It's (Not) Simply a Matter of Time: The Relationship Between CMC Cues and Interpersonal Affinity

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ABSTRACT
Nonverbal, paralinguistic cues such as punctuation and emoticons are believed to be one of the mechanisms through which interpersonal relationship development takes place in text-based interactions. We use a novel experimental apparatus to manipulate these cues in a live Instant Message conversation. Results show a positive causal relationship of conversation duration and cue use on perceived affinity, and the relationship is contingent upon whether or not partners are able to see each other's cues. Further analysis of the dialogue reveals that reciprocity may play a central role in supporting this effect. We then demonstrate how one's cue use is influenced by a partner's cue use, and show that cues are often used in greeting and sign-off rituals.

Author Keywords
Language use; affinity; instant messaging (IM); computer-mediated communication (CMC)

ACM Classification Keywords
H.5.3 [**Information Interfaces and Presentation**]: Group and Organization Interfaces – collaborative computing, computer-supported cooperative work

INTRODUCTION
In recent years we have seen an abundance of interactions that take place in computer-mediated communication (CMC) environments. We effectively argue, debate, and persuade one another in forums and discussion threads [15,36], we express a wide variety of emotions in blog posts [13,32], have exchanges with people we know as well as those we have never met, and we can form, maintain and dissolve relationships in various online communities [4,34]. We can trust those we have just met [41], and deceive those we know well [2,17] – and we can do all of these things using text-based communication technologies.

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Yet, while recent literature and common practice suggests that text-based communication is widespread and capable of yielding positive relational outcomes, we still lack a detailed understanding of the particular mechanisms by which such outcomes are achieved. When and how do we craft our messages to better support relational communication when we have a seemingly diminished set of cues available? How do different cues help us to better establish positive relationships?

In this paper we aim to answer these questions by making use of a novel experimental platform that allows us to surreptitiously alter the messages being sent from one person to another. Our approach permits examination of the causal role that paralinguistic cues (e.g., "that's *reallllly* great!!!") play in the development of perceived affinity between partners by varying the duration of conversations and whether or not certain cues are removed.

In a laboratory study of sixty pairs we show that time spent engaged in an instant message conversation and the use of paralinguistic CMC cues [26] are both positively associated with perceived affinity based on previously validated measures. We make use of conditional process analysis [20] to uncover some of the mechanisms through which these effects operate, and we expand on the relationship among conversation duration, cue use and reciprocity. We show that CMC cues are a causal mechanism through which the effect of duration on perceived affinity operates. We then go on to show that the effect of cue use is dependent on whether partners can see each other's cues, suggesting that they play a more social and communicative role. Finally, we show that cues appear to be more effective when used in a reciprocal fashion, and that they are often used toward the beginnings and ends of conversations, suggesting a more phatic role. We conclude by offering implications for theory and design.

BACKGROUND
In everyday face-to-face communication, speakers use a variety of verbal and non-verbal behaviors to achieve interpersonal outcomes. For example, conversational pairs have been shown to converge in their word use and facial expressions as a way to indicate social receptiveness [12], and these behaviors are associated with positive outcomes such as increased liking and better negotiation results.

However, many of the behaviors used to establish relationships in face-to-face environments are simply

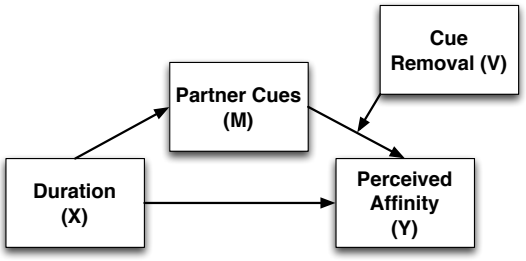

Figure 1. Conceptual representation capturing the conditional nature of the mechanisms by which duration influences perceived affinity.

unavailable in text-based CMC. Non-verbal and paralinguistic cues such as body language, facial expression, and vocal tone are all missing. This deficit, it is often argued, sets up a rather pernicious environment for effective interpersonal exchange. While older theories suggested that relational development is impeded in text-based environments [6], an emerging consensus suggests that speakers simply take more time [51] and rely on a different set of cues [28,50] to achieve similar outcomes to those in face-to-face environments. Furthermore, patterns of linguistic convergence have been identified in both laboratory settings [e.g., 42] as well as large-scale online environments such as Twitter [7] and Wikipedia pages [8].

The Role of Time, CMC Cues and Reciprocity

The social information processing (SIP) model provides guidance for understanding how relational development is possible in text-based CMC [47]. The SIP model was originally developed as a critique of earlier deficit theories (e.g., [6,29]) and it aimed to account for the proliferation of field data suggesting that users of text-based CMC were able to develop rich and lasting interpersonal relationships. The model has been widely applied to help explain a number of phenomena in CSCW and social computing including recent work on how non-native speakers interpret emotion in text [18], how Twitter users choose whom to follow [22], and how users choose media to develop relationships [40] or deal with conflicts [43], among others.

