Abstract

The aim of this study was to investigate the influence of Computer-Mediated Communication (CMC) on interpersonal attraction, and to examine some underlying processes in the CMC-interpersonal attraction relationship. We identified three variables that may mediate the influence of CMC on interpersonal attraction: similarity, self-disclosure, and direct questioning. Focusing on these potential mediating variables, we formulated and tested three explanatory hypotheses: the CMC-induced similarity hypothesis, CMC-induced direct questioning hypothesis, and CMC-induced self-disclosure hypothesis. Eighty-one cross-sex dyads were randomly assigned to one of three experimental conditions: text-only CMC, visual CMC, and face-to-face communication. We did not find a direct effect of CMC on interpersonal attraction. However, we did find two positive indirect effects of text-only CMC on interpersonal attraction: Text-only CMC stimulated both self-disclosure and direct questioning, which in turn both enhanced interpersonal attraction. Results are discussed in light of uncertainty reduction theory and CMC theories.

Introduction

The opportunities to form relationships on the Internet have multiplied in the past decade. Not only has the use of chat and Instant Messaging increased tremendously, but also social networking sites are rapidly gaining prominence as a venue to establish relationships. The growing popularity of the Internet as a setting for relationship formation is hardly surprising. Online communication or, more generally, computer-mediated communication (CMC) has some characteristics that may stimulate interpersonal attraction and thereby, relationship formation. In particular, the reduced visual and auditory cues of CMC and the resulting visual anonymity are assumed to stimulate interpersonal attraction (Cooper & Sportolari, 1997; Walther, 1996; Walther, Slovacek, & Tidwell, 2001).

Several studies have investigated the effect of reduced auditory and visual (i.e., nonverbal) cues in CMC on interpersonal attraction. Most of these studies have focused on the socio-emotional part of interpersonal attraction commonly called “liking” (McCroskey & McCain, 1974). The studies have yielded inconsistent results. Some studies found positive effects of CMC on interpersonal attraction (Bargh, McKenna, & Fitzsimons, 2002; McKenna, Green, & Gleason, 2002; Walther, 1995). However, several other studies demonstrated no effects (Coleman, Paternite, & Sherman, 1999; Walther & Burgoon, 1992), or even negative effects of CMC on interpersonal attraction (Burgoon et al., 2002; Kiesler, Siegel, & McGuire, 1984; Kiesler, Zubrow, Moses, & Geller, 1985; Weisband & Atwater, 1999).

An important factor that may contribute to the mixed findings of earlier CMC-interpersonal attraction studies derives from the fact that many of these studies did not specify how CMC is related to interpersonal attraction. Most CMC research has investigated the relationship between CMC and interpersonal attraction as a simple input-output process. Although many CMC studies implicitly assume that certain mechanisms, such as enhanced feelings of similarity or intimate self-disclosure, may explain CMC effects on interpersonal attraction, the mediating influence of these mechanisms have never been tested. In addition, there is no CMC research in which several alternative explanatory hypotheses have been pitted against each other.
Chapter 2

The first aim of our study is to fill these gaps in earlier research by investigating the validity of three potential mediators that may account for the effects of CMC on interpersonal attraction. On the basis of these mediators, we formulate three hypotheses that may explain the effect of CMC on interpersonal attraction. Each of these hypotheses attributes the effect of CMC to a different underlying process. By empirically contrasting the validity of the underlying mechanisms proposed in these three hypotheses, we hope to improve theory formation and contribute to a more profound understanding of CMC effects on interpersonal attraction.

The second aim of our study is to compare two types of CMC that have become very popular in recent years (Lenhart, Madden, & Hitlin, 2005; Peter, Valkenburg, & Schouten, 2007) and therefore have high ecological validity: Instant Messaging with and without a webcam. Until now, CMC research has been largely based on the assumption that CMC involves text-only communication. However, in recent years CMC has progressively lost its text-only character (Lenhart et al., 2005; Peter, Valkenburg, & Schouten, 2007). In fact, a considerable proportion of young people now add visual or auditory information to their CMC. In our view, these recent developments in CMC may provide many new challenges for CMC theories whose reasoning is based on the assumption that CMC necessarily involves reduced nonverbal cues.

