Feedback Delay Effects in Video Monitor Communication

Abstract

Rhythms have long been recognized as playing a role in physiological function. Nonverbal communication researchers have studied the role of rhythm in organizing social interactions. Communicators use language cues to coordinate their utterances but also perceive nonverbal cues in order to synchronize their behaviors. When engaged in interaction people will synchronize and eventually enter similar cycles. Research into synchronicity of behavior has presented mixed and often contradictory results with some researchers arguing that synchronization occurs with intense negative interactions while others argue that it happens when teams are achieving great performance. Based on cybernetic theory, recent approaches to the theme have defended that synchronicity is a necessary property for good interactions and that its valence is defined only by its content. Thus, the more cooperation that an interaction requires, the more synchronicity it needs, and communicators will try to automatically provide that. This laboratory study tested if disruption in synchronicity through the manipulation of feedback delay would disrupt communication and affects perceptions of social presence. Dyads (N = 17) interact in two conditions, one with delay and one with another. Results showed that social attraction was affected by feedback delay but no effects were found for communication satisfaction or involvement. Delay manipulation also did not affect social presence, but a continuous measure of perceived synchronicity was able to predict social presence. These results provide some evidence that feedback delay may affect communication variables but further work is needed to clarify the strength and mechanisms of this influence.

Introduction

Rhythm has long been recognized as playing a role in physiological function. Nonverbal communication researchers have studied the role of rhythm in organizing social interactions. Within a person's body, as well as within a dyad or group, there are several "waves" of rhythms occurring on different levels and within different time periods (Condon, 1967); it is through the coordination of these rhythms that synchrony occurs.

Synchrony is so natural that we do not notice it until something goes noticeably "out of sync" or unusually "in sync" (Bernieri, 1988). This is true when we use audio and video channels via Internet or satellite. As new communication technology becomes more and more affordable, web cameras and video conferencing are becoming common. There are often delays in communication signals, which, when pronounced, can cause frustration and stress for all members of an interaction. The rhythm of conversation is disrupted, as are rhythms within the bodies of the participants and the course of their conversation. Conversely, when communication is synchronous and there is a feeling of "being there," participants can experience positive emotions and rapport. This has implications for personal relationships, as well as teacher-student relationships, business meetings, and a variety of other situations where people need to be able to send and receive emotional expression through technology-mediated channels.

This experiment used a video-based communication environment as a medium for controlling feedback delay and therefore disrupting the rhythm of both verbal and nonverbal communication. This paper discusses changes in self-reports of communication outcomes and emotion.

Behavioral and Psychophysiological Synchrony

In this paper we use the term synchrony to describe a variety of rhythmic or coordinated behaviors. In 1970, Adam Kendon proposed that speakers are also attentive to what their listeners are doing. Based on their behavior, tumbling the fingers, looking around, the speaker can infer that the other is bored and produce change in his own behavior to counteract that. But the argument is that while many times such impression is conscious, the norm is for it to be going on constantly and automatically. The speaker may have a feeling of "no rapport" (p. 119), or uneasiness that is much more emotional than cognitive.

Researchers have been trying to determine the causes and compositions of those subtle features in behavior for several decades now. In original studies, they linked vocal synchrony to body movement (Condon & Ogston, 1967; Kendon, 1970). Since then, synchrony has been conceptually linked to interaction rhythms, simultaneous movement, and behavioral meshing (Bernieri, Reznick, & Rosenthal, 1988). Burgoon et al. (1995) offers a helpful overview of the evolution of this concept. More recently, VanLear (1999) has identified trough Fourier analysis several frequency cycles that occur simultaneous in patterns in the communication of openness. This result further suggests that different communication processes follow different physiological and behavioral oscillators.

Functions and Effects of Synchrony and Dissynchrony

It is generally agreed that synchrony is innate or biological. We have circadian rhythms that regulate body functioning. Biologists refer to this as an undetermined number of "oscillators" that are loosely organized or sometimes coupled. Following this concept, it is suggested that we coordinate our body movements to our speech movements (Hatfield et al, 1992). This is called intra-personal synchrony. However, synchrony also serves an inter-personal function: we may coordinate our speech and body movements with those of others.

