THE EFFECT OF GENDER ON THE CONSTRUCTION OF BACKWARD INFERENCES

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The main objective in the present study is to examine the effect of gender on primary school students' construction of elaborative backward inferences during text processing. A total of 333 children, aged 10–11 years (n = 158 girls and 175 boys) participated in the study. Each participant completed a backward inference test. The results indicate that girls outperform boys in constructing backward inferences. This finding is discussed in relation to the differences in episodic and semantic memory functions between females and males.

Successful reading comprehension requires that the reader not only identifies and understands individual text words, and processes the individual sentences of the text by detecting their syntactic structures, but also identifies the relations between the various parts of the text, as well as between the text and his/her world knowledge (van den Broek, 1994). This is crucial for comprehension because for most texts writers imply more than what they write explicitly. Therefore in order to construct the coherence of a text, a good reader actively deals with inferential meaning.

There are many classifications and definitions of inferences in the literature (Graesser, Singer & Trabasso, 1994; McKoon & Ratcliff, 1992; Richeit, Schnotz & Strohner, 1985; Singer, 1994; Singer, 1990; van den Broek, 1994). Despite different classification systems, the common ground is that three types of inferences are generated by the reader while trying to construct a situation model of what a text is about (Graesser et al., 1994). These are backward inferences (explanations), concurrent inferences (associations) and forward inferences (predictions). To comprehend a message, the reader may produce all three types of inferences. However, among them backward inferences play a crucial role in text comprehension since they identify unstated text connections by building relations between a current text proposition and a prior text proposition, and since discourse coherence is disrupted if they are not drawn (Singer, 1994; Singer & Remillard, 2004; Wiley & Myers, 2003).

Research on inferences points to the fact that backward inferences dominate associations and predictions during deep understanding. For example, Zwaan & Brown's findings (1996) indicate that skilled comprehenders generate significantly more backward inferences while they tend to generate fewer associations than less skilled comprehenders because this type of information does not contribute to a coherent mental representation. Laing & Kamhi (2002) point to the fact that average readers generate significantly more backward inferences than below average readers. Similarly, Magliano & Millis (2003) report that less skilled readers adopt

a local processing strategy and they are less sensitive to the potential causal relationships that could be inferred between story sentences. To conclude, research has shown that backward inferences (explanations) are more necessary than other kinds of inferences to construct a coherent text base, and therefore understanding is explanation-based (Graesser, Singer & Trabasso, 1994; Laing & Kamhi, 2002; Singer & Ferreira, 1983; Singer, Halldorson, Lear & Andrusiak, 1992; Suh & Trabasso, 1993; Trabasso & Magliano, 1996; Zwaan & Brown, 1996).

Despite the richness of the literature related to inferences, the topic still attracts the attention of the researchers since inference generation is multi-dimensional in nature. Inferring is not only data driven but also knowledge driven and the differences in the cultural context, situational context, medium context, verbal context and personal context can affect the activated relevant world knowledge (Richeit, Schnotz & Strohner, 1985). Van den Broek (1994) describes the generation of inferences as a complicated cognitive activity consisting of sub-processes. For him and many others (Bråten & Strømsø, 2003; Narvaez, van den Broek & Ruiz, 1999; van den Broek, Lorch, Linderholm & Gustafson, 2001) the execution of these processes depends on many variables such as the reader's knowledge, attention capacity, high working memory capacity (Virtue, Haberman, Clancy, Parrish & Beeman, 2006), purposes in reading, the information provided by the text and the demands imposed by the task. Richeit, Schnotz & Strohner (1985) suggest personal context as one of the salient variables which affect the inferences the readers generate during comprehension. The personal context includes knowledge, attitudes, and emotional factors of the recipient, and the comprehenders try to understand the meaning of the text by analyzing words, sentences, and paragraphs against the background of their personal knowledge. For the authors, this personal knowledge is conditioned by factors such as sex, age, education, occupation, and so on. Gender is considered to be one of the important factors that affect the comprehension process.

