

Alignment Is a Function of Conversational Dynamics

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Abstract

Two prominent theories of alignment (priming and grounding) are tested in human–human text-only computer interactions. In two experiments, dyads of strangers and dyads of friends conducted conversations using Instant Messenger. These conversations were either neutral in nature or interlocutors were told to disagree on a particular topic. Conversations were assessed for paralinguistic, linguistic, semantic, affective, and typographical alignment. Results show distinct differences in alignment patterns dependent on conversational dynamics. Grounding theory is supported and discussion includes examining how nonverbal cues are translated into text-only conversation.

Keywords

alignment, computer-mediated communication, coordination, grounding, priming, synchronization

When people interact, they often synchronize (Marsh, Richardson, & Schmidt, 2009) or align (Pickering & Garrod, 2004) both verbally and nonverbally, imitating and adapting to each other in the use of syntactic structure (e.g., active and passive sentences; Bock, 1986; Branigan, Pickering, & Cleland, 2000), phonology (e.g., Cleland & Pickering, 2003; Giles, Coupland, & Coupland, 1991), posture (e.g., Shockley, Santana, & Fowler, 2003), pragmatics (e.g., Roche, Dale, & Caucci, 2012), and pitch and speech rate (e.g., Street, 2006). Several researchers (e.g., Clark & Brennan, 1991) have argued that such alignment occurs due to a process called grounding, in which interlocutors establish mutual knowledge to promote efficient conversation.

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Interlocutors align both verbally and nonverbally and seek such alignment from others as a clue that they understand each other. For example, when telling a joke, the speaker assesses whether the listener is smiling at the same time the speaker is smiling, in order to determine whether the listener understands the joke.

In this way, grounding theory suggests that all interactions are collaborations between the speaker and listener, in which the listener's role is to indicate understanding of the speaker's communication, either verbally (e.g., "I see") or nonverbally (e.g., head nod). If the listener expresses misunderstanding, perhaps by crinkling his eyebrows in a questioning look, the speaker's role is to elaborate. In this way, with each utterance in a conversation, an indication of understanding or misunderstanding is received, and a new utterance or clarification is given.

One key part of grounding in alignment is the ability to design the communication for an audience. A speaker takes into account his or her knowledge of the listener's state of knowledge, beliefs, and abilities when devising utterances (Bell, 1984). For example, people often use simpler vocabulary and shorter sentences when speaking to children than to adults. These assumptions about the listener are often adjusted over the course of a conversation as more information is gleaned; for example, Issacs and Clark (1987) showed that, in a conversation about landmarks in New York City, speakers adjusted their simple visual descriptions of the landmarks to the name of the landmark on learning that the listener was a native to New York City, and vice versa on learning the listeners were nonnatives. In this way, alignment may change over the course of a conversation as the interlocutors gain new information about each other.

Such evidence of alignment has primarily been found for conversations between face-to-face interlocutors. However, people are increasingly socializing via the Internet and are projected to do so at ever more increasing rates in the future (Brenner & Smith, 2013; Lenhart, 2012; Lenhart, Purcell, Smith, & Zickuhr, 2010; Madden & Rainie, 2003; Rainie, Horrigan, Wellman, & Boase, 2006, The Radicati Group, 2011), specifically in primarily textual communication channels such as e-mail, instant messaging (IM), and social networking sites, such as Twitter. Primarily textual channels, such as IM are more complex than face-to-face interactions because of a disjointed dialogue style: assessments of understanding cannot co-occur with the "speaker's" utterance. For example, an IM user might write an entire joke before transmitting to an IM partner; assessments of understanding are only gleaned at the end of the joke, in which many repair attempts may be necessary in order to determine at what point misunderstanding occurred. In addition, textual channels remove the ability to assess nonverbal information, such as facial expression and pitch, which Clark and Brennan (1991) argue are valuable clues for grounding in ongoing conversations. For example, by constantly assessing the facial expression of the listener, a speaker who is telling a joke may further elaborate during the joke in order to ensure the listener's understanding; it is not necessary for the listener to wait until the end of the joke or depend on the listener to interrupt with a request for clarification in order to indicate any points of misunderstanding. It is likely that because textual environments remove such nonverbal information, many assessments of understanding are transmitted verbally instead. However, this possibility lacks evidence.

Despite these challenges, evidence for alignment still exists in such textual environments. For example, Branigan, Pickering, Pearson, McLean, and Nass (2003) found significant levels of linguistic alignment, and Branigan et al. (2004) found significant levels of lexical alignment, in interactions between a person and a computer. The authors argued that such alignment was a case of audience design (also see Branigan & Pearson, 2006); participants shaped their utterances using the words and phrases the computer used in order to fit the perceived constraints of the computer in the same way that they would shape their utterances to fit the person to whom they were speaking.

However, several researchers have argued that priming may be a better explanation for such alignment (for reviews, see Ferreira & Bock, 2006; Pickering & Garrod, 2004). This position suggests that when two interlocutors communicate, alignment both verbally and nonverbally is a result of each interlocutor priming the other; for example, a speaker will activate certain words and syntactic features for a listener, who in turn uses those features or very closely related forms of those features when he or she becomes the new speaker. In other words, a listener mentally maps the speaker's words, syntax, sentence structure, and so on, while listening, and this map is then used by the listener when it becomes his or her turn to speak. This shared mental map creates an efficient way to decrease processing effort in conversation (Smith & Wheeldon, 2001). As such, alignment between an interlocutor and computer in Branigan et al. (2003; Branigan et al., 2004) may have been less about establishing assessments for mutual understanding (i.e., the person accommodating what was determined to be the knowledge base of the computer), and more about being primed to use specific words and lexical formats by the computer.

