

Print or digital? Critical thinking in reading news in the information era

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The expansion of information resources in recent years challenges consumers with the need to employ critical thinking skills in reading news. Moreover, the co-existence of both printed and digital resources poses questions as to the ability of users to read news critically in multiple representation formats: the traditional printed and the digital, hypermedia-based newspaper formats. This research compares the critical ability of reading news in a print and a digital format, by two age-groups: high-school and college students. A variety of significant differences was found and is discussed in the paper. The most important finding is the better performance of the young participants (high school students) in reading digital news formats, and the better performance of the older participants (college students) in reading news in a print format. The paper discusses approaches for interpreting the results and for future studies. The Findings may provide designers, researchers and educators with useful guidelines for designing effective messages in the information age.

Introduction

In the digital era, information consumers are exposed to exponentially-increasing volumes of digital or printed information, which can be authentic-reliable, biased, or even false, using elaborate textual or multimedia manipulations to hide its biased or falsified nature (Dor, 2001, 2005; Wolfsfeld, et al., 2003). Therefore, the user's ability to read information critically has become a key-issue and "survival skill" in constructing well-founded knowledge (Minkel, 2000; Davitt-Maughan, 2001; Browne et al., 2000; Unn, 2002; Eshet-Alkalai & Amichai-Hamburger, 2004). The ability of consumers to read information critically requires a special kind of cognitive skill, termed "information literacy" (Mardis, 2002; Bawden, 2001; Marcum, 2002; Eshet-Alkalai, 2004).

In recent years we face a rapid growth in digital platforms for delivering information in general, and news in particular, as indicated by the blooming of digital newspapers on the expense of the printed ones, as well as in the reports that today more and more people retrieve news from the Internet (e.g. Saranto & Hovenga, 2004; Pew Research Center Report, 2006). These findings led to extensive research efforts that compare readability and critical thinking in print versus digital formats, (e.g. Morahan-Martin & Anderson, 2000; Hargittai, 2002; Eveland & Dunwoody, 2000; Baker et al., 2002; Shaikh, 2004; Bernard et. al., 2002), in order to establish standards for proper information design

formats (Brady & Philips, 2003). However, despite these efforts, the factors that control effective and meaningful reading in digital environments are not yet clear, and more research is needed, especially in understanding the differences in readability between the digital and print formats.

This paper compares the ability of users from different age and gender to apply critical thinking skills in reading news in digital and printed formats, in order to shed light on the critical thinking skills of readers.

Methodology

Participants

80 people participated in the research, all from the Upper Galilee, Israel: 40 high-school students, average age 16.5 (20 males; 20 females) and 40 3rd-year college students (20 males; 20 females), average age 26.4. All participants read a newspaper at least four times per week; they all had a computer and Internet connection at home, and they used it to read the news on a daily basis. All were proficient in other basic computer skills such as using *Office* programs and surfing the Internet.

Tasks

A task-oriented research approach, in which participants were required to perform with real-life authentic tasks (Wiggins, 1992; 1993), was employed to compare critical thinking skills in print and digital news formats. Participants were divided into two equal groups: Print and Digital, each consisting of 20 high-school students (10 males and 10 females) and 20 college students (10 males and 10 females). Each group received the same set of five news items that were published by the national newspaper *Haaretz*, and appeared in both printed and digital formats (www.haaretz.co.il). The news items belonged to five different subject areas (one item from each area): politics, science, economy, sport and art. The Print Group received the news items as excerpts from the newspaper whereas the Digital Group read the same news items in front of a computer.

After reading the five news items (in either print or digital format), participants were asked to write a short critical summary that reports on all the biased, false or manipulative treatment of information they could identify in each item, and to give an overall, justified, assessment of the item's reliability. The News Manipulation Model of Dor (2001; 2005) was used for the critical analysis.

Grading

Participants' performance in each task was assessed and graded by one of the authors, aided by a list of evaluation guidelines. Table 1 presents the grading guidelines used by referees to grade the reports on the analyzed news items. Grades represent the overall assessment of the report by the referees, based on these guidelines. A random selection of 20% of the reports was graded independently by two additional expert referees who used the same guidelines for evaluation, to test the validity of the grading guidelines. The close similarity between the referees' grades and the grades given by the authors (Pearson Correlation range 0.809 to 0.997, all significant at the 0.01 level, two-tailed) suggests a high coherence of the evaluation criteria utilized in this research.

Table 1. Grading guidelines

	Principle
General	<ul style="list-style-type: none"> • Overall assessment of report • Manipulative use of readers' misconceptions and prejudice • Manipulative use of readers' common knowledge • Manipulative use of readers' schemas and mental models
Text	<ul style="list-style-type: none"> • Manipulative use of headlines • Manipulative use of specific words to create bias • Manipulative use of sentence structure to create bias.
Graphics	<ul style="list-style-type: none"> • Using photographic manipulations to create bias (angle of photography; selecting a specific image). • Manipulative use of page or screen layout to create bias.(e.g. proximal placement of text and image) • Manipulative use of visual design elements to create bias (e.g. color, centering; emphasizing). • Manipulative use of principles of message design.