Three Hypotheses Compared

On the basis of earlier CMC literature, we formulated three hypotheses. The validity of the hypotheses was assessed in an experimental test. Our first hypothesis, the CMC-induced similarity hypothesis, assumes that the reduced nonverbal cues in CMC stimulate feelings of similarity (Dubrovsky, Kiesler, & Sethna, 1991), which in turn increase interpersonal attraction (e.g., Byrne, 1971). The second hypothesis, the CMC-induced direct questioning hypothesis, is based on the idea that CMC stimulates the deployment of interactive uncertainty-reduction strategies, such as direct questioning (e.g., Tidwell & Walther, 2002), which in turn leads to enhanced attraction. The third hypothesis, the CMC-induced self-disclosure hypothesis,
assumes that CMC-induced self-disclosure accounts for an enhanced interpersonal attraction (e.g., Walther, 1996).

The CMC-induced similarity hypothesis. This hypothesis states that the reduced nonverbal cues of CMC stimulate feelings of similarity, and subsequently interpersonal attraction. The hypothesis assumes that CMC partners have less access to nonverbal social status cues, like clothing, accent, and physical appearance, which often uncover interpersonal differences in face-to-face settings. CMC theories, like the hyperpersonal communication framework (Walther, 1996) and The Social Identity Model of Deindividuation Effects (Lea & Spears, 1992; Spears & Lea, 1992) suggest that CMC partners are forced to focus on whatever minimal cues do appear in a CMC setting. This may result in an over-reliance on the available cues, whereas the nonverbal cues that may normally prevent feelings of similarity are not present. As a result, CMC partners may more readily feel akin to their communication partner than face-to-face partners.

Although the assumption that CMC results in increased feelings of similarity received empirical support (Dubrovsky et al., 1991), it has not been investigated whether this CMC-induced similarity increases interpersonal attraction. However, a series of general studies into interpersonal attraction has demonstrated that similarity is one of the main determinants of interpersonal attraction (e.g., Aronson, 1999; Byrne, 1971; Secord & Backman, 1964; Shaikh & Kanekar, 1994). Based on these research findings, we expect that similarity will act as an important mediator in the relationship between CMC and interpersonal attraction. Therefore, our first hypothesis, which is visualized in Figure 1 (path 1a and 1b), is:

H1: CMC stimulates perceived feelings of similarity (path 1a), which in turn leads to higher levels of interpersonal attraction (path 1b).
The CMC-induced similarity hypothesis: 

CMC → similarity → interpersonal attraction

The CMC-induced direct questioning hypothesis: 

CMC → direct questioning → interpersonal attraction

The CMC-induced self-disclosure hypothesis: 

CMC → self-disclosure → interpersonal attraction

The CMC-induced direct questioning hypothesis. This hypothesis is inspired by Berger and Calabrese’s (1975) uncertainty reduction theory. Uncertainty reduction theory assumes that when strangers meet, their primary concern is to reduce uncertainty and increase the predictability of the behavior of the interaction partner. Berger (1979; Berger, Gardner, Parks, Schulman, & Miller, 1976) has identified three types of uncertainty reduction strategies: passive (e.g., reactivity search, social comparison), active (e.g., asking others about the target individual) and interactive strategies (e.g., direct questioning, self-disclosure).
The CMC-induced direct questioning hypothesis states that CMC stimulates interpersonal attraction, because CMC participants are forced to use interactive uncertainty reduction strategies, such as direct questioning. Tidwell and Walther (2002) argue that many passive and active uncertainty reduction strategies common in face-to-face settings are impossible to deploy in CMC settings. As a result, CMC users are forced to use interactive uncertainty reduction strategies, such as direct questioning. Asking others direct questions is less common in face-to-face settings; it is easily perceived as impolite. However, direct questioning may be forgiven in a CMC setting due to the lack of alternative strategies. A possible result of the enhanced use of direct questioning in CMC could be that communication partners feel privileged by this candid interest in different aspects of their self, which may stimulate their liking of this partner. After all, positive verbal attention in early stages of relationship formation can have a powerful effect on interpersonal attraction (Albada, Knapp, & Theune, 2002).

Although Tidwell and Walther (2002) found that CMC leads to more direct questioning, they did not examine the mediated relation between CMC, direct questioning, and interpersonal attraction. In our view, it is quite possible that direct questioning accounts for the relationship between CMC and interpersonal attraction. Therefore, our second hypothesis, which is visualized in Figure 1 (path 2a and 2b), states:

H2: CMC leads to more direct questioning (path 2a), which in turn enhances the levels of interpersonal attraction (path 2b).