Branigan et al. (2003; Branigan et al., 2004) found that the rates at which interlocutors aligned with a computer were not significantly different from the rates at which interlocutors aligned with each other in a computer-mediated dialogue. In the same way, a handful of studies suggest that two interlocutors conversing via computer align paralinguistically (i.e., in length and duration of utterances), semantically, structurally, and in their use of punctuation (e.g., Bunz & Campbell, 2004; Riordan, Dale, Kreuz, & Olney, 2011; Riordan, Markman, & Stewart, 2013; Scissors, Gill, Geraghty, & Gergle, 2009). However, these authors did not examine the theories of grounding and priming.

The current pair of studies contrasts grounding and priming by examining alignment in a text-only computerized conversation. Grounding would predict that the nature of the conversation would affect rates of alignment. Conversations involving disagreement inherently involve an inability to adopt the perspective of the other, and thus should have lower levels of alignment than conversations that are neutral. Priming, however, predicts no difference in alignment dependent on the nature of the conversation; alignment would occur at the same rate because in all cases, each interlocutor would be automatically activating words and sentence structures for the other interlocutor. Last, grounding would suggest that rates of alignment change with ongoing conversing because of adjustments as more information is gained, whereas priming would suggest the automatic process does not alter with ongoing conversing because activation does not vary as more information is gained.

While any number of variables can be measured in terms of alignment, six analyses of alignment were chosen for analysis in the following experiments. First, we assess semantic alignment and alignment in parts of speech, following a long research tradition. Second, recall that Clark and Brennan (1991) acknowledged that many clues to grounding exist (e.g., explicit acknowledgment, verbatim repetition), and among these are nonverbal cues such as facial expressions and gestures. Nonverbal cues, however, are largely missing in computerized conversation. It is possible that these nonverbal cues are translated into computerized communication via verbal, typographical, or paralinguistic means (Walther, 1992). Here, we examine four possible substitutions for nonverbal behavior that research suggests may be used in computer-mediated text-only communication. First, Walther, Loh, and Granka (2005) found that face-to-face dyads tended to express affinity using nonverbal cues such as vocal intonation, while dyads conversing by computer tended to use verbal expressions such as outright statements of liking. Thus, we assess the verbal cue of statements of affect. Second, several researchers have suggested that typographical cues, such as emoticons or repeating punctuation marks (e.g., !!!), may serve as substitutes for face-to-face nonverbal cues (Burgoon, 1985; Byron & Baldrige, 2005; Carey, 1980; Derks, Bos, & von Grumbkow, 2008; Rice & Love, 1987). Thus, we assess these typographical cues. Third, paralinguistic cues can suggest social information, particularly affecting understanding; for example, Cramton (2001) found that people tend to assume personal rather than situational causes for delays in responses, and Jarvenpaa, Knoll, and Leidner (1998) found that a lack of response eroded trust between interlocutors in virtual groups. In the current study, we examine the paralinguistic cues of both duration of an interlocutor's turn in a conversation and the length in number of words of each turn taken.

Experiment I

Method

Participants. Forty-two participants (11 males; mean age = 22.5 years, $SD = 7.5$) completed a 30-minute session and were given course credit for participation.

Procedure. This study was part of a larger project intended to study online turn construction and argumentation as well as alignment. Three variables of topic, agreement, and nonverbal cues were manipulated. Each dyad of a confederate and a participant received one of two topics, one of two agreement conditions, and one of two nonverbal cue conditions. For the current study, the topic was not a variable of interest and was not expected to affect results, and thus is not analyzed. Therefore, the current experiment is a 2 (nonverbal cues) \times 2 (agreement) design, with 42 dyads. The manipulation of agreement allows assessment of whether conversational dynamics (disagreement or neutrality) affect alignment, and the manipulation of nonverbal cues allows determination as to whether alignment can be found in nonverbal aspects of online interaction.

Participants reported to a lab, where a confederate was introduced as another participant in the study. The participant and confederate were then assigned to different

rooms with computers. Participants completed a demographic questionnaire and then read one of two short articles, one of which argued for making Gardasil a voluntary vaccination for sixth-grade girls, and the other which argued for mandating the vaccination (adapted from Colgrove, 2006 and Centers for Disease Control and Prevention, 2010). Participants then answered two questions to ensure they understood the article, and were given instructions that their task was to persuade the confederate to agree with the article. Participants were also told they were allowed to look for additional information on the Internet and were then given a short tutorial on how to use the IM program. The confederate was given the same treatment to ensure the participant remained naïve to the confederate's role. Chats lasted approximately 27 minutes, with a 2-minute warning before the end.

The confederate was used to manipulate agreement and nonverbal cues. The confederate either disagreed with the participant's arguments about the topic or was undecided/neutral, and either used or did not use nonverbal cues during the chat. Nonverbal cues included emoticons, repeating punctuation such as !!! or ???, spelled sounds such as *ugh*, capitalized words, words with repeating letters such as *hellllloo*, and words surrounded by asterisks (taken from Carey, 1980). Other than creating the two conditions in which nonverbal cues were either used or not, no attempt was made to control the number or type of nonverbal cues used in the nonverbal cues condition in order to ensure as natural a communication environment as possible. The confederate was trained in the use of agreement and nonverbal cues during several practice rounds and, once the confederate was assigned to her room, a reminder of the current condition was placed prominently on her computer. Other than these manipulations, the confederate remained naïve to the hypotheses of the study.

