HUMAN FACTORS IN A COMPUTER ASSISTED FOREIGN LANGUAGE ENVIRONMENT: THE EFFECTS OF GENDER, PERSONALITY AND KEYBOARD CONTROL

Lydie E. Meunier, The University of Tulsa

ABSTRACT

This multi-method research examines the effects of gender, personality and keyboard control on foreign language learning and interaction patterns of 60 intermediate French students in a computer assisted language learning environment at the university level. This study includes ten female dyads (pairs), ten male dyads, and ten mixed-gender dyads. Results of the Analyses of Variance reveal that learning achievement and interaction patterns at the computer are more strongly related to personality differences and keyboard control than to gender differences, although males and females still perform differently, yet not quite as expected. The most detrimental factor in this computer based French activity was shown to be the inability for linear learners, whether males or females, to adjust to the nonlinear format of foreign language hypertexts.

KEYWORDS

Computer assisted language instruction, gender differences, personality differences, keyboard control, verbal interaction, MBTI, linear and nonlinear learners, hidden agenda, socialization process.

GENDER DIFFERENCES AND COMPUTER USE
The Socialization Process

Several studies investigating gender differences in the use of computers revealed that males tend to be more interested in computers than females and that males use computers more than females (Collis 1985a; Collis 1985b; Fetler 1985; Fisher 1984; Adam and Bruce 1993; Murray 1993). Other studies indicate that a preference for computer
use, or lack of it, stems from socialization which takes place outside schools (Yelloushan 1989; Henwood 1993; Kirk 1992). For instance, parents are more likely to buy a computer and video games for their sons than for their daughters (Levin and Gordon 1989). Several studies also note that sex differences in computer use are engendered by the media which tend to advertise computer use essentially as a male activity (Forsyth and Lancy 1989; Jones 1987; Sanders 1985; DiMona and Herndon 1994); these studies found that companies selling video games essentially target a male audience by designing aggressive and competitive games that often deal with war, killing, car races, medieval-style combats, etc. According to DiMona, et al. (1994), boys are favored in commercials because of studies conducted in masculine psychology and summarized as follows: When boys associate a product with the presence of girls, they lose their interest in buying this product because they think "it is for girls" therefore a degrading product (p. 489). Likewise, the advertising for both hardware and software in computer magazines -meant for an adult audience- essentially depicts males actively involved in problem-solving situations, while females (when present) are confined to secondary roles such as typists (Forsyth and Lancy 1989; Jones 1987; Sanders 1985; DiMona, et al. 1994). The conclusions that can be drawn from these several studies are these: Western societies display a cultural bias in favor of males as users of the computer, while societal reinforcement for female interest in computers is lacking.

**Hidden Curricula in Schools**

Considering these detrimental effects of socialization on girls before they enter school, a logical question is whether teachers provide an equal opportunity for both genders to use computers. Unfortunately, research suggests that the bias is evident in the classroom too. Educators exhibit a strong hidden curriculum with tacit values that favor and encourage males in their computer expertise (Culley 1988; Fennema 1987; Levin and Gordon 1989; Smithson 1990; Stable 1990; Watson 1991). Because boys come to school more computer literate than girls, in mixed-gender schools the boys have a skill advantage, and their more competitive attitudes have a negative effect on girls in computer laboratories (Stable 1990; Levin and Gordon 1989; Smithson 1990). Classroom observations of computer assisted lessons in mixed-gender schools have revealed that educators make very little effort to counteract the tendency of boys to elbow out girls on theirway to get to the newest computer equipment (Culley 1988). Siann and Macleod (1986) observed that in computer based group activities, females showed lower results when working with males even though the same females had no disadvantage in similar tasks when working individually or in same-gender groups. Observations of interactions in mixed-gender groups show that males compete for control of the computer keyboard and thus hinder females during the learning process: A positive
correlation was found between time spent on the keyboard and the results on achievement tests Palton 1990; Siann, et al. 1986; Underwood and McCaffrey 1990; Webb 1985).

However, both Webb (1985) and Azmitia (1987) have reported that control of the keyboard is not necessary for understanding and that learning can also take place by watching other people. Other studies indicated that when educators give equal attention to males and females, no gender differences are reported (Feldmann, Fish, Friend and Bastone 1991; Forsyth, et al. 1989). Feldmann, et al. (1991) observed that gender differences are important in some social contexts but not in others, and the social climate is different when either males or females comprise a large majority in a class. Feldmann, et al. also suggest that humanities courses using computer based tasks might be considered less biased than traditionally male-oriented courses, which implies that academic disciplines may also affect classroom communication and gender interaction.

**Gender Differences in Computer Based Humanities Courses**

During a computer based English course, Cummings (1985, p. 157) made a negative judgment of female students who were perceived as talkative and off-task because they had less need of silence than male students to develop their inner thoughts while working on English syntax. Males were described as thoughtful, analytical and on-task because they were more silent than females. Interestingly, in this study, Cummings considered males better than females on the premise that their silence evinced the “appropriate analytical skill" required for computer tasks.

In a study conducted with ESL students (Abraham and Liou 1991), differences in gender-specific behavior were incidentally noticed and interpreted as follows: “In the mixed pairs, the female assumed the role of typist, perhaps encouraging the male to dominate the discussion and decision making” (Abraham, et al. 1991, p. 93). This study suggests that some computer based activities in mixed-gender groups may actually trigger socially acquired behaviors.

