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CHRONEMIC ASPECTS OF CHAT, AND THEIR RELATIONSHIP TO TRUST IN A VIRTUAL TEAM

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Abstract

How does user personality impact pauses in online synchronous chat, and how do these pauses correlate with the development of trust in online teams? An analysis of hundreds of short chat sessions which took place between 62 pairs of participants in the DayTrader social dilemma game reveals a link between chronemic (time-related) variables and personality traits. The three chronemic variables that were analyzed, interpost pause, switching pause, and personal rhythm, were shorter in players who rated higher on extraversion, and longer in players who rated higher on agreeableness. The relationship between extraversion and shorter pauses is comparable to similar findings in spoken communication, while the relationship with agreeableness is novel. Furthermore, an analysis of the relationships between the three chronemic variables and the establishment of trust in the virtual teams confirms the hypothesis that longer pauses are associated with decreased trust. Three non mutually exclusive explanations are offered for this association: 1) longer pauses cause the decrease in trust; 2) longer pauses are the result of increased cognitive load associated with deception creation; and, 3) longer pauses are the result of increased efforts related to the suspicion that deception is taking place.

Keywords: chronemics, trust, virtual team

1 INTRODUCTION

1.1 Chronemic aspects of conversation

Conversations are rhythmic in nature, and conversational rhythm is determined by the timing of the participants' exchanges (Jaffe & Feldstein, 1970). Timing is an important aspect of communication, and the study of chronemics examines the role of time and of timing cues in communication.

The importance of chronemics in Computer-Mediated Communication (CMC) has been demonstrated mainly in the context of asynchronous communication (Reviewed in Walther, 2002). One of the chronemic aspects of online communication that received significant attention is online responsiveness. Responsiveness is an important aspect of communication, and delayed responses often lead to negative consequences (McLaughlin & Cody, 1982). Responsiveness is also an important aspect of customer service, and information systems should support an organization's responsiveness – its ability to respond to customer needs, and to respond promptly (Jiang, Klein, & Carr, 2002).

Responsiveness in online communication has been studied in depth. One line of research has focused on the myriad factors that impact responsiveness. Scholars have examined variables related to the *message*, such as specific rhetorical strategies employed or the number of recipients the message was sent to (Burke, Joyce, Kim, Anand, & Kraut, 2007; Yechiam & Barron, 2003), variables related to the *sender*, such as having a work relationship with the sender (Dabbish, Kraut, Fussell, & Kiesler, 2005), and variables related to the *recipient*, such as their desktop activity at the time the message arrived (Avrahami & Hudson, 2006).

Other researchers studied the relational consequences of long and short response latencies, as well as of unresponsiveness (online silence) (Kalman & Rafaeli, in press; Sheldon, Thomas-Hunt, & Proell, 2006; Walther & Tidwell, 1995). They showed that the impact of shortened or elongated response latencies is complex, and that response latencies interact with other variables such as the reward valence of the sender, and the expectations of the recipient. These recipient expectations can be inferred from a third line of research which focused on identifying the chronemic norms of responsiveness, through a study of the distributions of response latencies in both asynchronous (Kalman, Ravid, Raban, & Rafaeli, 2006) and synchronous (Avrahami & Hudson, 2006) communication. These studies show that the distribution of response latencies in online communication is very similar to that distribution in traditional spoken conversation: it is highly skewed in favor of short response latencies, and long response latencies are rare.

Research on chronemics in CMC has tended to focus on chronemics as the independent variable. The initial goal of this study was to explore chronemics as a dependent variable in online interaction. In other words, the question was what might influence the chronemics of an online exchange? We begin to answer this question by exploring the impact of one of the most fundamental characteristics of the user, which is user personality. User personality, as measured through the Big Five personality traits (openness, conscientiousness, extroversion, agreeableness, and neuroticism), is relatively stable over adulthood, and influences major aspects of one's life course (Soldz & Vaillant, 1999). Some research on the link between personality and chronemic aspects of spoken conversation has been carried out in the past (Scherer & Scherer, 1981). For instance, studies have demonstrated that extraverts have shorter response latencies in face-to-face communication. This body of research has faced the challenge of measuring chronemic variables such as pauses and tempo in spoken conversation. However, CMC offers a new opportunity to collect detailed chronemic information on online conversations. The fact that many online conversations include detailed timestamps alleviate some of the technical challenges faced by those who study spoken conversation, and thus we looked for a dataset of online conversations between participants whose personality traits (and other demographic variables) were known.