Results

Manipulation Check. Each transcript was checked to ensure the confederate carried out the correct condition. The agreement condition was always manipulated successfully; for the nonverbal cues conditions, the confederate responded correctly for 39 of the 42 conversations. In three no-nonverbal-cues conversations, the confederate used a cue, but no more than twice. As slipups were rare, these transcripts were not dropped from the data set.

Transcripts. Each conversation consisted of, on average, 32 turns with 29 words per turn, for an average of 939 words per transcript. A turn consisted of everything one person wrote before his or her dyad partner responded. Conversations in which the confederate disagreed with the participant had approximately the same number of words as conversations in which the confederate was neutral (Disagree: $M = 876$, $SD = 211$; Neutral: $M = 1001$, $SD = 325$; $t(40) = 1.48$, *ns*).

Data. Our methods of measuring linguistic and semantic alignment are only capable of analyzing recognizable words. Thus, for these analyses, it was necessary to correct transcripts for misspelled words, common nonwords (e.g., "gonna" was corrected to

“going to”), and abbreviations (e.g., “STD” was written out as “sexually transmitted disease”). It is possible that these corrections may lead to artificial alignment such as if when one interlocutor writes, “gonna” and the other writes, “going to,” the correction of the first interlocutor’s “gonna” to “going to” would result in a higher rate of alignment for that dyad. However, this effect should be the same for all conditions and therefore not render statistical comparisons invalid. For analyses of typographical cues and length and duration of turns, however, unedited transcripts were used.

All data were analyzed using linear mixed effects (LME) models that controlled for multiple observations from the same dyad in the same conversation. LME models assume the data are normally distributed, whereas all our data had a gamma distribution; as a result, all dependent variables were log-transformed except for typographical cue use. Fixed effects included the conversation condition, each additional turn taken in the conversation, and the interaction of these two variables.

Semantics. Explicit semantic analysis (ESA; Gabrilovich & Markovitch, 2007) is a computational method that allows comparisons of the semantic content of two texts on several dimensions; words and texts that share similar contexts have similar semantic dimensions and thus have a high semantic relatedness. The semantic space used to generate relatedness scores consists of Wikipedia articles.

The LME model (see Table 1) shows that semantic alignment (i.e., how semantically related adjacent turns are) was not affected by the disagreement or neutrality or by additional turns in the conversation.

Parts of Speech and Affect. Linguistic Inquiry and Word Count (LIWC; Pennebaker, Booth, & Francis, 2007) is a text-analysis program that categorizes words from a text file based on an internal dictionary and returns a percentage that reflects the number of words in a category divided by the total number of words in the text, thus calculating the degree to which different categories of words are present in the text. The program has been used extensively in several disciplines to examine text in online formats (e.g., Dino, Reysen, & Branscombe, 2009; Gill, French, Gergle, & Oberlander, 2008).

While LIWC offers 80 categories for analysis, not all were of theoretical interest in the current analyses. Six were selected. First, to detect alignment in parts of speech, we used the categories of pronouns, verbs, prepositions, and conjunctions. LIWC also has categories for articles and adverbs; because of very low frequencies, these were not included in the current analyses. Second, to detect affective alignment, we used the categories of negative emotion words and positive emotion words.

LIWC percentages were computed for each of the eight categories for each turn taken in the conversation. The difference in the LIWC percentages between adjacent turns was then computed for each category. All negative values for these differences were made positive to reflect the difference from zero (i.e., perfect alignment). The average difference across categories within each of the parts of speech and affect was then computed. Thus, for example, our dependent variable represents the difference in the percentage value of each part of speech between adjacent turns in a conversation, averaged across all four parts of speech.

Table 1. Experiment I Linear Mixed Effects Models.

	Intercept	If disagree condition (as opposed to neutral)	Each additional turn	Disagree condition × Additional turn
Length	2.24 (9.39)	-0.10 (8.50)	+0.02*** (9.58)	+0.03** (9.68)
Duration	3.04 (20.91)	+0.11 (23.34)	+0.01* (21.12)	+0.02* (21.33)
% Four parts of speech	1.73 (5.64)	+0.14 (6.49)	+0.003 (5.66)	-0.01* (5.58)
% Affect words	0.71 (2.03)	+0.06 (2.16)	+0.03*** (2.10)	-0.008 (2.02)
ESA relatedness score	-0.46 (0.63)	-0.007 (0.63)	+0.000 (0.63)	+0.002 (0.63)

Note. Non-log-transformed values are in parentheses. Lower values indicate greater alignment except for explicit semantic analysis (ESA), in which lower values indicate less alignment.

* $p < .05$. ** $p < .01$. *** $p < .001$.

The LME model (see Table 1) shows that alignment in parts of speech increased more with each additional turn in the disagreement condition than the neutral condition. A second LME model shows that interlocutors aligned less in the use of affect words with each additional turn in a conversation.

Typographical Cues. Though the confederate deliberately used typographical cues in half of the conversations ($M = 14$ cues, $SD = 9$ per conversation), the use of such cues by the participants was quite low. In the cue-use condition only, 8% of participants' turns included a cue; in the no-cue-use condition, 6% of participants' turns included a cue. The lack of change in this number depended on whether the confederate did or did not use cues shows a lack of alignment at this level. Because of such low use of cues, the data were reduced to a binary coding of whether or not the participant included a cue. Whether or not the participant used at least one cue in a transcript was not related to whether or not the confederate used cues, $t(40) = .27, ns$.

