

Influences of Comics Expertise and Comics Types in Comics Reading

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Abstract – Comics have been increasingly used in reading materials, e.g. newspaper, textbook, and signs. Despite its potential benefits, little is discussed in the merit of comics expertise in comics reading. This study, therefore, aims to investigate how experienced vs. inexperienced comics readers comprehend comics. It investigates additionally whether comics types (picture vs. text-picture comics) influence reading patterns. Experienced ($N = 12$) and inexperienced comics readers ($N = 12$) comprehended 2 picture comics and 2 text-picture comics firstly with an eye tracker and then answered comprehension questions on papers. Results showed that experienced readers had shorter fixations than inexperienced readers in comics reading. All readers reported that picture comics were more difficult to read than text-picture comics. Inexperienced comic readers showed better comprehension scores in text-picture comics than picture comics possibly due to low graphical literacy.

Keywords – Graphical Literacy, Conjoint Processing of Text and Picture, Eye Tracking, Adult, Cognitive Process.

I. INTRODUCTION

Comics are a special genre of literature. It once suffered from prejudice (Mellini, 1991). There was even a campaign to abolish comic books in 1950s (Twomey, 1955). Nowadays comics have become one of the most popular literatures in the world. According to a comic sales report from North America, the comics and graphic novel market grew on average 8.7% per year from 2011 to 2016. The sales to consumers have reached \$1.085 billion in 2016 (Griep & Miller, 2016). Using comic books as teaching materials is significantly increasing in last decades as well. When typing comic academic book as search words, 420 academic books showed as results on the book seller Amazon.de. For traditional academic books, educators alike insert short comic strips or using comic format to teaching materials to motivate learning, e.g. the book series *Info comics*. The rising interest on comics has led comic literacy become a critical pedagogies of new media literacy (Duffy, 2016).

However, comics can have different types: picture comics and text-picture comics. One of the most famous comic strips *Father and Son* (Plauen & Rottenberg, 2017) is an example of picture comics. A well-known example of text-picture comics is *Donald Duck*. However, little is known about how comics expertise and comics types influence understanding of comics. We therefore aim at exploring how experienced comics readers compared to inexperienced comics readers read picture comics versus text-picture comics.

II. THEORY

A. What are Comics?

Although defining comics has become a routine in comics studies, it is still a difficult question to answer. Comics are defined as influential and entertaining arts, which are popular since 19th century, which was associated with children and uneducated and was even considered as “JUNK” (Kunzle, 1973). Comics are also defined as a literature genre presented by images and sometimes with words in a visual and sequential way (McCloud, 2006). Comics are not merely a display of text and image interaction or episodic narrative; they are a system guided by a collection of iconic images (Groensteen, 2007). In literature studies, comics are defined as a hybrid word-and-image form, in which verbal and pictorial forms are spatially registered. Although the definitions focus on different perspectives, all agree that comics are seamless integration of images and maybe words in creating narratives.

B. Unique Features of Comics

Differed from other literature, comics have at least three unique features. First, comics are often displayed in panels, which are fragmentary, gap-riddled, multi-component form (Miodrag, 2013). Storyline is presented by the chosen moment and chosen frame (Iser & Schalk, 1970). Second, words are used for communication between different characters inside thought or speech balloons (Tversky, 2011), which establish word-image unity and distinguish comics from other text-picture materials (Carrier, 2000). Third, comic designers have developed their own expressions for sound words (i.e. onomatopoeia, like BOOM for explosion, THWIP for Spider Mann’s web shooters and Zzzzzz for sleeping), feelings (drawn symbols, such as hearts represent “in love”) and movement (e.g. speed lines) (McCloud, 2006).

C. Picture Comics versus Text-picture Comics

Comics do not have to contain words but must contain pictures (Harvey, 2001). Here, we define pictures as all the icons, shades, shapes that differ from words. We group comics into: picture comics and text-picture comics. Picture comics are stories that are primarily presented by pictures. Readers can however see some texts in these comics, such as the title of the story and the author names. Although picture comics are not well known as text-picture comics, Dowhower (1997) proposed that picture comics are a special genre of literature. In 1992, Richey and Puckett (1992) compiled a list of 685 picture comics published in English. Arizpe (2013) has reviewed the literature to use wordless picture books with children in pedagogic. Text-

picture comics are those using juxtaposed words and images to convey narration. Here texts are mainly displayed as conversations in speech balloons. They manifest character's speech, reflection, thought, etc.