Underwood, et al. (1990) examined interaction styles in mixed- and single-gender pairs during a computer based English course. Their study was designed to measure the interactional effects on learning taking place in the zone of proximal development during computer based communicative activities. Students had three sessions: (1) an individual CAI session, (2) a cooperative CAI session, and (3) another individual CAI session. The effect of cooperative work was measured by comparing the results of session 3 with those of session 1. The results indicated that both types of single-gender pairs improved individual performance in session 3, but mixed-gender pairs did not show any improvement of individual abilities. The authors explained the flat performance of the mixed-gender groups by stating that partners had difficulty
cooperating and that females tended to be dominated by their male partners who
competed for keyboard control.

The hypothesis of Feldman, et al. (1991), that computer based humanities courses may
be less biased than courses traditionally seen as more male-oriented, is not supported
by these studies. Interestingly, in computer based humanities courses, the poor
performance of female students seems to be related more to interaction styles and
personality differences than to their level of computer literacy.

SUMMARY

Past studies have indicated that males tend to be dominant in a computer assisted
environment and that in mixed-gender situations their competitive attitude has a
negative effect on the females in that environment. This has shown to be the case in
computer assisted instruction across the curriculum, humanities classes included. Past
research in computer assisted humanities courses taught in middle schools also
suggests that interaction styles and personality differences seem to be additional
variables influencing computer assisted learning. To date, no study has been conducted
to investigate the effects of both gender and personality differences in computer based
foreign language group activities at the university level, hence the research project
outlined below.

PRESENT STUDY

Purpose

The purpose of this research is to investigate the effects of gender- and personality
differences in computer based foreign language group activities at the university level.
Based upon the survey of current research, the following four research questions were
considered:

1. Do males and females perform differently regardless of dyad types?
2. Do males and females perform differently in mixed- vs. same-gender dyads?
3. Is gender a stronger factor than personality in predicting language learning and
   interaction patterns?
4. Does keyboard control have an effect on language learning?
Sample Population

The participants were sixty students (N = 60) enrolled in intermediate (second year) French classes at a major research institution. Contact forms were distributed, inviting students to participate in an experimental computer based foreign language activity. On these forms, no information was provided about the actual purpose of the research. Only experimental procedures were detailed. The forms clearly stated that students with no computer background would be offered a pre-training session on the use of Macintosh computers. All students were given a $10 incentive for volunteering two hours of their time. I deemed this monetary incentive was necessary because only a few instructors agreed to integrate their students’ participation into class work. Therefore, another form of extrinsic motivation had to be offered to select a sample that would be as representative as possible of the sampling frame. Students interested in participating in the study were asked to sign the contact form and to indicate available hours. Of the 364 students enrolled in second-year French, 137 students volunteered. An equal number of mates and females were needed in order to conduct the study. Some students had to be eliminated on the basis of their education background: All students needed to be graduates of American high schools to eliminate possible confounding variables due to differences in the socialization and education process as practiced in other countries. Other volunteers had to be eliminated on the basis of their age to control for the age factor: All students retained for this study were considered traditional age students (19 - 25). From the remaining pool of 115 volunteers, a stratified sampling design was adopted. Volunteers were categorized according to the following: (1) gender, (2) computer background (only two students did not have any needed computer pre-training), and (3) time availability. Gender and time availability became the basic categories retained for the random pairing of students to partners of the same or opposite sex. The two students with no computer background were included in the final sample. I was aware that the lack of computer background for these two students could have been the source of a possible confounding variable. However, the final results indicated that the learning achievement and interaction patterns of these two students were consistent with other students of the same gender and personality type, and that computer pre-training was successful.

Design

This study included ten female dyads (or pairs), ten male dyads, and ten mixed-gender dyads. All 60 subjects were asked to participate in pre-test sessions. Pretest measures consisted of the Myers Briggs Type Indicator (MBTI) personality profile test, and a software-based pretest (both tests are detailed in the "instrumentation" section). Subjects then played the French version of a computerized mystery game, *Carmen San Diego*, in dyads, and performed a post-test. *Carmen San Diego* involves (1) French reading skills in French, (2) decision making skills, and (3) computer manipulation.
The experiment took place entirely in a computer laboratory. In addition to the experimental manipulation, a descriptive component was integrated into the design to examine interaction patterns by means of video taping.

Instrumentation

To establish the participants' personality profile, the MBTI was selected because it has been used previously as an adequate, valid, and reliable instrument by other L2 researchers (Ehrman and Oxford 1988, 1995; Ehrman 1994, Oxford 1990; Carrell and Monroe 1993). The MBTI instrument was originally designed according to Jung’s psychological theory advocating that personality variation relies on orderly and systematic dynamics. These orderly dynamics are described below across four different psychological traits, each trait defined in terms of dichotomies:

**Extraversion (E) or Introversion (I)**

This factor expresses a person's preferred attitude toward the world. Extraverts (E) are stimulated by people and things, whereas introverts (I) are stimulated by inner thoughts and reflections.

**Sensing (S) or Intuition (N)**

This factor indicates the perception mode, that is, how individuals receive and process information. Sensing (S) types learn best through their 'Use of sight, hearing, touch, smell, and taste. Intuitives (N) use their sensory perception less and rely more on imagination and supposition to guide information gathering.