Although gender is considered as a distinctive variable for the comprehension process, contradictory findings are reported for the effect of gender on verbal abilities (APA, 2005; Chen, 2000; Feingold, 1994; Hyde, 2005; Lin & Wu, 2003; Mccoby & Jacklin, 1974; Moore, Yin, Weaver, Lydell & Logan, 2007; Robert & Savoie, 2006). In their milestone study, Mccoby & Jacklin point to gender differences in four areas: verbal ability, visual-spatial ability, mathematical ability and aggression. They conclude that with regard to verbal ability, girls outperform boys. On the other hand, Hyde's meta-analysis provides support for similarities between genders rather than differences. Furthermore, the findings of the studies which highlight the superiority of females in verbal ability tests do not point to a significant difference for the overall test. For example, females' superiority over males in this area is limited to either the generation of a certain type of vocabulary, the task type, the type of the verbal test, or the type of the language skill considered (Chen, 2000; Lin & Wu, 2003; Robert &

Savoie, 2006).

As we have discussed so far, readers' successful comprehension of texts heavily depends on their drawing backward inferences. Despite the richness of the literature on inferences, the relationship between sex/gender and backward inference generation is still open to question. Therefore, this study aims to investigate whether or not there is any difference between the fourth-grade primary school students' construction of backward inferences in terms of their sex.

Method

Participants

Participants were 333 fourth-grade primary school students being educated in four different schools in Mersin, in Turkey; 158 of the students were girls and 175 were boys. All of the students were the children of low-socio-economic status families and their ages varied between 10 and 11.

Procedures

In order to explore possible gender differences with regard to drawing backward inferences, a backward inference test in Turkish was developed. As the first step, a trial test was prepared. For this, 12 test items were selected among the ones developed by Aydın (2003). Aydın's test items were prepared following models by Singer et al. (1992) and Halldorson & Singer (2002).

The test was administered to the children in their classes in four different schools. The students were told that they would not be graded but they would contribute to a scholarly study. Prior to the implementation of the test, a sample item similar to the ones in the trial test was written on the board and the students were shown how to deal with it. The test was completed in a 40-minute class period.

For scoring the data obtained from the trial backward inference test, a norming study was conducted (Singer & Ferreira, 1983) to identify the backward inferences that could normally be drawn by expert readers when they processed the texts in the test. To this end, the 12-item test was given to 20 instructors working at Mersin University, Faculty of Education. They were asked to bridge the gaps by writing the most likely outcome of the events described in the12 test texts. A sample test item is given and explained below:

a. Ali sokaktaki sarı kediyi yakalamaya çalısıyordu.
(Ali was trying to catch the yellow cat in the street)
b. Sarı kedi,birden gelen arabanın önüne atladı.
(The yellow cat suddenly jumped in front of an approaching car.)
c. .....
d. Ali aglamaya basladı.
(Ali began to cry)

For the above test item, the instructors drew the possible backward inferences for sentence 'c': "the cat died", "the cat was wounded", "the cat was crushed", "the car hit the cat", which were the specifications of the indeterminate "something bad happened to the cat". The alternatives constructed by the instructors were the inferences which stated the consequence of the stimulus sentence 'b' and the cause of stimulus sentence 'd' and therefore, bridge 'b' to 'd'. In doing so, for each test

item, a pool of possible backward inferences was prepared to be used for scoring the responses of the participants.

Afterwards, the participants' responses for each test item were scored as 1 or 0. They were given 1 point for drawing inferences which were included in the pool of backward inferences, and 0 point for responses which were not included in the pool and therefore not acceptable. The grammar and spelling mistakes in the students' writings were not taken into consideration as long as the sentences were clear enough to understand.

After the scoring, factor analysis was conducted to determine the dimensional structure of the test. As a result of this analysis, two items in the test with low item total test correlations and factor loadings were eliminated. Finally, factor analysis revealed that first factor explained 43.486 per cent of total variance (Eigen Value: 14.785). Then, KR-20 of the test was calculated. The results of these analyses are given in Table 1.

Table 1: Results of the Statistical Analysis of the Test Items

Item No.	Item Total Test Cor.	Factor Loadings
		1
K1	.7396	.805
K2	.6932	.802
K3	.7010	.792
K4	.6889	.783
K5	.7435	.766
K6	.7152	.754
K7	.7609	.748
K8	.6996	.744
K9	.7480	.744
K10	.7500	.734
Eigen Values		14.785
Explained Variance		43.486
Reliability (KR-20)		0.79

After eliminating the two items in the test, the final form of the test consisted of ten items (see Appendix 1 for the English version of the test) which proved to be one-dimensional. The value of KR-20, 0.79, was acceptable. The participants' trial administration responses for the ten items in the test were considered as the final data for analyzing their ability to construct backward inferences.