Two factors are particularly salient for relational formation in text-based CMC according to SIP theory. The first is that an *appropriate amount of time is needed* for the exchange of messages [47]. SIP posits that relational development in CMC takes longer than in face-to-face, and suggests this may be due to the lower time density of cues in CMC, which makes the transmission of affective information slower [49, p.535]. Utz [45] expanded this notion to suggest that it is the number of nonverbal cues transmitted per unit time that ultimately influences interpersonal development, and her correlational research suggests that both time and cue usage are associated with friendship development *within a single text-based CMC environment* [45]. The notion that time is an important factor has been further supported in work on trust in text-based environments [42], where the evidence suggests pairs can achieve equivalent levels to face-to-face environments; it simply takes longer to achieve [51].

Second, SIP posits that users adapt and develop new ways to express relational information, and in doing so it elaborates *a richer view of verbal and non-verbal cues* than other theories. Deficit theories tend to treat text-based exchanges as a simple collection of alpha-numeric characters and little more. The SIP model suggests that non-verbal cues from a face-to-face environment can be replaced by new cues unique to the technology [50], what have come to be called CMC cues [26]. These CMC cues can be *chronemic cues* [27,28,50] that capture the time-related aspects of messages such as response latencies or the time of day when a message was sent, or *paralinguistic cues* [3,25,26] that include the creative use of punctuation and capitalization, emoticons (":-)"), elongated letter repetitions ("wheeee"), or kinesic surrogates ("<grin>").

Researchers have also highlighted the role of higher-level discourse strategies as they relate to relational development in text-based CMC. One such dialogue pattern is reciprocity – the extent to which conversational pairs converge in their use of words or sets of conventions and norms. Reciprocity can take many forms, including linguistic style matching [14] or similarities based on semantic, syntactic, or stylistic properties of the dialogue [41,42]. It can also vary in granularity from semantic word clusters to individual words to the timing of individual characters. In this paper we examine reciprocity by looking for similar use in sets of cues as opposed to exact cue matching. Studies have shown that these adaptations, in the aggregate, are correlated with outcomes such as increased group cohesiveness and trust [14,42]. While the particular forms of these adaptations vary (for a review see [44]), they all rely on the ability of the partner to see the conversations[1].

Toward an Integrated Model

While prior work has identified the relationship among many pairs of variables, our research aims to integrate these separate findings into a unified and integrated process model. Figure 1 presents the conceptual model under investigation that links together notions of time (duration), cue usage (partner cues) and cue visibility (via cue removal) to better reveal both *when and how* perceived affinity develops in text-based CMC. Our analytical approach is based on conditional process analysis [20], which integrates mediation and moderation analyses to unveil the causal and dependent relations among the variables in the conceptual path model.

To review, prior work has shown time to be an important factor that enables positive social outcomes in text-based CMC environments [e.g., 45,51]. This relationship is

[1] It should be noted that the degree to which conversational partners need to be cognizant of these patterns is an active research area in the psycholinguistics discipline and the subject of considerable debate.

captured in Figure 1 as the direct effect from conversation duration to perceived affinity (X→Y). As previously discussed, prior work has also revealed connections among important process-level constructs such as the link between time and the production of CMC cues (X→M), and the relationship between the presence of CMC cues and relational outcomes such as trust and rapport (M→Y)[2]. The link between cues and social outcomes has been shown to result from impression formation [27,50] that often requires visibility of the cues. Furthermore, reciprocity-based research [14,42] suggests that partner-specific linguistic adaptations such as mimicry are also correlated with relational outcomes such as trust and cohesiveness, and they too rely on visibility.

The goal of our work is to bring these previously discrete findings together under an integrated model and to *experimentally identify the causal path through which duration influences perceived affinity*. We propose that increased duration leads to increased cue production, which in turn leads to increased perceived affinity. However, when the pairs do not see the cues (V) and therefore cannot form cue-based impressions or engage in reciprocal cue usage, the mediated path through cue generation should no longer be effective. In other words, the indirect effect that duration has on relational outcomes through CMC cue generation (X→M→Y) should be contingent upon the pairs being able to witness their partner's cues. A key contribution of our study is the ability to experimentally manipulate whether one can see a partner's cues during the conversation, as it allows us to examine a conditional influence on the degree to which cues affect relational outcomes such as perceived partner affinity.

HYPOTHESES

The following hypotheses summarize our thinking regarding the role of conversation duration, cue usage and cue visibility. Based on the links between time and social outcomes, we might expect a direct effect whereby:

H1: Pairs that converse in the long duration (15 minutes) condition will have higher perceived affinity ratings of the pair than those that converse in the short duration (5 minutes) condition (i.e., a direct effect from X→Y).

Increased conversational duration provides more time to affiliate and produce a greater number of cues, and prior literature also suggests that greater cue production is associated with positive social outcomes. Therefore, we should also expect:

H2a: Pairs that converse in the long duration condition will produce a greater number of cues than those that converse in the short duration condition (i.e., X→M).

H2b: Pairs that produce a greater number of cues will exhibit higher perceived affinity ratings (i.e., M→Y).

