can't go wrong there
BPCC038: is it four weeks?
BPCC039: oh well
BPCC038: i thought it was a little bit less because
BPCC039: i think yeah [i think you're right]
BPCC038: [school starts]
BPCC039: [the seventh]
BPCC038: [the seventh] right
and then, everyone tests- everyones's finished with tests on
BPCC036: the fourteenth i think
BPCC039: so yeah it's like three weeks
BPCC036: three weeks

In line 10 BPCC039 says that finals week on the quarter system is week 11, and in line 16, BPCC039 adds that week 11 falls on the first week of December. She makes an assessment saying "what a great way to start december" in line 17, and while she is saying that, participant BPCC038 breaks eye contact and then asks in line 20 "is it four weeks" which she continues in lines 22 and 26 with "I thought it was a bit less because school starts the seventeenth". BPCC039 accepts BPCC038's opposing view and repair, and in line 29 BPCC039 says "so yeah it's like three weeks". So this disagreement is resolved and a consensus is achieved at the end. In terms of the participants' pre-post HR and SC, we can observe that BPCC038, the disagreer, sees an increase of HR from 72.28 to 78.94 while her SC remained fairly the same, from 29.99 to 30.30; the disagreed with participant, BPCC039, sees a HR decrease from 81.14 to 78.77 but an increase in SC from 42.06 to 44.07. BPCC036 also sees a decrease in HR from 68.19 to 66.38 and a decrease in SC from 26.07 to 24.50. What the data could indicate in this case is that compared with the previous disagreement, in which participants expressed different opinions without reaching a consensus agreement, here participant BPCC039 agrees with participant BPCC038 at the end. BPCC039 shows a small stress elevation with the increase in SC, but the action on disagreeing seemed to have elicited elevated HR. This might indicate that the act of disagreeing can potentially increase HR depending on the type of correction involved, and how the type of information is expected to be well known or not by the speakers. In this case, BPCC039 was expected to know how long Winter break was, and when classes end or restart.

Example 5: Word Search. In this segment, participant BPCC039 is talking about a movie called "Love Actually", and asked if the other participants had seen this movie. BPCC036 says she has seen this movie, but BPCC038 displays that she had not by asking who plays in this movie. The main speaker, BPCC039, can not remember the name of a famous actor that is in the movie, called Alan Rickman, and resorts to another famous movie "Harry Potter" to get the other participants to help her in the name search. The name of Alan Rickman's character in "Harry Potter" is Severus Snape.

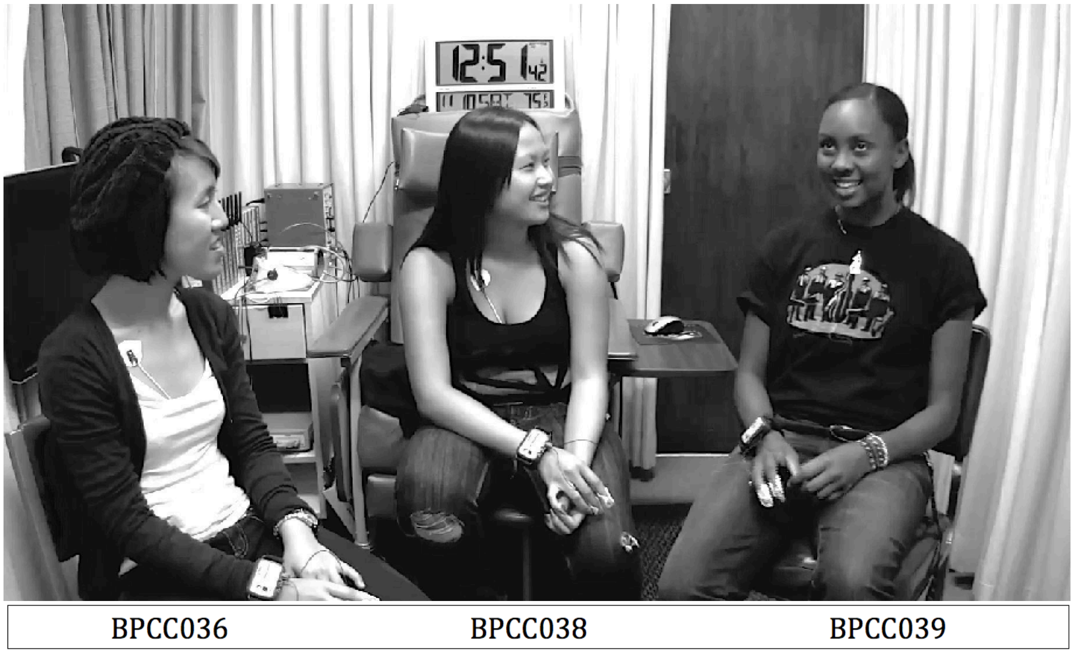

Figure 28. BPCC039 does a word search for the name of a movie character

The frame grab above is from the exact moment in which participant BPCC039 starts a word search. After breaking eye contact with the other participants, she looks up and says “okay, s- well i uh-” which in combination reflects her action of thinking of a word, or performing a word search. The context of this word search and how the dialogue develops are in the following transcript:

Transcript [Word Search 2: Harry Potter]

```
1    BPCC039: i- have you guys ever seen love actually?
2    BPCC036: yes
3    BPCC039: i lo:ve that movie, i- i recommend the ( )
4             [()]
5    BPCC038: [wait who's] in it?
6    BPCC039: okay, s- well i uh- snape, um i forget his real name all the
```

time, or no not snape, no, what's the guy from harry potter, the- the- the one- the- the-
BPCC036: dumbledore?
BPCC039: the other- no the- the- the other guy, he's- he's a teacher there he has the black hair he's very rrr, what's- [what's his name]
BPCC038: [is it snape?]
BPCC039: wait which one?
BPCC038: snape?
BPCC039: no [not s-]
BPCC038: [hagrid?]
BPCC039: gosh, how am i forgetting his name? it's- he's the guy that harry always has problems with him... okay i must be really tired, i'm forgetting his- we're gonna come back to that one. but he's- he's the head of um slytherin
BPCC038: yeah that is snape
BPCC039: it [is snape]
BPCC038: [long hair]
BPCC039: yeah. what is his name
BPCC036: yeah
BPCC039: oh for some reason when i said it it didn't sound li- okay, anywho, he's in it, i love seeing him in movies or just him not playing snape, i just always () okay he's in it, who else, lots of brtish actors are in it, kiera knightley's in it, um hugh grant, the- m- the kid who plays the voice of finneas and ferb on the disney channel, he's in it, it's a really good- it's just like overall it's just a really good movie ()

BPCC038 asks BPCC039 who is in the movie in line 5, and BPCC039 can not remember the name of one of the main actors. But BPCC039 remembers that he played a role in another movie called “Harry Potter”. The name of the character is Snape, which is suggested by BPCC038 in line 13, but she does not think that is him at first. She describes him instead, in lines 18-21, and after this description BPCC038 confirms the name of character. In line 27 BPCC039 hints at the fact that the name did not sound familiar at first, but she accepts BPCC038’s confirmation of the character’s name. In terms of the participants’ HR and SC, both physiological responses for all three participants see a decrease. Searching for the name of a character in a movie did not elicit any stressful response from the part of any of the subjects.

Example 6: Word Search. In this particular example, BPCC038 wants to tell the other participants that a famous person they might know attends classes at UCLA. She is referring to a boy who plays the main character’s (“Zoey Brooks”) little brother in a Nickelodeon Channel show called “Zoey One Oh One”. The name of the little boy is Paul Butcher and his character’s name was “Dustin Brooks.” This word search was unsuccessful, although BPCC038 succeeded in helping her recipients know who she was talking about by referring to a TV network and show that they were both familiar with.

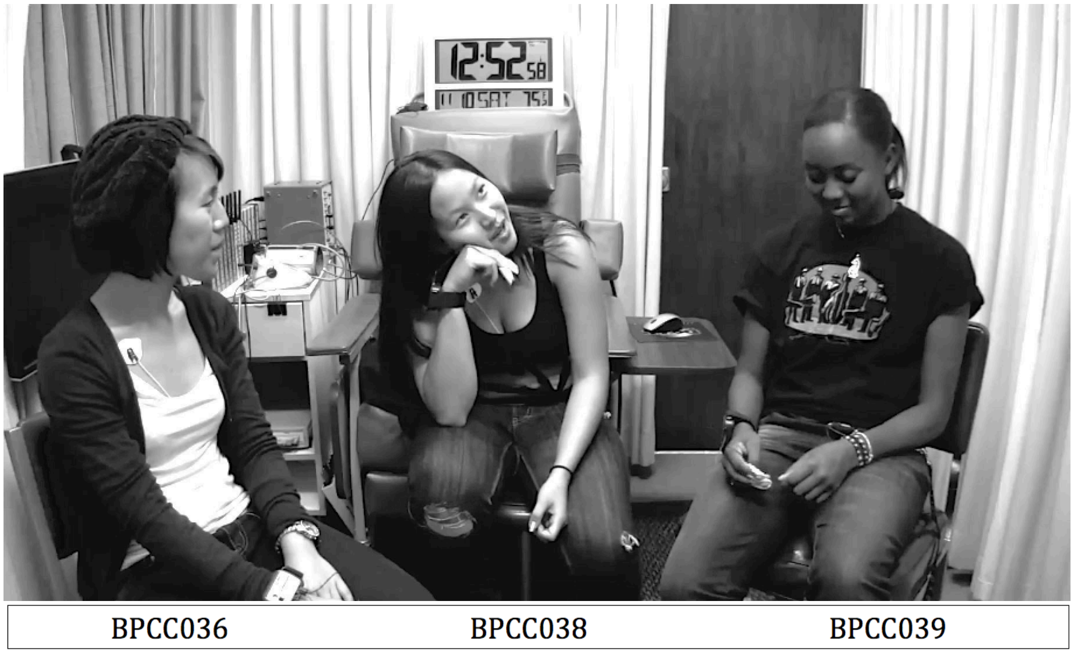

Figure 29. BPCC038 performs a word search

In the particular word search depicted here, participant BPCC038 is looking for the name of a nickelodeon's show actor. BPCC038 breaks eye contact during the word search, and the other 2 participants are letting her carry out the action. The actual dialogue is in the transcript below:

Transcript [Word Search 5: Zoey One Oh One]

```
BPCC038: did you know that um, did you watch nickelodeon, either one
         of you?
BPCC036: when i was a kid
BPCC039: [yes, years ago]
BPCC038: [u:m >what was that show<, the one that] britney spears'
         little sister, something zo[ey one oh one  ]
BPCC039:                            [zoey one oh one]
```

```
BPCC038: did you know that the little boy, the brother
BPCC039: yes
BPCC038: goes here?
BPCC039: what?
BPCC038: he goes here
BPCC039: really?
BPCC038: yes
BPCC039: wow
BPCC038: he lives in i think evergreen i wanna say. yeah he goes here,
         he's a first-year
```

During this segment, participants BPCC036 and BPCC039 wait for BPCC038 to provide more clues about the name she is looking for. Until she does, they can not help her, and they show they are aware that she will have the floor until then by looking down or away from her. Nevertheless, as soon as she provides more clues, as in the name “zoey” in line 6, participant BPCC039 is able to offer assistance in the word search and provides a candidate answer for the name of the TV show (but not for the name of the actor) in overlap with the speaker, BPCC038. Interestingly, the HR of all three participants increases during this interaction. BPCC036’s HR goes from 66.87 to 68.38, BPCC038’s HR goes from 71.14 to 73.61, and BPCC039’s HR goes from 75.15 to 82.58. It is clear that these changes represent the three participants are engaged in the word search, that it does create some amount of physiological arousal, without being necessarily stressful. This is because their SC remains fairly unchanged during this interchange. It is possible that these participants did not feel stress personally because the lack of knowledge of this information is not embarrassing or shameful, or it is not perceived as a negative thing but any of them.

GROUP 26

Data Analysis I: Demographics, Psychophysiology, and Distribution of Tokens of Behavior

Several kinds of information about the participants in Group 26 are relevant for a more thorough understanding of their performance. Among the types of data available are demographic information, scores on psychological surveys, quantified target behavior, heart rate variability, and relations between pre and post- target behaviors and heart rate and skin conductance. *Table* 48 provides demographic information of Group 26 participants:

Table 48

Demographic information about participants in Group 26

Participant ID	Gender	Age Range	Educational Background	Race	Employed
BPCC103	Male	18-20	High school degree	Asian descent	Employed, working 1-39 hours/ week
BPCC105	Male	18-20	High school degree	Asian descent	Not employed, not looking for work
BPCC104	Male	18-20	High school degree	White	Not employed, not looking for work

All subjects were male, college students, with completed high school degrees. All participants were between the ages of 18 and 20. Two participants were Asian descent, and one was white. One participant worked, and the other two were not employed, nor were they looking for work. Besides demographic information, it is important to note health related data, as seen in *table* 49.