Although individuals prefer different interaction tempos at different periods, they often coordinate their rhythms and movements with their conversational partner (Bernieri, 1988; Kendon, 1970). This is thought to be an unconscious process based on physiological systems (Schmidt & O'Brien, 1997). It is, however, thought to be observable by judges (Bernieri, Reznick, & Rosenthal, 1988)

Synchrony

Studies present differing accounts of the effect of rhythm and synchrony on emotion. Kendon (1970) suggested that synchrony communicates interest and approval. Bernieri and colleagues (1988) found, in a study of mother-infant coordinated behavior, that movement synchrony was significantly related to a child's positive affect: the happier the child, the greater the synchrony. (Interestingly, however, there was no significant relationship found between the mothers' expression of emotion and movement synchrony.) Tickle-Degnen and Rosenthal (1990) find a positive correlation between rapport and coordinated movement; and LaFrance also finds a positive connection between rapport and posture sharing (1979). Synchrony, as it relates to primitive emotional contagion, may also serve a regulatory function that allows people to track others' feelings from moment to moment (Hatfield et al, 1992). All of these conceptualizations indicate that increased synchrony covaries with increased positive emotions.

Some authors have proposed that synchrony is more closely associated with negative emotions. Levenson and Gottman (1983) hypothesized that distressed couples would show more physiological linkage and negative affect than non-distressed couples, and that this effect would be more pronounced when conflict was high. Although their hypothesis was strongly supported by their research, Warner et al. (1987) take a middle ground, stating " Up

to a certain point, increases in rhythmicity or patterning may be associated with increases in positive affect; beyond that point, further increases in predictability may make the interaction too predictable or inflexible to be enjoyable" (p.62). Henning, Boucsein and Gil (2001) ananlyzed team performance and psychophysiological measures and concluded that greater synchrony is a predictor of better team performance. The authors critique the results from Levenson and Gottman (1983) and offer the hypothesis that greater synchronicity is a measure of greater coupling and more effective interaction – married couples in distress would be undergoing deeper and more intense relational interactions than normal couples.

Dissynchrony

The study of dissynchrony, in contrast, consistently associates it with negative emotion. Hatfield et. al (1992) suggest that it may be disruptive to social exchanges, and foster miscommunication and conflict (p. 157). Without coordination, we may feel mildly stressed or unpleasant. Bolstering the argument for the biological model, lack of synchrony is found in mothers with unrelated infants (Bernieri, 1988), depressed people, dyslexics and schizophrenics (Condon & Ogston, 1966). Burgoon and colleagues (1995) note studies where cultural differences between groups contributed to dissynchrony. There may also be a social function to dissynchrony: it may be a way for an infant to communicate "stop" to its mother by turning its head (Tronick, Als & Brazelton, 1977).

Social Cybernetic Theory

The social cybernetic theory can give an explanation for those results. Human behavior is based on cybernetic principles of feedback control (Smith & Smith, 1987). Whenever interaction between two or more people occurs, there is reciprocal control based on feedback. The more coordination, or involvement, present or necessary in the interaction,

more and precise feedback is needed. To obtain greater feedback interactants would be more coupled as a system and therefore more synchronized. Cybernetic theory is a systems theory and proposes that is behavior is synchronous, so would be all other processes in the system, from emotional, cognitive and physiological.

Based on the above discussion that feedback delays will affect synchronization and that in turn will have detrimental effect on communication, we hypothesize that:

H1: People will report less communication satisfaction when there is feedback delay in the communication than when there is no delay.

H2: People will report less involvement when there is feedback delay in the communication than when there is no delay.

H3: People will report less social attraction when there is feedback delay in the communication process than when there is no delay.

Presence

The concept of Social Presence has been investigated by several researchers in computer mediated communication (Nowak & Biocca, in press; Schroeder, 2002; Lombard et al., 2000) and it refers to how much two people interacting through a technological media feel as if they were together. The concept has been originally defined as "the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationship" (Short, Williams & Christie, 1976, p. 65). Although this definition is not clear and seems to imply the use of salience as traditionally defined in psychology, salience here is only that part of the information that is presented by the media. The authors clearly state that social presence is "a property of the medium" (p.65). The research on presence follows the technological deterministic approach of information richness theory

whereas the amount of cues that can be transmitted by the medium defines the interaction (Daft & Lengel, 1984).

Again following the cybernetic theory argument, we propose that it is not the amount of information or cues transmitted by the media but the feedback provided by it that will define presence. More specifically, given a certain interaction goal, the amount of appropriate *feedback* that the medium provides to attain that goal will define the perception of Presence That is, the more synchronized with the remote environment the more presence will be reported. Based on that we hypothesize that:

H4: Given the same amount of cues, participants will report less social presence if feedback delay is present in the communication than if there is no delay.