If CMC cues are indeed a mechanism through which pairs establish positive social outcomes, then we should expect to see that conversational duration has an indirect influence on perceived affinity through cue production. However, visibility is important for both impression formation as well as reciprocity. Therefore, we expect this relationship to be conditional on whether or not the pairs can see one another's cues. In other words, it is not simply the production of cues per se, but rather that both partners can see the cues, form impressions, and have the opportunity to reciprocate that matters. If this is the case, then we should expect:

H3: Conversational duration will lead to higher perceived affinity through the indirect path of cue generation, but only when those cues are visible to the partner (i.e., an indirect effect of X→M→Y, conditioned upon V)

Alternatively, if we see the influence of cue usage regardless of cue visibility, it may suggest more of a reflection of internal state resulting from affinity (e.g., I'm happy with how things are going, so I produce more paralinguistic cues). This is analogous to a smile serving a communicative function as opposed to being a reflection of an internal state of happiness [30]. Another possible alternative is that it is simply homophily in language use and not a pair-based social language phenomenon.

In addition to these path relations, we also explore the role of reciprocity on the production of cues over the entire conversation in order to gain deeper insight into the temporal and partner-contingent patterns of cue use. We expect that mutual visibility and its ability to support reciprocity is a mechanism through which pairs converge on cue use, and therefore:

H4: Pairs who can see each other's CMC cues will use similar numbers of cues, while those who cannot will not.

THE CURRENT STUDY

To examine the degree to which CMC cues can influence perceived affinity, and to better understand the interactive processes by which this occurs, we designed an experimental paradigm that allowed us to manipulate real-time transmission of CMC cues to a conversational partner. While previous research has experimentally manipulated nonverbal cues, it has done so largely through the use of pre-constructed stimuli in a non-interactive fashion [e.g.,

[2] In this paper we only investigate one of numerous potential models. Other conversational tasks and settings may exhibit different linkages such as bidirectional influence when pairs or groups already know one another (e.g., Y→M along with M→Y). Our goal is to establish definitive causal relations for the constructs and paths discussed, and we are not arguing that these are the only possible relationships that may exist.

Original message sent by participant A	What participant A sees in their chat window	What participant B sees in their chat window	Original message sent by participant B
Hey!	*A:* Hey!	*A:* Hey.	-
-	*B:* What?	*B:* What?!	What?!
this is gonna be so hard :(	*A:* this is gonna be so hard :(	*A:* this is gonna be so hard	-
-	*B:* clearly shes good at that	*B:* clearly shes GOOD at that	clearly shes GOOD at that

Table 1. Illustration showing example messages and how they looked for both the sender and receiver when in the condition where the CMC cues were manipulated.

5,27,28,48,50]. While this can reveal insights into outcomes such as perceptions of a message sender, it reveals little about the dynamic processes by which cues influence relational outcomes over time. Our approach isolates the effect of CMC cues, yet retains the language and timing of naturally occurring instant-message dialogue.

Our study apparatus makes use of a customized instant messaging environment called the Dialogue Experimentation Toolkit, or DiET [21]. DiET is a Java-based instant messaging client–server package specifically designed to manipulate conversations. We created a custom manipulation to automatically remove targeted paralinguistic cues in real time. This allowed us to perform experimental manipulations on naturalistic conversation with no perceivable delay, similar to an approach used by [16] in a different context.

Using this customized instant messaging environment, we assigned some pairs to have certain CMC cues[3] removed from their conversation. For the pairs in the cues removed condition, we targeted several specific paralinguistic cues: emoticons, exclamation points, interrobangs (e.g., ?!) and repeated question marks, the use of asterisks for emphasis (e.g., "that's *really* great"), and words in all capital letters (e.g., "SO ANNOYING"). We focused on these cues because they are commonly used [39] and can be detected and manipulated without significantly influencing the semantic meaning of the message.

Messages were manipulated as follows: exclamation points were replaced with periods, combinations of consecutive question marks and exclamation points were replaced with a single question mark, asterisks for emphasis and emoticons were removed, and words written in all capital letters were changed to lowercase. When developing these manipulations, we were careful to minimize any impact they could have on message meaning. For example, while we changed any number of exclamation points to a single period, if the string of exclamation points contained one or more question marks, the entire string was reduced to a question mark. This is because a question mark carries more semantic meaning than an exclamation point. We did not see any unexpected shifts in meaning when we reviewed the final transcripts and the changes that were made by our system.

To maintain the integrity of the experiment, it appeared to participants that their messages were transmitted intact even if cues were removed. In other words, there was no indication to the sender that their message was being altered as only the receiver saw the manipulated text strings. None of the participants stated that they were aware that the cues were being removed. Table 1 presents some examples from the final corpus and shows what the lines in the chat history looked like for both the sender and receiver.

METHOD

Participants were randomly assigned to two-person groups and each group was then randomly assigned to one of four experimental conditions drawn from a 2 × 2 between-subjects design: The first factor is the duration of conversation (*5 minutes vs. 15 minutes),* and the second factor is the cue removal condition (*cues intact vs. cues removed)*. We determined conversation durations based on pilot testing, with the shorter time being near the minimum needed to complete the task.

