COMPUTER-MEDIATED COMMUNICATION AND GENDER DIFFERENCE: A META-ANALYSIS

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Summary

The purpose of this review paper is to conduct an extensive meta-analysis of the empirical literature on gender difference in the use of computer-mediated communication (CMC). Specifically, the questions that this research addresses are:

1) Are there gender differences in people's behaviors in relation to CMC? If yes, to what extent?
2) What study features moderate the gender effects on the outcomes in a CMC environment?

In this paper, 321 independent effect sizes were extracted from 50 studies involving a total of 63889 users exploring the gender difference in the use of CMC. The results of this study show that just like in face-to-face environments, gender related stereotypical patterns do exist in virtual environments.

Introduction

According to American Association of University Women, despite the dramatic entry of the Internet into our schools in the past several years, technologies seem to have caused a new gender gap. Therefore, "we need to assess the role of technology in schools to ensure that it promotes equity and collaboration among all students" (American-Association-of-University-Women, 1999). Particularly, the increasing use of computer-mediated communication (CMC) in society has attracted more and more researchers' attention.

When CMC was introduced, there was much excitement among researchers and practitioners. Many educators and researchers had high hopes for CMC, believing that it provided more equal access to information and communication and would ultimately lead to greater equity (Grabe & Grabe, 2001; Warren, 1998). Is it true that CMC is a gender equalizer? Findings from research are mixed. "There have been many claims made by disparate groups and institutions…which have claimed that CMC-based interactions lack the overt structures of inequality found in other communicative situations" (Yates, 1997). In contrast, others (Kiesler, Siegel, & McGuire, 1984) believe that CMC brings out the worst aspects of male behaviour and gender relations due to the lack of face-to-face cues. Some research findings (Herring, 1993; Li, 2002, 2002a; Yates, 1997) suggest that gender differences and their social consequences persist in computer-mediated networks. That is, CMC reflects the same gendered identities and practices, as opposed to the claims that CMC provides an environment "free of the power structures of face-to-face interactions," (Yates, 1997, p. 287).

These mixed findings demand scholars to re-evaluate the very nature of the human communication process and to emphasize the importance of gender-related issues in CMC (Soukup, 1999). The unclear nature of the gender difference in the use of and learning with CMC calls "for a systematic integration of the literature both for theory development and for pedagogical guidance (Lou, Abrami, & d'Apollonia, 2001). To date, no meta-analysis of these issues exists. In addition, the gender effects on the use of CMC need to be assessed in light of the total available literature in order to promote

equity, and this has not so far been attempted.

Objectives and Significance

In view of the unknown nature of gender differences, particularly in terms of males' and females' approaches of using CMC and their different preferences for the kinds of activities they pursue with CMC (Roberts, 2002, xiv), it is important to attain a comprehensive theoretical grasp of these relationships based on the total empirical evidence. Hence, there is a need for a thorough quantitative integration of the literature in this area. The purpose of this review paper is, therefore, to conduct an extensive meta-analysis of the empirical literature on gender difference in the use of CMC. Specifically, the questions that this research addresses are:

3) Are there gender differences in people's behaviors in relation to CMC? If yes, to what extent?
4) What study features moderate the gender effects on the outcomes in a CMC environment?

Method

A comprehensive search of the literature was first conducted to locate appropriate studies to be included in this meta-analysis. This was performed through electronic searches on the ERIC (1966-2002) and PsycInfo (1985-2002) databases. Depending on the database, the search strategy varied and search terms included: computer-mediated communication and any term related to gender such as gender*, sex*, or male or female, or girl*. Branching from primary studies and review articles, further appropriate citations were also identified. In this meta-analysis, every study had to meet the following inclusion/exclusion criteria:

1. The study had to involve situations where student use computer-mediated communication.
2. The study had to have data related to gender differences.
3. The study had to report cognitive outcomes or process measures for both male and female groups. Different types of outcomes were coded and analyzed separately (see section "outcomes and study features coding" for the types of outcomes coded and analyzed; some outcomes were dropped due to small sample sizes.) Studies with insufficient data for effect size calculations (e.g., with means but no standard deviations or no inferential statistics) were excluded.

Coding and Effect Size Calculations

The coding scheme was developed following a three step procedure. First, a set of broad coding categories was established based on the review of the related literature. Based on these categories, a random sample of 25% of the primary studies was then nomologically coded to identify salient study features. Finally, the original coding scheme was revised and a codebook was created. Table 1 presents the communicative and interactive outcomes extracted and analyzed in this review.