Results

All scores are summarized in Table 2, showing a variety of differences between the participating groups in both subject areas and reading formats.

An ANOVA analysis was performed (Table 3) to test the significance of these differences. The most prominent and significant finding is the better performance of the High-school group (H) in digital format compared to their performance in print format, whereas the scores of the C Group were higher in reading news in a print format than their grades in the digital format tasks. The significant differences are:

- **Print versus Digital Groups:** Significant differences were found in all the major groups (H and C) and in all subject areas (except for sport in the C Group). Significant differences were also found in the sub-groups (i.e. HM, HF, CM, CF). However, the Print (P) – Digital (D) difference was not found significant in the Total participants, Total Male (M) and Total Female (F) Groups.
- **High-School versus College Groups:** Significant differences were found in the Total group (except sport), in the M Group (except sport and art) and in the F Group (except science). Significant differences were also found in the sub-groups: PM (except science), PF (except sport), DM, and DF (except art).
- **Males versus Females Groups:** Significant differences were found in the major groups Total, H, and C (except science), as well as in the sub-groups PH, PC (except science), DH, and DC.

Table 2. Results: Average digital literacy grades by format, age and gender

Age Group	Gender	Topic Format		Politics		Science		Economy		Sport		Art			
		Print	Digital	Print	Digital	Print	Digital	Print	Digital	Print	Digital	Print	Digital		
High-school	Male	N	10	10	20	20	20	10	10	10	10	10	10	20	
		Mean	45.8	53.3	49.6	73.7	81.4	77.6	33.7	40.4	37.1	80.2	91.6	85.9	75.4
		Std. D.	5.5	3.6	5.9	3.7	4.1	5.5	3.4	2.4	4.5	2.3	3.1	6.4	5.1
	Female	N	10	10	20	10	10	20	10	10	20	10	10	20	20
		Mean	56.8	63.9	60.4	65.1	73.6	69.4	49.9	59.0	54.5	72.9	80.2	76.6	81.1
		Std. D.	4.8	3.5	5.5	6.0	4.3	6.7	4.5	2.6	5.9	2.8	2.9	4.7	5.2
Total	N	20	20	40	20	20	40	20	20	40	20	20	40	40	
	Mean	51.3	58.6	55.0	69.4	77.5	73.5	41.8	49.7	45.8	76.6	85.9	81.2	78.2	
	Std. D.	7.5	6.5	7.9	6.5	5.7	7.3	9.2	9.8	10.2	4.5	6.5	7.3	5.9	
College	Male	N	10	10	20	10	10	20	10	10	20	10	10	20	
		Mean	83.4	75.1	79.3	72.7	65.4	69.1	77.3	70.4	73.9	91.8	84.8	88.3	77.8
		Std. D.	4.2	4.8	6.1	5.5	5.1	6.4	3.4	2.8	4.7	2.4	3.3	4.6	4.5
	Female	N	10	10	20	10	10	20	10	10	20	10	10	20	20
		Mean	90.4	86.3	88.4	72.0	57.1	64.6	87.2	78.1	82.7	69.7	64.6	67.2	86.6
		Std. D.	3.3	4.3	4.3	3.8	5.2	8.8	4.6	3.1	6.0	3.5	3.0	4.1	5.2
Total	N	20	20	40	20	20	40	20	20	40	20	20	40	40	
	Mean	86.9	80.7	83.8	72.4	61.3	66.8	82.3	74.3	78.3	80.8	74.7	77.7	82.2	
	Std. D.	5.1	7.3	7.0	4.6	6.6	8.0	6.4	4.9	6.9	11.7	10.8	11.5	6.6	
Total	Male	N	20	20	40	20	20	40	20	20	40	20	20	40	40
		Mean	64.6	64.2	64.4	73.2	73.4	73.3	55.5	55.4	55.5	86.0	88.2	87.1	76.6
		Std. D.	19.9	11.9	16.2	4.6	9.4	7.3	22.6	15.6	19.2	6.4	4.7	5.6	4.9
	Female	N	20	20	40	20	20	40	20	20	40	20	20	40	40
		Mean	73.6	75.1	74.4	68.6	65.4	67.0	68.6	68.6	68.6	71.3	72.4	71.9	83.8
		Std. D.	17.7	12.1	15.0	6.0	9.7	8.1	19.6	10.2	15.4	3.5	8.5	6.4	5.9
Total	N	40	40	80	40	40	80	40	40	80	40	40	80	80	
	Mean	69.1	69.7	69.4	70.9	69.4	70.1	62.0	62.0	62.0	78.7	80.3	79.5	80.2	
	Std. D.	19.1	13.1	16.3	5.8	10.2	8.3	21.9	14.6	18.5	9.0	10.5	9.7	6.5	