Results and Discussion

In order to observe whether girls and boys differ in constructing backward inferences, t test was conducted for the ten items in the final form of the test. t test results indicate a significant difference between girls and boys in drawing backward inferences for the test items. Results are given in Table 2.

Table 2: t Test Results for the Differences between Genders in Backward Inference Generation

Sex	N	X	S	t	p
Female	158	7.45	2.66	2.987	0.00
Male	175	6.54	2.85		

Research related to memory functions in men and women demonstrate certain differences between the two sexes. Findings of the studies provide sufficient evidence for a female advantage in episodic memory tasks (Herlitz, Nilsson & Backman, 1997; Kormi-Nouri, Moniri & Nilsson, 2003; Nyberg, Habib & Herlitz, 2000; Pillemer, Wink, DiDonato & Sanborn, 2003; Robert & Savoie, 2006; Yonker, Eriksson, Nilsson & Herlitz, 2003). On the other hand, some of the studies also highlight the female superiority not only for the episodic memory but also for some domains of semantic memory (Boman, 2004; Maitland, Herlitz, Nyberg, Backman & Nilsson, 2004). Boman's study indicates that girls outperformed boys both in episodic and semantic memory tasks, but the girls could not take advantage of their higher memory performance during noise exposure. Maitland et al. (2004) report a female advantage for both episodic and semantic memory at the second-order level. Their study indicates that at the first-order level, sex differences in episodic memory are apparent for both recall and recognition; however, female superiority can be observed only in fluency task for the semantic memory. Wirth, Horn, Koenig, Federspiel, Meier, Michel & Strik's (2007) results suggest that men and women encode semantic information similarly but they differ in the controlled processing of meaning. Women spontaneously conduct a deeper semantic analysis. That is to say, their findings demonstrate that there is a selective sex difference in the controlled semantic analysis during passive word reading that is not reflected in different functional organization but in the depth of processing. The reason why girls outperformed boys in the present study may be related to the memory differences between females and males.

Conclusion

As Tulving (1993) states, episodic memory enables a person to remember personally experienced events. It makes a person consciously aware of an earlier individual experience in a certain situation at a certain time. Semantic memory pertains to individuals' knowledge of the world in the broadest sense and makes it available for retrieval. Although the functions of episodic and semantic memory are distinctive, both memories are interrelated.

Understanding a text is a dynamic and cognitively complex process. What readers try to achieve during this process is to construct a coherent mental representation of the text. To this end, backward inferences are critical. Van den Broek (1994) analyses backward inferences in three groups: connecting inferences, reinstatements and backward elaborations. For him, "a connecting inference is generated when the reader identifies a causal relation between the focal event and information that has remained activated after processing of the prior event". Therefore, connecting inferences necessitate short-term memory operations. On the other hand, reinstatement "occurs when textual information is no longer activated is reactivated (reinstated) in order to provide missing causal support". For this reason reinstatements reactivate memory for the prior text. Finally, backward elaborations draw on the reader's background knowledge to provide causal antecedents and therefore they necessitate semantic memory operations.

The test items (Appendix 1) in the present study are the ones which fall into the third category of backward inferences (i e. backward elaborations) suggested by van den Broek:

a. Ayse was running in order to catch her class.
b. She stepped on a banana peel.
c. .....
d She suddenly found herself on the ground.

Thus, in order to explain the event in (d), readers will need to access background knowledge " banana peel is something slippery".

Studies indicate that backward elaborations are derived from general background knowledge as a function of semantic memory operations (van den Broek, 1994; Magliano, Trabasso & Graesser, 1999; Trabasso & Magliano, 1996). Episodic memories also contribute to semantic memories during this process. Recent research provides support for the relationship between episodic and semantic memory for the generation of causal backward inferences. Hannigan & Tippens (2001) study reports that backward inference errors involve the recollection of episodic information rather than generic semantic information. They conclude that it is conceivable that inferences are simply bound to a specific episode context or even modify the underlying episodic representation of a specific event sequence.

Therefore, when the generation of backward elaborative inferences are considered as the functioning of semantic and episodic memories, and when the research reporting the tendency for female superiority for the different domains of these memories are taken into consideration, the finding of the female superiority for backward elaborative inferences can be

attributed to the memory differences between genders. Of course this is an issue which seeks further investigation.