The dataset chosen for the current analysis was created as a part of a study of the impact of linguistic similarity on interpersonal trust in online teams (Scissors, Gill, Geraghty, & Gergle, 2009). In that study, 62 pairs of participants played a social dilemma investment game and periodically

communicated via text-chat. Unlike typical chat datasets, where disrupted adjacency, overlapping exchanges and topic decay make it difficult to track turn-taking and progression (Herring, 1999), this dataset was attractive for the purpose of exploring online chronemics since it included a very large number of precisely time-stamped exchanges and since the exchanges were created with one specific goal in mind, and took place primarily between only two people. In addition, the carefully controlled experiment included information about participant demographics, as well as their personality profile measured by the Big Five model (Goldberg, 1993), though personality was not included in the analyses reported in the original study. This dataset allowed us to study the hypothesis that chronemic variables of online conversation were influenced by user personality.

1.2 Trust in online teams

The fact that the dataset we selected also included information about trust development in the teams, opened up the opportunity not only to explore the impact of personality on the chronemic dependent variables that constitute the rhythm of the conversation, but also to further our understanding of chronemics as an independent variable that impacts trust in online teams. Trust is an important component in online interactions. It is complex (Gefen, 2002) and multifaceted. Although early studies of online communication emphasized the difficulty of achieving trust in online interactions, later studies have shown that trust can develop even in media which were considered poor in social and interpersonal cues (Walther & Parks, 2002; Wilson, Straus, & McEvily, 2006). Ridings et al. (2002) define trust as “an implicit set of beliefs that the other party will refrain from opportunistic behavior and will not take advantage of the situation”, and explain that in online environments, where rules do not provide sufficient guarantees that others will behave as they are expected to, “trust serves as a subjective substitute to such rules, creating the necessary atmosphere that makes engagement with others more open” (p. 275). In our study we were able to explore the relationship between chronemics and trust in an anonymous team. We are not aware of other studies that have explored this relationship, though several studies peripherally touch on this topic. The above mentioned Ridings et al. (2002) paper surveyed members of bulletin board based online communities, and found that perceived responsiveness of team members was positively correlated with trust in the team members. Additionally, in a study of responsiveness to e-mail messages, Kalman and Rafaeli (in press) also found that unusually long response latencies as well as unresponsiveness (online silence) can violate expectations, and that these violations can negatively impact the perception of the unresponsive partner who will be perceived as less credible and less receptive/trustworthy. Given these findings, we hypothesize that longer pauses will be associated with decreased trust in an online team.

In conclusion, the two hypotheses of this study are:

H1: User personality influences the chronemics of online chat conversation.

H2: Longer pauses are associated with decreased trust in online teams.

2 METHOD

2.1 Participants

Participants ($N = 124$, 53% female) were students and staff at a mid-sized university in the Midwest region of the United States of America. Participants completed the study in pairs, were assigned randomly to these pairs, and did not meet prior to or after the study's completion. Participants were all native speakers of English and the average age of participants was 20.4 years.