The effect size is calculated by the mean of the female group minus the means of the male group divided by the pooled standard deviation (PSD). That is, the effect size is a measure of the superiority of using CMC between females and males. Using the PSD is because of homogeneity of variance in the population, in which case the PSD is more stable and provides a better estimation of the population variance than the control group SD alone (Hedges & Olkin, 1985; Hunter & Schmidt, 1990). Further, estimated effect sizes based on incomplete results (e.g. t values, F values, ANOVA tables, or p levels) are more readily comparable to effect sizes calculated in PSD.

Data Analyses

Outlier analyses were performed by eliminating extreme values from the effect size distribution (Lipsey & Wilson, 2001). Based on Lipsey and Wilson's (2001) recommendation, it was decided to exclude the studies that have effect size greater than 3 standard deviations from the mean of all the effect sizes.
Due to the nature of this type of study, majority studies only have post-test in which case the post-test mean difference is the numerator and the post-test PSD is the denominator. For the few studies that provided both pre-test and post-test data, only post-test data were used to insure the independency of the effect sizes. When the group effects were explored, the mixed group data was excluded because majority of the studies did not provide enough information to estimate the number of males and females in the group hence impossible to assess gender differences.

Homogeneity tests were then conducted for all effect sizes extracted from studies (Hedges & Olkin, 1985). First, effect sizes were corrected for bias and weighted by the inverse of its sampling variance. That is, findings based on larger sample sizes were given more weight. The weighted effect sizes were then aggregated to form an overall weighted mean estimate of the gender effects (d). The significance of d was judged by its 95% confidence interval. If the confidence interval did not contain zero, d was considered significantly positive or negative depending on the sign of the mean value. To determine whether the findings shared a common effect size, the set of effect sizes was tested for homogeneity by the homogeneity statistics (Q_t). When all findings share the same population effect size, Q_t has an approximate chi-square distribution with k-1 degrees of freedom, where k is the number of effect sizes. If the obtained Q_t value is larger than the critical value, the findings are determined to be significantly heterogeneous, meaning that there is more variability in the effect sizes than chance fluctuation would allow.

Summary of the Results

In total, 321 independent effect sizes were extracted from 50 studies involving a total of 63889 users exploring the gender difference in the use of computer-mediated communication. Eighty four percent of the studies were from refereed journal articles and sixteen percent from unpublished reports or conference presentations.

Communicative Outcome

What are some gender differences in users' communication patterns in CMC? The overall effect of collaboration was based on 27 independent effect sizes extracted from 25 studies. There was a small but significant gender effect on users' collaborative orientation. The mean ES (d_+) equaled to -0.09. On average, female users had a significantly higher frequency of collaborative instances using computer-mediated communication than males.

Relatively fewer studies reported other communicative outcomes. Based on the findings extracted and analyzed in this review, gender had significant effects on several communication variables. On average, females had a significantly higher frequency of challenging others (d_+ =-0.15) and were more personal oriented (d_+=-0.13). Males, on the other hand, used more authoritative statements (d_+=+0.20). However, each set of effect sizes for all the communicative measures was significantly heterogeneous, indicating considerable variability in the findings within each of these communicative measures.

Interactive Outcome

To what extent do male and female differ in their interaction pattern in CMC? In terms of participation, twenty six independent effect sizes were extracted from twenty-two studies that explored these gender differences. Participation measures included frequencies of messages posted and access length to the Internet. The results indicated that, on average, there was a small but significant gender effect on users' participation pattern (d_+=+0.08). On average, male users had a significantly higher frequency of posting messages or accessing longer to the Internet than female users.

Further, access to CMC was examined. A total of eleven independent effect sizes extracted from eleven studies showed that male users have better access to CMC environments (d_+=+0.08). Homogeneity statistics indicated that each set of effect sizes for these two measures was significantly heterogeneous, indicating considerable variability in the findings within each of these interactive measures.

Affective Outcome

Who would enjoy CMC environment, males or females? Thirty-two independent effect sizes were extracted from twenty-one studies that explored the gender differences of the enjoyment of CMC. Enjoyment measures included users' degree of enjoyment or satisfactory of CMC environments, preferred environments, the extent to which CMC was used for entertainment. The results indicated that, on average, there was a moderate but significant gender effect on users' enjoyment of CMC (d_+=+0.24). Male users enjoyed more about CMC environments than their female counterparts.

Relatively fewer studies reported other variables of affective outcomes. Based on the findings extracted and analyzed in this review, gender had significant effects on several affective variables. On average, male users were more confident about using CMC (d_+=+0.18). No significant differences were found between males and females on their negative attitudes such as apprehension, anxiety or difficulty. Homogeneity statistics indicate that each set of effect sizes for these three measures was significantly heterogeneous, indicating considerable variability in the findings within each of these communicative measures. See table 2 for details.