**Thinking (T) or Feeling (F)**

Decision making, according to Jung, occurs with either thinking (T) or feeling (F). Thinkers (T) prefer to use logic and analysis to decide. Feelers (F) prefer to use subjective values to arrive at decisions.

**Judgment (J) or Perception (P)**

This dimension refers to lifestyle. Judging (J) types prefer an orderly lifestyle, both in their values or practical organization, and get satisfaction out of finishing things. Perceiving (P) types are flexible, adaptable and are feeling comfortable in unstructured situations (Barrett, Sorensen, and Hartung 1987, 1-2).
In addition to the MBTI, students took software-based pre-and post-tests which evaluated their language-learning achievement in this experiment. Both pre- and post-tests measured two competencies: (1) French vocabulary pertaining to descriptions of people, and 2) French vocabulary pertaining to geographical knowledge. The pretest procedure was meant to control for preexisting language differences across students by establishing every student’s initial reading proficiency. The results of the post-test were compared to those of the pretest to gauge the instructional efficiency of the language software across genders, personalities and dyad types. I postulated that the CALL treatment would help develop a more automatic reading process during the post-test and that a more controlled and slower reading process would be used during the pretest. In these tests, the participants had to pretend to be detectives reading reports on the whereabouts and descriptions of criminals, a task similar to that required by the software. Written instructions given in English were read to the students before the test was administered. The whole test was limited to 20 minutes, with 10 minutes for each of the two parts. In order to avoid a ceiling effect, the tests contained more questions (total = 130) than students could possibly answer in 20 minutes. Students were not expected to complete all items; however, they were advised to work efficiently and accurately, and were asked to complete as many items as possible within the time allotted. Pretests and post-tests contained identical items, but questions were scrambled and reorganized for the post-test to minimize transfer of learning from pretest to post-test.

*Carmen San Diego* was selected for the CALL treatment because it is a mystery game that falls into the category of "collaborative" software (Meunier 1992; Wyatt 1987) defined as computerized open-ended and discovery activities which motivate group discussions prior to making branching decisions. Because one important aspect of this research study is the description of group dynamics, I came to the conclusion that *Carmen San Diego* was ideally adequate. (This hypothesis was confirmed by the results obtained through a pilot test used to determine the suitability of the instrumentation.) Prior to the 30-minute treatment, I explained and demonstrated the game to students. After the demonstration, I asked participants to play in dyads for 30 minutes, to share the keyboard and mouse, and to collaborate as a team on solving mysteries.

In addition to the experimental treatment, I observed and investigated interactional and conversational patterns. The 30-minute treatment session was videotaped to increase the accuracy of analysis and facilitate interpretation. To help reduce the inhibiting effects of video taping on behavior, a camera was set up with no operator. A tiny wireless FM microphone was used to record the conversation of both partners. The participants’ use of slang and some curse words was taken as a good indicator that they were not disturbed by the recording equipment.
Measurement

For each of the four psychological constructs contained in the MBTI, that is Extraversion (E) - Introversion (I); Sensing (S) - Intuition (N); Thinking (T) - Feeling (F); and judging (J) - Perception (P); detailed in the "instrumentation" section, each subject favors one pole over the other, as illustrated below. All psychological constructs are measured through a series of multiple choice questions with different weights assigned to each answer on the basis of prediction ratios (0, 1, or 2). Points for each pole are then totaled, and the strongest pole determines the psychological preference of the testee within each psychological construct. For example, if a subject had the following final scores, the personality profile of that person would be INFP:

<table>
<thead>
<tr>
<th>E -- I</th>
<th>S -- N</th>
<th>T -- F</th>
<th>J -- P</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>22</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>1</td>
<td>28</td>
</tr>
</tbody>
</table>

Because the number of subjects per personality profile was too narrow, computation lacked statistical distribution. To overcome this problem, the computation was run using function pairs for interaction profiles (IP, IJ, EP, EJ) and for learning profiles (ST, SF, NF, NT) as independent variables, two subgroups of the MBTI personality instrument (Briggs Myers and McCaulley 1992). The participants' learning profile was considered the independent variable in computations dealing with learning achievement, and the interaction profile was deemed the independent variable in studying interactional behaviors during the experiment.

After the personality profiles were established, the pre- and post-tests were scored. The learning achievement of each participant was measured by subtracting pre- from post-test results.

Once the participants' gain scores were calculated from pre- and post-tests, I analyzed and classified all conversations — on the 15 hours of video tapes — that took place at the computer according to three categories: (1) task statements, (2) management statements, and (3) social statements. All statements in each of these categories were added and then compared across genders, personality profiles, and dyad types: FF (female only), FM (mixed-gender), MM (male only). A second rater coded 10% of the transcripts according to the given criteria in order to provide a sample for inter-rater reliability. The correlation coefficient (r = .95) obtained by applying a Fisher's R to Z procedure was significant (p < .001) and indicated very little variance in the rating procedure.

I analyzed the video tapes a second time to measure keyboard control. Keyboard control was measured in seconds with stopwatches then averaged for each gender, personality profile, and dyad type. In this study, every mouse or keyboard manipulation was considered an instance of "keyboard control." Because Macintoshes
lend themselves to greater keyboard participation by the person sitting on the right of the computer (the mouse is attached to the right of the Macintosh), the position of subjects at the computer also had to be included as an additional variable while computing data (in spite of the fact that the mouse was placed in front of the keyboard, between the participants of each dyad).