Participants

Participants (N = 120, 71% female) were students, staff, and members of the surrounding community of a mid-sized Midwestern U.S. university. Their mean age was 22.9 years. Five (8.3%) of the dyads were male–male, 30 (50%) were female–female, and 25 (41.6%) were mixed gender. Participants did not know or see their partner before or during the study, and were not made aware of their partner's gender. Additionally, they were instructed not to divulge personal information during the conversation.

Procedure

The study took place in two physically separate rooms. Arrival times were staggered and participants arrived at two separate locations and were then taken individually to their respective study rooms. Upon arriving, participants consented to enrollment and then completed a pre-chat demographics questionnaire. They then engaged in an instant message conversation with their partner for five or fifteen minutes. Participants were told how long their

[3] For the sake of brevity, when discussing this study we use the term "CMC cues" to refer only to the cues that we manipulated rather than the full array of CMC cues that users may have in their repertoire.

conversation would be, and were given a warning when one minute was left so they could conclude their conversation.

Because the goal of this study was to understand the ways in which CMC cues are related to beliefs regarding pair affinity, we required a conversational elicitation task that would generate lively discussions. Pairs were asked to engage in a discussion about a moral dilemma with the aim of arriving at a resolution (adapted from [46]). Each partner was also given a potential resolution that they could argue for during the conversation. An example of such a moral dilemma is:

> *"You and your partner have a mutual friend who is engaged to be married in two months. You both just learned that your friend's fiancé may have recently cheated on your friend. You and your partner are discussing what to do with this information.*
>
> *The goal of your discussion is to try to agree on what to do in this situation.*
>
> *For the purposes of this discussion, your opinion is that you need to tell your friend what you heard."*

Other scenarios addressed whether friends should hide their cohabiting relationship from unsuspecting parents, and how to deal with the suspicion that a friend's sibling was a thief.

Each partner was instructed to try to convince their partner of their assigned position, but only one participant in each pair was told that they could better convince their partner to take their stance if their partner liked them. To that end, that participant was given a sheet of paper with suggested strategies to increase liking in text-based communication, including using the CMC cues we were manipulating: "Be positive!; Use emoticons :); Don't wait too long between messages; Show how you're feeling – 'Vocal surrogates' like haha or uggghhh are ways to do this; Be expressive – feel free to use CAPS or *emphasis*". This was done to ensure some production of cues and to permit examination of reciprocity effects, as our pilot testing indicated that some participants were unsure whether they were allowed to use a wide variety of cues to express themselves.

To maintain participants' privacy and minimize any potential gender effects, each participant was assigned a unique ID number and username. The usernames were not English words, did not strongly evoke another word, and did not evoke anything gender normative. This was done with a password generator for pronounceable passwords such as *Zorest*, *Pajles*, and *Jerigl*.

At the conclusion of the instant message conversation, participants recorded responses for two scales that captured how they believed their partner perceived the rapport and likeability of the pair.

Measures

We assessed the impact of conversation duration and cue usage on both outcome and process measures. The primary outcome measure, perceived affinity, was constructed from multi-item response scales that captured beliefs about the relational constructs of rapport and likeability. We measured these using partner-based assessments (e.g., "I think my partner believes I am…") to better capture relationship-level dyadic perceptions rather than direct assessments of the other individual.

Perceived rapport was measured using LaFrance's 6-item scale [31]. Each of six semantic differential items was measured on a 7-point bipolar scale (e.g., with endpoints "out of step – in step" or "incompatible – compatible"). Perceived likeability was measured using Jones' 4-item scale [23]. Each of four semantic differential items were measured on a 7-point bipolar scale (e.g., with endpoints "not friendly at all – very friendly" or "not understanding at all – very understanding").

Principal component analysis was used to assess the dimensionality of the questions. The Kaiser criterion was used and suggested a single factor existed. We therefore combined the rapport and likeability questions into a single composite index by taking the mean of all of the items from both of the scales. Throughout the remainder of this paper we refer to this variable as *perceived affinity*, and it was normally distributed (M = 4.74, SD = 1.07) and composed of highly reliable items (Cronbach's α = .95).

A number of process measures were also computed from the interaction logs. These include the total number of cues, the number of cues generated by each participant and their partner, and when the cues occurred. These measures serve as the basis for secondary analyses such as the reciprocity results described below.

RESULTS

Our results are presented in three stages. The first stage of analysis presents descriptive statistics that capture the amount of conversation produced and provide insight into the types of CMC cues produced by the pairs. The second stage applies conditional process analysis [20] techniques to examine the moderated mediation effect of CMC cues and the cue removal condition (see Figure 1). Finally, we conclude with an analysis of reciprocal cue use between partners, and a temporal analysis of when cues are used during the conversations to glean additional insight into when and how the pairs made use of the cues.

