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Gender, Pair Composition and Computer Versus Paper Presentations of an English Language Task

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ABSTRACT *The aim of the study was to compare the verbal and physical interactions of same-gender pairs and mixed-gender pairs when equivalent tasks were presented on a computer and on paper. Children aged between 13 and 14 years old (24 boys and 24 girls) were placed into either same-gender or mixed-gender pairs and worked on a computer presentation and a paper presentation of an English language task. The main finding of the study was that the children's verbal interactions and manipulation of the physical materials were mediated by the mode of presentation. There were no significant differences between mixed-gender pairs and same-gender pairs in the paper presentation of the task. However, in the mixed-gender computer-based pairs, boys dominated both the amount and type of verbal interaction and the control of the mouse. These findings are explained in terms of gender differences in perceived expertise with computers and theoretical and practical implications are discussed.*

Computers are becoming increasingly common in schools. Originally intended as a means to provide individualised instruction, they are now often used to support collaborative learning (Littleton & Light, 1999). Although there is general enthusiasm for the greater use of computers, there are also concerns that these changes may exacerbate gender inequalities and that girls could be disadvantaged when making use of information technology in education (Littleton, 1996). As Corston and Colman (1996) note, these concerns are surprising considering that many of pioneers in the field of computing were women and that in the early days of the industry 65% of the computer operators were women. However, a number of recent papers indicate that this concern is justified (e.g. Camp, 1997; Newton & Beck, 1993; Janssen Reinen & Plomp, 1997; Whitley, 1997). Whitley (1997) carried out a metaanalysis of 82 studies, conducted in the US, on gender differences in computer attitudes and behaviour. He reported in general that men and boys have higher computer self-efficacy and have

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more positive attitudes towards computers than women and girls. He also found that men and boys tend to have greater computer experience than women and girls. Janssen Reinen and Plomp (1997) carried out an extensive study of gender and educational computer use in a number of countries. They found that female students knew less about information technology than male students, enjoyed using computers less and perceived more problems with the software. Other studies have reported that the ratio of female students enrolling for computing courses at secondary and higher levels is decreasing with time (e.g. Camp, 1997; Newton & Beck, 1993).

A growing body of research has examined the effect of changing the social context of computer work on girls' attitudes and performance across a number of tasks. For example, one focus has been on whether girls benefit from working in same-gender or mixed-gender groups. The findings on this issue are mixed. Some studies have reported that mixed-gender groups perform worse than same-gender groups, and that girls are at a disadvantage when they work in mixed-gender groups. Dalton (1990), in a science learning task using an interactive video, found that same-gender groups performed better than mixed-gender groups. Underwood and Underwood, in a series of studies involving a sentence completion task, found that same-gender pairs performed better than mixed-gender pairs (Underwood *et al.*, 1990; Underwood *et al.*, 1994). However, Hughes *et al.* (1988) reported girls actually benefit from working in mixed-gender pairs when they used a spatial navigation task (LOGO). The performance of boy–boy and boy–girl pairs was significantly better than the performance of girl–girl pairs. Still other researchers report no difference between same- and mixed-gender pairs. For example, Barbieri and Light (1992) and Littleton *et al.* (1992) found that with a computer-based navigation task there was no difference in performance between boy–boy pairs, girl–girl pairs and boy–girl pairs. Finally, just to complete the picture, Underwood and Underwood (1998) carried out a study using a CD-Rom interactive talking book and found that girl–girl pairs outperformed the boy–girl pairs and boy–boy pairs. One possible explanation for these mixed results is that the task may mediate the effects of the gender composition of the pairs. Yelland (1994) reported that changing the nature of the task can dramatically change the pattern of findings. Yelland reported one study, which replicated Hughes *et al.* (1988), but when the focus was changed from time taken to complete a LOGO navigation task to how accurate they were at keeping within the track, she found the opposite: Girl–girl pairs performed significantly better than boy–boy pairs and boy–girl pairs.

One of the more consistent findings in this literature is that boys in boy–girl pairs dominate the interaction with the computer by dominating the control of the mouse and/or the keyboard. Siann and Macleod (1986) and Siann *et al.* (1990) observed that boys dominated the control of the mouse in boy–girl pairs. Barbieri and Light (1992), using a computer-based planning task, found that the greatest mouse disparity scores were in the boy–girl pairs, with boys spending more time on the mouse than girls. Pheasey and Underwood (1994), using a word completion task, observed that in the majority of boy–girl pairs it is the boy that controls the mouse and decides when pairs should move onto a new word. Underwood *et al.* (1990), using a similar word completion task, also observed that boys tended to dominate the girls. Underwood and Underwood (1998), using an interactive talking book, found that boys were significantly more in control of the activity than girls.