Duration. The number of seconds between when one person's turn was first presented to his dyad partner and when the partner responded was computed to determine the duration of a turn. The difference in duration between adjacent turns was then computed, and negative values made positive to reflect the difference from zero (i.e., perfect alignment).

An LME model (see Table 1) shows that alignment decreased with each additional turn in the conversation, and that alignment decreased more with each additional turn in the disagreement condition than the neutral condition.

Length. The number of words in each turn was computed, and the difference in length between adjacent turns was computed. All negative values were made positive to reflect the difference from zero (i.e., perfect alignment). As such, greater values indicate a greater difference, or lower alignment, between interlocutors.

The LME model (see Table 1) shows decreasing alignment with each additional turn taken in a conversation; further, alignment decreased more with each additional turn in the disagreement condition than the neutral condition.

Discussion

Experiment 1 shows significant effects of additional turns in a conversation on the levels of alignment between interlocutors, particularly in paralinguistic (length and duration) and affective (positive and negative emotion words) variables. Experiment 1 also shows interactions between conversation condition and additional turns, particularly for paralinguistic and parts of speech variables. It is clear that conversational dynamics, including those that unfold with more conversing, affect patterns of alignment, a conclusion that supports grounding theory. A full discussion of these results is related after Experiment 2.

However, though the confederate in Experiment 1 remained naïve as to the analyses to be performed, it is possible that repeated use of the same confederate influenced the results regarding conversational dynamics; that is, because the same confederate was arguing the same topic multiple times, the confederate may have gotten faster and more articulate during the disagreement conversation and this accounts for the differences in conversational dynamics. In Experiment 2, we seek address of this concern by ensuring that no participant is in the same topic condition more than once.

Also in Experiment 2, participants were dyads of friends, rather than a stranger and confederate as in Experiment 1, in order to make conversations more naturalistic; it can be effectively argued that most IM conversations take place between people who are familiar with each other. In addition, new disagreement and neutral conditions were designed in order to generalize Experiment 1 results. Last, these conversation conditions were designed to be within-subjects rather than between-subjects as in Experiment 1 in order to allow more powerful analyses of conversation type.

Experiment 2

Method

Participants. Thirty-five dyads of friends ($N = 70$, 22 males, M age = 19.7 years, $SD = 3.58$ years) participated in the study for course credit or 10 dollars each. Eighteen dyads consisted of two females, 12 of mixed sex. The average length of friendship was 3.57 years ($SD = 4.58$).

Procedure. Participants reported to a lab with a friend, who also participated. Each participant was placed in a room with a computer separate from her friend. Each filled out a short demographics questionnaire.

This study included two parts. The first part was an e-mail study in which participants e-mailed back and forth with their partner about two different topics. The second part, which is relevant here, consists of two IM conversations. The parts were counterbalanced as to which was completed first.

Each dyad completed two 20-minute IM conversations, a disagreement, and a neutral conversation. Conversation type was counterbalanced as to which came first. For the neutral conversation, participants were told to IM about any topic they desired. For the disagreement conversation, each participant was given a short article. One participant read arguments supporting a change in printing fees at their university from a tuition-based to a per-use based system. The other participant read arguments for not changing the tuition-based system (see the appendix). Each was told to persuade the other to agree with the viewpoint of the side they were assigned.

Results

Transcripts. Each of the 70 conversations consisted of, on average, 56 turns with 17 words per turn, for an average of 739 words per transcript. Interlocutors wrote approximately the same number of words per conversation in each condition (Neutral: $M = 772$, $SD = 237$; Disagreement: $M = 706$, $SD = 238$; $t(68) = 1.17$, *ns*).

Data. All data were analyzed using the same methods as in Experiment 1.

Semantics. For Experiment 2, we again used ESA to examine semantic analysis and also attempted to generalize the results using a second method. Correlated occurrence analogue to lexical semantic (COALS; Rohde, Gonnerman, & Plaut, 2005) is different from the ESA method used in Experiment 1 because it normalizes high frequency words (such as *the*) in order to factor out an effect of frequency in calculations of semantic similarity, resulting in more consistent judgments.

LME models (see Table 2) show the same effects result from the use of either method; semantic alignment is greater in the disagreement condition than the neutral condition, though the level of alignment decreases with additional turns in the conversation.

Parts of Speech and Affect. As in Experiment 1, LIWC was employed for analyses. LME models (see Table 2) show greater alignment for parts of speech in the disagreement condition than the neutral condition. This alignment increased with each additional turn in a conversation.

The LME model (see Table 2) also shows greater alignment in affect words in the disagreement condition than in the neutral condition. Affect word alignment decreases with each additional turn, but increases more with each additional turn in the disagreement condition than the neutral condition.

Typographical Cues. While a confederate either used or did not use cues in Experiment 1, in Experiment 2, no instructions regarding the use of typographical cues were given.

Table 2. Experiment 2 Linear Mixed Effects Models.