CONCLUSION

This meta-analysis extends knowledge base of gender in relation to computer-mediated communication. It, for the first time, provides a systematic, quantitative review analysis of existing empirical evidence integrating the available literature. This analysis has also identified critical factors that contribute to the gender differences related to CMC. This can inform educators and policy makers for the assessment of what and when intervention prevention may be most effective to promote equity.

Just like in face-to-face environments, gender related stereotypical patterns do exist in virtual environments. Females, compared to males, are more collaborative and personal oriented such as using first person and self-closure. This concurs with previous research results (Sussman & Tyson, 2000) that female communication is socio-emotionally oriented and that females engage in supportive work.

The gendered communication and other behavior patterns demonstrated in this study contrast to the belief (Siegel et al., 1986) that in CMC, people could "transcend the socialized constraints on their communicative expressiveness and adopt a more androgynous style of interaction" (Sussman & Tyson,

2000). Rather, it supports the idea that communication and interaction mirror the power structure of the society. As explained by Socialization Theory, regardless of the medium used for discourse, the gender "power-behaviors in communication…have become intransiently socialized into behavioral dynamics... Power differentials in communication still persist and it appears that cyberspace is a male-dominated atmosphere" (Sussman & Tyson, 2000).

TABLES

TABLE 1

Description of the Outcomes

Outcome	**Description**
Communicative outcome	
Collaboration	Collaborative communication including the use of supportive language such as agreeing, providing positive comments; prefer working in cooperative environments, more enjoy discussion groups.
Challenge	Use of challenging statements such as argumentation and disagreement.
Authoritative	Use of powerful language including assertion, authoritative and directive language
Personal	Personal orientation including the use of closing, signature and self-disclosure.
Interactive outcome	
Participation	Frequency of messages posted or length of accessing CMC
Access	Access to the Internet

TABLE 2

Overall Effects of Gender on Communicative, Interactive, and Affective Outcomes

Outcome	**k**	d_+	**95%CI**	**QT**
Communicative variable				
Collaboration	27(25)	-0.09	-0.16/-0.02	96.88*
Challenge	16(15)	-0.15	-0.25/-0.04	42.06*
Authoritative	7(7)	+0.20	+0.09/+0.31	18.09*
Personal	19(14)	-0.13	-0.21/-0.05	146.48*
Interactive outcome				
Participation	26(22)	+0.08	+0.04/+0.13	726.92*
Access	11(11)	+0.08	+0.04/+0.13	36.03*

Note: k is the total number of independent findings integrated. The values in parentheses are the numbers of studies from which the findings were extracted. d_+ is the weighted mean effect size. 95%CI is the 95% confidence interval for d_+. Q_t is the homogeneity statistics, where * =$p<0.05$, indicating that the effect sizes integrated are heterogeneous.

TABLE 3
Study Features Coded

Study Features	Description
Methodology features	
Publication status	Was the study published or unpublished?
Publication year	Was the study reported in the last five years (i.e. 1998 and after) or earlier?
Technology characteristics	
Type of CMC	What type of CMC was considered? Was it computer conference such as WebCT/Blackboard, or email, news groups, chat rooms, videoconferences or other?
Synchronicity	Was CMC considered synchronous, asynchronous, or blended?
Online	Was CMC considered online only or blended including online and face-to-face?

TABLE 4
Results of the Univariate Study Features Analysis: Collaboration findings

Study Feature	Q_B	k	d_+	95% CI	Q_w
Methodology features					
Publication status	.05	27			
Publication year	6.88*	27			
Recent five years		22	-.13	-.21/-.05	60.64*
Earlier		5	.14	-.05/+.32	29.37*
Technology characteristics					
Type of CMC	3.19	27			
Synchronous	3.49	27			
Online	9.33*	27			
Online only		13	.05	-.07/.16	51.66*
Blended		14	-.18	-.27/-.02	35.90*

Note. Q_B is the between-class homogeneity statistics, k is the number of findings, and d_+ is the weighted mean effect size. 95% CI is the 95% confidence interval for d_+. Q_w is the within-class goodness-of-fit statistics.
*p<.05

TABLE 5
Results of the Univariate Study Features Analysis: Participation findings

Study Feature	Q_B	k	d_+	95% CI	Q_w
Methodology features					
Publication status	.07	26			
Publication year	350.98*	26			
Recent five years		16	.29	+.24/+.34	111.28*
Earlier		10	-.93	-1.05/-.81	264.66*
Technology characteristics					
Type of CMC	2.87	26			
Synchronous	2.92	26			
Online	7.12*	26			
Online only		9	.05	-.01/.10	697.13*
Blended		17	.20	+.03/+.13	22.68

Note. Q_B is the between-class homogeneity statistics, k is the number of findings, and d_+ is the weighted mean effect size. 95% CI is the 95% confidence interval for d_+. Q_w is the within-class goodness-of-fit statistics.
*p<.05

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