Lee (1993) found that in computer-based mixed-gender groups boys became more verbally active and girls less verbally active. This difference could be explained in terms of gender differences in perceived expertise in computer-based tasks. Boys are often perceived, rightly or wrongly, to be more expert with computers than girls (Joiner *et al.*, 1998; Robinson-Stavely & Cooper, 1990). Recent work on collaborative learning has shown that where there is a difference in perceived expertise between partners this can influence the nature and style of the interaction between them (Grossen & Liengme, 1993; Liengme Bessire *et al.*, 1994; Verba & Winnykamen, 1992). Differences in perceived expertise could lead to the type of asymmetric interactions observed by Lee (1993) in mixed-gender groups, with the partner perceived as more expert taking the lead role and the partner perceived as less expert taking the supportive role. Therefore, in a non-computer setting, with a gender neutral task, the expectation would be that activity will be more equally distributed.

The aim of this paper is to compare the patterns of interaction of mixed-gender pairs and same-gender pairs when a task is presented on a computer, with when the task is presented on paper. It is expected that the pattern of interaction will be more equitably distributed when the task is presented on paper than when it is presented on the computer.

Method

Design

The study employed a three factor mixed design with gender (boy and girl) and type of pair (same and mixed) as the between-participants factors and the mode of presentation (computer and paper) as the within-participants factor.

Participants

A total of 48 children (24 boys and 24 girls), aged between 13 and 14 years, participated in the study and were placed, with their consultation, into either boy–boy pairs, girl–girl pairs or boy–girl pairs. They were from a large state school in west London, which served a socially mixed catchment area. The children already had considerable experience using computers and working in pairs and groups, including mixed-gender groups.

Tasks

Two poems were used in this study: 'The Wife's Lament' by Nikolay Nekrasov and 'On a Cat, Ageing' by Alexander Gray. The lines in the poems had been placed in a standard random order (see Appendix 1 for the original poems and the randomised presentations). The pupils' task was to discuss the order in which the lines should appear and move them into what they considered was the correct order. The task was presented either on paper or on a computer. In the paper presentation, the students used a pair of scissors to cut the lines into individual strips and move them until they were satisfied that they were in the correct order. In the computer presentation, all the lines were visible on the computer screen and the students used the mouse to select lines and move them into what they thought was the correct order for the poem.

Procedure

The study consisted of two sessions, for each of which the children were taken to a quiet area of the school by the experimenter, who was the class teacher. The sessions

TABLE I. Order of presentation

Session	Order 1	Order 2	Order 3	Order 4
1	Computer *The Wife's Lament*	Paper *On a Cat, Ageing*	Computer *On a Cat, Ageing*	Paper *The Wife's Lament*
2	Paper *On a Cat, Ageing*	Computer *The Wife's Lament*	Paper *The Wife's Lament*	Computer *On a Cat, Ageing*

lasted 20 minutes and they were recorded on audio-tape. For the paper presentation of the task, the children worked in pairs, seated at a table. In the centre of the table was a sheet of A3 paper, a copy of the poem, a pair of scissors and some glue. For the computer presentation, the children worked in pairs and were seated at a computer placed on top of a trolley. The children were shown how to move the lines of the poem. On the top of the computer were instructions in case the children forgot how to move the lines.

Before the students started the first session, they were given the following instruction:

> "We've talked a lot about spoken English and how your teacher has to assess this for the National Curriculum. Today I'm going to look at your discussion work when you're working with a partner. The paper/screen you see in front of you has a poem on it, but the lines are in the wrong order. What I'd like you to do, between you, is cut up/move the lines until you think the poem makes sense. Remember that we're not looking at who gets it right, but at how well you discuss things with your partner. I'm just going to watch and take a few notes, so I can't answer any questions once you start. Okay."