Table 49 *Health Related Information About Participants in Group 26*					
Participant ID	Smoke	Psychiatric Disorders	Coffee Intake	Menstrual Cycle	Pregnant
BPCC103	No	No	Yes, less than once a month	N/A	N/A
BPCC105	No	No	Yes, less than once a month	N/A	N/A
BPCC104	No	No	Yes, once a week	N/A	N/A

As can be observed in *table* 49, none of the participants smoked or were diagnosed with psychiatric disorders. All participants said they drank coffee, but two said it was less than once a month, and one participant said he had coffee once a week. In any case, they were told to abstain from coffee at least 2 hours prior to coming to their lab appointments.

Table 50 *Distribution of Target Behaviors Across Participants in Group 7*						
Participant ID	TURNS LENGTH (SECONDS)	TURNS NUMBER	SILENCE	PAUSE	DISAGREE MENTS	WORD SEARCH
BPCC103	331	72	14	1	0	1
BPCC105	430	67	14	7	1	1
BPCC104	490	100	14	10	0	3

Participant BPCC103 had the lowest total length of floor during the entire conversation. He spoke for a total of 331 seconds. Participant BPCC105 had the floor a bit longer than the previous participant, for 430 seconds. And the participant who had the floor the longest was BPCC104, who spoke for 490 seconds. In terms of number of turns taken, BPCC105 had the lowest number of turns (67), but his turns were longer than BPCC103's. BPCC103 had 72 turns but he had the floor for only 331 seconds. His turns were short. On the other hand, BPCC104 not only had the highest amount of floor time (490 seconds), but he also had the highest number of turns (100). This indicates that this participant somewhat dominated this conversation. By looking at participants' behavior during this conversation, they address their turns and responses to this participant, making him the main addressee and speaker most of the time.

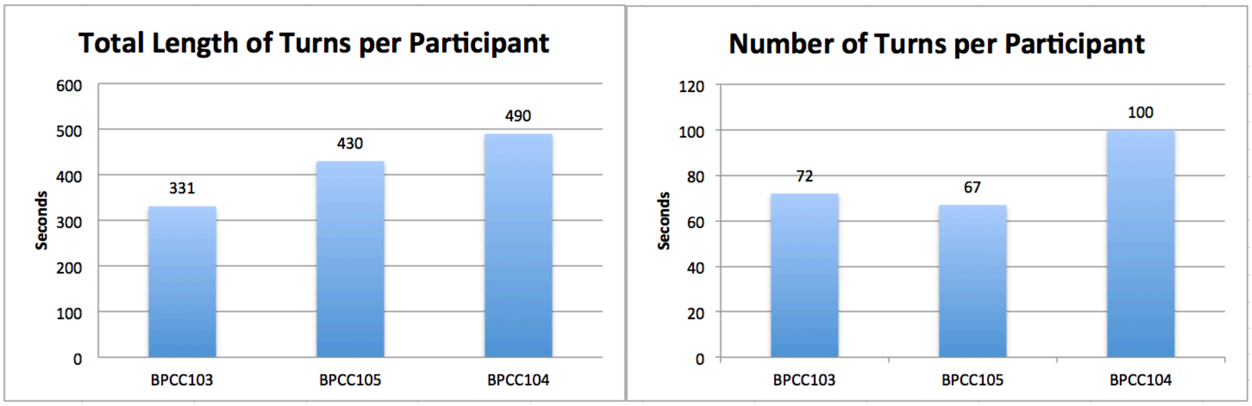

Figure 30. Total length of turns taken by each participant in group 26, in seconds, and the number of turns each participant took during the conversation.

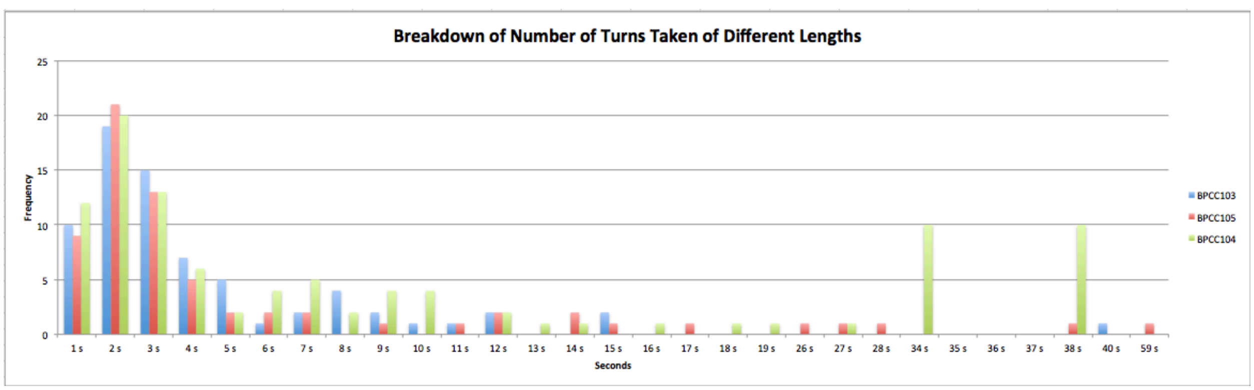

Figure 31. Breakdown of the number of turns of each length that each participant took

Additionally, participant BPCC104 has the highest number of pauses, possibly because he also held the floor the longest, and had more turns. This participant had 10 pauses, while BPCC103 had 1 and BPCC105 had 7, which also relates to the higher length of floor this participant had. Only participant BPCC105 had a disagreement, and participants BPCC103 and BPCC105 had 1 word search each, while BPCC104 searched for words 3 times altogether (see *figure* 32).

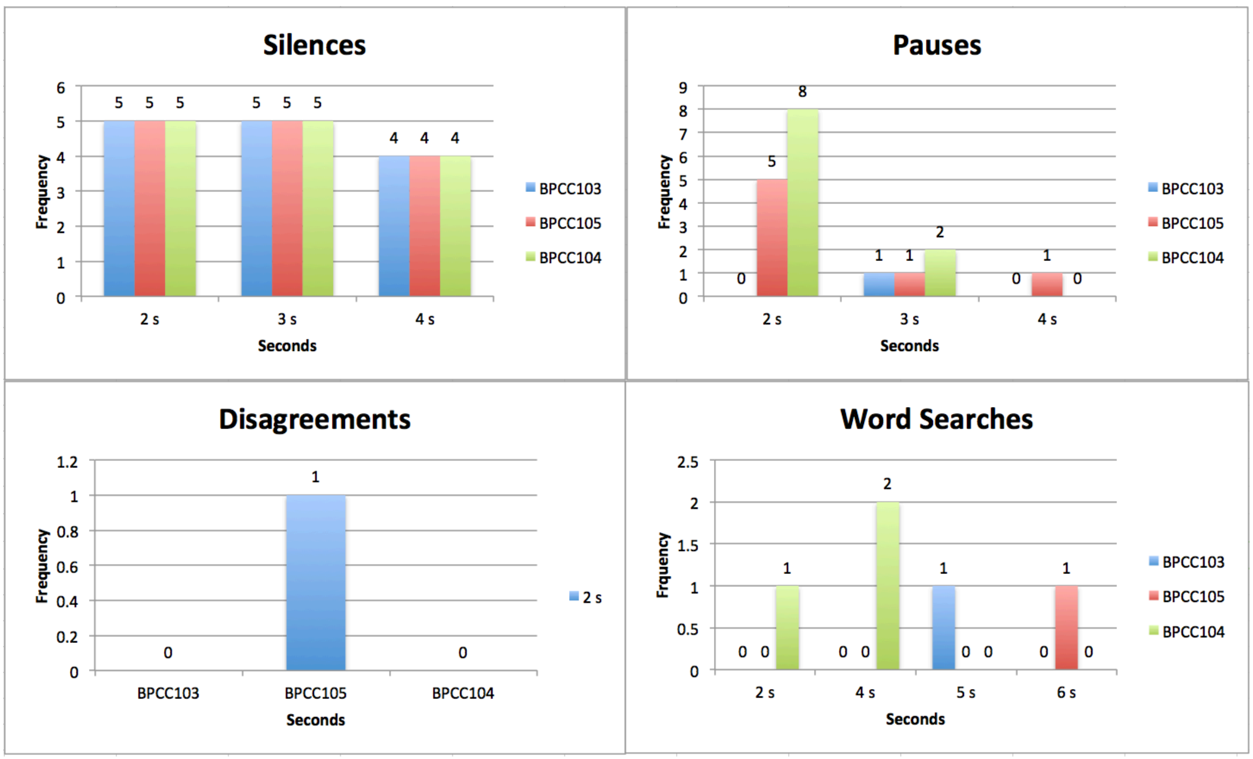

Figure 32. Breakdown of silences, pauses, disagreements, and word searches during the conversation, per participant, displayed by frequency and length in seconds

Compared with others in the group, participant BPCC103's behavior showed a smaller number of turns during the conversation task, less time holding the floor, fewer pauses, word searches, and overlaps. This seemingly introspective behavioral predisposition relates with BPCC103's personality characteristics. Participant BPCC103's as well as participants

BPCC105's and BPCC104's scores on several scales of psychological traits and states are displayed in the *table* 51 and *figure* 33 below.

Table 51

Group 26 participants' scores on psychological scales

Participant ID	BAS DRIVE	BAS FUN SEEKING	BAS REWARD RESPONSIVENESS	BIS	RCBS	CDS	CES-D
BPCC103	11	11	19	23	33	20	30
BPCC105	11	12	17	24	45	4	19
BPCC104	13	15	17	21	42	20	19

Participant ID	LS	PANAS POSITIVE AFFECT	PANAS NEGATIVE AFFECT	PRCA-24 OVERALL CA	PRCA-24 GROUP DISCUSSION	PRCA-24 INTERPERSONAL CONVERSATIONS	PRCA-24 PUBLIC SPEAKING
BPCC103	7	20	35	80	13	17	28
BPCC105	6	30	13	81	19	19	24
BPCC104	8	22	10	72	17	16	23

Participant ID	SIAS	STAI Y1	STAI Y2	STAXI_S-ANG	STAXI_T-ANG	STAXI_AC-O	STAXI AX INDEX
BPCC103	45	66	53	44	20	16	49
BPCC105	34	35	51	15	15	16	52
BPCC104	26	28	47	15	17	20	34

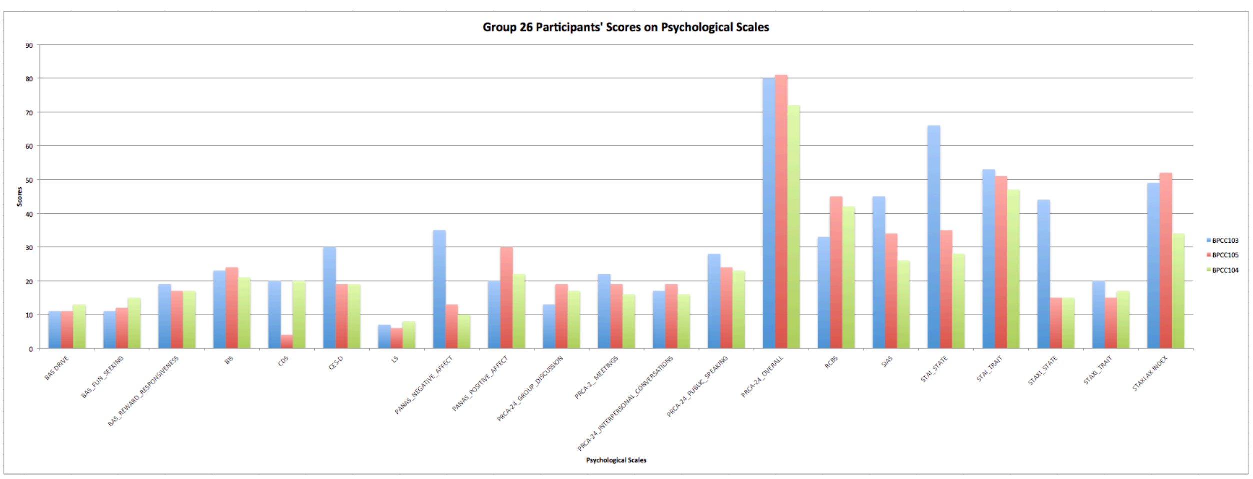

Figure 33. Graphic representation of Group 26 participants' scores on psychological scales

As can be seen in *table* 48 and *figure* 33, BPCC103's behavioral characteristics reflect some of his scores on the psychological constructs. For example, BPCC103's score on BAS (believed to drive behavior when the goal is to move toward something desired) was as low as participant BPCC105's (score for both was 11), and it was lower than BPCC104's score (13); therefore, it can be assumed that BPCC104 saw more reward or motivation in participating in the conversation task than the other participants. A reduced motivation to participate is reflected on BPCC103's lower number of turns taken as well as on his reduced total length of turns in seconds. In addition, BPCC103's score on BIS, which is said to inhibit an individual from non-rewarding or punishing situations, was 23, while BPCC105's score was 24, and BPCC104's score was 21. This shows that BPCC103's and BPCC105's scores on the BIS were higher than BPCC104's score, possibly indicating that the former 2 are more inhibited than the latter.