**STATISTICAL PROCEDURES**

I chose t-tests to analyze gender differences in learning achievement. ANOVA was used to (1) investigate the relationships between dyad types and genders (independent variables) and test results (dependent variable); (2) examine whether gender or personality was a stronger predictor of language learning, interaction patterns, and keyboard control; and (3) measure the effect of keyboard control on language learning.

**DATA ANALYSIS AND RESULTS**

**Results of General Comparisons between Males and Females**

The difference between post- and pretest scores was first established for all males and females, regardless of dyad type. Results were subdivided into three categories: (1) overall learning, (2) learning of vocabulary pertaining to descriptions of people, and (3) learning of vocabulary pertaining to geographical facts. The results of the t-test performed on the overall learning quota indicated that the difference between males and females was not statistically significant (Table 1). The rate of overall learning was then broken down into (1) vocabulary pertaining to geographical facts, and (2) vocabulary pertaining to story characters. Males outperformed females numerically in acquiring vocabulary dealing with geographical facts (Table 1). Females outperformed males with differences that were statistically significant (Mean cliff. = 6.73, t = 2.34; p = .02 <.05) in the acquisition of vocabulary pertaining to story characters.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Err.</th>
<th>t Value</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall F Learning</td>
<td>30</td>
<td>18.00</td>
<td>1.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall M Learning</td>
<td>30</td>
<td>15.00</td>
<td>1.32</td>
<td>1.29</td>
<td>.20</td>
</tr>
<tr>
<td>F Learning of vocab./geography</td>
<td>30</td>
<td>15.62</td>
<td>1.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M Learning of vocab./geography</td>
<td>30</td>
<td>17.63</td>
<td>1.74</td>
<td>-.91</td>
<td>.36</td>
</tr>
<tr>
<td>F Learning of vocab./people description</td>
<td>30</td>
<td>12.99</td>
<td>1.79</td>
<td>2.34</td>
<td>.02</td>
</tr>
<tr>
<td>M Learning of vocab./people description</td>
<td></td>
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Table 1: General comparisons between male and female learning (regardless of dyad type)
Effect of Dyad Type

Gain scores illustrated in Table 2 show no statistical significance in the differences computed through ANOVA. Clearly, neither males nor females are significantly affected by group types. Results indicate that in mixed-gender dyads, females tend to acquiesce to male factual preferences by learning more vocabulary pertaining to geographical facts and by lowering their interest in vocabulary related to story characters. On the other hand, males tend to assert themselves—with geographical facts in mixed-gender dyads, and there is no adjustment on their part to female interests, i.e., story characters. Relatively lower scores of males in MM groups for the acquisition of geographical facts may stem from a lack of cooperation between males or from a lack of motivation on their part. One of my colleagues suggested that the phenomenon of greater male learning in mixed groups could also result from males showing off for females. However, video analysis displayed neither verbal nor behavioral clues supporting this hypothesis. The following analysis will show that personality differences actually account for this phenomenon (see discussion).

<table>
<thead>
<tr>
<th></th>
<th>Overall Learning</th>
<th>Vocab./Geo</th>
<th>Vocab./People</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>P-value</td>
<td>Mean</td>
</tr>
<tr>
<td>Females in FF Dyads</td>
<td>17.65</td>
<td></td>
<td>14.56</td>
</tr>
<tr>
<td>Females in FM Dyads</td>
<td>17.60</td>
<td>.98</td>
<td>17.75</td>
</tr>
<tr>
<td>Males in MM Dyads</td>
<td>14.12</td>
<td></td>
<td>15.80</td>
</tr>
<tr>
<td>Males in FM Dyads</td>
<td>17.35</td>
<td>.25</td>
<td>21.29</td>
</tr>
</tbody>
</table>

(FF= female-only dyads; MM= male-only dyads; FM= mixed-gender dyads)

Table 2: Mean of learning rate across genders and dyad types

Distribution of Personality Profiles Across Genders

The personality types for all 60 male and female students were recorded (Graph A). Reported results of the contingency procedures performed on the two independent variables (gender and interaction profile) indicate that introversion and perceiving (IP) are the strongest traits for the females of this study (36.66% of the female population), and that extraversion and perceiving (EP) are the strongest traits for the males (33.34% of the male population). The major difference between gender, regarding the strongest traits mentioned, seems to reside in the preferred attitude toward the world (extraversion for males and introversion for females). Both genders seem to prefer a perceptive and flexible attitude toward life.
Differences between genders seemed more acute in the participants' learning profiles than in their interaction profiles. Results of contingency procedures performed on the two independent variables (gender and learning profiles) indicate that Intuition and Feeling (NF) are preferred approaches for females (40% of the female population) and that Sensing and Thinking (ST) are preferred approaches for males (43.34% of the male population). The second preferred learning profile for both females and males of this study is Intuition and Thinking (NT), a combination of both male and female dominant traits (33.34% of the female population and 23.34% of the male population are NT).