All students attempted both the computer and paper presentation of the task. In the first session they attempted one presentation of the task and in the second session they attempted the other. The second session was approximately 2 weeks after the first session. The order of presentation for both versions of the task (computer vs paper) and for each poem were counterbalanced (see Table I for the order of presentation). In the second session, the students were given the following instructions:

> "If you remember, a couple of weeks ago you looked at a poem that was mixed up and tried to put it in the right order. Well today, you are going to do a similar exercise, with a different poem only this time its on paper/the computer."

Analysis of Interaction

During the sessions, the experimenter recorded the number of times the lines of poetry were moved by each student and this was analysed. The audio-tape recordings of the interactions were transcribed. The transcripts were analysed for utterance length and type of utterance. Five types of interaction were identified:

(i) *Proposing*: an utterance was classified as proposing when one of the pair suggested something they might do (e.g. cutting the paper). For example,

A I'll cut and you sort.

An utterance was also classified as proposing if it concerned a decision about where a line might go. For example,

A Oh. This is definitely the start. 'My life is like daytime. Where my life is like night.'

(ii) *Supporting*: an utterance was classified as supporting when one pair agreed or encouraged the other's proposal. For example,

A Oh that's definitely first.
B Oh yeah.

(iii) *Disagreeing*: an utterance was classified as disagreeing when one member of the pair disagreed with or discouraged their partner's proposal. For example,

A That comes last.
B No, it's got a comma.

(iv) *Seeking Information*: an utterance was classified as seeking information when one or both members were trying to seek information from the other. For example,

A Where do you think that goes, before or after?

(v) *Repetition*: an utterance was classified as repetition when one pair merely repeated the lines of the poetry. An example is shown below. The lines are repeated from 'On a Cat, Ageing':
A 'And watches me always.'
B 'But even while snoring.'

An independent coder performed a reliability check. The coder analysed 25% of the transcripts and agreed with all but three of the utterances.

Results

Interaction Analysis

To examine the interaction, a three-way ANOVA was employed with gender (boy and girl), type of pair (mixed and same) and mode of presentation (computer and paper) as the three factors. There was a significant three-way interaction between mode of presentation, gender and type of pair in terms of utterances, $F(1,44) = 15.3$, $p < 0.05$; proposals, $F(1,44) = 17.8$, $p < 0.05$; supportive statements, $F(1,44) = 4.2$, $p < 0.05$; information seeking, $F(1,44) = 6.1$, $p < 0.05$; disagreements, $F(1,44) = 35.2$, $p < 0.05$; and a marginally significant interaction for repetitions, $F(1,44) = 3.7$, $p < 0.1$.

Simple effect analysis revealed that this three-way interaction was due to a significant two-way interaction of gender and type of pair in the computer condition for number of utterances, $F(1,44) = 21.9$, $p < 0.05$; proposals, $F(1,44) = 22.8$, $p < 0.05$; supportive statements, $F(1,44) = 13.0$, $p < 0.05$; information seeking, $F(1,44) = 6.7$, $p < 0.05$; disagreements, $F(1,44) = 36.1$, $p < 0.05$; and a marginally significant interaction effect for repetitions, $F(1,44) = 3.8$, $p < 0.1$. Table II shows that there were no significant two-way interaction effects on any of the interaction measures for the paper condition (for all measures $F < 1$).

To investigate the two-way interaction between gender and type of pair in the computer condition, a further simple effect analysis was carried out. Table III shows

TABLE II. Verbal interaction with the paper presentation of the task

	Boys		Girls	
	Mixed M (SD)	Same M (SD)	Mixed M (SD)	Same M (SD)
Utterances	34.9 (5.1)	35.3 (6.3)	35.6 (4.8)	34.3 (4.9)
Proposals	12.0 (2.5)	13.8 (3.5)	12.6 (2.8)	13.0 (2.9)
Supportive	5.0 (1.3)	5.7 (1.4)	4.6 (1.4)	4.6 (1.4)
Information seek	5.1 (1.1)	4.4 (1.7)	4.5 (1.6)	4.6 (1.6)
Disagreement	4.8 (1.6)	3.3 (1.5)	5.6 (1.8)	4.5 (1.1)
Repetition	8.0 (2.0)	8.1 (1.9)	8.2 (1.5)	7.6 (1.4)

that in the computer condition, boys in mixed-gender pairs made significantly more utterances, $F(1,22) = 19.6$, $p < 0.05$; more proposals, $F(1,22) = 26.5$, $p < 0.05$; more information seeking, $F(1,22) = 7.0$, $p < 0.05$, more disagreements, $F(1,22) = 35.5$ $p < 0.05$; and more repetitions, $F(1,22) = 10.0$, $p < 0.05$, than boys in same-gender pairs. Also, boys in mixed-gender pairs made significantly fewer supportive utterances than boys in same-gender pairs, $F(1,22) = 4.9$, $p < 0.05$.