Table 3. Analysis of Variance Results

	n	Print (P) vs. Digital (D)					High school (H) vs. College (C)					Males (M) vs. Females (F)				
		Politics	Science	Economy	Sport	Art	Politics	Science	Economy	Sport	Art	Politics	Science	Economy	Sport	Art
Total	80	0.0	0.7	0.0	0.6	0.0	302.5**	15.1**	277.5**	2.6	8.2**	13.6**	11.3**	127.3**	35.5**	
Males (M)	40	0.0	0.0	0.0	1.5	0.0	244.2**	20.3**	648.5**	1.9	2.5	N/A				
Females (F)	40	0.1	1.6	0.0	0.3	0.0	322.0**	3.8	225.3**	45.9**	11.2**	N/A				
High School (H)	40	10.8**	17.4**	6.7*	27.8**	23.6**	N/A					35.7**	18.0**	111.3**	27.8**	11.9**
College (C)	40	9.7**	37.9**	19.7**	2.9**	19.1**	N/A					29.8**	3.4	26.7**	238.5**	32.3**
High School - Males (HM)	20	13.1**	19.6**	25.8**	88.6**	15.8**	N/A					N/A				
High School - Females (HF)	20	14.1**	13.3**	31.2**	32.3**	21.1**	N/A					N/A				
College - Males (CM)	20	17.2**	9.3**	24.6**	29.2**	26.7**	N/A					N/A				
College - Females (CF)	20	5.7*	53.3**	27.2**	12.6**	32.4**	N/A					N/A				
Print - High School (PH)	20	N/A					N/A					22.8**	15.0**	83.5**	40.5**	8.4**
Print - College (PC)	20	N/A					N/A					17.3**	0.1	29.8**	275.2**	45.2**
Digital - High School (DH)	20	N/A					N/A					43.8**	17.3**	277.0**	72.2**	16.1**
digital - College (DC)	20	N/A					N/A					30.3**	12.8**	34.8**	206.3**	36.2**
Print - Males (PM)	20	N/A					300.1**	0.2	813.9**	124.6**	31.0**	N/A				
Print - Females (PF)	20	N/A					329.9**	9.5**	339.8**	5.1*	68.4**	N/A				
Digital - Males (DM)	20	N/A					132.4**	59.0**	670.5**	22.4**	10.0**	N/A				
Digital - Females (DF)	20	N/A					160.7**	59.9**	226.6**	142.2**	2.5**	N/A				

Legend: Level of significance ** p<0.01, * p<0.05. N/A = not applicable.

The numbers present F values, the degrees of freedom can be computed from the n (number of observations) data

Discussion

The variety of significant differences found in the research sheds light on the possible effect of information representation format (print or digital) on the ability of readers of different age and gender to utilize critical thinking skills in reading news. In light of the present-day expansion of reading information in a digital format, these findings are valuable by providing information designers (Baker et al., 2002; Bernard et al., 2002), researchers and educators (O'sullivan, 2002; Grafstein, 2002; Johnston & Webster, 2003) with important guidelines. Due to the yet-insufficient understanding of the mechanisms that control such differences, as reported in the literature (e.g. Bruce, 2003), we suggest several possible approaches for interpreting our findings as a platform for further research:

- **A sociological approach:** According to this approach, the data should be interpreted in terms of generation-differences and digital-divide (Hargittai, 2002). Since younger people are more proficient in using the Internet and other technological platforms for information-retrieval (Beentjes, 2001; Subrahmanyam et al., 2001), they perform better in these “friendly” environments, which are more “hostile” for adults.
- **A cognitive approach:** Research shows that younger people perform better with hypermedia non-linear environments that require a higher cognitive flexibility (Spiro et al., 1991; Eshet-Alkalai & Amichai-Hamburger, 2004; Saranto & Hovenga, 2004; Rigmor & Rosemary, 2006). This may explain the higher scores of the younger participants, who were able to make a better use of the non-linear presentation of news in the digital format.
- **A design approach:** According to this approach, the difference between the advanced-colorful and multimedia design of the digital information and the traditional, black & white design of printed information in newspapers affects the ability of different groups of people to read information effectively (Baker et al., 2002; Brady et al., 2003; Shaikh, 2004; Chaparro et al., 2005).
- **An information economics approach:** Information does not have an absolute universal value. The value of information is always relative and depends on the user, the time it is used and the circumstances (Ahituv, 1980, 1989). Therefore, people differ in their preferences of information formats for certain tasks and their performance is affected by the information format, as well as their perceived usefulness of the information (Lim & Benbasat, 2000; Speier et al., 2003).
- **An ergonomic approach:** The experience of users affects their ability to learn effectively especially in highly-technological environments, where performance depends to a large extent on technical abilities to control devices (Shneiderman, 1998). This may explain the higher scores of the younger and more experienced participants in the digital platforms.

Conclusions

Findings of the present study shed light on the ability of different groups of information consumers to read information critically. The younger participants (high-school students) performed significantly better in critically reading news that appeared in a digital format, while the older participants performed significantly better in a print format environment. A variety of additional significant differences in gender and age were identified in this exploratory study, and interpretation approaches and directions for further research were outlined. More research is required in order to confirm the validity of the present research findings as guidelines for information designers, educators and researchers.

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