The CMC-induced self-disclosure hypothesis. The third hypothesis attributes the positive effect of CMC on interpersonal attraction to enhanced self-disclosure. There are two conceptually related explanations for why CMC leads to more self-disclosure. A first explanation follows from uncertainty reduction theory. As discussed in the previous section, self-disclosure is, just as direct questioning, an interactive uncertainty reduction strategy (Berger, 1979; Berger et al., 1976). Therefore it is possible that, given the lack of alternative strategies, CMC partners are forced to use the self-disclosure strategy more often than face-to-face partners.
A second explanation of CMC-induced self-disclosure is provided by Walther’s (1996) hyperpersonal communication framework. This theory assumes that the reduced nonverbal cues of CMC encourage people to feel less inhibited and to disclose their inner feelings at an earlier stage (1996). Anonymous CMC interactions resemble those identified in the “Stranger on the train phenomenon” (Thibaut & Kelly, 1959), in which people sometimes reveal their most intimate thoughts to unknown companions on a train or plane (McKenna & Bargh, 2000).

Although it is still unknown which of the aforementioned theories is more plausible to explain positive CMC effects on self-disclosure, empirical research has consistently demonstrated that CMC stimulates intimate self-disclosure (Bargh et al., 2002; Coleman et al., 1999; Joinson, 2001; Tidwell & Walther, 2002). However, because self-disclosure is a main determinant of interpersonal attraction (Bargh et al., 2002; Collins & Miller, 1994; McKenna et al., 2002), CMC-induced self-disclosure may act as an important mediating variable in the CMC-interpersonal attraction relationship. Therefore, our third hypothesis, which is visualized in Figure 1 (path 3a and 3b) states:

H3: CMC leads to higher levels of intimate self-disclosure (path 3a), which in turn results in higher levels of interpersonal attraction (path 3b).

**Testing the Validity of the Three Hypotheses**

Many of the causal relations that are hypothesized in the previous sections have been empirically verified. First, the direct connection between CMC and interpersonal attraction has been demonstrated, albeit not consistently (e.g., Bargh et al., 2002; Coleman et al., 1999; Kiesler et al., 1985). Second, the relationship between CMC and the three mediators, including similarity (Dubrovsky et al., 1991), direct questioning (Tidwell & Walther, 2002), and self-disclosure (e.g., Joinson, 2001) have been tested (see path 1a, 2a, and 3a in Figure 1). Third, the relationships between the mediators, similarity (e.g., Byrne, 1971), direct questioning and self-disclosure (e.g., Collins & Miller, 1994) and interpersonal attraction have been tested (see path 1b, 2b, and 3b in Figure 1).
Although there is empirical support for each of the causal paths displayed in Figure 1, there is no study that has simultaneously tested the proposed mediated processes in the relationship between CMC and interpersonal attraction. Furthermore, no study has set the three hypotheses against each other to investigate their validity. As discussed, the first goal of this study is to examine which of the three above-mentioned explanatory hypotheses is the most valid: the CMC-induced similarity hypothesis, the CMC-induced direct questioning hypothesis, or the CMC-induced self-disclosure hypothesis.

Comparing Text-only CMC Versus Visual CMC

A second aim of our experiment is to investigate whether and to what extent our hypotheses hold for text-only CMC and visual CMC. Several earlier studies suggest that the addition of visual cues to text-only CMC can significantly change interpersonal perceptions. However, the studies that have compared text-only CMC with visual CMC (Joinson, 2001; Walther et al., 2001) yielded opposing results and offered opposing explanations for their findings. Walther et al. (2001) demonstrated that the addition of a picture of the conversation partner to text-only CMC increased interpersonal attraction. This result was explained by uncertainty reduction theory, which assumes that a greater amount of information about a communication partner increases interpersonal attraction (Walther et al., 2001). However, Joinson (2001) found that self-disclosure, an important predictor of interpersonal attraction, was higher in text-only CMC than in visual CMC. This result was explained with Walther’s hyperpersonal communication theory (1996), which assumes that the visual anonymity in CMC stimulates self-disclosure and, thereby, interpersonal attraction.

To investigate to what extent our hypotheses hold for text-only CMC and visual CMC, we compared a text-only CMC condition with both a face-to-face condition and also a visual CMC condition. Uncertainty reduction theory predicts that interpersonal attraction will be lower in the text-only CMC condition than in the visual CMC and the face-to-face condition because both the visual CMC and the face-to-face condition
provide more information about the communication partner than the text-only CMC condition. In contrast, Walther’s (1996) hyperpersonal communication framework predicts that interpersonal attraction will be highest in the text-only CMC condition because this condition leaves more room for idealized impressions. Because earlier research is too scarce and inconsistent to formulate a hypothesis on the specific effects of our three experimental conditions, we investigate the following research question:

**RQ1:** How does the visual CMC condition differ from the text-only CMC condition and the face-to-face condition regarding its effects on perceived similarity, direct questioning, and self-disclosure (the mediators in Figure 1), and interpersonal attraction (the dependent variable in Figure 1)?