2.2 Procedure

Sixty-two pairs of participants played a social dilemma investment game called DayTrader (originally developed by Bos, Olson, Gergle, Olson, & Wright, 2002). The players were able to communicate only via text-chat, only five times during the game, for up to five minutes each time. Each chat session was preceded by five rounds of investment, where the maximum group earnings per round was 360

tokens. The game was structured so as to reward the maintenance of trust within the team with high financial earnings for the team (both investors), as well as to tempt each member of the team to increase their individual earnings by betraying the trust of their partner and not sticking to the agreement they reached in their chat-sessions. Accordingly, the quantitative measure of trust which is commonly used in this experiment is the average amount of earnings the team achieved in the five investment rounds which follow each chat session (Rocco, 1998). Higher average group earnings are indicative of increased trust, while reduced group earnings are evidence of decreased trust within the team. Idle sessions of more than 60 seconds were flagged by the system which prompted them to either resume the game or continue the conversation. The IM sessions were time-stamped and recorded. The two players were able to refer questions to a "regulator" who followed the chat session and answered game related questions in the chat window.¹ Prior to playing the DayTrader game, participants filled a survey measuring the Big Five personality traits and reported on other demographic variables including age and gender.

2.3 Variables

<i>Chronemic Variables</i>	
Interpost pause	INT
Switching pause	SWT
Personal rhythm	PRT
<i>Personality Variables</i>	
Openness	OPN
Conscientiousness	CON
Extraversion	EXT
Agreeableness	AGR
Neuroticism	NUR

Table 1. Codes for variables used in the study.

Below is a list of the variables that were used in the study (see Table 1):

- Chronemic variables: Three chronemic variables were used to describe the rhythm of the conversation. All chronemic variables were measured, in seconds, within each of the five chat rounds, but not between the chat rounds. The natural log of the pause was used. The timing of each posting is measured at the moment it is posted.
 - Interpost pause (INT): for each posting made by each of the two players, the INT is the pause between that posting and the previous posting made in the forum by any of the participants (including by the regulator). INT represents the rhythm of the conversation, from the point of view of each of the two members of the team.
 - Switching pause (SWT): when a posting by one player was immediately followed by a posting by the second player (and not by a posting by the regulator or by the same player), the time between these postings is the switching pause. This measure serves as proxy for the time between turns (Avrahami & Hudson, 2006). Note that SWT is a subset of INT.
 - Personal rhythm (PRT): for each posting made by each of the two players, the PRT is the pause between that posting and the previous posting made in the forum by the same player.

¹ For further details, see Scissors et al., 2009.

- Big 5 personality traits: Openness (OPN), Conscientiousness (CON), Extroversion (EXT), Agreeableness (AGR), and Neuroticism (NUR).
- Trust: as described in section 2.2 above, the measure of trust was the average amount of earnings the team achieved in the five investment rounds which follow each chat session (Rocco, 1998).
- Demographic variables: Age and gender. The demographic variables were used as control variables.
- Message length, measured in total number of characters and spaces (LNG). Since longer messages take, on average, a longer time to type, LNG too was used as a control variable.

2.3 Analysis

After converting the chronemic variables to a natural logarithmic scale, to compensate for the highly skewed distributions, correlations between all variables were calculated. Since the participants played several rounds of the game, within-group correlation was present in the data. To account for the correlation, participants were modeled as a random effect (Rogers, 1993).

The correlation analysis did not reveal any statistically significant strong correlations that inform the hypotheses (i.e. between any single chronemic variable and any single personality variable or trust), and was thus followed by search for significant higher order interactions. The first multivariate regression analysis explored the three chronemic variables as dependent variables, with the demographic and personality variables as independent variables. Since longer messages take longer to type, the number of characters (LNG) was included as one of the control variables. The second multivariate regression analysis explored trust as the dependent variable, in relation to chronemics and to the other variables².

3 RESULTS

3.1 Correlations amongst variables

A correlation matrix of all variables revealed many statistically significant correlations. Only correlations above an absolute value of 0.4 were examined, and were later analyzed separately to avoid collinearity in the regression analysis: INT and SWT were fully correlated (since SWT is a subset of INT); INT and PRT were highly correlated ($r=0.67$), as well as PRT and SWT ($r=0.62$). All other correlations were below an absolute value of 0.4.