However, BPCC103 and BPCC104 had the same score on the Cognitive Disinhibition Scale (CDS): 20; whereas participant BPCC105 scored 4. This shows that both BPCC103 and BPCC104 are far more creative than BPCC105. The scale that measures shyness is the RCBS (Revised Cheek and Buss Shyness scale). The results yielded in this category are also surprising. BPCC103, the quietest participant, is not the shyest of the three, according to their scores. BPCC103 scored 33, while both BPCC105 and BPCC104 scored fairly high, 45 and 42 respectively.

The next category may help explain BPCC103's introverted floor holding tendencies. Participants' behaviors may be reflected on the results on the Social Interaction Anxiety Scale (SIAS). For example, BPCC103 scored 45, while BPCC105 and BPCC104 scored 34 and 26 respectively. BPCC104's score on the SIAS shows lower social interaction anxiety, which may very well lead to higher predisposition to talk with strangers during this particular study. The scores on the Depression Scale (CES-D) provide some interesting data as well. BPCC103 scored 30 while BPCC105 and BPCC104 scored 19 and 19 respectively. This indicates a significant difference in the psychological traits of these participants, given that BPCC103 had a score on the depression scale much higher than the other 2 participants. This can directly influence BPCC103's willingness to take turns and hold the floor.

Supporting the observed trends in participants' conversational behaviors are their scores on the remaining scales. Participant BPCC103 showed substantially higher scores for general trait and state anxiety (STAI) and state and trait anger than the other two participants. His score on the STAI was 66 while BPCC105 and BPCC104 scored 35 and 28 respectively, and BPCC103's score on the state anger was also high, 44, while the other two scored the same, 15. These scores show that participant BPCC103 was feeling a lot angrier on the day of the recorded conversation than did the other 2 participants, possibly affecting his behavior.

Tables 52 and 53 displays the surveys that correlate more highly with the studied behaviors. Noteworthy are the scales BAS Fun Seeking, which strongly correlates with all of the studied behaviors listed in the table below, and Trait and State Anxiety (STAI), which strongly negatively correlate with all of the studied behaviors. Given the small sample available for this Pearson Single Correlation analysis (n=3) these correlations have small statistical significance. However, these correlations help determine which psychological constructs might help explain differences in conversational performance.

TABLE 52

Single Pearson Correlations between Behaviors and Psychological Scores for Group 26 – 1st Half

	1	2	3	4	5	6	7	8	9	10	11	12
1.DISAGREE	1											
2.PAUSE	.189	1										
3.WORD SEARCH	-.500	.756	1									
4.TURNS LENGTH	.140	.999*	.787	1								
5.TURNS NUMBER	-.617	.656	.990	.693	1							
6.BAS DRIVE	-.500	.756	1.000**	.787	.990	1						
7.BAS FUN SEEKING	-.277	.891	.971	.912	.927	.971	1					
8.BAS REW RESP	-.500	-.945	-.500	-.928	-.373	-.500	-.693	1				
9.BIS	.756	-.500	-.945	-.542	-.982	-.945	-.839	.189	1			
10.CDS	-1.000**	-.189	.500	-.140	.617	.500	.277	.500	-.756	1		
11.CES-D	-.500	-.945	-.500	-.928	-.373	-.500	-.693	1.000**	.189	.500	1	
12.LS	-.866	.327	.866	.374	.928	.866	.721	0.000	-.982	.866	0.000	1
13.PANAS NEG	-.402	-.975	-.592	-.963	-.473	-.592	-.768	.994	.296	.402	.994	-.110
14.PANAS POS	.982	.371	-.327	.325	-.457	-.327	-.091	-.655	.619	-.982	-.655	-.756
15.PRCA GROUP DISC	.756	.786	.189	.754	.049	.189	.419	-.945	.143	-.756	-.945	-.327
16.PRCA MEETINGS	0.000	-.982	-.866	-.990	-.787	-.866	-.961	.866	.655	0.000	.866	-.500
17.PRCA INT CONV	.945	-.143	-.756	-.192	-.840	-.756	-.577	-.189	.929	-.945	-.189	-.982
18.PRCA PUB SPEAK	-.327	-.990	-.655	-.981	-.542	-.655	-.817	.982	.371	.327	.982	-.189
19.RCBS	.693	.839	.277	.811	.140	.277	.500	-.971	.052	-.693	-.971	-.240
20.SIAS	-.091	-.995	-.817	-.999*	-.728	-.817	-.932	.908	.583	.091	.908	-.419
21.STAI STATE	-.343	-.987	-.642	-.978	-.528	-.642	-.808	.985	.356	.343	.985	-.173
22.STAI TRAIT	.189	-.929	-.945	-.946	-.890	-.945	-.996	.756	.786	-.189	.756	-.655
23.STAXI STATE	-.500	-.945	-.500	-.928	-.373	-.500	-.693	1.000**	.189	.500	1.000**	0.000
24.STAXI TRAIT	-.803	-.737	-.115	-.703	.026	-.115	-.350	.918	-.217	.803	.918	.397

TABLE 53 *Single Pearson Correlations between Behaviors and Psychological Scores for Group 26 – 2nd Half*												
	13	14	15	16	17	18	19	20	21	22	23	24
1.DISAGREE												
2.PAUSE												
3.WORD SEARCH												
4.TURNS LENGTH												
5.TURNS NUMBER												
6.BAS DRIVE												
7.BAS FUN SEEKING												
8.BAS REW RESP												
9.BIS												
10.CDS												
11.CES-D												
12.LS												
13.PANAS NEG	1											
14.PANAS POS	-.568	1										
15.PRCA GROUP DISC	-.903	.866	1									
16.PRCA MEETINGS	.916	-.189	-.655	1								
17.PRCA INT CONV	-.080	.866	.500	.327	1							
18.PRCA PUB SPEAK	.997	-.500	-.866	.945	0.000	1						
19.RCBS	-.938	.817	.996	-.721	.419	-.908	1					
20.SIAS	.948	-.277	-.721	.996	.240	.971	-.781	1				
21.STAI STATE	.998*	-.514	-.874	.939	-.016	1.000*	-.915	.967	1			
22.STAI TRAIT	.823	.000	-.500	.982	.500	.866	-.577	.961	.858	1		
23.STAXI STATE	.994	-.655	-.945	.866	-.189	.982	-.971	.908	.985	.756	1	.
24.STAXI TRAIT	.868	-.901	-.997*	.596	-.564	.826	-.986	.666	.835	.434	.918	1

In addition, the following *table* displays participants' measures of heart rate variability.

Table 54 *HRV Values for the 3 Participants in Group 26, throughout Baselines and Tasks*			
	PARTICIPANT ID		
	BPCC103	BPCC105	BPCC104
Resting			
SDNN	55.30	49.80	75.10
RMSSD	52.90	20.40	38.50
HF	15.28	11.99	10.81
LF	12.88	22.29	43.52
Reading			
SDNN	65.50	48.30	64.20
RMSSD	44.70	25.00	30.40
HF	18.78	15.00	10.05
LF	33.05	52.04	19.16
Question-and-Answer			
SDNN	68.09	39.10	46.20
RMSSD	53.30	17.20	26.20
HF	23.98	6.97	15.43
LF	25.12	60.12	43.52
Group Resting			
SDNN	44.70	76.20	73.10
RMSSD	29.90	56.00	54.5
HF	18.55	40.14	18.44
LF	36.79	30.82	71.41
Group Conversation			
SDNN	47.24	79.00	47.21
RMSSD	29.90	56.00	54.50
HF	20.14	17.62	7.10
LF	47.45	33.40	29.02

As can be observed in *table* 54, participant BPCC103, the same participant who had the lowest amount of floor, had fewer overlaps and pauses, and no word searches, displays the highest high frequency and low frequency HRV values during the conversation task, possibly marking a high amount of stress during this group activity.

Pre and Post Heart Rate and Skin Conductance for Silence. As can be observed in *table* 55 and *figures* 34 and 35, most silences are 2 or 3 seconds long. Some of these silences below elicit minor physiological changes in the participants while others do not.

Table 55

Heart Rate and Skin Conductance of Participants in Group 26 During Silences

PRE	1	2	3	4	5
LENGTH OF SILENCE	2 SECONDS	1 SECOND	2 SECONDS	2 SECONDS	3 SECONDS
HR BPCC103	76.96	83.12	80.68	81.99	77.13
SC BPCC103	11.61	11.13	11.26	11.94	10.93
HR BPCC105	97.09	74.85	85.54	76.25	75.35
SC BPCC105	30.59	26.15	28.97	25.82	24.93
HR BPCC104	81.42	70.18	66.60	72.82	75.25
SC BPCC104	13.88	14.34	14.05	13.35	12.90
POST	1	2	3	4	5
HR BPCC103	77.69	80.29	80.94	85.15	77.67
SC BPCC103	11.39	11.22	12.24	12.21	11.28
HR BPCC105	83.45	80.50	78.62	76.66	77.49
SC BPCC105	31.42	28.36	27.76	25.49	24.91
HR BPCC104	79.08	66.86	71.29	73.46	74.95
SC BPCC104	13.89	14.07	13.78	13.25	13.12
PRE	6	7	8	9	10
LENGTH OF SILENCE	3 SECONDS	3 SECONDS	1 SECOND	1 SECOND	2 SECONDS
HR BPCC103	84.40	77.20	80.11	77.86	79.62
SC BPCC103	12.09	10.54	10.70	11.57	11.58
HR BPCC105	70.32	75.18	68.69	67.76	66.63
SC BPCC105	26.70	21.16	21.85	19.49	15.67
HR BPCC104	69.13	72.07	72.10	72.62	70.74
SC BPCC104	13.55	13.61	13.62	13.91	12.56
POST	6	7	8	9	10
HR BPCC103	78.90	80.47	81.55	84.85	80.57
SC BPCC103	11.73	10.84	11.24	11.99	11.58
HR BPCC105	75.89	66.47	64.95	69.21	65.60
SC BPCC105	26.13	20.09	22.08	18.82	22.89
HR BPCC104	69.78	68.70	71.07	68.41	78.09
SC BPCC104	13.23	13.51	13.95	13.52	15.08
PRE	11	12	13	14	

LENGTH OF SILENCE	2 SECONDS	1 SECOND	3 SECONDS	1 SECOND	
HR BPCC103	82.95	83.02	87.46	81.66	
SC BPCC103	11.59	11.26	11.14	11.65	
HR BPCC105	73.74	71.66	70.12	69.59	
SC BPCC105	23.25	19.83	19.89	22.85	
HR BPCC104	70.24	76.02	76.64	74.08	
SC BPCC104	13.40	13.55	13.46	13.93	
POST	11	12	13	14	
HR BPCC103	78.72	86.77	82.15	79.29	
SC BPCC103	11.57	11.03	11.31	11.52	
HR BPCC105	70.12	69.01	69.02	69.30	
SC BPCC105	22.96	19.67	19.46	23.05	
HR BPCC104	70.94	75.15	73.78	77.75	
SC BPCC104	13.21	13.32	13.25	13.88	
Note. The heart rate (HR) and skin conductance (SC) values in this table are averages of 10 seconds before the group inter-turn silence occurred (PRE) and 10 seconds after it was over (POST).					

As can be observed in *table* 55, various instances and lengths of silence had different effects on participants' heart rate and skin conductance, relative to pre and post means surrounding the studied behavior. The variations noted are across participants and lengths, so to understand how these observations correlate with participants'' individual differences, the context of each of these silences need to be examined. In order to do that and bring some light to possible contextual differences, some cases are described later in this chapter.