**Method**

**Sample**

A total of 168 University students (84 females, 84 males) between 17 and 31 years of age ($M = 21.07; SD = 2.61$) participated in our experiment. About three-quarters of the students were recruited from an introductory course in communication science. One quarter was contacted through a database of students from the University of Amsterdam who had agreed to participate in research projects.

To form cross-sex dyads, we asked participants to sign up on a list with one-hour time slots. We verified that each time slot was filled with a female and a male participant. We asked participants to ensure that they signed up with someone they did not know. After the experiment, we checked whether they were indeed unacquainted with each other. None of the participants had known his or her conversation partner beforehand. Three dyads were excluded due to technical difficulties during the experiment. Hence, the analyses here are based on 81 cross-sex dyads. Because the scores of the individual participants in the dyad were not independent from each other, they bear the risk of inflated $p$ values (e.g., Kenny, 1995, 1996). Therefore, we used the dyad rather than the individual participant as the unit of analysis.
**Procedure**

The 81 dyads were randomly assigned to one of three experimental conditions: a face-to-face condition ($n = 27$ dyads), a visual CMC condition ($n = 27$ dyads) and a text-only CMC condition ($n = 27$ dyads). In the text-only CMC condition, participants interacted via Instant Messaging software especially designed for the experiment. In the visual CMC condition, participants interacted through the same Instant Messaging software but they saw their conversation partner in a window at the right-hand corner of their computer screen. Partners in the visual CMC condition could not hear each other. In the face-to-face condition, the participants interacted in a laboratory living room provided with hidden recording equipment.

To ascertain that the participants did not see each other before they started their conversations, one member of the dyad was invited to the lab and the other to an office room from where he/she was led to the lab. The subjects received the instructions for the experimental task separately. We used a get-acquainted task based on Frank and Gilovich (1989), which asked the subjects to get to know each other as well as possible during the conversation. The subjects were able to discuss any topic they wanted.

Similar to previous research (Hian, Chuan, Trevor, & Detenber, 2004; Walther, 1996; Walther et al., 2001), we gave the participants in the two CMC conditions more time to interact than the participants in the face-to-face condition. In both CMC conditions, participants interacted for 24 minutes. In the face-to-face condition, they interacted for 12 minutes. The CMC interactions were logged and the face-to-face interactions were taped. After the conversations, each participant completed a questionnaire about their own and their partner’s behavior. We asked participants for their permission to evaluate the transcripts of their conversations. All participants gave their consent to do so. Each participant was shortly debriefed immediately after the experiment and was provided with more detail by e-mail as soon as the experiment period was over.

**Measures**

*Interpersonal attraction.* We based our four items on McCroskey and McCain’s Measurement of Interpersonal Attraction (1974). The four items
were: “I think my conversation partner could be a friend of mine,” “I think my conversation partner is attractive,” “I think my conversation partner is friendly,” and “I would like to meet my conversation partner again.” The response categories ranged from 1 (completely disagree) to 5 (completely agree). The third item was removed, because it had no variance (M = 3.99, SD = 0.26): Everyone believed their conversation partner was friendly. The three remaining items formed an one-dimensional scale, with a Cronbach’s alpha of .68.

**Similarity.** To measure similarity we used four items of the Perceived Homophily Measure (McCroskey, Richmond, & Daly, 1975): “My conversation partner thinks like me;” “My conversation partner behaves like me;” “My conversation partner is similar to me;” and “My conversation partner is like me.” The response categories for each of the items ranged from 1 (completely disagree) to 5 (completely agree). The items formed a one-dimensional scale, with a Cronbach’s alpha of .85.

**Self-disclosure.** Self-disclosure was based on the measures by Altman and Taylor (1973) and Jourard (1971). Participants were asked to indicate how much their conversation partner told them about five relatively intimate self-disclosure topics, measured on a scale from 1 (nothing) to 7 (everything). The items involved: “relationships,” “love,” “physical appearance,” “secrets,” and “going out.”

**Direct questioning.** Participants were asked to indicate to what extent their conversation partner asked them about the following topics: “going out,” “relations,” “secrets,” and “sex.” The exact question was: “How much did your conversation partner ask you about…” The response categories varied from 1 (nothing) to 7 (everything).