3.2 Distribution of chronemic variables

The three chronemic variables showed the same highly skewed distribution already observed in response times (response latencies) in spoken conversation, and synchronous and asynchronous online communication (Avrahami & Hudson, 2006; Kalman, et al., 2006). The response latencies were binned in bins of ten seconds, and their distribution plotted. INT, SWT and PRT all exhibited a power law distribution with an $R^2=0.88$ or higher, with slopes of -3.3, -3.0 and -2.6 respectively.

3.3 Variables influencing chronemics

Three multiple regression analyses were performed, one for each of the three chronemic variables. The independent variables were user personality variables, with user demographics (age and gender) and message length (LNG) included as control variables. The analyses identified three variables which have a significant impact on each of the three chronemic variables: the personality variables extraversion (EXT) and agreeableness (AGR), and the control variable message length (LNG). Table 2 shows the results for interpost pause (INT) ($R^2_{adj}=0.24$; $n=3491$). The results for switching pause

² Since the trust measure was weighted by earnings that centered near the maximal earning of 360 (effectively resulting from an experimental ceiling effect), we also analyzed the data using a Tobit analysis. This analysis accounts for the censored earnings, however, nearly identical results were found. For ease of exposition we report the more standard multiple regression results.

(SWT) ($R^2_{adj}=0.23$; $n=2185$) and personal rhythm (PRT) ($R^2_{adj}=0.32$; $n=3204$) were similar, with the same three variables showing a trend toward influence on SWT ($p=.06$) and PRT ($p=.06$).

Term	Estimate	SE	T Ratio
Intercept	1.51	0.42	3.62**
Gender	0.02	0.04	0.48
Age	-0.00	0.01	-0.37
Extraversion	-0.08	0.03	-2.54*
Agreeableness	0.10	0.04	2.26*
Conscientiousness	-0.00	0.04	-0.17
Neuroticism	0.00	0.04	0.27
Openness	0.02	0.04	0.51
Message length	0.01	0.00	20.11**

Table 2. Multiple regression analysis for interpost pause (INT).

* $p<0.05$; ** $p<0.01$

3.4 The relationship between chronemics and trust

A regression analysis between trust and the chronemic variables was performed. Since SWT is a subset of INT, and since INT and PRT are also highly correlated, three separate analyses were performed, for each of the chronemic variables. The results for INT are reported in Table 3 ($R^2_{adj}=0.76$; $n=3491$). The regressions also included the same personality, demographic and posting length variables already described in the previous section, as control variables. A second level interaction which did not materially impact the findings was detected between INT and openness (OPN). A similar analysis of SWT and PRT revealed similar findings: the relationships between these variables and trust were statistically significant, in the same direction, and with a similar magnitude. In the case of SWT, a marginally significant ($0.05<p<0.1$) influence of Extraversion (EXT) and message length (LNG) was also detected, as well as a statistically significant interaction between SWT and OPN. In the case of PRT, a marginally significant influence of conscientiousness (CON) was detected, as well as statistically significant interactions between PRT and agreeableness (AGR), and PRT and OPN.

Term	Estimate	SE	T Ratio
Intercept	331.31	40.13	8.26**
Gender	4.34	3.67	1.18
Age	0.53	1.14	0.47
Extraversion	-4.12	2.98	-1.38
Agreeableness	6.56	4.37	1.50
Conscientiousness	-6.95	3.61	-1.93 [#]
Neuroticism	-1.65	3.44	-0.48
Openness	2.24	4.22	0.53
Message length	-0.01	0.01	-0.93
Interpost pause	-2.37	0.41	-5.79**

Table 3. Multiple regression analysis for trust with the chronemic variable interpost pause (INT). * $p < 0.05$; ** $p < 0.01$; # $p < 0.10$.