The pattern of results for girls was the exact opposite and is shown in Table III. Girls in mixed-gender pairs made significantly fewer proposals, $F(1,22) = 13.5$, $p < 0.05$. fewer disagreements, $F(1,22) = 6.6$, $p < 0.05$; and marginally significantly fewer utterances, $F(1,22) = 3.6$, $p = 0.07$, than girls in the same-gender pairs. Also, girls in mixed-gender pairs made significantly more supportive utterances than girls in the same-gender pairs, $F(1,22) = 9.5$, $p < 0.05$. There were no significant differences between girls in the mixed-gender pairs and girls in the same-gender pairs in terms of information seeking utterances, $F(1,22) = 2.0$, $p > 0.1$, and repetitions, $F < 1$.

Manipulation of the Physical Material

To investigate the manipulation of physical materials in the paper condition, a two-way ANOVA was carried out with gender and type of pair as the factors, and the number of times children moved pieces of paper as the dependent measure. There was no significant two-way interaction effect and no significant main effects (see Table IV). To analyse the control of the mouse during the session a two-way ANOVA was carried out with gender and type of pair as the two factors, and amount of time holding the mouse as the dependent measure. There was a significant two-way interaction effect between

TABLE III. Verbal interaction with the computer presentation of the task

	Boys		Girls	
	Mixed M (SD)	Same M (SD)	Mixed M (SD)	Same M (SD)
Utterances	57.0 (8.7)	44.0 (5.7)	36.6 (6.8)	40.7 (3.9)
Proposals	26.3 (4.7)	18.1 (3.1)	12.1 (3.9)	17.3 (2.9)
Supportive	4.9 (1.2)	6.6 (2.0)	6.3 (1.2)	4.6 (1.4)
Information seek	4.0 (1.8)	5.8 (1.4)	4.4 (1.7)	3.5 (1.3)
Disagreement	9.1 (2.7)	4.1 (1.4)	4.5 (2.4)	6.9 (1.7)
Repetition	12.8 (2.7)	9.5 (2.2)	9.3 (2.4)	8.6 (1.7)

TABLE IV. Manipulation of physical materials

	Boys		Girls	
	Mixed M (SD)	Same M (SD)	Mixed M (SD)	Same M (SD)
No. of times children moved pieces of paper	11.9 (4.1)	11.6 (3.0)	11.9 (2.5)	11.8 (2.6)
Time controlling the mouse (s)	752 (319)	544 (209)	287 (277)	496 (203)

gender and type of pair, $F(1,44) = 8.1$, $p < 0.05$. Simple effect analysis (see Table IV) showed that girls in the mixed-gender pairs controlled the mouse less than girls in the same-gender pairs, $F(1,22) = 4.4$, $p < 0.05$, and boys in the mixed-gender pairs controlled the mouse marginally more than boys in the same-gender pairs, $F(1,22) = 3.7$, $p < 0.1$.

To check whether there were any order effects, independent *t*-tests were carried out with order as the independent variable and the 14 interaction measures as the dependent variables. None of the *t*-tests was significant.

Discussion

The aim of this study was to compare the interactions of mixed-gender pairs and same-gender pairs working with an English language task, which was presented either on a computer or on paper. The main finding of the study was that the children's verbal interactions and manipulation of the physical materials were mediated by the mode of presentation. When the task was presented on paper, there were no significant differences between mixed-gender and same-gender pairs in terms of the students' verbal interactions or their physical manipulation of the materials. However, when the task was presented on the computer, the same pattern of interactions reported by Lee (1993) was found. There were significant differences, both in terms of the amount of verbal interaction, type of verbal interaction and physical manipulation of the materials, between girls and boys in the mixed-gender pairs compared with girls and boys in the same-gender pairs. Boys in mixed-gender pairs made more utterances, more proposals, more information seeking requests, more disagreements, more repetitions and controlled the mouse marginally more, than boys in same-gender pairs. The effect was the exact opposite for girls in mixed-gender pairs: they made fewer utterances, fewer proposals and fewer disagreements, but made more supportive comments than girls in same-gender pairs. The girls in mixed-gender pairs also controlled the computer mouse less than girls in the same-gender pairs. The finding that boys dominate the control of the mouse in computer-based mixed-gender pairs has been reported by a number of other researchers (Barbieri & Light, 1992; Pheasey & Underwood, 1994; Siann & Macleod, 1986; Siann *et al.*, 1990; Underwood *et al.*, 1990; Underwood & Underwood, 1998).