H5: Participants that perceive the system as being more synchronous will also have higher levels of social presence.

Often, studies of synchronicity try to locate indications of cycles in the data collected. In this study we assume that communication processes are already based on synchronicity and our aim is to detect the effects of changes in that. Rather than measure any particular aspect of nonverbal synchrony this study made use of an experimental design to manipulate the amount of feedback on the communication between two people and how that impact our dependent variables.

Methodology

A within subjects experiment was conducted with one factor: amount of feedback delay. Participants interacted through video monitors in both the control condition where no delay was present or in the delay condition where a 1 second delay was introduced in their signal.

Participants

Seventeen dyads (10 female-female, 5 male-female, 2 male-male) participated in this study. The mean age was 19.9 years (SD = 2.3). Participants were drawn from introductory level undergraduate communication courses of a large public northeastern American university, and received extra credit for their participation. Their level of previous familiarity with their partner ranged from zero-acquaintanceship to romantic partners.

Stimulus Material

Topics. Participants were asked to discuss 2 topics: the "Reality TV Show" and "World Trip". In the first topic, participants were instructed to discuss how a reality TV show where the participants would be students from the university. The second topic involved the planning of a trip around the world. The topics were chosen so that they would induce discussion for the whole interaction period (10 minutes) but such that no strong opinions were involved, such as political affiliation or religion. The topic choice turned out to be successful as all but 1 dyad did not discuss for the whole period. Topics were balanced to control for topic order effects.

Video Monitor Setup. Participants interact through a video monitor system. Two rooms were equipped with video cameras and large TVs. Signal from each camera would run through a delay unit and to the other room's TV. The cameras were setup on top of the TV to allow the participants to see each other while looking at the screen. While all effort was made reduce parallax effect, participants did not have perfect gaze contact. In the open questions asked about the experiment only one of the participants commented about this effect.

Delay. The delay was manipulated through the delay units. When powered on, the delay units have a default setting of 1 second. Manipulation condition was changed during the experiment by powering on and off the unit. Delay conditions were balanced to control for order effects.

Measurements

All communication perception measurements were based on Likert type items with 7-point scales ranging from strongly agree to strongly disagree.

Communication satisfaction. This variable was assessed using a 10-item subset of the Conversational Effectiveness Scale (Canary & Spitzberg, 1987). Items included "The other person let me know that I was communicating effectively", "I was very satisfied with the conversation", "I did not enjoy the conversation", and "I would like to have another conversation like this one". These items achieved a unidimensional inter-item alpha reliability of .85.

Involvement. This variable was assessed using a 4-item subset of the immediacy dimension of Burgoon and Hale (1987). Items were revised to reflect the participant's self reported involvement in the interaction and included "I was interested in talking to my partner", and "I found the interaction stimulating". These items achieved a unidimensional inter-item alpha reliability of .88.

Social presence. The measurement of social presence, or the perceived ability of the medium to provide social presence, consisted of 8 items from Short, Williams and Christie (1976). It included questions about how real the person at the other end seemed, whether or not the medium provided a sense of realism, and whether or not one felt they could get to

know a person they encountered only through the medium in question. These items achieved a unidimensional inter-item alpha reliability of .82.

Social Attraction. This variable was assessed using a 7-item subset of the social attraction dimension of the Interpersonal Attraction Scale (McCroskey & McCain, 1974). Items included "I think he/she could be a friend of mine" and "I would like to meet this person". These items achieved a unidimensional inter-item alpha reliability of .89.

Synchronicity. We measured the perceived synchronicity of the system (the lack of delay) using a 5 item scale developed by the authors. The items include items such as "The system was responsive to my actions", "When using the system I felt like I was in control" and "There was no delay in the system". These items achieved a unidimensional inter-item alpha reliability of .80.

Procedure

Dyads arrived and were asked for consent to participate in the experiment. Once consent was given, each participant was led to adjacent sound-proofed rooms. Each room contained a large video monitor with a camera mounted on top as described early. Participants sat in chairs facing the video monitor/cameras so that they were visible to each other from the chest up. Each wore headphones and a microphone to communicate to each other. In the room, participants received booklets with instructions, topics and surveys. They were instructed not to read and stop when directed in the booklet and only flip ahead or discuss ahead until signaled (an audio signal was used to minimize experimenter interference and possible research demands effects). Also, participants were asked to flip over their clipboards while talking, so as to avoid excessive downward gazing. Researchers monitored the rooms via video monitor and did not interrupt the participants unless there was a

technical difficulty with the microphones or sensors. All instructions in the booklet were also given by a proctor verbally.