	Intercept	If disagree condition (as opposed to neutral)	Each additional turn	Disagree condition × Additional turn
Length	1.80 (6.05)	+0.47*** (9.68)	-0.001 (6.04)	-0.004** (6.03)
Duration	2.30 (9.97)	+0.69*** (19.89)	-0.002** (9.95)	-0.004** (9.93)
% Four parts of speech	2.09 (8.08)	-0.15*** (6.96)	-0.002*** (8.07)	-0.000 (8.08)
% Affect words	1.14 (3.13)	-0.13* (2.75)	+0.002** (3.13)	-0.003** (3.12)
COALS relatedness score	0.12 (1.13)	+0.09*** (1.23)	-0.0004** (1.13)	-0.0004 (1.13)
ESA relatedness score	0.32 (1.38)	+0.18*** (1.65)	-0.0007** (1.38)	-0.0004 (1.38)
Typographical cues	0.43	-0.05	-0.0001	-0.0005

Note. COALS = correlated occurrence analogue to lexical semantic; ESA = explicit semantic analysis. Non-log-transformed values are in parentheses. Lower values indicate greater alignment except for COALS and ESA, in which lower values indicate less alignment.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Strikingly, in Experiment 1, only 6% to 8% of turns by participants included a typographical cue (depending on whether the confederate did or did not use cues), but in Experiment 2, between friends, 39% of all turns included some type of typographical cue. For Experiment 2, turns with cues and without cues were binary coded and the difference between adjacent turns calculated, such that adjacent turns that both had cues or both did not have cues exhibited perfect alignment (i.e., 0) and adjacent turns that were mismatched exhibited nonalignment (i.e., 1). The LME model (see Table 2) shows that alignment in the use of cues did not differ by condition, with additional turns, or with the interaction of these two variables.

Duration. The LME model (see Table 2) revealed less alignment in the disagreement condition than in the neutral condition. Duration alignment increased with each additional turn in the conversation and increased more with each additional turn in the disagreement condition than in the neutral condition.

Length. The LME model (see Table 2) shows less alignment in length in the disagreement condition than the neutral condition. Length alignment increased more with each additional turn in the disagreement condition than in the neutral condition.

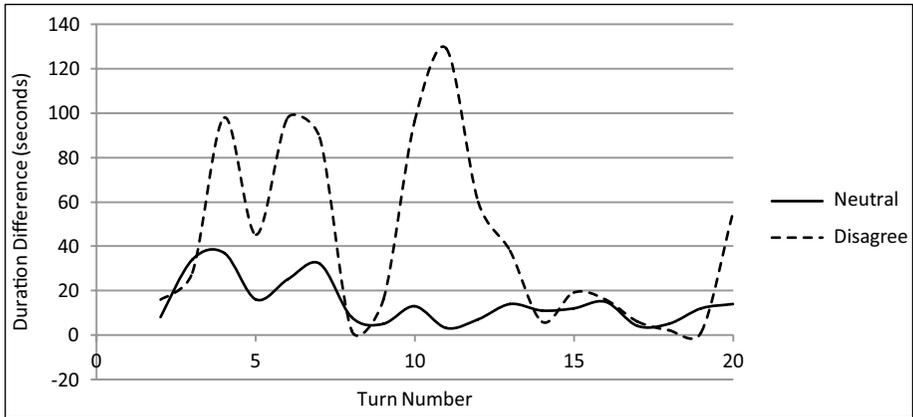


Figure 1. Duration alignment of one dyad's set of conversations from Experiment 2. Lower duration difference values indicate greater alignment.

Discussion

The current set of experiments examined levels of semantic, linguistic, affective, typographical, and paralinguistic alignment between human interlocutors conversing within different conversational dynamics in a text-only environment. Results reveal distinctly different patterns of alignment depending on conversation type, which varied with continued conversing. While the models suggest gradual change, however, the conversational dynamics are actually more varied and differ widely in variability by conversation type; for example, Figure 1 is a depiction of duration alignment between a dyad of two friends in Experiment 2 over the course of their two conversations. The variability seen in Figure 1 is representative of the kind of variability found in most friend dyads' conversations and suggests constant readjustment while conversing, with more adjustment necessary in disagreement than in neutral conversations, even for the same dyad. For a depiction of variability in duration alignment during the course of a conversation averaged across all dyads in both experiments, see Figure 2.

Results largely support grounding theory rather than priming. Several types of alignment are subject to conversational context and change with continued conversing, even within the same dyad. These effects would not be expected for priming; priming would suggest that interlocutors continually synchronize despite conversational dynamics. Furthermore, priming theory would not have predicted changes in alignment as conversations continued, whereas grounding theory is predicated on the idea that a conversation requires ongoing adjustment as more information is gathered.

One of the most interesting findings was that while ongoing conversation largely led to greater alignment for friends in Experiment 2, it led to no effect or less alignment for strangers in Experiment 1. While conclusions about the effect of relational dynamics are limited by the fact that direct statistical comparisons between strangers

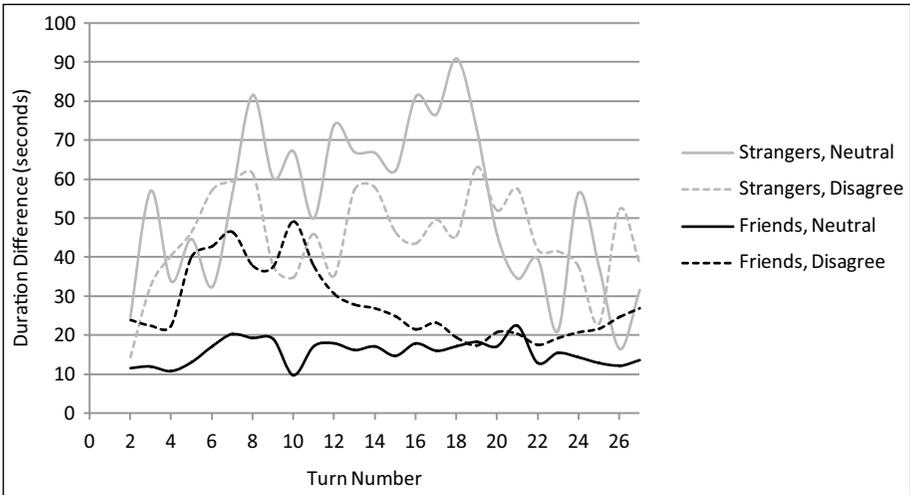


Figure 2. Duration alignment averaged across all dyads for first 27 turns (after which $n \leq 1$ for at least one category). Lower duration difference values indicate greater alignment.