These findings are consistent with the perceived expertise explanation discussed at the beginning of the article. Boys are more verbally active and girls less verbally active in mixed-gender groups because boys are perceived, by both parties, as more expert in these tasks than girls. These differences in perceived expertise lead to the asymmetric patterns of interaction. However, in a gender neutral non-computer-based task, there are no gender differences in perceived expertise and, thus, the activity is more equally distributed between girls and boys. Even the finding, which was contrary to the predictions, that girls made more supportive utterances in computer-based mixed-gender pairs than in same-gender computer-based pairs supports this explanation. It also suggests, in this study, that girls are taking a supportive role while boys are adopting a lead role in the mixed-gender computer-based pairs.

This explanation is compatible with some recent studies of non-computer-based learning by Monteil and his colleagues (Huget *et al.*, 1994; Monteil, 1993). This work is derived from social psychology and illustrates the extent to which children's expectations can impact on learning. Similar work undertaken by Grossen and Liengme (1993) and Liengme Bessire *et al.* (1994) showed that the perception of expertise influenced both the style of interaction and the learning outcome. Expert–novice pairs, who through an experimental manipulation perceived themselves at similar levels of ability, were more likely to collaborate and reach a common decision about the solution than expert–novice pairs who perceived themselves to be different levels of ability. The expert–novice pairs who perceived themselves at equal levels of ability also had greater pre- to post-test gains than expert–novice pairs who perceived themselves at different levels of expertise. The study reported in this paper, and the work just mentioned, highlight the importance of incorporating social and motivational aspects of collaborative activity into our existing and mainly cognitive explanations of collaborative learning.

The finding that boys dominate the interaction in computer-based mixed-gender pairs, but not in non-computer-based mixed-gender pairs, has important implications for educational practice. It supports the general view that girls should work with computers in same-gender groups. There have been a number of studies which have shown that girls benefit from working in this situation (Culley, 1988; Culley, 1993; Newton & Beck, 1993). However, the picture is made slightly more complicated by a study reported recently by Light *et al.* (2000). They found that boys' performance is enhanced by working alongside, but not interacting with, a girl; whereas girls' performance deteriorates when working in the presence of a boy, but there is no such effect when mixed-gender pairs work together on the same task. This finding suggests that computer-based mixed-gender collaboration can in certain circumstances foster gender equality by challenging children's perceptions. However, it is inconsistent with the findings reported in this study. These two contradictory findings can be reconciled by the suggestion that perceptions of expertise can be re-negotiated over time and they are not fixed. A goal for future research is to discover which situations can lead to a more equitable re-negotiation of boys' and girls' perceived expertise with computers.

In conclusion, the main finding of this study was that the amount and nature of the interaction in mixed-gender pairs is mediated by the mode of presentation. Boys dominated the verbal and nonverbal interaction when the task was presented on a computer, but there was more equitable distribution of activity when the task was presented on paper. These findings were explained in terms of gender differences in perceived expertise with computer-based tasks.

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Appendix 1: poems used in study

1. 'The Wife's Lament'

My life is like daytime
With no sun to warm it!
My life is like night
With no glimmer of moon!
And I—the young woman—
Am like the swift steed
On the curb, the young swallow
With wings crushed and broken;
My jealous husband,
Is drunken and snoring,
But even while snoring,
He keeps one eye open,
And watches me always,
Me, poor little wife!

(Written by Russian Nikolay Nekrasov, and translated by Juliet M. Soskice.)

2. 'On a Cat, Ageing'

He blinks upon the hearth rug,
And yawns in deep content,
Accepting all the comforts
That Providence has sent.
Louder he purrs, and louder,
In one glad hymn of praise
For all the night's adventures
For quiet restful days.

Life will go on for ever,
With all that cat can wish:
Warmth and the glad procession
Of fish and milk and fish.
Only—the thought disturbs him—
he's noticed once or twice,
The times are somehow breeding
A nimbler race of mice.

(Alexander Gray)