**Results**

**Conversation Output of Face-to-face Versus CMC Conditions**

To check for differences in the quantity of output in the face-to-face and CMC conditions, we counted the total number of words and the total number of conversational turns in each dyad. A conversational turn is the
contribution of one partner of the dyad to which the other partner subsequently reacted. The two CMC conditions and the face-to-face condition did not differ in the number of conversational turns, $F(2, 78) = .03, p = .97, \eta^2 = .01$ (Text-only CMC: $M = 194.63, SD = 76.77$; visual CMC: $M = 198.70, SD = 54.01$; face-to-face communication: $M = 195.93, SD = 50.68$). However, there was a significant difference in the total number of words between the two CMC conditions (text-only CMC: $M = 1113.19, SD = 261.33$; visual CMC: $M = 1124.74, SD = 231.55$) and the face-to-face condition ($M = 2117.74, SD = 410.33$), with $F(2, 78) = 92.80, p < .001, \eta^2 = .70$. These results suggest that although CMC and face-to-face partners did not differ in the number of turns, CMC partners used fewer words than face-to-face partners to express their thoughts.

**Direct Effects of Condition on Interpersonal Attraction**

To test the direct effects of each condition on interpersonal attraction, we conducted an ANOVA with the three experimental conditions (text-only CMC vs. visual CMC vs. face-to-face communication) as the independent variable and interpersonal attraction as the dependent variable. We did not find a significant main effect of experimental condition on interpersonal attraction, $F(1, 78) = .98, p = .37, \eta^2 = .03$. The means and standard deviations were $M = 2.86, SD = .48$ for text-only CMC, $M = 3.03, SD = .45$ for visual CMC, and $M = 2.93, SD = .46$ for face-to-face communication.

**Mediation Analysis**

In recent years, several approaches to examining indirect or mediation effects have been discussed (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). The most widely used method is the causal steps approach to mediation developed by Judd and Kenny (1981) and Baron and Kenny (1986). This approach assumes that in order to test mediation, the independent, dependent, and mediator variables must all correlate with each other. The causal steps approach has recently been criticized, firstly because it does not provide a statistical test of the size of the indirect effects, and secondly because the requirement of a significant direct association between
the independent and dependent variable is viewed as too restrictive (MacKinnon, Krull, & Lockwood, 2000; MacKinnon et al., 2002; Shrout & Bolger, 2002).

The problems of the causal steps approach are addressed in the intervening variable approach proposed by MacKinnon et al. (2000; 2002). The first step in this approach is to run a regression analysis with the independent variable predicting the mediator. The second step is to estimate the effect of the mediator on the dependent variable, after controlling for the independent variable. To test the differences between the text-only CMC condition and the two other conditions in a regression analysis, we created three dummy variables: One to investigate the difference between face-to-face communication (coded as 0) and text-only CMC (coded as 1); one to test the difference between visual CMC (coded as 0) and text-only CMC (coded as 1); and one to test the difference between face-to-face communication (coded as 0) and visual CMC (coded as 1).

In our mediation analysis, the three mediators were considered and separately analyzed: similarity, direct questioning, and self-disclosure. Table 1 and Table 2 present the results for the different regression analyses. The three models in Table 1 report the regression analyses of the independent variables (IVs) on the mediating variables (MVs). The first model in Table 2 reports the results of the three regression analyses in which the three mediating variables (MVs) predicted the dependent variable interpersonal attraction (DV), controlled for the dummy variable created to investigate differences between face-to-face communication and text-only CMC. Model 2 in Table 2 reports the regression coefficients of the three mediating variables predicting interpersonal attraction (DV), controlled for the dummy variable created to investigate differences between visual CMC and text-only CMC. Finally, model 3 in Table 2 reports the regressions coefficients of the mediating variables predicting interpersonal attraction (DV), controlled for the dummy variable created to investigate differences between face-to-face communication and visual CMC.
### Table 1. Mediation Analyses I: Predicting Effects of CMC on Mediators