As comics are an integration of pictures and sometimes words in a sequential order, the cognitive processes of text, picture and text-picture integration can help us to understand how people read comics.

D. Text Processing

Text processing is a more constrained processing than picture processing. Readers are expected to read texts word by word and line by line. The degree of freedom during text processing is relatively low. Van Dijk and Kintsch (1983) proposed text-based model, propositional representations and situational model during text reading. Although some information has to be inferred by the reader (McNamara, 2007), the content of texts is more clearly defined than the content of pictures. Texts are prior to pictures in conceptual guidance for the construction of a mental model. However, the linear structure of texts makes the search for information more difficult because the search path for specific information is relatively long.

E. Picture Processing

Picture processing includes organizing perceptual scenes into meaningful symbols under Gestalt laws (Todorovic, 2008). This process is less constrained than picture processing in terms of non-linear information presentation in pictures. Although pictures can convey sequential information, they do not have pre-defined order of information processing (Massironi, 2002). Therefore, pictures provide relatively low degree of conceptual guidance but the information search is easier than texts because pictures provide more flexible access to specific information (Schnotz & Wagner, in press).

F. Comics Processing

Until now, comics processing is still an undeveloped area. Neil Cohn (2013, 2014a, 2014b) finds that the drawings and the sequential pictures are structured the same as language. Comics are written in a visual language of sequential pictures that integrates text. Like spoken and written texts, he proposes "narrative grammar" that organizes sequential pictures in hierarchic constituents. Visual narratives use a lexicon of systematic patterns stored in memory, strategies for combining these patterns into meaningful units and a hierarchic grammar structure, which governs the sequential pictures into coherent meaning. The panel frame makes the search for information easier compared to text because one panel represents a part of the story. If readers need to search for the detail or conversation, they can spatially choose where to look at first. Although European or American readers read comics often in Z-path, they have relatively high degree of freedom in reading a single panel. They can either first read the speech balloon or the character or the background. The comprehension of comics also involves the interaction of multiple modes, namely the distinctive textual channel and pictorial channel (Mayer, 2005; Schnotz, 2014; Zhao, Schnotz, Wagner, & Gaschler, 2014).

G. Experienced versus Inexperienced Readers

Graphical literacy (Duesbery, Werblow, & Yovanoff, 2011) is the ability to understand information presented

graphically, including general knowledge about how to extract information and make inferences from different graphical formats to meaningful concepts. Studies on learning with text and pictures show that experienced readers are more competent in conjoint processing of text and pictures and they have better graphical literacy than inexperienced readers (Hochpöchler et al., 2013; Schnotz & Wagner, 2018). Additionally, experienced readers are more strategic than inexperienced readers in aggregating text processing and moment-by-moment processing (Seipel, Carlson, & Clinton, 2017).

H. Questions and Hypotheses

1) How does comics expertise influence comics reading?

Prediction a. Due to the training in comics reading, experienced comic readers should need less reading time and should have less difficulty in comprehending comics than inexperienced readers.

2) How do readers comprehend picture-comics compared to text-picture comics?

Prediction b. Picture-comics should be more difficult than text-picture comics for readers to understand due to lack of global coherence guidance from text.