4 DISCUSSION

4.1 Personality influences chronemics

The hypothesis that user personality influences the chronemics of online chat conversation was confirmed. We find consistent evidence that two personality traits, extraversion and agreeableness, influence the three chronemic variables examined: Players who rate higher on agreeableness exhibit somewhat longer pauses than those who rate lower, and players who rate higher on extraversion exhibit somewhat shorter pauses than those who rate lower. The only other variable for which a statistically significant impact was detected is message length. It is not surprising that messages which require more keystrokes increase the three chronemic variables. Nevertheless, it might be useful to use the impact of a single keystroke on the chronemic variables, as a tangible measure against which to compare the linear impact of personality on the chronemic variables. For example, in the case of interpost pause (Table 2), we can see that an increase of one point on the agreeableness scale (a seven-point scale) has the same impact on interpost pause as typing ten more characters. Or, that an increase of one point on the extraversion scale has the same impact as typing eight less characters. This is an illustration of the subtle effect of personality of the chronemics of chat.

As already mentioned in the introduction to this paper, the link between personality and the length of communicational pauses is not new. Scherer and Scherer (1981) review the relationships between spoken speech behavior and personality. They note the paucity of research on fluency aspects of speech such as pauses and tempo, noting the technical challenge of measuring these aspects of spoken speech using automated methods. They review the relationship between extraversion and various aspects of speech, including the evidence for a link between extraversion and shorter and fewer pauses. Later research strengthened the assertion for this link between extraversion (as well as perceived extraversion) and shorter pauses (e.g., Feldstein & Sloan, 1984; Gocsál, 2009), and it is now accepted that response latencies of extraverts are shorter than those of introverts (Mairesse, Walker, Mehl, & Moore, 2007). The results of our study provide evidence for the existence of this relationship in online communication.

Unlike extraversion, we are not aware of previous evidence for a link between agreeableness and longer response latencies. This might either be a new finding, or a unique feature of online communication. It is not unreasonable to expect a person who is more considerate and friendly to

communicate in a gentler manner and to make slightly longer pauses. It might also be a unique feature of the social dilemma game, wherein longer pauses were one possible mechanism to communicate less competitiveness and more friendliness.

4.2 Shorter pauses are associated with increased trust

The hypothesis that longer pauses will be associated with decreased trust in online teams was also supported. Trust in online environments in general, and particularly trust amongst members of virtual teams, is a topic which received significant attention in the research literature (Benbasat, Gefen, & Pavlou, 2008; Ridings, et al., 2002). That research revealed a multiplicity of categories of antecedents and consequences of online trust. Over time, trust in virtual teams can be achieved as successfully as in face-to-face settings (Wilson, et al., 2006).

The findings reported in this paper clearly show that longer pauses are associated with lower levels of interpersonal trust. The question which remains open is the direction of the influence. Since we find no evidence of chronemics as a mediator of the effect on trust, there are several non-mutually exclusive possibilities. The first is that the increased pauses by one team member negatively impact the impression the other team member has of his or her partner. The negative effect of hesitancy and pausing is long established (e.g., McLaughlin & Cody, 1982) at least in American culture, and our findings demonstrate the same phenomenon in synchronous online communication. A second possible explanation is that the cognitive load required to carry out deception, results in longer pauses. It can be assumed that, as in other situations where trust is breached and deception takes place (e.g., Benus, Enos, Hirschberg, & Shriberg, 2006; Vrij, et al., 2008), the need to plan the deception and carry it out will also lead to longer pauses in the DayTrader game. A third possible explanation is that the pauses are a result of the increased cognitive load and hesitation of the team member who suspects deception by the other team member, and who considers his or her possible reactions (Hancock, 2007). It is difficult to tease apart the role of these three possible explanations since they are not mutually exclusive, as well as since participants in conversation are influenced by the prosodic components of their partner's speech and adjust their own rhythm to match their partner's. Such temporal entrainment (e.g., Kanashiro, Kobayashi, & Kitamura, 2009) means that changes in pause length by one player will be matched by that player's partner's consequential adjustment of pause times. As will be discussed later, these possible explanations are the basis of hypotheses which could be tested through direct experimental intervention.