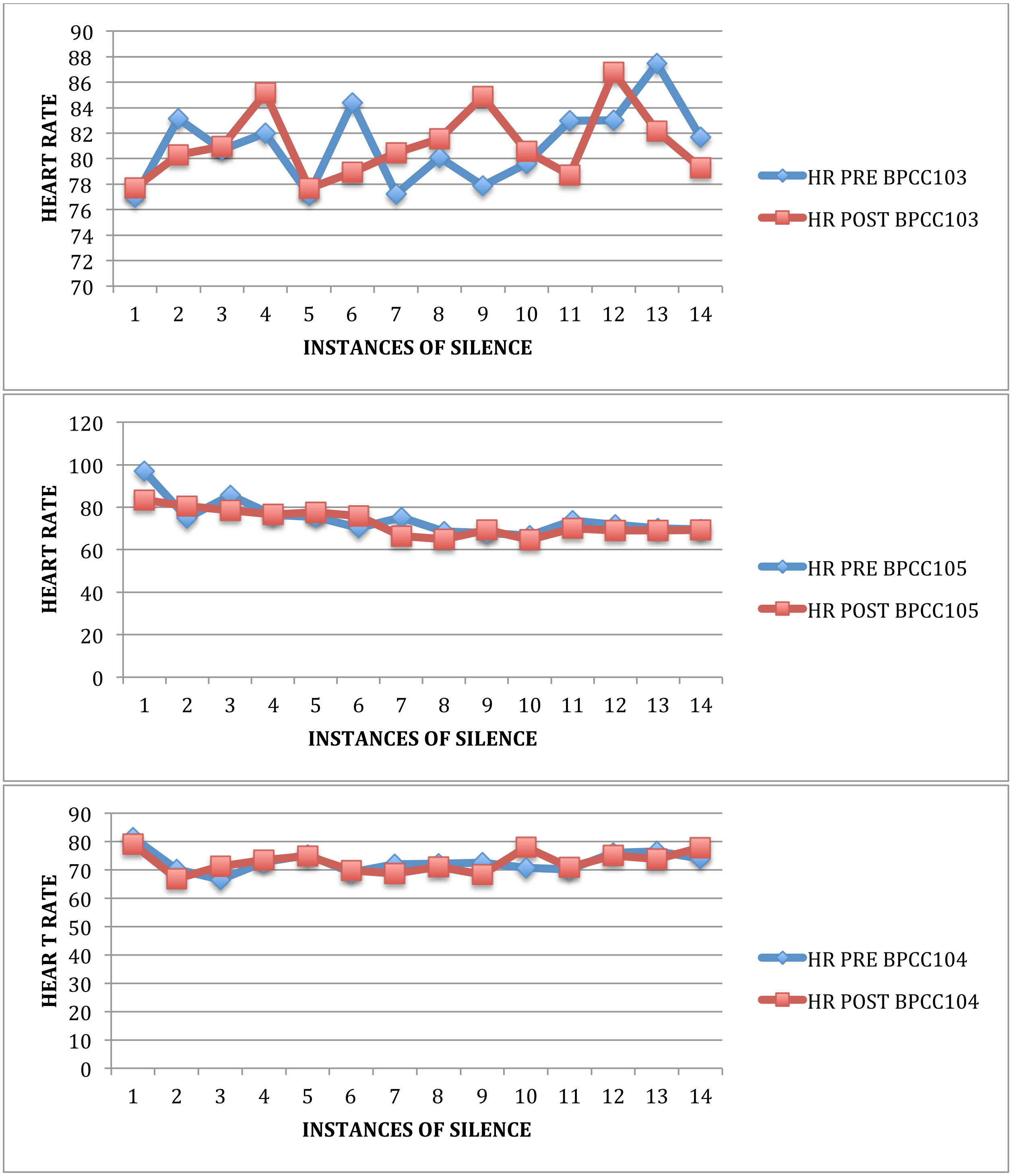

Figure 34. Pre and post means of heart rate for each of the participants in Group 26

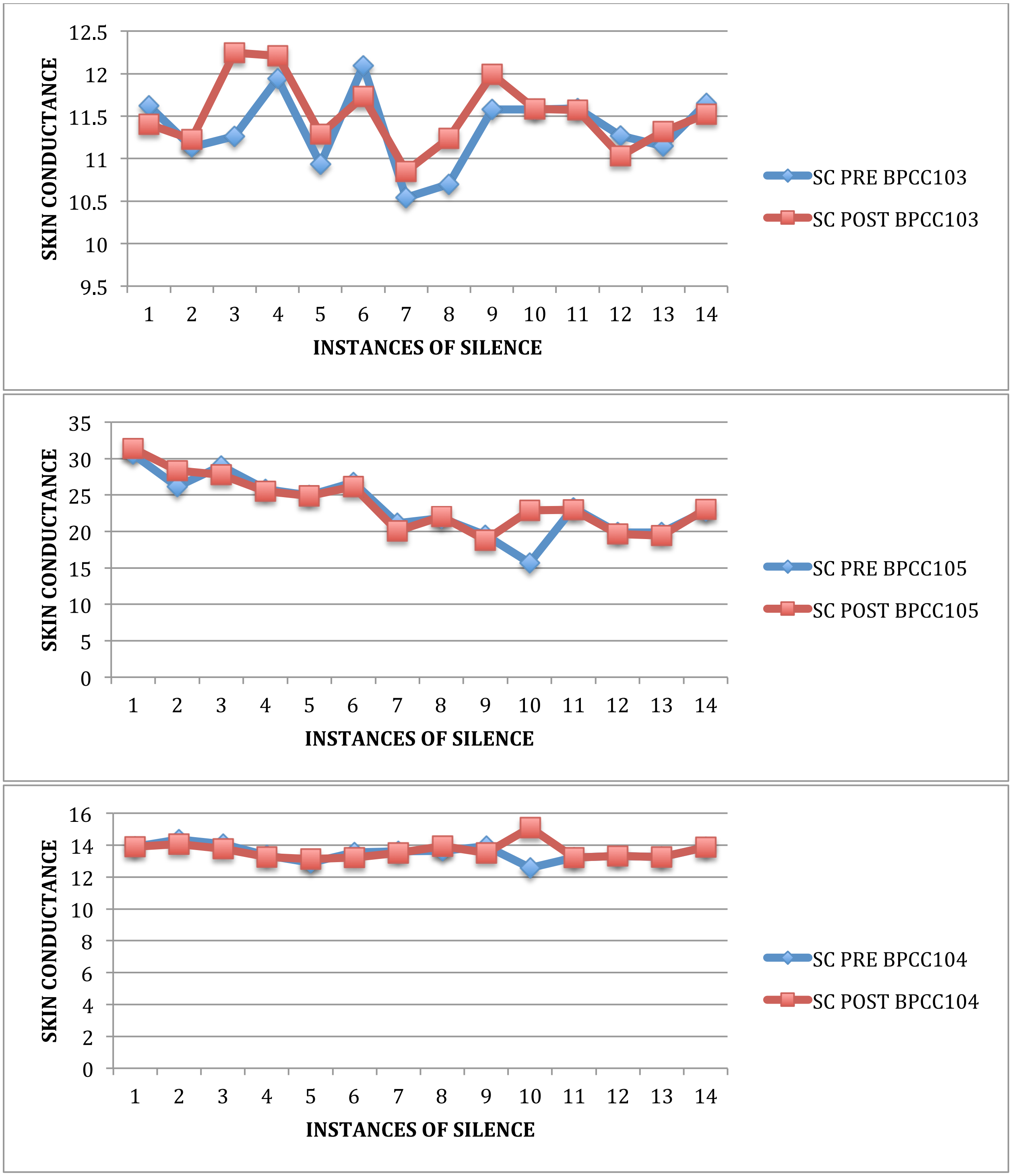

Figure 35. Pre and post means of skin conductance for each of the participants in Group 26

Pre and Post Heart Rate and Skin Conductance for Disagreements. *Table* 55 shows participants' heart rate (HR) and skin conductance (SC) data before and after the three instances of disagreements during the recorded conversation task. The values on the top labeled as PRE represent the average of the 10 seconds preceding the disagreement, while the values labeled POST are the averages of the 10 seconds following the observed disagreement, for each participant. It is important to note that there might be changes not only in the physiological responses of the person doing the disagreement, but also in the physiological responses of the person being disagreed with, as well as with the physiological responses of the third party who is just observing each of these particular interactions.

Table 56

Heart Rate and Skin Conductance of Participants in Group 26 During a Disagreement

PRE	1	POST	1
HR BPCC103	84.48	HR BPCC103	82.10
SC BPCC103	12.19	SC BPCC103	11.72
HR BPCC105	77.00	HR BPCC105	81.06
SC BPCC105	25.58	SC BPCC105	25.94
HR BPCC104	74.44	HR BPCC104	74.59
SC BPCC104	13.34	SC BPCC104	13.04

Note. The heart rate (HR) and skin conductance (SC) values in this table are averages of 10 seconds before the disagreement occurred (PRE) and 10 seconds after it was over (POST). Participant BPCC105 disagrees with participant BPCC104.

The most important information that can be extracted from *table* 56 is that the only participant who shows a significant rise in heart rate is the person who makes the disagreement, which is participant BPCC105. He disagrees with participant BPCC104, who did not show a significant change in heart rate or skin conductance. In addition, the third party on this interaction did not see a significant change either.

Pre and Post Heart Rate and Skin Conductance for Word Searches. *Table* 57 shows participants' heart rate (HR) and skin conductance (SC) data before and after five instances of word searches during the recorded conversation task. The values on the top labeled as PRE represent the average of the 10 seconds preceding the word search, while the values labeled POST are the averages of the 10 seconds following the observed word search, for each participant. It is important to note that there might be changes not only in the physiological responses of the person doing the word search, but also in the physiological responses of the people assisting in the search for a word, as well as with the physiological responses of the people who may just be listening. The word searches listed here are characterized by having one of the participants initiate a repair sequence. All the repair sequences were initiated by the current speaker.

Table 57

Heart Rate and Skin Conductance of Participants in Group 26 During Word Searches

PRE	1	2	3	4	5
HR BPCC103	79.22	79.46	80.84	86.00	84.19
SC BPCC103	11.48	10.86	11.87	11.57	11.11
HR BPCC105	74.53	75.83	76.77	74.57	69.90
SC BPCC105	29.23	28.59	26.43	18.40	6.48
HR BPCC104	77.68	74.29	72.06	66.35	73.51
SC BPCC104	14.08	14.35	13.45	13.36	14.22
POST	1	2	3	4	5
HR BPCC103	77.55	77.62	78.93	82.86	76.54
SC BPCC103	11.43	10.85	11.38	12.07	10.85
HR BPCC105	71.95	68.65	74.50	71.07	66.81
SC BPCC105	27.47	28.09	26.58	18.25	6.47
HR BPCC104	76.37	73.06	72.88	66.07	73.72
SC BPCC104	14.08	14.25	13.43	13.39	14.08

Note. The heart rate (HR) and skin conductance (SC) values in this table are averages of 10 seconds before the word search occurred (PRE) and 10 seconds after it was over (POST).

The most important information that can be extracted from the *table* above is that for each of the 5 instances of word search found in this segment, the means for post-behavior were always lower than the means for pre-behavior. This fact must indicate that the activity of word searching in each of these cases was collaborative, promoting face preservation and pro-social behavior, which may have allowed higher activation of the parasympathetic system. This assumption is further validated by the fact that post-behavior skin conductance was lower or the same than pre-behavior.

Data Analysis II: Video Data and Transcripts for Group 26

In order to add contextual information in the analysis of physiological changes in pre- and post-heart rate and skin conductance surrounding tokens of behavior, and to try to understand what might underlie up-regulation or down-regulation of heart rate and skin conductance for the same individual across similar tokens of behavior, the following examples are further discussed in detail.

Example 1: Disagreement. The participants in this segment are talking about places they know in Los Angeles. They start talking about Santa Monica and Venice as good candidates of places to go and find several different and interesting activities to do. For example, Santa Monica is well known for its Third Street Promenade, with several stores and restaurants, and this is what they are talking about at this moment. The participant who had originally claimed that he did not know Los Angeles too well says he knows where the promenade is, so all participants talk about it a while longer.

Transcript [Disagreement: Cold as Fuck]

BPCC103: (its) nice i-i like third street promenade
BPCC104: third street's easy
BPCC103: (an you after you're done shopping) just go to the beach and
just [chill
BPCC104: [yeah
BPCC104: no thats the thing like third street an venice are just like
they're so close to the beach and venice's on the beach
BPCC103: yeah
BPCC104: venice is pretty sweet
BPCC103: i (really) like the beaches here it's- it's actually warm
((laughs))
BPCC104: yeah, it's ((whispering))
BPCC103: (mac con)
BPCC105: it's cold as fuck
BPCC104: it's get-it's get cold at night- i will give you that but (.)
build a bonfire
BPCC103: oh imma do a bonfire=
BPCC104: =its its its something
BPCC103: yeah

Having established that talking about Santa Monica's Third Street Promenade in terms of having good things to do, participants start talking about being able to chill at the beach after having gone shopping on the promenade (lines 3 and 4). However, after participant BPCC103 says that he likes the beaches here (as in Los Angeles) because they are warm (line 10), BPCC105 raises an eyebrow, looks at participant BPCC104, who is agreeing with participant's

BPCC103's assessment of local beaches' balmy temperatures (line 12), after which he finally says, looking at the current speaker, "it's cold as fuck" (line 14).