<table>
<thead>
<tr>
<th>Model 1, MV: Similarity</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>IV: FtF vs. text-only CMC</td>
<td>-0.97</td>
<td>0.12</td>
<td>-0.11</td>
</tr>
<tr>
<td>IV: visual CMC vs. text-only CMC</td>
<td>0.05</td>
<td>0.14</td>
<td>0.05</td>
</tr>
<tr>
<td>IV: FtF vs. visual CMC</td>
<td>-0.15</td>
<td>0.12</td>
<td>-0.17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model 2, MV: Direct questioning</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IV: FtF vs. text-only CMC</td>
<td>0.58</td>
<td>0.18</td>
<td>0.40**</td>
</tr>
<tr>
<td>IV: visual CMC vs. text-only CMC</td>
<td>0.10</td>
<td>0.19</td>
<td>0.07</td>
</tr>
<tr>
<td>IV: FtF vs. visual CMC</td>
<td>0.48</td>
<td>0.16</td>
<td>0.39**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model 3, MV: Self-disclosure</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IV: FtF vs. text-only CMC</td>
<td>0.48</td>
<td>0.19</td>
<td>0.33*</td>
</tr>
<tr>
<td>IV: visual CMC vs. text-only CMC</td>
<td>0.08</td>
<td>0.22</td>
<td>0.05</td>
</tr>
<tr>
<td>IV: FtF vs. visual CMC</td>
<td>0.40</td>
<td>0.18</td>
<td>0.30*</td>
</tr>
</tbody>
</table>

*Note. MV = Mediating Variable; IV = Independent Variables based on dummy variables to compare three experimental conditions; FtF = face-to-face communication; CMC = computer-mediated communication. *p < .05. **p < .01.

We tested the significance of the indirect effects by means of the formula developed by Sobel (1982): \( z = \frac{A \times B}{\sqrt{B^2 \times S_A^2 + A^2 \times S_B^2}} \). In this formula, \( A \) is the unstandardized regression coefficient for the relationship between the independent variable and the mediator, \( S_A \) is the standard error of \( A \), \( B \) is the unstandardized regression coefficient for the relationship between the mediator and the dependent variable when controlled for the independent variable, and \( S_B \) is the standard error of \( B \) (Preacher & Leonardelli, 2005).

The Sobel test is by far the most commonly reported (Kenny, 1996, 2006). However, in recent years several methodologists have recognized
that the Sobel test suffers from low power (Kenny, 2006; MacKinnon et al., 2002). Because the distribution of the product of regression coefficients \( A \) and \( B \) is not normally distributed (MacKinnon et al., 2002), the critical \( z \)-value of 1.96 for the standard normal test at a level of \( p = .05 \) is too conservative. According to MacKinnon et al. (2002), “The empirical critical value is .97 for the .05 significance level rather than 1.96 for the standard normal test of \( A.B = 0 \)” (p. 90).

Significance Levels of Indirect Effects and Validity of Hypotheses

Our first hypothesis stated that text-only CMC would lead to higher levels of perceived feelings of similarity, which in turn would lead to higher levels of interpersonal attraction. This hypothesis was not supported. First, there was no significant effect of experimental condition on similarity (see model 1 in Table 1). There was a large and significant effect of similarity on interpersonal attraction in all three comparisons. However, because the first requirement for mediation (i.e., a significant effect of the IV on the MV) was not met, the CMC-induced similarity hypothesis was not supported.

The CMC-induced direct questioning hypothesis was supported only when we compared text-only CMC with face-to-face communication. As model 2 in Table 1 shows, there was a significant effect of text-only CMC on direct questioning (\( \beta = .40, p < .01 \)). As model 1 in Table 2 shows, there was a significant effect of direct questioning on interpersonal attraction when controlled for the dummy variable face-to-face communication versus text-only CMC (\( \beta = .32, p < .01 \)). The Sobel test yielded a \( z \)-value of 1.81, providing support for the CMC-induced direct questioning hypothesis when text-only CMC is compared with face-to-face communication.

The CMC-induced direct questioning hypothesis was not supported when we compared text-only CMC with visual CMC. There was no significant difference between the effects of text-only CMC and visual CMC on direct questioning (\( \beta = .07, n.s. \)). When we compared visual CMC with face-to-face communication, we found a significant effect of visual CMC on
question asking (see model 2 in Table 1: $\beta = .39, p < .01$). However, direct questioning did not predict interpersonal attraction when the effect of visual CMC versus face-to-face communication was controlled ($\beta = .11, n.s.$). Therefore the CMC-induced direct questioning hypothesis was not supported when visual CMC was compared with face-to-face communication.