Participants were instructed to talk on the first topic for ten minutes, then fill out surveys, then talk about the second topic for another ten minutes, then complete the remaining survey. Both survey were identical and included all scales but the synchronicity scale since that could provide clues to the participants about the objectives of the experiment. This assessment was only done after the last survey along with demographic information. Sessions were videotaped for future use so at the end of the process participants were asked to sign video image release consent forms and given debriefing letters.

Following the interaction participants were asked to complete a post-test questionnaire with a set of measures relating to their impressions of their partners, the interaction and the system used.

Results

The following hypotheses were tested using GLM Repeated-Measures analysis.

H1: People will report less communication satisfaction when there is feedback delay in the communication than when there is no delay.

This hypothesis was not supported ($F(1,32) = .22$, $p=.64$). There were no differences between the participants that interacted without a delay ($M = 5.41$, $SD= .93$) and those who interacted with a delay ($M = 5.35$, $SD = 1.02$).

H2: People will report less involvement when there is feedback delay in the communication than when there is no delay.

This hypothesis was not supported ($F(1,32) = 3.02$, $p = .09$). Again, there were no differences in the reported involvement between participants that interacted without a delay ($M = 5.05$, $SD = 1.41$) and those who interacted with a delay ($M = 4.74$, $SD = 1.34$).

H3: People will report less social attraction when there is feedback delay in the communication process than when there is no delay.

This hypothesis was supported ($F(1,31)=7.16$, $p=.01$). The participants who interacted without a delay were more socially attracted to their partners ($M = 5.66$, $SD = 1.11$) than the participants who interacted with a delay ($M = 5.44$, $SD = 1.30$).

H4: Given the same amount of cues, participants will report less social presence if feedback delay is present in the communication than if there is no delay.

This hypothesis was not supported ($F(1,33) = 1.33$, $p = .26$). There were no differences in social presence for the participants that interacted without a delay ($M = 4.92$, $SD = .98$) compared to those who interacted with a delay ($M = 4.75$, $SD=1.18$).

H5: Participants that perceive the system as being more synchronous will also have higher levels of social presence.

To test this hypothesis we ran a linear regression on social presence with synchronicity as a predictor. Because synchronicity was assessed only at the end of the session, the social presence score used in the regression was the one reported also in the second survey. The hypothesis was supported with a moderate effect ($\beta = .42$, $R=.42$, $p = .01$). This result shows that if a participant felt the system was more synchronized, it will also have a greater feeling of presence.

Post-hoc t-test analysis showed that there was no difference between the reports of synchronicity due to delay manipulation ($t(32)=.64$, $p=.53$). The participants who had their last topic discussion without delay just before reporting synchrony ($M = 4.35$, $SD = 1.36$) did not report statistically significant different synchronicity than those who had their last topic discussion with delay ($M = 4.63$, $SD = 1.23$).

Discussion

The above results do not provide enough information to make a conclusive statement about the influence of feedback delay and as a consequence synchrony in communication. Only social attraction was reduced by the one second delay. Communication satisfaction and involvement had no statistically significant differences. It should be noted though that all means were in the right direction. Even the post-hoc analysis of the manipulation affecting synchronicity also had the means in the right direction, although, as the previous variables, not statistically significant.

The results on social presence on the other hand bring new insight to this construct. Similar to the previously discussed variables, the delay manipulation did not have a statistically significant effect on social presence although the means were also in the right direction. Yet, the fact that the perception of synchrony was able to predict social presence is contrary to the original definition of social presence as a property of the medium – user's perceptions of the same medium influenced their feelings of social presence. This indicates that lower processes such as the perceptions of synchrony and feedback may be used to generate higher processes concepts of social presence.

Two explanations can be made to explain the lack of stronger results based on limitations of the experiment setup. First, the manipulation of the experiment may have been too modest. The choice of 1 second of delay was, in fact, a design option so that the delay

would be imperceptible to the participants. It may be, however, that the delay must be at the perceptual level to have a greater effect on the interaction. Another explanation for no effects found, and that is related to the size of the manipulation, is that effect sized may be small and we did not have enough power to detect them. The small sample size used in the experiment may not be sufficient to capture the subtle changes in the interaction caused by imperceptible delays. The fact that all means, including the social presence means were in the right direction is encouraging and future work should further inspect the hypothesis with a larger sample size and/or delay.

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