A visual breakdown of the disagreement sequence follows:

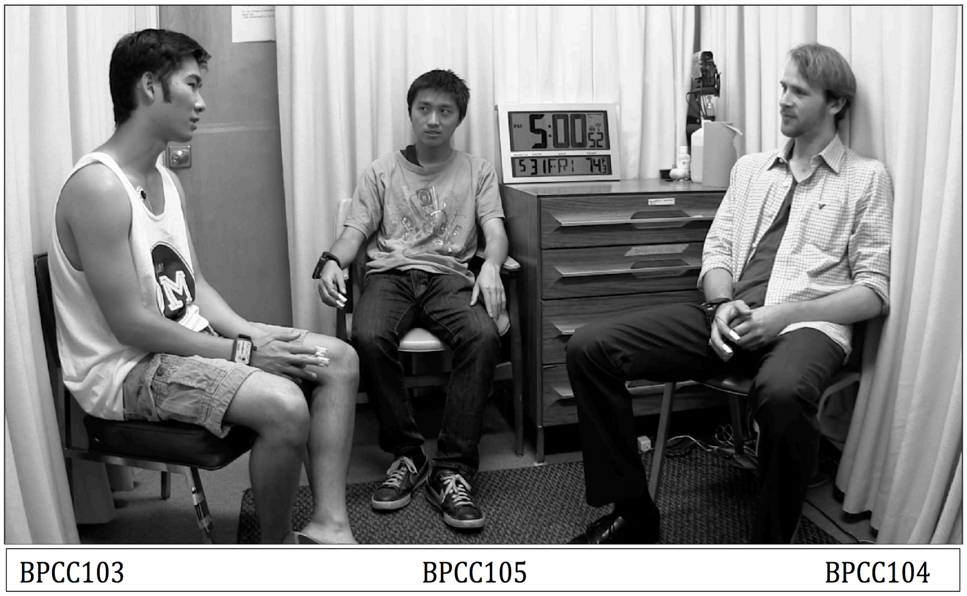

Figure 36. Participant BPCC103 makes an assessment about the beaches in Los Angeles

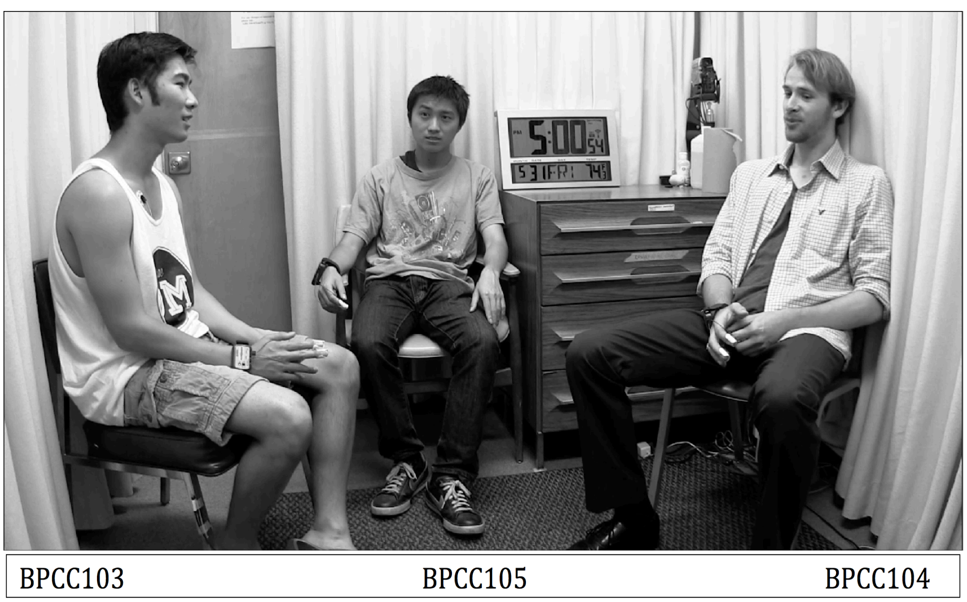

Figure 37. Participant BPCC105 breaks eye contact, raises his eyebrow, displaying an incoming disagreement

BPCC103	BPCC105	BPCC104

Figure 38. Participant BPCC105 looks at BPCC104 while he is agreeing with BPCC103's assessment

BPCC103	BPCC105	BPCC104

Figure 39. Participant BPCC105 delivers his disagreement

In reference with this segment, participant BPCC103, who had originally offered the assessment, had a small decrease from pre to post disagreement HR, going from 84.48 to 82.10. Participant BPCC104, who had agreed with BPCC103's assessment, and who later agrees with BPCC105's disagreement as well, saw no significant change in pre and post HR and SC. Only participant BPCC105, who disagreed with BPCC103's assessment, and who had to wait a turn to deliver his opposing view, saw an increase in HR. His pre HR was 77.00 and it increased to 81.06. SC values were fairly steady across the board, the changes being very small. So it is possible to assume that this behavior does not elicit an immediate stress response or arousal, but it does create immediate changes in HR acceleration. Being disagreed with in this particular case does not seem to be a stressor for BPCC103, but having to so openly and directly deliver a disagreement with a contrasting sentence such as "it's cold as fuck" correlated with the observed increase in BPCC105's HR.

Example 2: Word Search 1. The topic these participants are talking about during this word search segment is food trucks. Participant BPCC104 had asked the others if they had heard of *First Friday* on Abbot Kinney Boulevard in Venice. The other participants did not know what that was, so participant BPCC104 was explaining that on every first Friday of the month, select gourmet food trucks from all over Los Angeles come to that street, and there are open and free art exhibits everywhere, and a lot of people come to walk around, see the art, and eat at those food trucks. After this brief explanation, participant BPCC105 remembers that there used to be food trucks that came to UCLA, and that they used to park near a food court area that was under construction at that time. The official name of this food area is *Court of Sciences Student Center*, but all students at UCLA call it *Bombshelter*. After reopening, this food court offered several options for restaurants, out of which two stood out and became more popular: the *Bistro*, and *Fusion*. Participant BPCC103 says that he tried one of those, but he doesn't say which one. Participant BPCC104 then requests BPCC103 to specify which one, and he offers assistance with the names of the restaurants at the *Bombshelter*. The transcript of this segment is below:

Transcript [Word Search: Argentinean Burrito]

```
BPCC105: they had trucks that used to come here, right?
BPCC104: i know they used to have them in b-by the bombshelter
BPCC103: oh what happened
BPCC104: but now that the bombshelters open they stopped coming. have
         you had the uh, the argentinean burrito at, fusion (.) in the
         bombshelter
BPCC105: no [my a] my friends told me to try out the fusion one
BPCC104:    [awww]
BPCC104: it's [it's pretty good]
BPCC103:      [i tried like] i tried like the other one
BPCC104: yeah
BPCC103: ( )
BPCC104: the bristo one?
BPCC103: uhh (.) i thought it was a korean an like,
         i tr[ied] the korean and
BPCC104:     [ohh]
BPCC103: viet one
BPCC104: ok yeah yeah yeah [ok] from fusion?
BPCC103:                   [oh] yeah=
BPCC104: =ok good.  yeah it's a (.) it's a great deal, too.  and, like=
BPCC103: =yeah=
BPCC104: =it feels you up just as much as subway does and it's like a
```

```
23            dollar less
24   BPCC103: yeah
```

In line 1 we see BPCC105 moving the context of food trucks from Abbot Kinney to UCLA, by an initial position delivery of news with a change of epistemic status from not knowing to knowing. He went from not knowing what *First Friday* was to knowing that there were food trucks at UCLA. He also invites the last speaker's alignment with his action, but saying "right?" (line 1) and looking directly at him. For this delivery, BPCC105 waits until BPCC103 ends his previous assessment about wanting to visit Abbot Kinney (see figure 37).

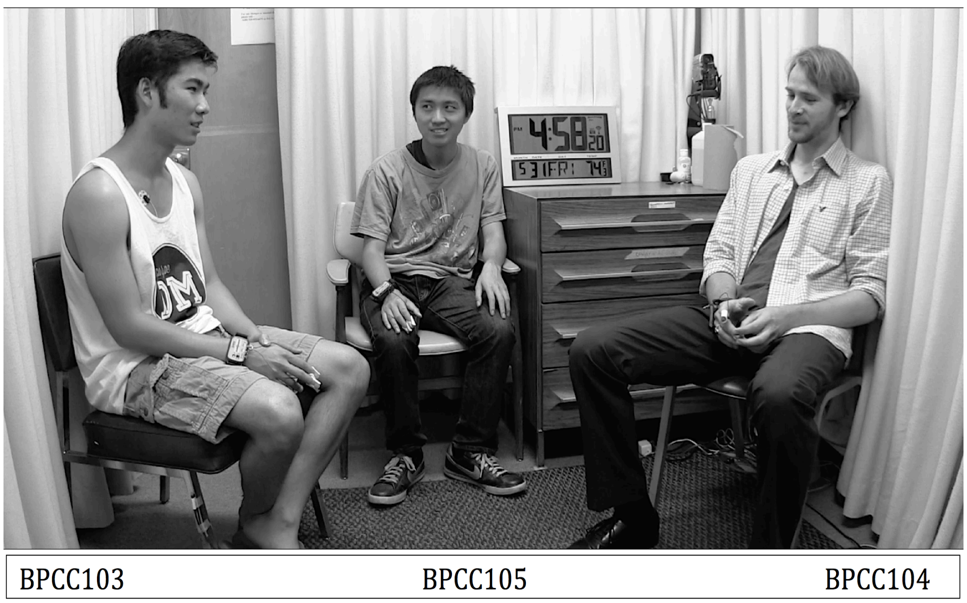

Figure 40. BPCC105 waits for BPCC103's end of assessment turn

BPCC105 waits till BPCC103 is finished with his turn. BPCC105 then turns to BPCC104, raises his left thumb as he takes the turn. His thumb raise indicates not only the beginning of his turn, but also a semi-pointing gesture to the location of *Bombshelter* (see figure 38).

BPCC103 BPCC105 BPCC104

Figure 41. BPCC105 takes the turn and switches referential location for food trucks

BPCC103 BPCC105 BPCC104

Figure 42. BPCC104 acknowledges the existence of food trucks at this new location (the bombshelter at UCLA)

In line 2 BPCC104 maintains equal footing with BPCC105 in terms of epistemic status by saying “I know they used to have them in b-by the bombshelter”. BPCC103 seems to be unaware of this fact and he asks in line 3 “oh what happened”, looking at BPCC104, which gives BPCC104 the next turn and the right to offer an account of what happened, even though it was BPCC105 who initiated this topic. So BPCC104 takes the turn and offers the explanation in line 4, saying “but now that the bombshelters open they stopped coming”. BPCC105 participates in the co-telling of what happened to the trucks by waving and showing his hands, palms up (see figure 40). This gesture and his facial expression with tightened lips seems to indicate that he thinks is was a shame that the food trucks left.

BPCC103 BPCC105 BPCC104

Figure 43. BPCC104 tells BPCC103 that the food trucks left when the bombshelter opened. BPCC105 co-participates in this turn.

BPCC104 then keeps the floor and epistemic ground but turning to the others and asking if they had had “the argentinean burrito, at fusion” (line 5). By asking the other participants this question, BPCC104 re-upgrades his epistemic stance, as he not only knows of a restaurant in the Bombshelter area, but he has tried some of the foods there (see figure 41).

BPCC103 BPCC105 BPCC104

Figure 44. BPCC104 looks at and asks both participants if they had heard of the "argentinean burrito" sold at fusion

BPCC103 BPCC105 BPCC104

Figure 45. BPCC103 and BPCC105 display thinking faces at the same time in response to BPCC104's question about the argentinean burrito

As can be seen in figure 42, participants BPCC103 and BPCC105 display a thinking face. They accomplish this act by breaking eye contact and looking up and away from their co-participants. Then in line 7, BPCC105 says that his friends had told him to try that restaurant, "fusion" and in line 10 BPCC103 says that he had tried "the other one". By saying this, BPCC103 seems to imply that he had not tried "fusion", but at least he did know about restaurant the bombshelter. This response helps in his face preservation, since he does not come across as completely ignorant of the restaurant choices and food choices that this food court has to offer. BPCC104 pursues BPCC103's lack of a name by asking "the bristo one?" (line 13). But BPCC103 does not seem to be sure of the name of the other restaurant, as he says "uhh (.)" and pauses for a moment (line 14). In the search of the name of the restaurant he is talking about, BPCC103 breaks eye contact with participants, looks away, to his right, displaying a thinking face (figure 43).