**Effects of Personality and Gender on Learning**

A two-way ANOVA was performed to determine whether the learning profile of students had a stronger effect than gender in this study. The results indicate that the learning profile of students had a stronger effect than gender at a significant $p$ value of $0.02 < 0.05 (F = 3.263)$. The Bonferroni/Dunn post hoc test indicates a significant difference ($p < 0.008$) between the mean values of the pairs NF, ST (Mean diff. = 7.9; $p = 0.001$) and NT, ST (Mean diff. = 6.4; $p = 0.008$), with STs showing significantly lower results.
Concerning the acquisition of vocabulary related to story characters, the results of the two-way ANOVA indicate that the learning profile of subjects has a stronger effect ($F = 6.142; p = .001$) than gender. The Bonferroni/Dunn post hoc test indicates a statistically significant difference ($p < .008$) between the mean values (Graph B/a) of the pairs NF, ST (Mean diff. = 15.14; $p < .0001$) and NT, ST (Mean diff. = 11.55; $p = .0008$). The post hoc test also registers a significant difference for variances ($p = .008$) across genders, and gender differences are found to be statistically significant for NF students (Mean diff. = 12.13, $F = 4.40, p = .05$), with NF females learning more vocabulary related to story characters than NF males.

As for the learning of vocabulary related to geographical facts, the overall results of a two-way ANOVA indicate that none of the variables shows a significant effect (Gender: $F = .79; p = .38$ / Learning profile: $F = .05; p = .98$). Because NF males and females show the largest variance (Graph B/b), I decided to run an ANOVA test for NF students. Interestingly, males and females once again show the largest mean difference (Mean diff. = -7.50) in comparison with NT, SF and ST participants, this time with NF males performing better than NF females at an almost significant $p$ level of .06.
Effects of Personality and Gender on Keyboard Control

The results of a three-way ANOVA which examines the effect of three independent variables — gender, interaction style and position at the computer — on keyboard control indicate the following: (1) The position of students at the computer is the strongest variable \( F = 317.862; p < .001 \) because Macintoshes lend themselves to a greater keyboard participation of the person sitting on the right of the computer than the one on the left; (2) keyboard control differs significantly as a result of the subjects’ interaction profile \( F = 2.858; p = .04 \); and (3) the combination of gender and position at the keyboard is another significant factor affecting keyboard control \( F = 4.069; p = .04 \). Post hoc tests show significant differences \( p < .008 \) among keyboard controllers (students sitting on the right side of the computer) for the following pairs: EJ, EP (Mean diff. = 252.487; \( p = .004 \)); EJ, IJ (Mean diff. = 265.571; \( p = .006 \)); and EJ, IP (Mean diff. = 429.271; \( p < .0001 \)). These variances clearly indicate that extroverts and judging types are more likely to control the keyboard than introvert and perceptive participants.

Data computed across dyad types indicate a significantly larger effort to share the keyboard in FF dyads than in FM and MM dyads. The analysis of mean values computed across gender and dyad types indicates that females on the left-hand side of the keyboard participate significantly more (Mean diff. = 253.30; \( F = 4.181, p = .05 \)) in keyboard manipulation in same-gender dyads (Means: left F/FF 295.90; right F/FF = 1195.50) than in mixed-gender dyads (Means: left F/FM 53.20; right F/FM = 1430.40). Results also show that females do not seem inhibited in mixed-gender dyads because they actually use the keyboard more than males whether they are on the right or left-hand side of the computer (Means: left F/FM 53.20; right F/FM = 1430.40; left M/FM = 35.40; right M/FM = 1311.40), and because keyboard participating in FM groups do not differ much from that of MM groups (Means: left M/MM = 42.60; right M/MM = 1311.40).

Effects of Personality and Gender on Verbal Interaction

Mean variances for task, management and social statements across genders, dyad types and position at keyboard are statistically nonsignificant. However, the results of ANOVA computed across dyad types, interaction styles, and the position at the computer indicate that both the interaction profile and the position of participants at the computer have a significant effect \( F = 3.19; p .03 \) on overall verbal behavior (Graph C). Significant differences \( p < .05 \) for total statements, task statements and management statements occur for extraverts and, specifically, for the following pairs: left EJs / right EJs and left EPs / right EPs. No significant differences are found for social statements, probably because all students were focused on the game.
Graph C: Effects of personality profiles and position at the computer on verbal interaction

Overall, except for EJs, subjects tend to compensate for the lack of keyboard control with verbal control. The EJ case is somewhat interesting. Briggs Myers, et al. (1992) indicated that EJ types work best when they can plan their actions. Given that EJs are extroverts, Briggs Myers, et al. (1992) explain that EJs express easily what is on their mind when working with a partner. However, Briggs Myers, et al. further mention that EJs also like following their own action plan and dislike interruptions while focusing on problem-solving situations. The great number of task statements uttered by EJ keyboard
controllers in this study may reflect the fact that they feel comfortable expressing themselves while controlling the mouse. However, EJs sitting on the left seem to restrict their verbal participation because they may project onto their partner their own dislike of interruption, or simply because their position as non-keyboard controllers does not provide them with the sense of control that they need for participation. The fact that the variance between left EJs and right EJs is even greater for management statements (Graph C) seems to support the former explanation.

Effects of Keyboard Control and Verbal Interaction on Learning

The results of ANOVA computed across dyad types indicate that keyboard control has a negative effect on learning and that non-keyboard controllers learn significantly more (p = .01) than the keyboard controllers in this study. This may be due to the fact that students consciously or subconsciously divided the task to be performed at the computer between technical and language skills. Interestingly, the smallest variance noticed between keyboard controllers and non-keyboard controllers shows in mixed-gender (FM) groups and the largest in same-gender (FF and MM) groups (Mean cliff. FF = -6.341; p = .04; Mean diff. MM = -5.352, p = .12; Mean diff. FM = -1.873; p = .55). One possible explanation is that males and females were checking on each other.