Table 2. Mediation Analyses II: Predicting Effects of Mediators on Interpersonal Attraction

<table>
<thead>
<tr>
<th>DV: Interpersonal attraction</th>
<th>B</th>
<th>SE</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Model 1: FtF vs. text-only CMC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MV: Similarity</td>
<td>.70</td>
<td>.11</td>
<td>.66***</td>
</tr>
<tr>
<td>MV: Direct questioning</td>
<td>.21</td>
<td>.09</td>
<td>.32**</td>
</tr>
<tr>
<td>MV: Self-disclosure</td>
<td>.21</td>
<td>.09</td>
<td>.33**</td>
</tr>
<tr>
<td><strong>Model 2: visual CMC vs. text-only CMC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MV: Similarity</td>
<td>.55</td>
<td>.10</td>
<td>.61***</td>
</tr>
<tr>
<td>MV: Direct questioning</td>
<td>.11</td>
<td>.09</td>
<td>.16</td>
</tr>
<tr>
<td>MV: Self-disclosure</td>
<td>.14</td>
<td>.08</td>
<td>.25</td>
</tr>
<tr>
<td><strong>Model 3: FtF vs. visual CMC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MV: Similarity</td>
<td>.61</td>
<td>.12</td>
<td>.59***</td>
</tr>
<tr>
<td>MV: Direct questioning</td>
<td>.08</td>
<td>.11</td>
<td>.11</td>
</tr>
<tr>
<td>MV: Self-disclosure</td>
<td>.07</td>
<td>.10</td>
<td>.10</td>
</tr>
</tbody>
</table>

Note. DV = Dependent Variable; MV = Mediating Variable based on dummy variables to compare three experimental conditions; FtF = face-to-face communication; CMC = computer-mediated communication. *$p < .05$. **$p < .01$. ***$p < .001$.

Our CMC-induced self-disclosure hypothesis was supported only when we compared text-only CMC and face-to-face communication. As model 3 in Table 1 shows, there was a significant effect of text-only CMC
on self-disclosure ($\beta = .33, p < .05$). As model 1 in Table 2 shows, in support of the second requirement of mediation, there was also a significant effect of self-disclosure on interpersonal attraction when controlled for face-to-face communication versus text-only CMC ($\beta = .33, p < .01$). The Sobel test produced a $z$-value of 1.70, indicating support for the CMC-induced self-disclosure hypothesis when text-only CMC was compared with face-to-face communication.

There was no significant effect of experimental condition on self-disclosure when we compared text-only CMC with visual CMC ($\beta = .05, ns$), which suggests that the level of self-disclosure did not differ in the text-only and visual CMC condition. This result indicates that the CMC-induced self-disclosure hypothesis does not hold when text-only and visual CMC are compared.

When we compared visual CMC with face-to-face communication, we found a positive significant effect of visual CMC on self-disclosure ($\beta = .30, p < .05$). However, we did not find a significant effect of self-disclosure on interpersonal attraction when visual CMC versus face-to-face communication was controlled ($\beta = .10, ns$). This result suggests that although self-disclosure is higher in visual CMC than in face-to-face communication, the visual information in the CMC condition does not enhance interpersonal attraction.

**Discussion**

The main aim of the present study was to gain a better understanding of the relationship between CMC and interpersonal attraction. In line with earlier studies (Coleman et al., 1999; Walther & Burgoon, 1992), we did not find a direct effect of text-only CMC or visual CMC on interpersonal attraction. We did, however, find some important indirect effects, which may further our understanding of the effects of CMC on interpersonal attraction. In this study, we identified three mediating variables that could carry the influence of CMC on interpersonal attraction: similarity, direct questioning, and self-disclosure. Based on these potential mediating variables, we formulated three hypotheses: the CMC-induced similarity hypothesis, the CMC-induced direct questioning hypothesis, and
the CMC-induced self-disclosure hypothesis. By testing these three hypotheses in one study, we were able to identify which hypotheses are the most valid ones for future research.

Our first hypothesis, the CMC-induced similarity hypothesis, was not supported. In line with earlier research (e.g., Byrne, 1971; Shaikh & Kanekar, 1994), we did find that similarity was strongly correlated with interpersonal attraction, a result that provides support for the validity of our similarity measurement. However, we did not find any effect whatsoever of CMC on perceived similarity, neither in the text-only CMC condition nor in the visual CMC condition. Although it is often hypothesized that CMC enhances feelings of similarity (Lea & Spears, 1992; Putnam, 2000; Spears & Lea, 1992; Walther, 1996), until now this hypothesis rarely has been explicitly tested (Dubrovsky et al., 1991). Our study suggests that a mediating mechanism that is often implicitly assumed in theories on CMC may be empirically untenable.