References

APA (2005). Men and women: no big difference. Psychology Matters. http://www.psychology matters.org/nodifference.html. Date accessed 06.09.2007.

Aydın, E. (2003). *The analysis of backward inference process within the frame of discourse analysis*. Unpublished MA thesis, Mersin University.

Boman, E. (2004). The effects of noise and gender on children's episodic and semantic memory. *Scandinavian Journal of Psychology*, 45: 407–416.

Bråten, I. & Strømsø, H.I. (2003). A longitudinal think-aloud study of spontaneous strategic processing during the reading of multiple expository texts. *Reading and Writing*, 16: 195–218.

Chen, H.Y. (2000). Gender differences in cognitive abilities: trends from age 6 to age 16 based on WISCH-III standardization data for Taiwan. *Proc. Natl. Sci, Counc. ROC*(C), 10(2): 201–216.

Feingold, A. (1994). Gender differences in variability in intellectual abilities: a cross-cultural perspective. *Sex Roles*, 30(1–2), 81–92.

Graesser, C.A., Singer, M. & Trabasso, T. (1994). Constructing inferences during narrative text comprehension. *Psychological Review*, 10(1): 371–395.

Halldorson, M., & Singer, M. (2002). Inference process: Integrating relevant knowledge and text information. *Discourse Processes*, 34: 145–161.

Hannigan, S.L. & Tippens, M. (2001). A demonstration and comparison of two types of inference-based memory errors. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 27(4): 931–940.

Herlitz, A., Nilsson, L.G. & Backman, L. (1997). Gender differences in episodic memory. *Memory and Cognition*, 25: 801–811.

Hyde, J.S. (2005). The gender similarities hypthesis. *American Psychologist*, 60(6): 581–592.

Kormi-Nouri, R., Moniri, S. & Nilsson, L.G. (2003). Episodic and semantic memory in bilingual and monolingual children. *Scandinavian Journal of Psychology*, 44: 47–54.

Laing, P.S. & Kamhi, G.A. (2002). The use of think-aloud protocols to compare inferencing abilities in average and below-average readers. *Journal of Learning Disabilities*, 35: 436–447.

Lin, J. & Wu, F. (2003). Differential performance by gender to foreign language testing. Poster for the 2003 annnual meeting of NCME in Chicago. http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/1b/31/c1.pdf.

Magliano, P.J. & Millis, K.K. (2003). Assessing reading skill with a think-aloud procedure and latent semantic analysis. *Cognition and Instruction*, 21: 251–283.

Magliano, P.J., Trabasso, T. & Graesser, A.C. (1999). Strategic processing during comprehension. *Journal of Educational Psychology*, 91(4): 615–629.

Maitland, S.B., Herlitz, A., Nyberg, L., Backman, L. & Nilsson, L.-G. (2004). Selective sex differences in declarative memory. *Memory and Cognition*, 32(7): 1160–1169.

Mccoby, E.E. & Jacklin, C.N. (1974). *The psychology of sex differences*. Stanford, CA: Stanford University Press.

McKoon, G. & Ratcliff, R. (1992). Inference during reading. *Psychological Review*, 99(3): 440–466.

Moore, J., Yin, L., Weaver, T., Lydell, P. & Logan, A. S. (2007). Preschool caregiver perceptions of the effect of gender on literacy skills. *Reading Improvement*, 44(3): 132-148.

Narvaez, D., van den Broek, P. & Ruiz, B.A. (1999). The influence of reading purpose on inference generation and comprehension in reading. *Journal of Educational Psychology*, 91(3): 488–496.

Nyberg, L., Habib, R. & Herlitz, A. (2000). Brain activation during episodic memory retrieval: sex differences. *Acta Psychohology*, 105(2–3): 181–194.

Pillemer, D., Wink, P., DiDonato, T. & Sanborn, R. (2003). Gender differences in autobiographical memory styles of adults. *Memory*, 11(6): 525–532.

Richeit, G., Schnotz, W. & Strohner, H. (1985). The concept of inference in discourse comprehension. In G. Richeit & H. Strohner (Eds), *Inferences in text processing* (pp. 3–49). Elsevier Science Publishers B.V.

Robert, M. & Savoie, N. (2006). Are there gender differences in verbal and visuospatial working-memory resources?. *European Journal of Cognitive Psychology*, 18(3): 378–397.