Overall, considering that non-keyboard controllers tend to compensate for the lack of keyboard control with verbal control, I wondered if verbal output had an effect on learning as well. However, none of the statistics computed showed a significant effect of verbal output on learning, and correlation computations were not conclusive.

SUMMARY OF FINDINGS

The results of these analyses argue for the following conclusions:

Comparisons Between Male and Female Test Results:

1. In this study, females learn significantly more French vocabulary pertaining to the descriptions of the software characters than males; males outperform females in learning French vocabulary related to geographical facts in French.

2. Differences between same- and mixed-gender dyads suggest that females tend to acquiesce to male factual preferences in mixed-gender dyads.

Effects of Gender and Personality Differences:
1. In this study, personality is a stronger predictor of language learning than gender. Males and females have similar gain scores in overall language learning within each personality profile. NFs (Intuitive/Feeling) and NTs (Intuitive/Thinking) learn significantly more than STs (Sensing/Thinking). However, the analysis of subscores indicate that female NFs learn significantly more French vocabulary describing the characters in the software, and that male NFs learn significantly more vocabulary pertaining to geographical facts.

2. Personality is a stronger predictor of keyboard control than gender. No significant difference appear between genders. Results indicate personality is the primary factor affecting keyboard control, with extraverts controlling the keyboard more than introverts. However, there was a significant difference between the female-only groups and the other groups, namely that females shared the keyboard more with a female partner.

3. Both personality and position at the computer are a stronger predictor of verbal interaction than gender.

Effect of Keyboard Control on Language Learning:

We found that keyboard control had a negative effect on language learning, with non-keyboard controllers learning significantly more than keyboard controllers.

DISCUSSION

The results of this cooperative computer based French task show a complex dynamics. However, given that this research was based on an artificially designed experiment, the results reported herein may lack some ecological validity and must be interpreted with some caution. We could assume, for instance, that non-volunteering students did not sign up for this experiment because of negative experiences in the past with computers, although the $10 incentive was meant to overcome this. The percentage of non-respondents (62%) may have introduced some bias into the sample data, which may partially explain why the effects of gender and dyad types are not consistent with the results of past research. Nevertheless, several of the systematic and significant results in this study are noteworthy, and the possible bias just mentioned may have actually helped the purpose of finding additional information while examining some of the factors affecting a computer based FL environment.
Males and Females Perform Differently, But Not as One Might Expect

The data from the experiment indicate that females and males focus their attention on particular types of information: females learn significantly more vocabulary pertaining to story characters, while males learn more vocabulary related to geographical facts. This gender-specific attention to the computer-based French text is in accordance with previous findings which examined the effect of gender-specific schemata during the reading process outside the computer realm (Crawford and Chaffin 1986; Scarcella and Oxford 1992). Studies in gender-specific schemata posited that differences in background between females and males in our society lead to differences in the way females and males attend to texts. Males were found to focus their attention more on facts and detached information, and females to focus their attention more on personalized information while reading in both their native language (Crawford, et al. 1986) and a foreign language (Scarcella, et al. 1992). The present results suggest that the same applies to the reading of computerized L2 texts and that content-based CALL programs may suit males more -when information is presented in a detached way, whereas females may feel more comfortable when content is presented with story characters. Since computers are particularly well suited to handling facts in a paradigmatic way, some researchers have even suggested that certain computer programs lend themselves to be sexist because of too many factual manipulations (Chisholm and Krishnakumar 1981). However, the language software Carmen San Diego used in this study has given evidence that the various types of information which it includes, along with the software built-in flexibility to explore this information, appeals to both males and females.

Studies in gender-specific schemata conducted to date dealt essentially with "book reading." Yet, while "book reading" is essentially a private activity, our experiment clearly shows that "computer reading" during computer-based group activities is a public activity, and thus, it implies that the schemata of all participants in a group come into play during the process of looking for relevant information. The question is: For whom is this information relevant? Indeed, the results of this study indicate a schematic shift of females who acquiesce to male factual preferences in mixed-gender groups where the females' attention lessens in the descriptive part of the text dealing with story characters. Males show no tendency to adjust to female interests, that is, descriptions of story characters. This result supports findings from LI gender studies indicating that females are more likely to adjust to male-specific topics or schemata during mixed-gender interactions, and that males show less sensitivity to topics preferred by females (Meunier 1994; Steinem 1991, 1994; Tannen 1994). According to the present data, this interactional pattern transfers from L1 to L2.
Adjustment on the part of females during this cooperative CALL activity does not seem to be limited to textual attention. Females also display a behavior shift in keyboard control. The data indicate that females share the keyboard significantly more with a female partner than with a male partner. In fact, females in this study tend to be more dominant with male partners when females are in control of the keyboard. Female keyboard controllers not only share the keyboard less with a male partner than with a female one, they also use more management statements with a male partner when passing the control of the keyboard to him than with a female partner. Clearly, dyad types in this study have a different effect on female learning behavior than that reported by Culley (1988) and Siann, et al. (1986). Specifically, mixed-gender groups in this study were not detrimental to females during computer based activities. Rather than a detrimental effect, it seems more appropriate to speak in terms of "shift effect." Whereas females at a younger age seem to be inhibited by male partners in mixed-gender groups (Culley 1988; Siann, et al. 1986), these female college students seem to see mixed-gender groups rather as a challenge.