and friends were not possible, we offer two potential explanations. First, the low possibility of future conversation may have mediated the motivation of strangers to work toward mutual understanding, whereas a high possibility motivated friends to do so. Indeed, Walther (1992) argued that in order for two people to develop a relationship online, there must be a motivation for that relationship; it is possible that strangers lack motivation to develop any form of relationship for the duration of the experiment. Second, the relational dynamics themselves may have played a role in alignment. For example, Bell (1984) showed that a speaker will take into account his or her knowledge of the listener's beliefs and abilities when formulating sentences; Issacs and Clark (1987) showed that speakers make adjustments in their descriptions of landmarks on learning that the listener lives near the landmark. In the same way, friends begin a conversation with prior knowledge about the other, which strangers either gain or do not gain over the course of a conversation; this prior knowledge may affect rates of alignment. Unfortunately, no definitive conclusions can be reached with the current set of experiments; the effect remains to be determined by future research.

This study also suggests that in text-only computer-mediated communication, the nonverbal dynamics that are key to grounding in face-to-face become verbal or paralinguistic rather than typographical. That is, in order to accommodate a channel in which body language is absent, interlocutors are expressing cues to emotion using words, response delays, or long/short responses rather than varied punctuation cues. Interestingly, patterns of alignment for these variables were very different between the Experiment 1 dyads of strangers and the Experiment 2 dyads of friends (see Figure 2 for a visual comparison of duration alignment). These patterns suggest that interlocutors may be aware that such information is indicative of relational information, in line

with Cramton (2001), Jarvenpaa et al. (1998), Liu, Ginther, and Zelhart (2002), Walther and Bunz (2005), Rintel and Pittam (1997), and others. Friends may be more motivated to pay attention to, and to generate, this information than strangers. Future research might assess this possibility.

In addition, the use of verbal cues (in this case, affect words) occurred at a much higher rate in the conversations than did typographical cues and was affected by conversational dynamics that differed between the types of interlocutor relationships and changed with continued conversing. It is interesting that we found far greater use of typographical cues between friends than between strangers; if typographical cues were helpful for filling in missing nonverbal information (as several researchers have argued: e.g., Byron & Baldrige, 2005; Derks et al., 2008; Harris & Paradice, 2007; Lo, 2008; but see Walther & D'Addario, 2001), it should be more important to use these cues with interlocutors who are unfamiliar with one's personality and emotions because those who are familiar may be able to fill in this information on the basis of prior knowledge about the interlocutor. However, it is possible that the meaning of typographical cues lies in the relationship between those interacting; Utz (2000) found that Multi-User Dungeon players used more emoticons as they developed relationships with other players and the use of emoticons correlated with friendship development. The findings of the current study reflect this idea; the friends in Experiment 2 used typographical cues far more often than the strangers in Experiment 1. It may also be that emoticons are substitutes for social information that people simply do not share during interactions with strangers, only with friends. In either case, this supposition would fit with explanations of audience design and, in turn, support grounding theory.

Conclusion

The current study suggests that alignment is subject to conversational dynamics that unfold with continued conversing, which supports grounding theory. This study also generalizes patterns of alignment to a text-only computer-mediated channel, suggesting that nonverbal information present in face-to-face conversation is translated into other formats, such as alignment in the length and duration of responses or in explicit statements of affect.

Appendix

The University currently charges everyone a flat rate for printing as part of tuition. The University is currently considering a proposal to charge for paper use on a per-use basis instead of including these costs as part of tuition.

In this chat, we want you to try and persuade your friend that this per-use fee is a (GOOD/BAD) IDEA!

Below are some arguments you might want to use, but you can use whatever arguments you think will be the most persuasive.

[Arguments presented to participants assigned "good idea":]

1. It will reduce the amount of printing on campus because students will only print what they are willing to pay for.
2. It will reduce tuition costs because printing fees will not be included in tuition.
3. It will teach students to be more environmental because they will learn to use alternatives to paper printing.
4. It will make printing necessary print jobs in computer labs easier because there will be fewer unnecessary print jobs in the printer queue.
5. It will save students money because they won't have to pay for printing they don't do as part of their tuition, and because students who use eReaders, iPads, etc, won't have to pay for printing they don't do.

[Arguments presented to participants assigned "bad idea":]

1. It will punish students for doing their work because they will pay to print out their readings and assignments. Students who don't print them out won't have to pay.
2. It will increase the fees students pay because tuition may not be reduced the full amount of their printing costs.
3. It will be frustrating for students because they will have to authorize a charge every time they print or copy.
4. It will be a financial burden on students because the bill will come at the end of the semester, long after financial aid has been disbursed.
5. It will not teach students to be more environmental because students will just print at home or somewhere else where they won't be charged.