	Cues Removed Condition	Cues Intact Condition	Total
Exclamation points	88	102	190
Interrobangs and repeated question marks	12	4	16
Emoticons	30	44	74
All caps	25	14	39
Emphasis	0	2	2
All cues	155	166	321

Table 2. CMC cues generated by participants.

		Partner Cues (M)					Perceived Affinity (Y)			
		Coeff.	SE	t-value	p		Coeff.	SE	t-value	p
Duration (X)	a	1.744	.434	4.02	*.0001*	c'	.3605	.2044	1.76	*.081*
Partner Cues (M)		---	---	---	---	b_1	.1498	.0482	3.11	*.002*
Cue Removal (V)		---	---	---	---	b_2	.0399	.1897	.2102	*.8339*
Partner Cues × Cue Removal (M×V)		---	---	---	---	b_3	-.1627	.0820	-1.9858	*.0495*
Intercept	i_1	-.8433	.301	-2.80	*.006*	i_2	4.5213	.1650	27.4	*.0001*
		F (1,114) = 16.18, p < .001					F (4,111) = 3.95, p < .01			

Table 3. Model coefficients for the conditional process model presented in Figure 1 and formalized in Eqs. (1.0) and (2.0).

Descriptive Statistics

Sixty pairs generated a total of 23,467 words across 2,363 lines of text chat. The duration of the conversation had the expected effect on the amount of content produced. The pairs produced more words[4] in conversations of longer duration than those of shorter durations ($M_{15\text{-}mins}$ = 577.6 vs. $M_{5\text{-}mins}$ = 204.7; $t(58) = 11.23$, $p < .001$). Yet, the cue removal manipulation did not appear to alter the overall amount of words produced ($M_{cues\text{-}removed}$ = 408.3 vs. $M_{cues\text{-}intact}$ = 373.9; $t(58) = 0.58$, $p = 0.56$). This is important because it shows that cue removal did not artificially stifle conversation.

The pairs also generated a number of CMC cues in the study. These include exclamation points, interrobangs and repeated question marks, emoticons, all capital usage and other emphasis cues. The mean number of cues produced by each pair was 5.35 (with a mean of 3.33 cues in the 5-min condition and 7.34 in the 15-min condition). Table 2 presents the number of cue types produced broken out by their particular form. The partner in each pair that received the list of strategies used a mean of 3.31 cues compared to 1.83 for those who did not. In total, 9.7% of lines included a CMC cue based on our operationalization. Of the 1,426 lines generated by participants in the cue removal condition, 155 cues on 105 lines (7.36% of lines) were removed by our system[5].

The Contingent Effects of Duration and Cue Usage

Conditional process analysis [20, p.327], or more specifically moderated mediation in path analytic terms [9], allows us to better understand how time and cue usage influence perceived affinity. It reveals the degree to which duration directly affects perceived affinity or whether some other variables—in this case the production and availability of CMC cues—appear to be mechanisms through which duration acts upon perceived affinity. We make use of Hayes' PROCESS macro[6] to statistically analyze the conceptual model presented in Figure 1, which can be formally specified with two equations:

$$M = i_1 + aX + e_M \quad (1.0)$$
$$Y = i_2 + c'X + b_1M + b_2V + b_3MV + e_Y \quad (2.0)$$

The results[7] of the model are presented in Table 3.

When investigating *H1*, we start by seeing an effect of duration on perceived affinity, $t(118) = 2.20$, $p = .029$. However, when controlling for the indirect effect of partner cues the remaining direct effect of duration on perceived affinity is no longer significantly different from zero (c' = .3605, $p = .081$). This supports the idea that partner cues resulting from duration, and not conversation duration itself, is the mechanism that drives perceived affinity[8].

Further examination of the results demonstrates that conversation duration leads to greater production of partner cues (a = 1.744, $p < .0001$), in support of *H2a*. In addition, an increase in partner cues also leads to higher ratings of perceived affinity (b_1 = .1498, $p = .002$), in support of *H2b*. However, this relationship depends on whether or not the cues were removed. The effect of partner cues on perceived affinity is contingent upon whether or not they are removed and therefore visible by the partner. This can be seen in the partner cues × cue removal interaction (b_3 = -.1627, p = .0495), in support of *H3*.

Calculating the conditional indirect effects of duration on perceived affinity reveals a more detailed understanding of

[4] The same pattern of findings is found when examining the number of lines of chat produced for each of the various conditions.

[5] These rates tend to be in line with rates found in other natural settings. For example, 9.7% of English tweets contain at least one emoticon [39], while our corpus had 3.1% of contributions contain an emoticon, and 13.6% of lines contain any of the cues we considered (including exclamation points).

[6] Readers may be familiar with the related "causal steps approach" of Baron & Kenny [1] and we find a similar pattern of results using this approach; however, the causal steps approach has been challenged due to its low power and lack of direct statistical inferences regarding the mediating path [10,19,35].

[7] While the parameters in the final model are correlated to an extent, they did not exhibit multicollinearity at a problematic level. The Variance Inflation Factors (VIFs) were < 1.25 for all of the final model parameters. This is considered well within the range of acceptable practice.