Singer, M. (1990). *Psychology of language*. New Jersey: Lawrence Erlbaum Associates.

Singer, M. (1994). Discourse inference process. In M.A. Gernsbacher (Ed.), *Handbook of psycholinguistics* (pp. 479–513). San Diego, CA: Academic.

Singer, M. & Ferreira, F. (1983). Inferring consequences in story comprehension. *Journal of Verbal Learning and Verbal Behavior,* 22: 437–448.

Singer. M. & Remillard, G. (2004). Retrieving text inferences: controlled and automatic influences. *Memory and Cognition*, 32 (8): 1223–1237.

Singer, M., Halldorson, M., Lear, C.J. & Andrusiak, P. (1992). Validation of causal bridging inferences in discourse understanding. *Journal of Memory and Language*, 31: 507–524.

Suh, S. & Trabasso, T. (1993). Inferences during reading: Converging evidence from discourse analysis, talk-aloud protocols, and recognition priming. *Journal of Memory and Language*, 32: 279–300.

Trabasso, T. & Magliano, J.P. (1996). Conscious understanding during comprehension. *Discourse Processes,* 12: 255–287.

Tulving, E. (1993). Human memory. In P. Andersen, O. Hvalby, O. Paulsen & B. Hökfelt (Eds.), *Memory concepts* 1993: *Basic and clinical aspects* (pp. 27–45). Amsterdam: Elsevier Science.

Van Den Broek, P. (1994). Comprehension and memory of narrative texts: inferences and coherence. In M.A. Gernsbacher (Ed.), *Handbook of psycholinguistics* (pp. 539–583). San Diego, CA: Academic.

Van Den Broek, P., Lorch, Jr. F.R., Linderholm, T. & Gustafson, M. (2001). The effect of readers' goals on inference generation and memory for texts. *Memory and Cognition*, 29: 1081–1087.

Virtue, S., Haberman, J., Clancy, Z., Parrish, T. & Beeman, M.J. (2006). Neural activity of inferences during story comprehension. *Brain Research*, 1084(1): 104–114.

Wiley, J. & Myers, J.L. (2003). Availability and accessibility of information and causal inferences from scientific text. *Discourse Processes,* 36(2): 109–129.

Wirth, M., Horn, H., Koenig, T., Federspiel, A., Meier, B., Michel, C.M. & Strik, W. (2007). Sex differences in semantic processing: event-related brain potentials distinguish between lower and higher order semantic analysis during word reading. *Cerebral Cortex*, 17(9): 1987–1997.

Yonker, J.E., Eriksson, E., Nilsson, L.-G. & Herlitz, A. (2003). Sex differences in episodic memory: minimal influence of estradiol. *Brain and Cognition,* 52(2): 231–238.

Zwaan, A.R. & Brown, M.C. (1996). The influence of language proficiency and comprehension skill on situation model construction. Discourse Processes, 21: 289–327.

APPENDIX I

1.
a. Ayşe was running in order to catch her class.
b. She stepped on a banana peel.
c. .....
d. She suddenly found herself on the ground.

2.
a. Ali was trying to catch the yellow cat in the street.
b. The cat suddenly jumped in front of an approaching car.
c. .....
d. Ali began to cry.

3.
a. The children were shivering because the house was cold.
b. In the evening, their father brought a sack of wood.
c. .....
d. The children slept warmly.

4.
a. They had okra to eat.
b. .....
c. Kaan left the table without taking a bite.

5.
a. Kaan caught cold and he couldn't breathe comfortably.
b. .....
c. He was breathing comfortably and throwing the tissue into the wastebasket.

6.
a. It started to rain heavily when Efe and Özge left school.
b. .....
c. They had to change their clothes when they arrived home.

7.
a. The school was over.
b. While Ahmet was going home, he looked longingly at the chocolate cake in the pastry shop window.
c. .....
d. When he arrived home, his mouth was covered with chocolate.

8.
a. Ayşe put a basket of trousers on the ironing board.
b. .....
c. An hour later all the trousers were razor sharp.

9.
a. Feyyaz opened the cookie box.
b. .....
c. As he closed the box he was licking his lips.

10.
a. Hasan and his aunt went to a tailor and gave her a bag of old and worn clothes.
b. .....
c. Two days later, they thanked the tailor for her work.