With regard to verbal participation, results indicate that both males and females are as active and talkative, and that all participants, regardless of gender, are on task. This implies that computer skills do not necessarily relate to silence, in spite of what Cummings (1985) suggested. In fact, the results of this study reveal that both personality and position at the computer are a stronger predictor than gender.

**Personality is a stronger factor than gender, yet gender can also be a stronger factor than personality.**

A closer look at the data reveals gender-related differences between "Intuitive/Feeling" (NF) males and (NF) females who, although sharing the same feeling trait (characterized as "people oriented" according to the MBTI type theory), concentrate on what appears to be gender-specific topics. The gain scores in this study indicate that NF males attend to the computer based French text like sensing types, namely, by focusing on detached facts. At this point it seems appropriate to mention that the socialization process does not only affect females, it also affects males, who are often trained to fear sounding like a female, a schema which may account for the gender differences observed for "Intuitive/Feeling" students in this study. As a child, being raised to acquiesce to what is traditionally considered "appropriate" gender-specific behaviors can be as hard on NF males as it is on ST females. In this study, the differences in gain scores between NF females (people) and NF males (geography) demonstrate that gender affects personality manifestations and that the socialization process leading to "appropriate gender roles" can certainly play as strong a role in our foreign language courses as personalities. However, the fact that ST females (Graph B) do not outperform ST males in learning French descriptive vocabulary and that they are actually better than males in learning geographical facts (ST, a trait more likely to be preferred by
males, is characterized as fact oriented by the MBTI theory) seems to speak against this hypothesis. Yet, research in gender studies (Schweickart 1986, 1990) indicates that it is less shameful for a female to act as a male than it is for a male to act as a female. In fact, Schweickart observes that the "imasculination" of females is part of universities' hidden agenda, namely, that learning has to be analytical, logical, fact oriented, and that feelings, intuition, and sensitivity are eliminated as valid learning approaches. Admittedly, this study is also based on a traditional view of gender differences. Such definition, as still often used today, only takes into consideration sex differences. A more modern definition accounts for not only sex differences but also for sexuality differences, a distinction that more recent gender studies are starting to make (Anderson 1993; West and Fenstermaker 1993). Indeed, this study did not account for hetero- and homosexuality as possible extraneous variables in FL learning in a computer environment.

In the present study, both NF and NT types perform best on the criterion measure. SF (Sensing and Feeling) also had good scores, while ST types showed the lowest overall gain scores at a .05 significant level in this computer based French experiment. These results fit the MBTI type theory which posits that NT and especially NF types can feel comfortable in liberal arts or social studies and that ST types fit scientific and technical fields better. This implies that ST students are likely to experience more difficulties in foreign language studies, a trend confirmed in this research. The question is: Why do these differences exist? Observations during the video analysis appear to provide a partial answer. Because language learning was based in this experiment on the participants' hypertextual reading skills, reporting on what appeared to reflect hypertextual reading strategies observed during video analysis in the participants' discourse and behavior is relevant at this point of the discussion. The following observations represent trends observed through note-taking while observing verbal and nonverbal interactions taking place around the computers.

Observations made during video analysis suggest that NF and NT students, especially extroverts, verbalize more easily what appear to reflect skimming and scanning strategies, that is, a rather quick extraction of keywords and relevant information for solving each problem in the software. Students who prefer intuition also enjoy solving new problems and are good at reaching quick conclusions. Such participants appear to take more risks than students who prefer sensing by checking verbalized hypotheses through hypertextual maneuvers, especially when intuition is combined with perceiving (NP). Since people who prefer perceiving are often comfortable with nonlinearity, and people who prefer judging tend to like orderly approaches and linearity, intuitive and perceiving students seem to have an advantageous combination of psychological constructs for efficient L2 "hypertextual reading," which lends...
itself to a nonlinear format. Indeed, 'Intuitive' students in this study are more inclined to use the software's browsing possibilities with a purpose or a hypothesis in mind than "Sensing" students, who are more likely to browse through the software randomly for the sole purpose of manipulation. Furthermore, ST (Sensing and Thinking) students display more difficulties going beyond the word level, and they express frustrations or show long periods of silence when in front of unknown linguistic elements, especially for “Extravert/judging” (EJ) ST non-keyboard controllers. ESTJs, according to the MBTI type theory, work best when they can plan their own actions; therefore they lack collaborative skills, dislike disruptions from partners and therefore group activities. In all appearance, ST participants have been facing three obstacles in this experiment: (1) having to collaborate with a partner, (2) deciphering a foreign language text in a bottom-up way, thus losing track of gathered and relevant information for the purpose of solving the mystery case at stake; and (3) reading hypertext which lends itself to a nonlinear approach, whereas STs prefer linearity. Indeed, ST students show less enjoyment than "Intuitive" students in this experiment, maybe because there is no standard and orderly way to solve mystery cases. Interestingly, ST students seem to benefit more from "Intuitive" and/or "Feeling" partners when they, themselves, are not in a position to control the keyboard. This may explain why males, whose preferred learning profile is "Sensing/Thinking," learn more in FM groups when paired with a female, more likely to be 'Intuitive' and/or "Feeling" than in MM groups where an ST male has a higher probability to be paired with another ST partner. In fact, ST students showed the lowest gain scores when paired with another ST partner and obtained higher gain scores when paired with a partner of another learning profile. Indeed, seeing the positive results of different cognitive reasonings on the screen may have provided ST students with an excellent demonstration of the applicability of non-preferred learning and reading strategies. After all, it is not uncommon to say that "seeing is believing," a cognitive style which actually applies to ST students. The fact that non-keyboard controllers in this study learn more than keyboard controllers is a good indication that students may benefit from the visual demonstration of non-preferred cognitive strategies during this computer based French activity. Clearly, computers have the potential in this respect to be excellent tools for the teaching of non-preferred learning strategies.