BPCC103 BPCC105 BPCC104

Figure 46. BPCC103 display a word search for the name of the restaurant he was referring to

Figure 47. BPCC103 offers more information in lieu of a word retrieval

After having paused and looked away, BPCC103 says “I thought it was a korean an like, I tried the korean and viet one” (lines 14, 15, 17). He says that scratching his chin, displaying uncertainty, as in still actively searching for a word, and by providing additional information, he seems to hope to get some help from the other participants, especially from the person who he is looking at, BPCC104, who also happens to be the one who asked him if he was talking about the *bistro*. After that, BPCC104 offers to help BPCC103 to find the name of the restaurant he is referring to and says in line 18 “ok yeah yeah yeah ok from fusion?” to which BPCC103 seems to finally agree or accept the name help in line 19 saying “oh yeah”. BPCC104 closes this word search in line 20 saying “ok good”.

This entire segment only takes 11 seconds, and it includes two word searches. The first one was BPCC103 and BPCC105’s search for the *argentinean burrito,* and the other one was BPCC103’s search for the name of the restaurant he had tried at the *bombshelter*. The mean heart rate and skin conductance for these participants before and after this 11-second segment saw a decrease across the board. BPCC103's HR went from 79.46 to 77.62, while his SC went from 10.86 to 10.85. BPCC105's HR went from 75.83 to 68.65 while his SC went from 28.59 to 28.09. BPCC104's HR went from 74.29 to 73.06 while his SC went from 14.35 to 14.25. What this information seems to indicate is that these word searches were not stressors for any of these participants, since their skin conductance was fairly stable across the segment. Their heart rate slowed down a little, showing possibly that the parasympathetic system was more activated and the sympathetic system during that time. There is a chance that a collaborative action such as a word search is pro-social and has a calming effect on participants' physiological states.

Example 3: Silence. As can be observed in figures 31 and 32, in table 52, all the silences in this conversation have typical length, ranging from 1 to 3 seconds. Out of a total of 14 coded instances of inter-turn silences, 5 of them lasted 1 second, 5 lasted 2 seconds, and 4 lasted 3 seconds. Silences seem to cause significant SC and HR pre to post mean changes for participant BPCC103, but for participants BPCC105 and BPCC104 there are very few pre and post differences in mean for silences during the 14 cases coded. This evidently relates to the participants' individual psychological and physiological scores.

Of all cases, segment #10 seemed to have caused a significant change in HR and SC for all, and it is of special research interest. The answer to what might have caused this reaction from all participants must lie within the embedded context of the silence. Case #10 is depicted in this section. In this segment, BPCC103's HR pre- and post-mean increases from 79.62 to 80.57 while his SC remains the same. BPCC105's HR remains fairly stable, going from 66.63 to 65.60, but his SC increases significantly from 15.67 to 22.89. Finally, BPCC104's HR increases significantly from 70.74 to 78.09, and so does his SC, increasing from 12.56 to 15.08.

There is a strong possibility that the explanation for such atypical changes for participants BPCC105 and BPCC104 lies in the context and sequential positioning of this silence. It comes at the end of a long sequence of sharing stories about violence, which start 5 minutes earlier, with BPCC105 telling the others about the day he fell asleep in the bus he took from Santa Monica to Westwood, following along on Wilshire. When he woke up, he was in downtown Los Angeles at night time, and what he saw frightened him. Next in the sequence, BPCC103 says that he was walking around downtown once, also at night, and he remembers seeing people "exchanging bags", and "ladies in little tight dresses just standing around", and he remembers thinking that he was in the "wrong part of town". Next in the sequence, BPCC104 says that when he was with the boy scouts, he had to do something downtown for them, wearing the uniform. He remembers being followed by a woman, and he was wishing she would stop, as it was making him nervous. Then BPCC105 says he once saw a fight on the bus, to which BPCC104 responds by asking the others if they had seen a Hip Hop video about a couple who was in a bus, and the girl slaps the boy, and in turn the boy punches her in the jaw, and they keep fighting throughout the video. Then BPCC105 asks the others if they had seen another video about an old white guy beating up a black guy on a bus. Apparently the white guy, who was much older, was supposed to be an old war veteran, and in this story he offended the black guy, who demanded satisfaction. But at the end the old man gets into a fight with the black guy and he beats him up, and there is blood everywhere. Nobody takes the floor after this story, so BPCC105 tells another story of when he was on a train going somewhere in Los Angeles, and a guy steps on a girl's foot, but he apologizes. When he leaves the train at the next stop, she gets off after him, and she attacks him. Apparently she was "buff" enough to beat up a guy. This story is in the transcript below (lines 1-23). At the end of this series of stories related to crime and violence, there is a 2 second silence (line 33), and this is when we observe the changes in heart rate and skin conductance in all participants.

The immediate surroundings of the silence can be seen in the following transcript:

Transcript [Silence: Having a Bad Day]

BPCC105: do you know the: (.) train station, the subway station,
BPCC104: which [station]
BPCC105: [there's] there's this subway at union station,
BPCC104: yeah
BPCC105: so um there's this guy like (.) um i think he was getting on
the bus and he didn't see this girl so he kinda like bumps
into her foot and like she gets pissed but
BPCC104: uh-hum
BPCC105: he didn't notice that he like stepped on her foot ( ) so he
apologized to her but she starts to explode (.) she gets
really pissed (.) and like I don't know why but she's like
threatening this guy and this guy's like this guy's like
trying to shake her off cause he didn't want to get in trouble
he apologized already and like the moment they get off the
train i see him and you see that girl running on the side and
she tackles him and they [fight outside the bus stop.
BPCC104: [((laughs))
BPCC103: [[((laughs))
BPCC105: [i was like oh and everyone's like what the ((laughs))
BPCC104: yeah
BPCC105: and she was like she was like she wasn't like super strong too
but she was buff and i was like holy. i think she was beat the
crap out of him

24 BPCC103: did he even try ((laughs))
25 BPCC105: yeah I dont know but
26 BPCC104: that's terrible (.) huh
27 BPCC105: that's how i learned about ()
28 BPCC104: so unnecessary
29 BPCC105: ehh
30 BPCC104: it's like you stepped on my foot (.) big deal
31 BPCC103: she must have been having a really bad day or something
32 BPCC105: probably
33 (2.0)
34 BPCC104: oh (.) well anyway (.) happy things, ((laughs))
35 BPCC103: yeah we like finished the topic in like five minutes
36 BPCC104: yeah so where so you haven't been around L A much have you?
37 BPCC103: no

There are some closing comments to this story telling (lines 30-32). These comments lead to a 2-second silence. In line 24 participant BPCC103 asks the story teller, BPCC105, if the guy being beaten up by the girl tried to fight back. In line 26 BPCC104 says “that’s terrible” and in line 28 he adds “so unnecessary”, continuing in line 30 with “it’s like you stepped on my foot (big deal)”. With this imaginary reported speech, participant BPCC104 is projecting what the girl should have thought or said after having her foot stepped on, which should have been the proper behavior. The BPCC103 adds a possible justification for such an unacceptable behavior, saying “she must have been having a really bad day or something” (line 31), to which BPCC105 agrees saying “probably” (line 32). Silence takes over, and BPCC104 assesses what the last series of stories were about: “happy things” (line 34), evidently being sarcastic.

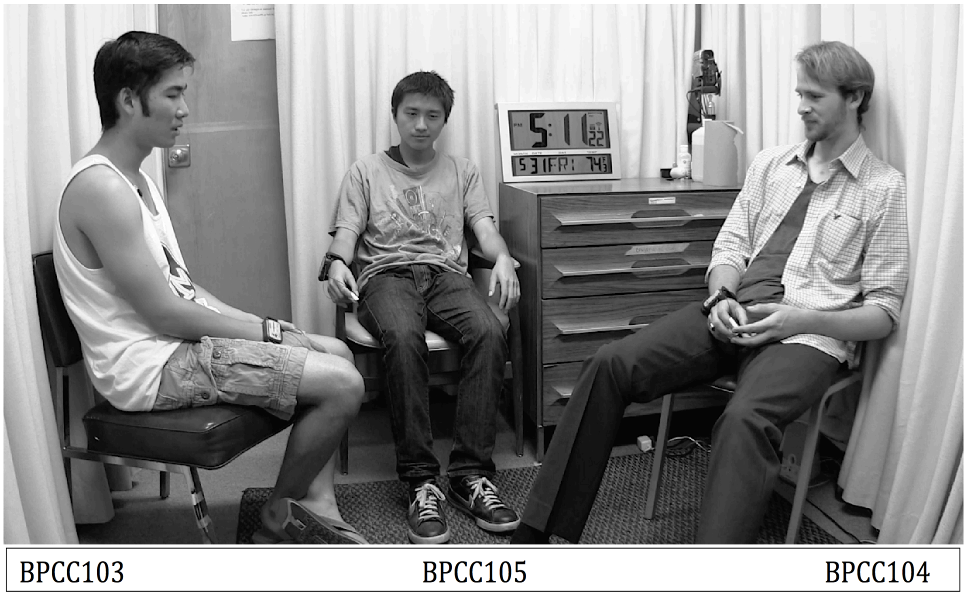

Figure 48. Moment of silence, participants looking down

This silence is evidently seen as a transition relevant point by all participants and is seized as a good opportunity – hinted by BPCC104 as having been enough – to change topics. During this silence all participants break eye contact, and look down (see figure 45). This is a typical behavior observed during an inter-turn silence when none of the participants is ready to claim the floor next. As soon as anybody makes a noise the others will look up and make eye contact with the person who is taking the floor. BPCC104 breaks the silence by saying “well anyway, happy things” (line 34). Participants look at him (see figure 46).

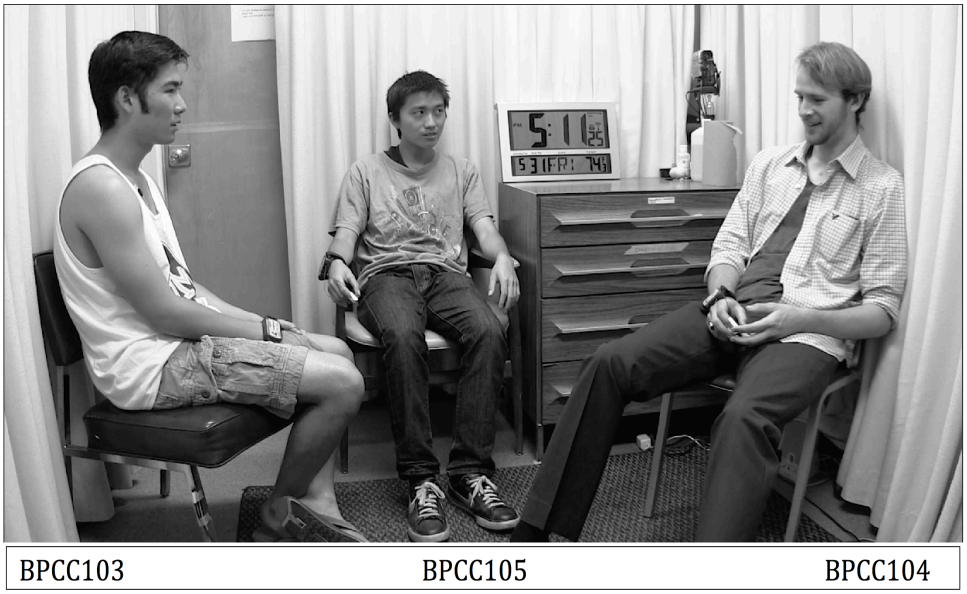

Figure 49. BPCC104 breaks the silence, other participants look at him

Next in this sequence, BPCC103 says “we like finished the topic in five minutes” (line 35) referring to the topic given to them by the study coordinator, implying that they had long moved on. Evidence that this is indeed what he meant is furthered by BPCC104 when he goes back to the topic given to them for this conversation activity, which was about places in Los Angeles they would recommend to out of town family members and friends. In line 36 BPCC104 asks BPCC103 “yeah so where so you haven't been around LA much have you?”. After having observed that BPCC103 did not know about places BPCC104 and BPCC105 were talking about, it was evident that BPCC103 had not been around the city much. BPCC103 confirms this assumption by replying “no” in line 37.

Summary and Conclusion

It is undeniable that behaviors during social interactions are shaped by individual personality traits and states, as well as being related to high frequency heart rate variability. Therefore, the investigation of individual psychophysiological characteristics of the people participating in a video recorded and transcribed conversation may help conversation analysts describe such interactions beyond the immediate context of the talk. However, such psychophysiological variables can not be studied in isolation, as it is the context that feeds information to participants' brains regarding how stressful or stress-free a given talk-related situation is; this judgment will be made at a tenth of a second, biased by previously stored somatic markers, based on how the individual perceives the conversation topic, relevance, and goal.