[8] It should be noted that the remaining direct effect approaches statistical significance (p = .081). While a significant finding here would not invalidate any claims made in this paper, it would suggest that partial mediation may be occurring and that duration itself may also have a significant impact on the dependent variable.

the partner cues × cue removal interaction. The indirect influence of partner cues on perceived affinity remains significant and positive when the cues are intact and visible to the partner (.2614 with 95% bootstrapped CI's [.1030, .5065]), but it appears to have no effect when cues are removed (-.0225 with 95% CI [-.3357, .2247]); the difference between these conditional indirect effects is significant (-.2838 with 95% CI [-.7039, -.0166]).

In other words, we find statistical support that conversational duration yields more cues, and those cues lead to greater perceived affinity, but only when the partner can see them. This latter point is particularly important as it suggests that *the visible presence of cues are a causal mechanism*, whereas prior literature has not definitively demonstrated either the causal effect of increased cues on affinity or the causal effect of greater affinity on cue usage. We demonstrate the former, but this does not necessarily preclude the latter.

By showing that cues are a mechanism through which added time can lead to greater positive social outcomes, we provide evidence for the notion that time plays a critical role in how people form positive beliefs regarding affinity in our task setting, and that cues appear to be a mechanism through which this is achieved.

Social and Paralinguistic Processes

In addition to establishing the role that CMC cues play in developing perceived affinity, it is also important to examine how and when cues are used. One important question centers on whether cue use takes place in isolation, or whether partners converge on a set of expected behaviors during a conversation. An advantage of using natural conversations is the ability to test whether a feedback loop of cue use is present. Previous work [14,42] has found correlations between partner cue use, but here we are able to demonstrate that the number of cues a participant uses not only depends on how many cues their partner uses, but also whether or not they can see those cues. In other words, it is not just a result of similarity in general language use.

To investigate the degree of cue reciprocity occurring, for each pair we predicted one partner's cue use based on the other's. We employed a Poisson regression approach where the response (Y) has a Poisson distribution, and we apply generalized linear modeling with a log link function ($\ln(\mu_i)$), since cue usage exhibits a distributional form typical of count data. The model can be formally specified as follows:

$$logY = i_1 + b_1X_1 + b_2X_2 + b_3X_1X_2 + e_Y \quad (3.0)$$

The model included partner total cue use (X_1), a binary indicator variable for cue removal condition (X_2), and an interaction of the two terms (X_1, X_2). The resulting coefficient can be interpreted as the impact of a unit change in the predictor on the difference in the log of the expected count of one's own cue usage.

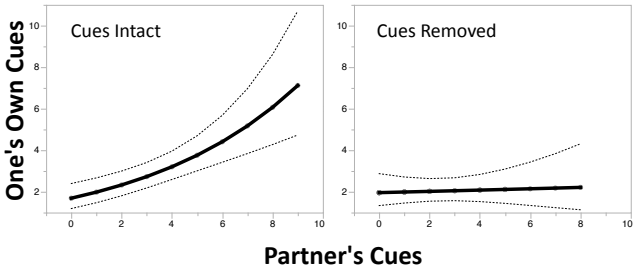

Figure 2. Partner cues influence one's own cue uses, but only when the cues are intact and can be seen. The left panel presents the regression line and 95% CI's when the cues were left intact, and the right panel presents the regression line and 95% CIs when the cues were removed.

We find a significant relationship between partner cues and one's own cues ($b_1 = 0.087$, $p < .012$), but this is driven primarily by the reciprocity exhibited in the cues intact condition, as seen in the significant interaction between partner cues and cue manipulation ($b_3 = 0.072$, $p < 0.029$). The interaction is illustrated in Figure 2. This graph shows that the number of cues someone uses depends on whether they can see their partner's cues. In other words, reciprocity appears to play a primary role in determining cue use patterns within our pairs. This is in support of *H4*: users who can see each other's cues use similar numbers of cues, but there is no relationship between partners' cue use when they are unable to see each other's cues.

This interaction between cue reciprocity and the cue removal condition suggests a kind of conversation-level entrainment or style-matching. If this is taking place, we would also expect to see that pairs whose cues are not being manipulated will be more likely to continue using cues throughout a conversation, while those whose cues are being removed will have their cue use largely confined to the beginning of their conversations, before the norms have been entrenched.

A histogram of the temporal distribution of cue use is shown in Figure 3. The horizontal axis is the time into a conversation, as a fraction of the total length of the conversation (in lines). The top figure shows that, when a conversation's cues are left intact, cues seem to be used more at the beginning and end of the conversation – essentially during greetings and signoffs. The bottom figure shows the same distribution when cues are removed. Here the number of cues starts off similarly high, but levels off at a low rate that stays relatively constant though the rest of the conversation, with a much smaller uptick toward the end. These patterns are partially confirmed using χ^2 tests that reveal little difference in the beginning third of the distributions (χ^2 (1, N = 274) = 0.068, p = 0.81), while the latter third of the distributions appear to be different at the trend level (χ^2 (1, N = 274) = 3.33, p = 0.056). This further suggests some degree of reciprocity may be involved when people are crafting messages that include CMC cues.