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References

- Bell, A. (1984). Language style as audience design. *Language in Society, 13*, 145-204. doi:10.1017/S004740450001037X
- Bock, J. K. (1986). Syntactic persistence in language production. *Cognitive Psychology, 18*, 355-387. doi:10.1016/0010-0285(86)90004-6
- Branigan, H. P., & Pearson, J. (2006). Alignment in human-computer interaction. In K. Fischer (Ed.), *How people talk to computers, robots, and other artificial communication partners* (pp. 140-156; Report Series of the Transregional Collaborative Research Center SFB/TR 8 Spatial Cognition). Bremen, Germany: Universitaet Bremen.
- Branigan, H. P., Pickering, M. J., & Cleland, A. A. (2000). Syntactic co-ordination in dialogue. *Cognition, 75*, B13-B25. doi:10.1016/S0010-0277(99)00081-5

- Branigan, H. P., Pickering, M. J., Pearson, J., McLean, J. F., & Nass, C. I. (2003, July-August). *Syntactic alignment between computers and people: The role of belief about mental states*. Paper presented at the 25th annual meeting of the Cognitive Science Society, Boston, MA.
- Branigan, H. P., Pickering, M. J., Pearson, J., McLean, J. F., Nass, C. I., & Hu, J. (2004, March). *Beliefs about mental states in lexical and syntactic alignment: Evidence from human-computer dialogs*. Paper presented at the 17th annual meeting of the CUNY Human Sentence Processing Conference, College Park, MD.
- Brenner, J., & Smith, A. (2013). *72% of online adults are social networking site users*. Retrieved from <http://www.pewinternet.org/Reports/2013/social-networking-sites.aspx>
- Bunz, U., & Campbell, S. W. (2004). Politeness accommodation in electronic mail. *Communication Research Reports*, 21, 11-25. doi:10.1080/08824090409359963
- Burgoon, J. K. (1985). Nonverbal signals. In M. L. Knapp & G. R. Miller (Eds.), *Handbook of interpersonal communication* (pp. 344-392). Beverly Hills, CA: Sage.
- Byron, K., & Baldridge, D. (2005). Toward a model of nonverbal cues and emotion in email. In K. M. Weaver (Ed.), *Academy of Management best papers. Proceedings of the Academy of Management annual meeting, Organizational communication and information systems division* (pp. B1-B6). Briarcliff Manor, NY: Pace University. doi:10.5465/AMBPP.2005.18781269
- Carey, J. (1980). Paralanguage in computer mediated communication. In N. K. Sondheimer (Ed.), *The 18th annual meeting of the Association for Computational Linguistics and parasession on topics in interactive discourse: Proceedings of the conference* (pp. 67-69). Philadelphia: University of Pennsylvania. doi:10.3115/981436.981458
- Centers for Disease Control and Prevention. (2010). *Vaccines and preventable diseases: HPV vaccination*. Retrieved from <http://www.cdc.gov/vaccines/vpd-vac/hpv/default.htm>.
- Clark, H. H., & Brennan, S. A. (1991). Grounding in communication. In L. B. Resnick, J. M. Levine, & S. D. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 127-149). Washington, DC: APA Books.
- Cleland, A. A., & Pickering, M. J. (2003). The use of lexical and syntactic information in language production: Evidence from the priming of noun-phrase structure. *Journal of Memory and Language*, 49, 214-230. doi: 10.1016/S0749-596X(03)00060-3
- Colgrove, J. (2006). The ethics and politics of compulsory HPV vaccination. *New England Journal of Medicine*, 355, 2389-2391. doi:10.1056/NEJMp068248
- Cramton, C. D. (2001). The mutual knowledge problem and its consequences for dispersed collaboration. *Organization Science*, 12, 346-371. doi:10.1287/orsc.12.3.346.10098
- Derks, D., Bos, A. E. R., & von Grumbkow, J. (2008). Emoticons in computer-mediated communication: Social motives and social context. *CyberPsychology & Behavior*, 11, 99-101. doi:10.1089/cpb.2007.9926
- Dino, A., Reysen, S., & Branscombe, N. R. (2009). Online interactions between group members who differ in status. *Journal of Language and Social Psychology*, 28, 85-93. doi:10.1177/0261927X08325916
- Ferreira, V. S., & Bock, K. (2006). The functions of structural priming. *Language and Cognitive Processes*, 21, 1011-1029. doi:10.1080/01690960600824609
- Gabrilovich, E., & Markovitch, S. (2007). Computing semantic relatedness using Wikipedia-based explicit semantic analysis. *Proceedings of the 20th international joint conference on artificial intelligence* (pp. 1606-1611). San Francisco, CA: Morgan Kaufmann.
- Giles, H., Coupland, N., & Coupland, J. (1991). Accommodation theory: Communication, context, and consequence. In H. Giles, J. Coupland, & N. Coupland (Eds.), *Contexts of*