Whereas strategic hypertextual reading patterns show for 'Intuitive" and 'Sensing" students respectively, gender differences do not seem to lend themselves to an easy profile of gender-specific hypertextual reading styles. Given the fact that in this study, females were essentially "Intuitive" readers and that males were essentially "Sensing" (ST) readers, a quick analysis without consideration of personality differences could, indeed, indicate strong gender differences in second language acquisition and interactive patterns. However, this study provides evidence that gender differences constitute a multifaceted variable for which personality differences are a
strong construct. Obviously, it is not enough to refer to gender-specific schemata and gender-specific language learning strategies, and more research is needed to examine “personality-specific” content and formal schemata for the reading of foreign language texts and hypertexts. Overall, this research leads to the hypothesis that second language acquisition through “book reading” can be more suitable to “Sensing” students, who prefer a predetermined path in approaching a reading task, while hypertextual reading seems better suited to “Intuitive” students, who tend to accommodate themselves more easily to flexible reading strategies. This hypothesis remains, of course, to be tested, with the present observations serving as a starting point for future studies with a larger pool of participants.

CONCLUSION AND RECOMMENDATIONS

This study suggests that particular attention should be paid to group dynamics in cooperative computer based foreign language activities, as well as to the compatibility of software types with gender differences and the multiplicity of personality types. Foreign language software designers should attempt to integrate more than one path of data exploration along with a large diversity of information to accommodate personality and gender differences.

Although this study shows no detrimental effect of group type on either males or females, computer based foreign language group activities should still be closely monitored for potential gender differences at the platform. This research indicates that gender differences are not necessarily those we might expect and that other factors such as personality and keyboard control represent other significant variables in the way students interact in a computer based L2 instructional environment.

The results of this study also suggest Pedagogical recommendations for structuring and monitoring cooperative CALL activities: 1) L2 instructors should demonstrate the language software to students; 2) L2 instructors should circulate among students and remind them to share the control of the keyboard: we have seen that the student who is using the mouse, navigating through the software, has a greater cognitive load therefore less capacity left for language learning; 3) L2 instructors should identify as early as possible linear learners who have difficulties using the full potential of hypertext; 4) as much as possible, linear learners should be paired with nonlinear students for the purpose of being exposed to other cognitive styles; 5) linear learners can be made more comfortable with hypertexts by providing them with a path to follow; this way, even if students explore (which should be encouraged) they would have a ‘road map’ to fall back on when they begin to feel lost; 6) L2 instructors should encourage students to cooperate, to teach each other computer skills, to demonstrate computer moves, and to praise each other on successful cognitive strategies.
(competitive behaviors should be closely monitored); 7) L2 instructors should make it clear that "branching decisions" are neither final nor fatal and that the possibility of branching back remains open in case of error; 8) L2 instructors should also organize advance-organizing activities prior to computer based group work in order to teach cognitive strategies necessary for the location of relevant information. Indeed, while computers have been around for quite a while, this study reveals that many students still need to be taught and encouraged to use all possible options offered by hypertexts. The data analysis of this study indicates that the most detrimental factor in this computer based French activity is the inability for linear ST learners, whether males or females, to adjust to the nonlinear format of foreign language hypertexts, and that hypertextual L2 reading requires some preliminary training before students can fully address the foreign language content of a hypertextual software.

Finally, since the conclusions of this study point to the personality type as the dominant feature in determining second language learning in a computer assisted instructional context, some language instructors may wonder how to apply the recommendations just mentioned. One may object, indeed, that the results of psychology tests administered in academic institutions are usually kept confidential, notwithstanding the fact that the MBTI test battery is rather expensive. The purpose for using the MBTI in this research was to control and to isolate personality differences as independent variables, and I am aware that the MBTI cannot be administered on a systematic basis in second language classrooms. However, in the light of this study's findings, language instructors can now observe and understand their students' behavior, and thus locate then minimize possible sources of frustration during computer assisted language sessions.

REFERENCES


**AUTHOR’S BIODATA**

Lydie E. Meunier (Ph.D., University of Arizona) is Assistant Professor of French and applied linguistics at The University of Tulsa, Oklahoma. Her responsibilities include teacher education, coordination of the elementary French program, content-based French courses in preparation for business and translation certificates, as well as courses in the Women’s Studies program. Her primary research interests are in second language acquisition and pedagogy. She is particularly interested in the use of technology and its role in efficient language learning, as well as in gender and personality differences in a foreign language instructional environment. She has published in the *French Review, Applied Language Learning, CALICO Journal*, and in the AAUSC series.

**AUTHOR’S ADDRESS**

The University of Tulsa
Department of Languages
600 South College Avenue
Tulsa, OK 74104-3189

Phone: 918-631-2813
Fax: 918-744-1902
E-mail: ang_lem@centum.utulsa.edu