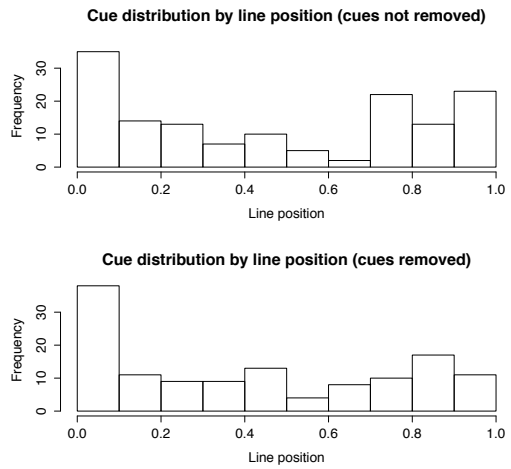

Figure 3. CMC cue distributions (normalized over different conversation lengths).

DISCUSSION

In this paper we set out to establish the relationship between time, CMC cues, and perceived affinity, and integrate these findings into a more comprehensive model that captures the processes, mechanisms and conditions under which each of these factors operate. As previously discussed, prior work has shown time to be an important variable related to positive social outcomes in text-based environments, links have been drawn between time and the production of cues, and cue usage has been correlated to important social outcomes such as rapport. However, prior work falls short of describing how these variables interoperate and as a result we are left with a fragmented theoretical picture that does not capture the contingent relations among the various variables. The richer process-oriented understanding developed here also provides deeper insight into the ways in which these findings can be applied to technological systems.

Theoretical Implications

We find that conversation duration appears, at first glance, to have an effect on perceived affinity: more time facilitates better social outcomes. However, our results go beyond demonstrating the existence of this effect to uncover the conditions under which it operates, as well as expose the boundaries and limits of those conditions. An important point to highlight is our finding that the effect of duration, which in the past has been trumpeted as a primary driver of positive social outcomes, does not appear to have a direct effect upon perceived affinity. Instead, its effectiveness appears to come from enabling conversational strategies that are more directly related to relational outcomes. In other words, it is not simply a matter of time.

The number of CMC cues that a participant's partner produces mediates the effect of duration on perceived affinity. Put another way, in this study we show that longer conversations yield more partner cues, and more partner cues yield greater perceived affinity. This indirect effect, however, is conditional: It depends upon the pairs being able to see the cues. When we experimentally remove the ability of pairs to see their partners' cues, the effect disappears altogether.

The fact that the partner needs to see the cues is an important piece of causal evidence in support of the idea that CMC cues themselves can directly influence one's perception of important social outcomes such as likeability and rapport. Prior approaches examining cue generation in natural dialogue have not been able to exclude reverse causality. For example, Scissors et al. [42] point out that, based on their findings and methodology, they were unable to say whether the use of CMC cues influences positive social outcomes, or whether positive social outcomes lead to more cues. While we do not rule out that affinity can lead to increased cue usage (i.e., there may still exist a bi-directional relationship), we definitively demonstrate that increased and visible cue usage mediates the effect of duration on perceived affinity. This is because our methodology allows us to turn off specific dialogue behaviors and observe the causal impact that doing so has on social outcomes. With our approach we can disentangle the direction of the relationship between cues and perceived affinity and show that, at least in this context, visible cue usage influences perceived affinity. The relationship may, in hindsight, appear unsurprising; but demonstrating causal direction is a novel and important contribution to theory.

The implications of visibility and the role of reciprocity also merit discussion. Recall that we find that an increase in partner cues yields increased ratings of perceived affinity; however, when those cues are not visible due to the cue removal condition, an increase in partner cues is no longer effective. From the perspective of impression formation, this makes sense, as we need to "see" what was said in order for the cues to influence our impressions. Reciprocity effects, however, pose a slightly more complex challenge. Seeing a partner reciprocate one's own use of cues can be perceived as an indicator of affinity. Alternatively, a participant that produces their own cues and does not see them reciprocated may form a negative impression. Unfortunately, our analytical approach does not specifically include these dyadic contingencies and therefore we cannot say with certainty how reciprocity plays a direct role upon perceived affinity. However, we present evidence of reciprocal cue *production* when the cues are visually available, and this suggests that reciprocity plays some role. Disentangling this relationship requires additional studies.

We also examined the temporal aspects of cue use within conversations. It is interesting to note that while reciprocity appears to be driving much of the cue use (or lack thereof) within the pairs, their social function occurred in large part during greetings and sign-offs. It has been suggested that emoticons may serve as a form of phatic communication; that is, they serve a social function rather than contain much

content [48]. Our data corroborate this: the following contains numerous cues, but is nearly devoid of content:

Mavagl: Hello!
Ralect: Hi!
Mavagl: How was your day?
Ralect: So far, so good
Ralect: yours?
Mavagl: I'm glad :). Mine was good as well!