- accommodation: Developments in applied sociolinguistics* (pp. 1-68). Cambridge, England: Cambridge University Press.
- Gill, A., French, R. M., Gergle, D., & Oberlander, J. (2008). Emotion rating from short blog texts. *Proceedings of CHI 2008* (pp. 1121-1124). New York, NY: ACM Press. doi:10.1145/1357054.1357229
- Harris, R. B., & Paradise, D. (2007). An investigation of the computer-mediated communication of emotion. *Journal of Applied Sciences Research*, 3, 2081-2090.
- Issacs, E. A., & Clark, H. H. (1987). References in conversation between experts and novices. *Journal of Experimental Psychology: General*, 116, 26-37. doi:10.1037/0096-3445.116.1.26
- Jarvenpaa, S. L., Knoll, K., & Leidner, D. E. (1998). Is anybody out there? Antecedents of trust in global virtual teams. *Journal of Management Information Systems*, 14, 29-64.
- Lenhart, A. (2012). *Teens, smartphones, and texting*. Retrieved from <http://www.pewinternet.org/Reports/2012/Teens-and-smartphones.aspx>
- Lenhart, A., Purcell, K., Smith, A., & Zickuhr, K. (2010). *Social media and mobile internet use among teens and young adults*. Retrieved from <http://www.pewinternet.org/Reports/2010/social-media-and-young-adults.aspx>
- Liu, Y. L., Ginther, D., & Zelhart, P. (2002). An exploratory study of the effects of frequency and duration of messaging on impression development in computer-mediated communication. *Social Science Computer Review*, 20, 73-80. doi:10.1177/089443930202000107
- Lo, S. (2008). The nonverbal communication functions of emoticons in computer-mediated communication. *CyberPsychology & Behavior*, 11, 595-597. doi:10.1089/cpb.2007.0132
- Madden, M., & Rainie, L. (2003). *America's online pursuits*. Retrieved from <http://www.pewinternet.org/Reports/2003/Americas-Online-Pursuits.aspx>
- Marsh, K. L., Richardson, M. J., & Schmidt, R. C. (2009). Social connection through joint action and interpersonal coordination. *Topics in Cognitive Science*, 1, 320-339. doi:10.1111/j.1756-8765.2009.01022.x
- Pennebaker, J. W., Booth, R. J., & Francis, M. E. (2007). *Linguistic inquiry and word count: LIWC 2007*. Austin, TX: LIWC.
- Pickering, M. J., & Garrod, S. (2004). The interactive-alignment model: Developments and refinements. *Behavioral and Brain Sciences*, 27, 212-225. doi:10.1017/S0140525X04450055
- Rainie, L., Horrigan, J., Wellman, B., & Boase, J. (2006). *The strength of Internet ties*. Retrieved from <http://www.pewinternet.org/Reports/2006/The-Strength-of-Internet-Ties.aspx>
- Rice, R. E., & Love, G. (1987). Electronic emotion: Socioemotional content in a computer-mediated network. *Communication Research*, 14, 85-108. doi:10.1177/009365087014001005
- Rintel, E. S., & Pittam, J. (1997). Strangers in a strange land: Interaction management on Internet Relay Chat. *Human Communication Research*, 23, 507-534. doi:10.1111/j.1468-2958.1997.tb00408.x
- Riordan, M. A., Dale, R., Kreuz, R. J., & Olney, A. (2011). Evidence for alignment in a computer-mediated text-only environment. In L. Carlson, C. Hoelscher, & T. F. Shipley (Eds.), *Proceedings of the 33rd annual meeting of the Cognitive Science Society* (pp. 2411-2416). Austin, TX: Cognitive Science Society.
- Riordan, M. A., Markman, K. M., & Stewart, C. O. (2013). Communication accommodation in instant messaging: An examination of temporal convergence. *Journal of Language and Social Psychology*, 32, 84-95. doi:10.1177/0261927X12462695
- Roche, J. M., Dale, R., & Caucci, G. M. (2012). Doubling up on double meanings: Pragmatic alignment. *Language and Cognitive Processes*, 27, 1-24. doi:10.1080/01690965.2010.509929

- Rohde, D. L. T., Gonnerman, L. M., & Plaut, D. C. (2005). *An improved model of semantic similarity based on lexical co-occurrence*. Unpublished manuscript. Retrieved from <http://www.cnbc.cmu.edu/~plaut/papers/pdf/RohdeGonnermanPlautSUB-CogSci.COALS.pdf>
- Scissors, L. E., Gill, A. J., Geraghty, K., & Gergle, D. (2009). In CMC we trust: The role of similarity. In *Proceedings of the ACM CHI 2009 conference on human factors in computing systems* (pp. 527-536). New York, NY: ACM. doi:10.1145/1518701.1518783
- Shockley, K., Santana, M., & Fowler, C. A. (2003). Mutual interpersonal postural constraints are involved in cooperative conversation. *Journal of Experimental Psychology: Human Perception and Performance*, *29*, 326-332. doi:10.1037/0096-1523.29.2.326
- Smith, M. C., & Wheeldon, L. R. (2001). Syntactic priming in spoken sentence production: An online study. *Cognition*, *78*, 123-164. doi:10.1016/S0010-0277(00)00110-4
- Street, R. L. (2006). Speech convergence and speech evaluation in fact-finding interviews. *Human Communication Research*, *11*, 139-169. doi:10.1111/j.1468-2958.1984.tb00043.x
- The Radicati Group. (2011). *Email statistics report, 2011-2015*. Retrieved from <http://www.radicati.com/wp/wp-content/uploads/2011/05/Email-Statistics-Report-2011-2015-Executive-Summary.pdf>
- Utz, S. (2000). Social information processing in MUDs: The development of friendships in virtual worlds. *Journal of Online Behavior*, *1*(1). Retrieved from <http://old.behavior.net/JOB/v1n1/utz.html>
- Walther, J. B. (1992). Interpersonal effects in computer-mediated interaction: A relational perspective. *Communication Research*, *19*, 52-90. doi:10.1177/009365092019001003
- Walther, J. B., & Bunz, U. (2005). The rules of virtual groups: Trust, liking, and performance in computer-mediated communication. *Journal of Communication*, *55*, 828-846. doi:10.1111/j.1460-2466.2005.tb03025.x
- Walther, J. B., & D'Addario, K. P. (2001). The impacts of emoticons on message interpretation in computer-mediated communication. *Social Science Computer Review*, *19*, 324-347. doi:10.1177/089443930101900307
- Walther, J. B., Loh, T., & Granka, L. (2005). Let me count the ways: Verbal and nonverbal cues in computer-mediated and face-to-face affinity. *Journal of Language and Social Psychology*, *24*, 36-65. doi:10.1177/0261927X04273036

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