4.3 Future research

The key finding of this study is that chronemics is a subtle but integral component of online language and thus of online interaction. Variations in communicator attributes such as their personality are reflected in increased or decreased pauses, and variations in pauses are associated with increased or decreased trust. This finding suggests several new questions for future research. Communicators who use online tools incorporate many available cues to form an impression of the person they are communicating with (Hancock & Dunham, 2001). Despite the fact that chronemics is a nonverbal cue, this study adds to the mounting evidence that chronemic cues are easily conveyed by even the simplest of CMC media, and that they impact impression formation (Walther, 2002). The finding that personality traits are reflected in the pauses between text-chat postings, could explain why it might be justified to use pauses as evidence for the personality of the otherwise invisible partner on the other side of the chat screen. On the other hand, it is evident that since pause length is a one-dimensional variable, and since different personality traits influence this variable in different directions, it would be wrong to make any inference based solely on this variable. Like other nonverbal cues, chronemics should only be interpreted in conjunction with the many other verbal and nonverbal cues available to the user. For example, the research by Scissors et al. (2009) showed the association between linguistic similarity and trust outcomes. Taken together with the findings reported here of the association between chronemics and personality, and trust, the question of causal relationships becomes pertinent. Future research should explore, through a controlled experiment, the hypothesis that even slight modifications in language variables such as chronemics and linguistic similarity will impact the level of trust in the online team. If this hypothesis is supported, this would have a significant implication for

the design of chat systems. If even slight delays in transmission can negatively impact trust, then systems need to be designed so as to alert users when a system's transmission speed drops. This might, at least partially, prevent users from incorrectly attributing the elongated response times as longer pauses of their conversational partners. This design challenge is somewhat similar to the challenge of coping with the very slight, but highly influential apparent inappropriate gaze direction in video conferencing (Grayson & Monk, 2003).

4.4 Conclusion

Synchronous text-based online communication is considered one of the leanest of communication media, limited in its ability to convey nonverbal cues and subtleties. Despite this purported limitation, it has long been known that chronemics is an important category of nonverbal cues in text-based computer-mediated communication (Walther, 2006). The complexity and apparent "interactional incoherence" of chat limited researchers' ability to automatically parse chat sessions and extract meaningful chronemic variables to study. Consequently, little is known about the involvement of chronemic cues as independent variables in chat, and even less about chronemic cues as dependent variables in chat. To overcome these challenges, in this study we explored 510 highly structured chat sessions created by 62 teams, for the purpose of a study of language and trust formation in online teams. The structure of these chat sessions allowed the extraction of three chronemic variables: interpost pause, switching pause and personal rhythm. The data collected for the experiment allowed a carefully controlled multivariate analysis of the impact of personality on the chronemic variables, as well as an analysis of the impact of chronemics on trust in the online team.

The results showed that, when controlling for message length and demographic variables, the three chronemic variables were influenced by participant extraversion and agreeableness: more extraverted players exhibited shorter pauses, and more agreeable players exhibited longer pauses. The relationship between extraversion and shorter pauses is not new, and has been observed in other forms of communication. In contrast, we are not aware of published findings linking agreeableness and longer pauses. This relationship might be specific to online chat or to this social dilemma game.

The dataset also gave us the opportunity to study the impact of chronemics on trust. We found that longer pauses were associated with decreased team trust. Personality variables also co-varied with trust, and interacted with the chronemic variables. We suggest three non-mutually exclusive explanations for this association: 1) the longer pauses cause the decrease in trust; 2) the longer pauses are the result of the increased cognitive load on the player who is carrying out the deception; 3) the longer pauses are the result of the increased cognitive load on the player who is suspecting that he or she is being deceived by the other player. We also point to the increased complexity that dyadic entrainment introduces into this already complicated picture. Based on what is already known about the impact of long communicative pauses in traditional and in computer-mediated communication, we suggest a controlled experiment that will isolate the causal influence of the chronemic variables on trust in a virtual team.

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