Our CMC-induced direct questioning hypothesis was supported by our results, but only in the case of text-only CMC. As for the first step of the hypothesis, we found that in comparison to the face-to-face condition, participants in both the text-only CMC and the visual CMC condition asked their conversation partners more direct questions. As for the second step of the hypothesis, we found that direct questioning did enhance interpersonal attraction, but solely in the text-only CMC condition and not in the visual CMC condition. These results suggest that although both text-only and visual CMC have the potential to enhance direct questioning, the conditions do differ in their potential to enhance interpersonal attraction via this mediator. Probably, when information about the physical appearance of the partner is available in a CMC condition, the mediated effect of direct questioning on interpersonal attraction is overshadowed by cues about a partner’s physical attractiveness.

The CMC-induced self-disclosure hypothesis was also supported only in the case of text-only CMC. When compared to face-to-face communication, both text-only and visual CMC enhanced intimate self-disclosure. However, only in the case of text-only CMC this enhanced intimate self-disclosure resulted in higher levels of interpersonal attraction. These results also suggest that a positive indirect effect of CMC on
interpersonal attraction via self-disclosure disappears when cues about physical appearance are available. Although we do not have data on the physical attractiveness of the communication partners in our study, the nonsignificant relationship between self-disclosure and direct questioning in the visual CMC and the face-to-face condition could mean that interpersonal attraction increases when the partner is considered to be physically attractive by the other, and decreases when the partner is considered to be physically unattractive by the other. In this way, physical attractiveness acts as a confounding variable in the relationship between the mediators (direct questioning and self-disclosure) and interpersonal attractiveness.

**Implications of the Study and Future Research**

Our study has important implications for CMC-applied uncertainty reduction theory. We found that the addition of visuals to text-only CMC had differential effects on the mediating and dependent variables. In fact, we found that interactive uncertainty strategies (i.e., direct questioning and self-disclosure) did not differ for text-only and visual CMC. This result supports Walther et al.’s (2001) assumption that certain uncertainty reduction strategies, which are inappropriate in face-to-face settings, do appear to be appropriate in CMC settings, irrespective of whether visual information is added. However, although text-only and visual CMC did not trigger different uncertainty reduction strategies, they did result in different levels of interpersonal attraction. Uncertainty reduction theory would predict that in comparison to text-only CMC, the visual CMC condition would enhance interpersonal attraction. After all, according to uncertainty reduction theory, the greater amount of information in the visual CMC condition would increase one’s partner’s predictability and therefore enhance interpersonal attraction. This presupposition did not receive support. The increased information in visual CMC did not stimulate interpersonal attraction. This result suggests that it is not the quantity of information that increases interpersonal attraction in CMC; rather, it is the quality of information that counts.
Our study also has implications for Walther’s (1996) hyperpersonal communication theory, which predicts that visual anonymity in CMC stimulates self-disclosure and interpersonal attraction. Our study demonstrated that visual anonymity has a differential effect on self-disclosure and interpersonal attraction. In agreement with Walther’s hyperpersonal theory, visual anonymity does lead to interpersonal attraction, albeit only indirectly. However, in contradiction to Walther’s hyperpersonal theory, the addition of visuals to text-only CMC does not decrease levels of self-disclosure. In fact, we found that the level of self-disclosure in the visual CMC condition was just as high as in the text-only CMC condition. This suggests that it is not visual anonymity per se that enhances self-disclosure; more precisely, there must be other factors that account for the enhanced self-disclosure. Walther et al. (2001) provide the most plausible explanation: CMC users are forced to rely on self-disclosure, because they lack other, more subtle uncertainty reduction strategies that are commonly used in face-to-face settings. Future research should elaborate on our findings, for example by testing whether it is indeed a forced use of reduction strategies in different types of CMC that account for changes in the level of self-disclosure.

A final implication of our study is that future research should incorporate a more differentiated view on the concept of reduced nonverbal cues. Our study clearly suggests that a simple dichotomous experimental comparison of text-only CMC and a face-to-face condition may mask important differentiations in the social effects of CMC. In particular, our result that in comparison to text-only CMC, visual CMC has the same effect on the mediating variables but a different effect on the dependent variable deserves further research attention. In our view, future research should not only experimentally compare the amount of information that is reduced in different experimental conditions, but also the type of information (e.g., information about physical attractiveness, social status cues). Now that the majority of people use visual and/or auditory devices while communicating online (Peter et al., 2007), extending the dichotomous CMC-face-to-face paradigm seems to be an important step in CMC research.
References