In this chapter it was possible to observe a few trends as well as some variability across tokens of behaviors, within and across the two groups investigated. In terms of correlations found between psychological constructs and tokens of conversational behavior, I have found that individuals' scores on BAS highly correlate with number of turns, amount of floor, and pauses in both groups; individuals' scores on BIS negatively correlate with overlaps in group 7 and positively correlates with disagreements in group 26; individuals' scores on Cognitive Disinhibition (CDS) strongly correlate with disagreements, number of turns, amount of floor, overlaps, pauses, and word searches in group 7, and with disagreements, word searches and number of turns for group 26; individuals' scores on Negative and Positive Affect strongly negatively correlate with all behaviors in both groups; individuals' scores on Communication Apprehension (PRCA) Group Discussion strongly negatively correlate with overlaps in group 7, and it strongly correlates positively with pauses, disagreements and length of turns in group 26;

individuals' scores on PRCA Interpersonal Conversations strongly correlate with number of turns in group 7, and they strongly correlates with disagreements, negatively with word searches, and negatively with number of turns in group 26; individuals' scores on Shyness (RCBS) strongly negatively correlate with number of turns, amount of floor, and pauses in both groups; individuals' scores on State Social Anxiety (STAI) strongly negatively correlate with number of turns, amount of floor, and pauses for both groups, in addition to word searches in group 26; individuals' scores on Trait Social Anxiety (STAI) strongly correlate negatively with overlaps in group 7 and with pauses, word searches, turns and amount of floor in group 26; and that individuals' scores on the Anger Scale (STAXI) strongly negatively correlate with amount of floor, overlaps, pauses and word searches in both groups. These strong positively and negative correlations between frequency of occurrences of the studied behaviors in relation to the psychological scales used in this study only show us that they are appropriate for the investigation of individual differences in conversational social behavior, and that they can shed some light on variations in behavior across group participants, keeping in mind the variability of behavior embedded contexts as well.

There were also a few clear correlations between mean heart rate (MHR), Standard Deviation of Interbeat Intervals (SDNN-HRV) and high frequency heart rate variability (HF-HRV). In group 7, the participant who had the least amount of floor and lowest number of turns, fewer overlaps and pauses, and who had initiated no word searches displayed the lowest values across baselines and in the conversation task, while the participant who was the most active and talkative during the conversation task displayed the highest MHR and SDNN-HRV values. In group 26, the participant who had the lowest amount of floor, fewer overlaps and pauses, and no word searches, displayed the highest high frequency and low frequency HRV values during the conversation task. This pattern indicates that his sympathetic system was more highly activated and was influencing his behavior during this group activity.

Whereas individual personality traits and states and physiological predispositions can help conversation analysts anticipate the amount of certain types of conversational behavior, interpreting how participants perceive various contexts of talk requires detailed analysis of the context surrounding those behaviors. This can only be accomplished through discourse analysis of transcripts, facial expressions, gestures, and prosody. In this chapter I have shown how different tokens of the same type of conversational behavior yielded slightly different physiological responses, in terms of pre and post action means of heart rate and skin conductance. For example, in group 7, the first token of disagreement shows that not only did the person who disagreed with another have a pre-post HR mean increase, but also the person being disagreed with underwent the same change. In that example, participants had different opinions that did not change after discussing them. The disagreement also involved statements of personal preferences regarding the other sex, which would indeed very likely increase HR. In the second token of disagreement in group 7, the participant disagreed with ends up agreeing with the disagreer, who displays a small stress elevation with the increase in SC. The disagreeing action itself elicited elevated HR on the person doing the disagreement. The same was observed in group 26's example of disagreement, in which only the person who disagreed had an increase of HR. This fact might indicate that the act of disagreeing can potentially increase HR depending on the type of correction involved. It may also indicate whether or not the information is expected to be well known by the other co-participants.

In addition, based on the word searches produced by group 26, it can be observed that all participants displayed a decrease of heart rate, with a stable skin conductance. This seems to indicate that collaborative word searching is possibly a pro-social soothing activity that promotes the activation of the parasympathetic system. It is not face-threatening when collaboration is involved, and it is not perceived as an stressor, or we would have seen an increase of skin conductance. The same was observed in group 7's first example of a word search, and it would have been also observed in the second example if it weren't for the fact that the participant who had the floor and was performing the word search was about to deliver a highly emotionally charged piece of news (about which she was excited), so while the other participants aiding in the word search saw a decrease in HR, she had an increase of HR. This last example tells us how complex the study of conversational behaviors can be, trying to keep track of several possible underlying motivators, individual differences, and contexts that intercalate continuously.

Finally, the effects of silences on participants' physiological states were quite unpredictable in both groups. Given that the lengths of silence of all examples given were fairly ordinary (i.e., average lengths from 1 to 3 seconds are fairly common in ordinary conversation) the changes in HR and SC observed would have to be explained by individual characteristics and the sequential positioning of that silence. In group 26, the silence was at the end of a long sequence of negatively charged stories of violence that was carried out for over 5 minutes. At the end, silence was an indicator that all participants had had enough of those types of stories, and the next speaker marked that fact with the assessment "happy things". There was an unspoken urgent need to change the tone and the direction of this conversation, and the floor was open to all. For this silence, participants' HR and/or SC displayed some level of stress increase. However, in group 7's examples of silence, we observed that the silence came after requests for information, and the person requesting the information had a decrease of HR in one example, and an increase in another example, while the person who was asked to provide the information showed an increase in both cases.

This chapter demonstrates how to take into account all dimensions of expressions of affect and physiological regulation in order to study human interaction in regular conversation. A systematic methodology such as this one allows the conversational analyst to better understand what might be driving trends of conversational behaviors during social interactions not only in a micro 1-token scale, but also in a framing larger picture, which includes several instances of the same type of behavior. Nevertheless, I have demonstrated that analysis of individual contexts of those behaviors are crucial in order to explain variations in MHR, HF-HRV, SDNN-HRV across tasks, as well as variations in up and down regulation of pre-and-post behavior heart rate and skin conductance changes within samples of the same category of conversational behaviors.

Chapter 9: Summary and Conclusion

This dissertation had the goal of investigating psychophysiological mechanisms co-occurring with ordinary behaviors in conversation. Its main hypothesis was that certain interactional behaviors are partially guided by a feedback system embedded in the psychological and physiological characteristics of the individuals engaged in a conversation. In other words, this dissertation examined the role of the human autonomic nervous system in framing and informing social engagement behaviors. The overarching theory underlying this work was the interest in an expanded neurobiological perspective of embodied cognition and embodied talk during everyday social interactions. Having this research goal in mind, it was clear that the understanding and careful utilization of two research methods were required for this endeavor — the first being conversation analysis, and the second, psychophysiology.

First of all, the conversation analysis method is adequate to investigate sequential organization, adjacent pairs, superficial action-specific distributed cognition and intentionality, hierarchy statuses, epistemic stances, co-construction of meaning through conversational behaviors, distribution and utilization of shared knowledge, embedded gestures, pointing, facial expressions, and prosody, among other conversation related features. All of these sources of visual and aural data are available to researchers planning to study and better understand resources available during typical human interactions. However, these variables only account for information that is accessible visually and aurally. There are other variables that play a very important role in human interaction, but that are not captured in regular video-recorded interactions. But in order to get access to that kind of information, we need to make use of psychophysiological methodologies, making the nature of this kind of investigation transdisciplinary.

Methods in psychophysiology can provide information about participants' individual differences in personality traits and states, as well as physiological predispositions and behavioral tendencies. Both dimensions have a direct influence on individual behavior because during group conversations, individuals may react and respond to contextual cues and demands differently, based on particular traits of their individualities. Therefore, this information should not be taken for granted, and it should be utilized in studies of conversational analysis that aim at understanding differences in dynamics across populations for any given conversational behavior. Conversation analysts who are interested in the underlying motivators of certain behaviors going beyond the immediate context of talk in larger pools of data would need to make use of a transdisciplinary and quantitative approach that takes into account the subjects' psychological and physiological differences.

This dissertation has shown that there are some correlations between participants' psychological predispositions and their actual behaviors, which in this study were *turn-taking, silences, pauses, disagreements,* and *word searches.* These sources of additional data can help especially in the interpretation of group behaviors, since there is a more distributed responsibility to maintain the conversation, minimize overlaps, and avoid long silences. For example, it is very likely that a person with the highest score of communication apprehension or shyness in a group would hold the floor less than participants who have higher scores in anger and lower scores in communication apprehension for interpersonal conversation. Nevertheless, the freedom to contribute less in the maintenance of the floor, or to offer assistance when needed, is extremely reduced when the group consists of only two participants; but it grows exponentially when the number of participants in an interacting group increases, to a point in which some of the participants may choose not to contribute to a conversation at all.

How each of the targeted conversational behaviors correlated with psychological constructs and physiological readings is summarized below, along with conjectures about what these findings might mean. In order to understand how several variables comprising this dataset could inform this research, it was required that all data be compiled in one place, so that statistical analyses could be performed. Such statistical analyses included standardization of scores, normal distribution assumption checks, T-Tests Paired Distribution checks, and Single Pearson Correlations. The latter allowed the investigation of trends in conversational behaviors, as well as how they may operate and influence each other in the production of the outcomes explored. The first area of exploration was how the conversational behaviors correlated with each other, as a test to verify the validity and usefulness of this method of analysis. Then correlations between psychological scores and behaviors were tested, followed by correlations between the behaviors and participants' heart rate variability.

The first group of correlations investigated was the correlation across conversational behaviors. Some of the pre-selected target behaviors have higher chances of co-ocurring with each other than others. For example, the *length of floor held* per participant and the *number of turns taken* were moderately correlated with each other. This might be explained by the fact that participants who held the floor the most would also take more turns back. The *length of floor held* also correlated with *pauses* and *word searches*, while *number of turns taken* did not correlate with any other behavior. These observations may be explained by the fact that the longer one keeps the floor, the higher the chances there will be intra-turn *pauses* and *word searches*, while just taking consecutive turns may not provide enough time for other conversational behaviors to occur. Moreover, *word searches* strongly correlated with *pauses*, indicating that pauses and *word searches* frequently occur together. Finally, the *number of turns* and the *length of turns* showed positive moderate correlation with *disagreements*. This is understandable given that the higher the occurrences of ongoing turns, the higher the likelihood of occurrences of *disagreements* as well; and the same applies to the *length of turns*, because the longer the turns are, the greater the likelihood of *disagreements*.

The next group of correlations investigated was on the relationship between participants' psychological characteristics and conversational behaviors. In terms of what could be observed regarding the usefulness of psychological scales in the study of turn-taking behavior, it was pointed out here that certain psychological individual differences in personality traits and states were highly correlated with the conversational behaviors of *length of floor held*, *number of turns taken, silences, pauses, disagreements* and *word searches.* For example, the psychological constructs that most highly correlate with *length of floor held* were Communication Apprehension for Group Discussion (PRCA, negatively correlated), Depression (CES-D, positively correlated) and Communication Apprehension Interpersonal Conversation (PRCA, negatively correlated). On the other hand, the psychological construct that most highly correlated with *number of turns taken* was Behavioral Approach Drive (BAS). Given that this psychological construct represents variables that drive social behavior, it can be argued that participants with higher scores on this scale had the motivation necessary to keep engaged in the conversation and work toward its continuous maintenance. Inter-turn *silences* moderately correlated with the construct of Communication Apprehension for Group Discussion, which means that higher scores on this type of communication anxiety is connected to higher occurrences of *silences* during a conversation. *Silences* also showed a moderate negative correlation with Behavioral Approach for Fun Seeking (PRCA) and Loneliness. These personality traits might represent some of the driving forces that might potentially decrease the number of *silences* in a given conversation. This is because the higher the motivation to seek fun at a given conversational activity, the lower the number of *silences* will be utilized; and the higher the levels of loneliness participants may have, the lower the number of *silences*, which will lead to a higher amount of continuous talk. In addition, *silences* also showed a weak negative correlation with anger and a weak positive correlation with communication apprehension for meetings. Intra-turn *pauses*, on the other hand, correlated moderately with Depression, general Trait Anxiety (STAI), and Loneliness. It is possible that these three psychological traits might interfere with memory retrieval and thought processing, causing the speaker to pause his or her talk. *Pauses* also showed a weak negative correlation with Behavioral Approach for Fun Seeking and for Fun Reward Response, which might indicate that higher scores on these constructs might increase uninterrupted stream of speech. However, the observed weak negative correlation with Communication Apprehension for Interpersonal Conversation, and Social Interaction Anxiety (SIAS) might indicate that *pauses* are not caused by fear of communicating with other people, even if they are strangers. Behavioral Approach Drive (BAS) and Trait Anger (STAXI) showed moderate positive correlation with *disagreements*. The correlation with BAS might be related to the fact that disagreeing requires an outgoing personality with the motivation to approach others and to speak one's mind. The correlation with Trait Anger shows that this type of behavior requires willingness to undertake a potentially negative action. It suggests that the performance of *disagreement* could be related to some level of interactional aggression, which is not necessarily a negative characteristic. This is because if one is too afraid to generate a face-threatening situation even with the slightest opposing comment, one would never dare perform a *disagreement*, especially with people who are strangers, as was the case of the participants in this study. Additionally, *disagreements* showed a negative moderate correlation with two dimensions of Communication Apprehension, namely Interpersonal Conversation and Public Speaking, and also to Shyness, Social Interaction Anxiety (SIAS), and general trait Anxiety (STAI). This fact is interesting because these constructs seem to be ones that would indeed prevent *disagreements*. If one is too shy, anxious, and afraid of carrying out conversations and speaking out loud, one would also be less likely not only to speak at all, but specially to perform a *disagreement*. Finally, *disagreements* also showed a weak negative correlation to Behavioral Inhibition (BIS), negative affect (PANAS) and Communication Apprehension for (PRCA) Group Discussion and Meetings. This may indicate that if one is inhibited, afraid of communicating in group discussion or in group meetings, or if one has high scores of negative affect, it is very likely that this person will be less prone to displaying conversational behaviors, including *disagreements*, which apparently require a more extraverted approach (based on this behavior's higher correlation to behavioral approach drive). *Word searches* showed moderate negative correlation with trait Anger (STAXI), suggesting that because this conversational behavior involves taking a chance at a turn during the current speaker's turn, it requires the participant to have somewhat aggressive behavior. This is further supported by the fact that *word searches* correlate negatively with Social Interaction Anxiety (SIAS) scores, meaning that this type of anxiety paired with a lack of anger would lower the odds of a recipient taking the chance to help someone else with a *word search*, risking offering an inadequate candidate answer. This behavior, therefore, seems to involve some level of risk-taking.

