CAIS Paper: Using Sonification to Explore Texting Response Time in Time Stamped Interactional Data

Abstract: We examine the utility of sonification for exploring temporal patterns in time stamped logs of text messages. Using sonification, we identify patterns in a subset of the logs, and examine how these patterns vary by relational closeness. We then verify these patterns' generalizability in the full dataset using statistical analysis.

1. Introduction

This paper explores the utility of data sonification – transforming data into sound – as a tool for exploring time stamped logs of text message interactions. Data sonification is similar to data visualization, but since sight and sound involve different cognitive processes, sonification may be particularly effective for identifying certain types of patterns. Specifically, we suspect that the inherent temporality of sound makes sonification well suited to exploring time stamped interactional data, such as the mobile text messages that we use for our analysis. Although there has been extensive research about how to do sonification, it has rarely been applied to social scientific research, and only tentatively been applied to the natural sciences (Supper 2011). We use sonification to explore temporal patterns in anonymized logs of asynchronous text messaging. Asynchronous text messaging has changed temporal patterns of communication. Unlike synchronous modes of communication, text messages afford the ability to delay responses and weave text messaging behavior to into other activities, such as in-person conversations (DiDomenico and Boase 2013). Evidence from a variety of scholarly studies shows that individuals tend to respond most quickly when texting with strong bonding ties. Nevertheless, given that relational closeness consists of several dimensions, it is possible that not all dimensions of relational closeness are equally associated with rapid texting response time. The first stage of our analysis uses data sonification to explore whether texting response time varies with several dimensions of relational closeness. We then further examine the statistical significance of these patterns using statistical methods to confirm their generalizability to the larger sample. Through these two stages of analysis we will examine the utility of data sonification for exploring time stamped data, as well as investigating relationships between texting response time and other dimensions of relational closeness.

2. Literature Review

Our use of sonification is motivated by previous studies about the merits and limitations of sonification for analyzing data. A significant limitation of sonification is that data points are often heard sequentially rather than simultaneously, so comparing such points

is made difficult by a memorization task (Walker and Nees 2011, 21). However, it is this temporality that makes sonification well suited to analyzing time based data. Notably, the human auditory system performs significantly better with rhythmic perception and temporal resolution than the visual system (Neuhoff 2011); for example, it is able to detect gaps in broadband noise stimuli as short as 2–3 milliseconds (Carlile 2011, 49). Ferguson, Martens, and Cabrera note the utility of sonification for exploratory data analysis – particularly that "invisible regularities can become audible, and complex temporal patterns can be 'heard out' in what might appear to be noise" (2011, 178).

By using sonification to analyze temporal patterns in text messaging logs, our study builds upon previous research about texting and relational closeness. Text messaging has been described as useful for developing intimacy in new relationships and expanding relationships with weak ties. It has been argued that its utility for fostering close relationships is partly due to its flexible asynchronous nature (Kim et al. 2007; Lin and Tong 2007). Resulting from this asynchronicity, the time at which one chooses to reply to a text message becomes a non-verbal cue, and short response times can communicate "thoughtfulness, eagerness, or closeness" (Döring and Pöschl 2009, 111). Studies of Japanese (Mizuko Ito and Okabe 2005) and Danish (Laursen 2005) texters suggest expectations of swift replies to text messages, but both of these findings refer to adolescents, so older texters may have different expectations. It has been argued that intense texting exchange acts as a type of tele-cocooning, whereby time spend bonding with strong ties comes at the expense of forming and maintaining weaker relationships (Campbell and Kwak 2012; Habuchi 2005; R. Ling and Stald 2010). As such, swift texting response time with certain ties may not only strengthen bonds with those ties, but decrease time devoted to bonding with weaker ties. Our study builds upon this research by considering the relationship between texting response time and individual dimensions of relational closeness among adult users, using an innovative technique that merges smartphone log data with more rational survey measures of relational closeness.

3. Research Questions

Through our two stages of analysis, we will investigate two research questions:

RQ1: To what extent does the sonication of text message data allow us to discover patterns of texting response among various dimensions of strong tie relationships?

RQ2: To what extent do the text messaging patterns identified using the sonification method show statistical significance when examined using more traditional quantitative analysis?

4. Data Collection

The data for this study was collected using the Communication Explorer application for Android smartphones. This software anonymizes voice, text, and email log data and correlates these logs to results from on-screen survey questionnaires. Data was collected from 195 American respondents in the winter and spring of 2011. To preserve the anonymity of respondents, numeric codes were assigned to each respondent as well as each of their address book contacts. Once these codes were assigned, the date and time of all events was recorded. No content of voice, text or email messages was recorded.

After collecting this log data, the application prompted respondents to respond to at least 30 daily pop-up surveys, in which they were asked a short series of questions about a randomly selected individual with whom they had exchanged text messages, voice calls, or emails, in the previous 24 hours. Our data analysis in this study is limited to pairs of respondents and ties where 1) the respondent answered at least one pop-up survey about that tie and, 2) at least one text message was exchanged. This narrowed our selection to 76 respondents, who exchanged a total 13,003 text messages with 535 ties.

5. Analysis

Exploratory sonification analysis was conducted using the E-Rhythms Data Sonifier software, which was designed by the authors. This software uses parameter mapping sonification, a type of sonification in which dimensions from a data source are mapped to sound characteristics such as pitch, volume, and rhythm (Grond and Berger 2011). In particular, the software runs through the data sequentially and uses the timestamp to determine when to trigger a sound. Every 'beat' represents a fixed period of time within the data (the duration of which is set by the user). A loud sound indicates that many events occurred during that period, while a quiet sound indicates fewer events and silence indicates no events. Sent and received text messages were assigned to different sounds, allowing us to distinguish them when their playback overlapped. Focusing on exchanges between one respondent and one tie at a time, we compared when each party sent or received text messages to formulate a typical response time. This analysis was conducted for 16 randomly selected pairs of ties who had exchanged at least 100 text messages. Typical response time ranged from 15 minutes or less to 4 hours.

Our findings of this exploratory analysis suggest that text message response time has a noteworthy correlation to three indicators of tie closeness. First, when listening to the data there appeared to be a strong relationship between respondents who answered that they trust their texting partner and longer response time. Statistical analysis using Pearson correlation confirmed this to be a strong and positive relationship ($r = 0.48$). Additionally, there seemed to be a strong relationship between texts exchanged with family members and shorter response times. Statistical analysis confirmed a strong negative relationship between family and response time ($r = -0.44$). We also observed a relationship between shorter response times and whether respondents answered that they

talk about important matters with a particular texting partner. Statistical analysis confirmed there to be a moderate negative relationship between discussing important matters and response time ($r = -0.31$). These findings suggest a complex relationship between text message response time and tie closeness.

During the next stage of our study we will conduct more rigorous statistical analyses of response time between all pairs of ties for whom survey data was collected and at least one text message was exchanged. This will allow us to observe whether our preliminary findings can be generalized and allow us to evaluate whether our use of sonification was effective as an exploratory method. This study presents a complex perspective about the link between strong ties and swift texting responses by considering how that link is shaped across multiple dimensions of relational closeness. This promises to contribute to a greater understanding of the role of asynchronous text messaging in mediated communication. If our preliminary observations are consistent with our deeper analysis it will illustrate the potential of sonification for exploring time stamped interactional data as well as the relationship between text message response time and relational closeness.

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