In this example, we can see the extent to which cues are a part of ritualized communication because this particular pair is unable to see each other's cues, yet they both use them to open their conversation. This is despite the more general trend of cue use being reciprocal. While we do not investigate phatic communication in depth in this work, we feel it is a potentially rich area for future work that aims to focus on the temporal aspects of cue usage [cf. 33,37,38].

Finally, it is worth mention that our manipulation only removed a small subset of cues; yet, even with removal of only a small subset of cues we were still able to demonstrate their mediating role. In this regard the manipulation demonstrates strong causal efficacy. Even more surprising is that these effects exist despite allowing word choice, verbal content, the timing of the exchanges, and other properties of the discourse to remain intact. That being said, verbal content and word choice are quite likely to play an influential role – and previous work [48] suggests that some affective verbal content can overwhelm the influence of certain CMC cues. So while a cue may serve to heighten a given expression, the use of a superlative may have even greater impact. Our results rely on assumptions of similar verbal content, while it is likely that both content and cue usage would change in tandem during natural dialogue. This aspect of the work merits further exploration.

Practical Implications

The SIP model contends that communication media that can transmit a higher quantity of cues per time should facilitate relationship development in less time, and work by Utz [45], in concert with our findings, extend this idea to relationship development in a single communication technology. Our analysis shows that cues can lead to positive perceptions regarding social outcomes. Taken in isolation from our other findings, this suggests that text-based technologies that allow for higher cue density may be better suited to enabling relationship formation.

From a design perspective, it is important to know whether nonverbal cues in CMC are primarily useful to help form relationships, or whether they are useful to maintain and strengthen existing ones. In our work, even in the short time in the laboratory, we found that cue use was associated with the formation of positive impressions regarding pair affinity for individuals that do not know one another. Thus, our findings are potentially important for systems that aim to support text-based relational development on important social, relational and group outcomes (e.g., team assembly and new group formation, online dating, etc.).

Another practical application a richer understanding of nonverbal cues in text-based communication can provide is in automated chat agents. Many industries have begun using automated chat agents as part of their customer support chains. The ability of such agents to establish and maintain high levels of sociability can have a direct impact on companies and customers alike. Certain behaviors, like limiting the use of paralinguistic cues to the beginning and ends of conversations, and using them at a rate and in a contingent fashion similar to that of the human interlocutor, may help make the automated agent easier to get along with or feel more humanlike. Such an agent could also have a richer computational model that would enable it to better interpret the state of a conversation.

FUTURE WORK AND LIMITATIONS

There are a number of important limitations and avenues for future research. First, when examining the role of cues, we were only able to manipulate them in one way: removal. It would be interesting to investigate the effects of adding cues, as well. This presents challenges, however, because while we did remove cues, we did our best to retain all semantic meaning. For example, while an exclamation point became a period, a group of mixed exclamation points and question marks became a single question mark, thereby retaining the interrogative nature of the sentence. Algorithmically inserting CMC cues while retaining semantic meaning is a much more challenging proposition.

Second, we suspect that, as a laboratory study in which the conversation topic is given, participants may have been less willing to fully exploit the affordances of text-based communication. This may have pushed cue use and perceived affinity outcomes down. In addition to considering broader deployments and different contexts of use, future work should try to replicate our results among other populations and with other task types. Many of the participants in our study were associated with a university, which means that they skewed younger and female. This population is known to use CMC differently than other groups [52]. In order to make more generalizable claims, a sample that is more representative of all CMC users is needed. Another promising future direction would be to integrate richer models of paralinguistic cue usage into models that examine the longer-term relational development that takes place in large-scale online communities and environments [e.g., 11,24].

Third, the tasks used in this study contained emotional content and asked participants to be persuasive. Because we chose a task with high emotional content, it is possible that the topic may have exposed more CMC cues than would be expected in a less emotional conversation. This was partially by design, as we wanted a strong experimental manipulation, but may have introduced a bias that makes it harder to generalize to CMC use in general. Similarly, persuasion may have induced certain conversational strategies beyond what would have naturally been

employed. Whether or not the interpersonal dynamics in this study differ from those in other types of conversations is left to future work.

Finally, it is important to keep in mind that this is simply one experiment and one way of specifying a potential model. The study was designed to help identify the causal path through which duration influences perceived affinity. The finding that visible cue usage plays a mediating role does not preclude the fact that as affinity grows it could also influence cue usage. In other words, demonstrating causality in one direction does not necessarily mean causality does not occur in the other direction as well. In fact, it is quite likely that in other conversational settings, task environments, etc. a bi-directional influence may exist. Uncovering this, however, will require new experimental techniques and additional studies.

CONCLUSION

The contributions of this work are three-fold. First, we make use of conditional process analysis to elaborate some mechanisms by which duration and cue usage effects operate. Second, we demonstrate that social reciprocity likely plays a role: seeing cues influences someone to use them themself. Finally, we offer a novel experimental paradigm in which CMC cues are manipulated in order to make stronger causal claims about the role of CMC cues in text-based social interaction.

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