The third dimension of correlational analyses was performed between HRV scores during the conversation task and the investigated conversational behaviors. In terms of how measures of heart rate variability (HRV) informed this research, the data displayed in this dissertation have shown that all of the observed behaviors displayed some degree of correlations to heart rate variability for the group task. For example, the *length of floor held* correlated moderately with LF-HRV and with LF/HF ratio; and the *number of turns taken* weakly correlated with both LH-HRV and HF-HRV, indicating that both sympathetic and parasympathetic systems were involved in the transitions of turns, but maintaining the floor increased levels of stress. This is because higher values of high frequency HRV have been shown to be associated with parasympathetic activation and pro-social behavior, while higher low frequencies have been shown to be associated with sympathetic activity. Therefore, low-frequency-high-frequency (LF/HF) ratio represents parasympathetic-sympathetic autonomic influences. *Silences* weakly negatively correlated with high frequency HRV. HF-HRV has been shown to be associated with pro-social behaviors; therefore, a negative correlation with this construct might indicate that silences might be perceived as a breakdown of an aspect of social behavior, more specifically the flow of a conversation. HF-HRV is thought to be representative of the parasympathetic system, so in this sense, this system is not strongly activated during *silences*. *Pauses* weakly negatively correlated with both high frequency HRV and low frequency HRV. This fact might indicate that pauses are not strongly influenced by any one system in isolation, that is, the sympathetic or the parasympathetic system. In fact, pauses showed a positive correlation with HF/LF-HRV, further indicating that both systems are in balance and equally influencing this conversational behavior. *Disagreements* had a moderate positive correlation with SDNN, RSSD, SD1, SD2, and low frequencies. This indicates that it is correlated with some level of elevated stress state. It also had a weak positive correlation with all dimensions of high frequencies (LF/HF, NP HF, RP HF, AP HF), and one low frequency (PF LF). While the low frequency shows some correlation to stress, the high frequency values show that participants must be more pro-social and pro-conversation in order to perform this conversational behavior. This fact has already been demonstrated by the psychological scores discussed in the previous paragraph, and it is now confirmed with these physiological markers. *Word searches* did not show any strong correlations with any of the physiological measures. It did, however, show a weak positive correlation to the standard deviation of interbeat intervals, low-high frequency ratio, and all low frequencies. This indicates that this conversational behavior might require the suppression of the parasympathetic system, and activation of the sympathetic system. Searching for a word might be perceived as a stressor in the conversation, possibly because it would not allow the continuation of the ongoing stream of talk.

All in all, the intention of adding another dimension of statistical analysis to this study besides that of Single Pearson Correlations was to explore the possibility of exploring participants' individual characteristics that could lead to a possible anticipation of conversational behavioral trends for those individuals. This type of information can be provided by regression analysis. In order to perform regression analysis on the conversational behaviors selected in the dissertation, each of the behaviors was set as a separate dependent variable. For each of the dependent variables, independently correlated variables were selected, normalized, and tested for assumptions in this statistical procedure. By identifying which variables were correlated with *length of floor held* and *number of turns taken* but that were independent and non-correlated to each other, it was possible to create a regression model that might allow conversation analysts to predict conversational behaviors, or at least predict how likely any given individual would be to produce a certain type of conversational behavior. Such a model ideally takes into account various dimensions of individual psychological and physiological differences in the relevant behavior. What was found here was that the *number of turns taken* did not hold significant enough correlations with any of the variables produced in this research in order to pass regression analysis assumption tests. However, the *length of floor held* did. Four variables were selected for this regression, namely: Pauses, Depression, Interpersonal Conversation, and LF-HRV collected during the conversation task. This means that provided a researcher has access to these data, how long a participant is likely to hold the floor can be anticipated. As with the analysis of turns and floor, here, by identifying which variables were correlated with *silences* and *pauses* but that were independent and non-correlated to each other, it was possible to create a regression model that will allow conversation analysts to predict conversational behaviors, or at least predict how likely any given individual would be to produce a certain type of conversational behavior. Such a model ideally takes into account various dimensions of individual psychological and physiological differences in the relevant behavior. What was found here was that *silences* did not hold significant enough correlations with any of the variables produced in this research in order to pass regression analysis assumption tests. However, the *pauses* did. Two variables were selected for this regression, namely: word searches or number of turns, and depression. Because the number of turns and word searches are correlated, only one of them could be used in the regression. Provided a researcher has access to these data, how long a participant is likely to produce intra-turn pauses can be anticipated.

In sum, whereas individual characteristics in personality traits and states and physiological predispositions can help conversation analysts anticipate the amount of certain types of conversational behavior, interpreting how participants perceive various contexts of talk requires detailed analysis of the context surrounding those behaviors. This can only be accomplished through discourse analysis of transcripts, facial expressions, gestures, and prosody. In this dissertation I have shown how different tokens of the same type of conversational behavior yielded slightly different physiological responses, in terms of pre and post action means of heart rate and skin conductance. For example, the first token of *disagreement* shows that not only did the person who disagreed with another have a pre-post HR mean increase, but also the person being disagreed with underwent the same change. In that example, participants had different opinions that did not change after discussing what those were. The *disagreement* also involved statements of personal preferences regarding the other sex, which will indeed very likely increase HR. In the second token of *disagreement*, the participant disagreed with ends up agreeing with the disagreer, who displays a small stress elevation with the increase in SC. The disagreeing action itself elicited elevated HR on the person doing the *disagreement*. This might indicate that the act of disagreeing can potentially increase HR depending on the type of correction involved, and how the type of information is expected to be well known or not, and received by the speakers.

This dissertation demonstrated how to take into account all dimensions of expressions of affect and physiological regulation in order to study human interaction in regular conversation. A systematic methodology such as this one allows the conversational analyst to better understand what might be driving trends of conversational behaviors during social interactions not only in a micro 1-token scale, but also in a framing larger picture, which includes several instances of the same type of behavior. Nevertheless, I have demonstrated that analysis of individual contexts of those behaviors are crucial in order to explain variations in MHR, HF-HRV, SDNN-HRV across tasks, as well as variations in up and down regulation of pre-and-post behavior heart rate and skin conductance changes within samples of the same category of conversational behaviors.

Limitations

There were a number of limitations and challenges in this project. The research was exploratory in nature, and although I had sought advice from specialists in both fields and had some idea of where to start, many adjustments to procedures were made along the way. Finding a systematic methodology to bridge conversation analysis to psychophysiology seemed like a straight forward notion at first, but presented an overwhelming challenge when trying to explore the data, or display it in an orderly manner. Needless to say, a researcher intending to do this kind of transdisciplinary work needs to make sure to seek serious training and possibly cross-transdisciplinary collaboration beforehand, in order to not only be able to set up the experiment correctly, but also to interpret the data appropriately, in order to yield statistically sound and qualitatively meaningful results.

One of the limitations of this study was the decision to invite only people who did not know each other. Ideally, the groups would be comprised of people who knew each other, since this type of group formation is more common than group conversation among people who do not know each other. Another ideal scenario was to have half the sample of groups with strangers, and the other half of the groups comprised of friends. However, given the limited time to find participants and to group them as quickly as possible, it was decided that it would be easier to seek out participants across the university campus, and them randomly group them. The chances of them knowing each other were very small, and in fact, it never happened. Another limitation concerning the grouping of these participants also had to do with the strict nature of their very busy schedules, making it a challenge to find three people with overlapping free time. This problem generated another limitation, which was the composition of these groups in terms of gender. Ideally, there would be an equal number of groups of each possible combination of female and male participants (all females, all males, 1 female with 2 males, and 1 males with 2 females).

A final serious limitation in this project was the lack of a health survey given with the initial demographics survey. The Health Survey SF-36 has scales that could have collected information about participants' physical functioning, bodily pain, general health, vitality, social functioning, and emotional and mental health. When the lack of this type of information was detected, the survey was sent to all participants through a confidential online survey platform, but not all participants filled it out, given that they had already been paid, and their participation was no longer mandatory.

All in all, these limitations will certainly be addressed in future research projects. However, the current study still presents an important contribution not only to the study of talk-in-interaction, but as a model to study how relevant brain-viscera communication is for social behavior and general maintenance of conversation.

Recommendations for Future Research

Several possible directions could be taken from here. As an applied linguist thinking of much needed future research, it is hard not to immediately consider implications for second language users. It is possible that success in language acquisition is related to the same psychological and physiological traits discussed in this dissertation, and differences in HRV recordings between resting and speaking tasks may be higher than for those for first language speakers. The amplitude of this difference is very likely to be related to rate of development and ultimate proficiency in a second language. Tenets in second language acquisition theory, such as "affective filter" or "willingness to communicate" can be studied empirically with the aid of a psychophysiological approach. All one would need to do is set up second language speakers with electrodermal activity and heart rate recorders, and video-recorded classroom interaction, or look for other venues in which users would make use of the second language through a more naturalistic and interactional approach.

Other areas that need additional investigation are gender differences, cultural differences, and health correlations. First, there might be important differences in behavior between first language and second language speakers regarding gender, and the current dataset might be able to provide this information, given that it contains all four possible gender distributions. But in order for results to be statistically significant, more data would need to be collected containing all females and all males. Next, any of the findings discussed in this dissertation relate to native speakers of American English, of people who live in Los Angeles, who attend UCLA, and within roughly the same age group. It is possible that when any of these variables change that findings would be qualitatively different. Therefore, in order to verify how universal these findings are, they would need to be compared to data collected from each of these different culture-specific backgrounds. Finally, levels of fitness, weight, sleep patterns, eating habits, among other variables, might also create some variability and be the cause of lower correlations among behaviors, psychological scales, and physiological traits; therefore, it needs to be investigated.

Finally, there is a number of additional behaviors that could be further investigated in future publications concerning this dataset. For example, given that the group formation consists of three participants, it would be interesting to look at what happens when a person tries to get the floor and is unsuccessful. It would be interesting to look at what physiological changes that would correlate with, along with what psychological scores correlate with rates of success in taking the floor. Another interesting area of investigation is to look at what the psychophysiological scores are for a person who decides to not participate in the conversation. Video-coders can be used to label participants who are less active in the conversation in terms of body language and amount of talk, while their psychophysiological scores are correlated with their perceived behavior. Another area for future investigation is to try to better understand the unfolding cognition that takes place during the conversations in this dataset. In order to accomplish that, the percentage of word searches could be used to describe the manner in which talk is produced, how helpers in a word search are attuned to the other co-participants' minds, and how they resolve and collectively celebrate the finding of a word. In addition, it would be interesting to see if seating arrangements during the conversation tasks correlated with the co-participants' attention, or if it more strongly correlates with participants' psychophysiological scores. Lastly, another interesting study would involve getting video-coders to decide who the focus of attention is, and who the outliers are, based on a limited number of framegrabs of each group, and then compare these codes to the actual number of turns taken and amount floor held per participant. Additionally, it could be determined whether coders were successful in identifying who the most and least engaged co-participants are.

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