III. METHOD

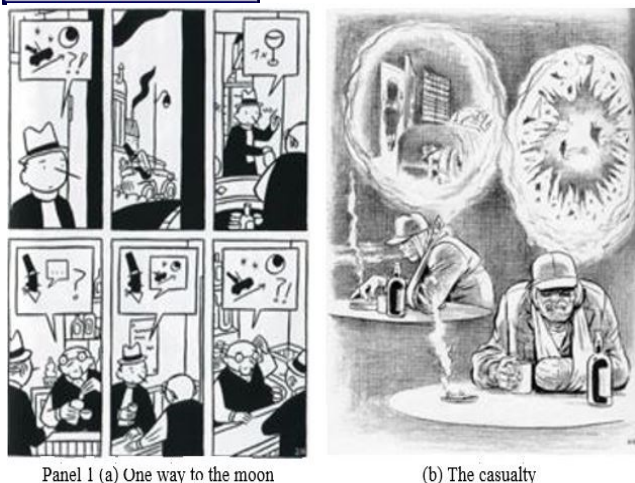
A. Participants

Twenty-four students and staffs at University of Koblenz-Landau in Germany participated in our experiment. Among them, 79.2% were between 21 - 30 years old, 12.5% were 31 - 40 and 8.3% were 41 - 50. We allocated them into two groups based on three questions in a questionnaire. First, how often do you read comic strips (e.g. can be a picture or a page)? Five scales were daily; once a week; once a month; several times per year; never. Second, regarding long comics, how many comics have you read in the last 3 years? 1 = less than 10; 2 = 10- 20; 3 = 21- 30; 4 = 31-40; 5 = more than 40. Third, regarding long comics, how many comics have you read in your childhood? 1= less than 10; 2 = 10- 20; 3= 21-30; 4 = 31-40; 5 = more than 40.

Twelve participants (7 females) were considered as experienced readers, as they read long comic strips at least once a month. They have additionally read at least 10-20 long comic strips in the last 3 years. They have read more than 31 long comic strips as a child. Twelve participants were considered as inexperienced readers (9 females). They read comic strips now either several times per year or never. They read less than 30 long comic strips in the past 3 years. They have read also less than 30 comic strips in their childhood.

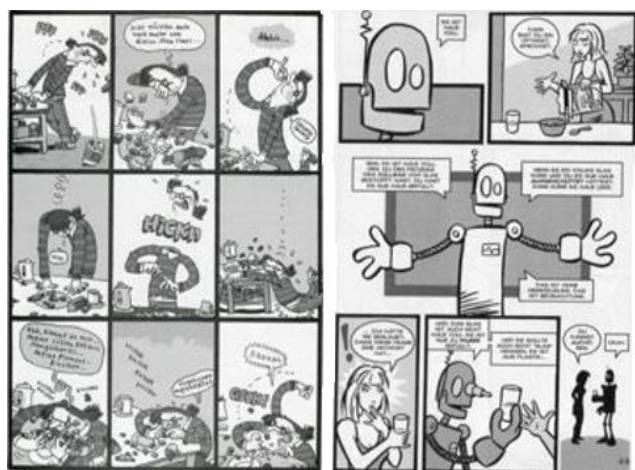
B. Experimental Materials

We selected 4 short comics. The 2 comics that contained words were in German, participants' native language (See Fig. 1). All the comics were not well-known to avoid the influence of prior knowledge. The materials were presented



Panel 1 (a) One way to the moon

(b) The casualty



Panel (c) I should not eat so much

Panel (d) Half full

Fig. 1. One page of the four comic stories as an example¹. Panel (a) One way to the moon (picture comics): containing 6 words; 24 panels; 6 pages. Panel (b) The casualty (picture comics): 3 words; 20 panels; 6 pages. Panel (c) I should not eat so much (text-picture comics): 77 words; 27 panels; 3 pages. Panel (d) Half full (text-picture comics): 399 words; 34 panels; 8 pages.

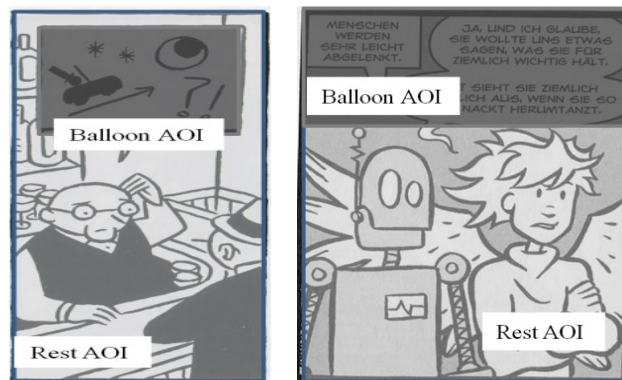
In black and white to eliminate the function of colour in highlighting elements (McCloud, 1994). In order to answer the comprehension question correctly, participants needed to understand the story of comics globally and in detail. Two picture comics presented the most information with ONLY pictures (see Fig. 1). Two text-picture comics presented the information with text and pictures. The comics were from 3 to 8 pages long.

C. Procedure

We conducted the experiment (each taking about 20 min) individually in a lab environment under the participants' permission. The experiment included three parts: (a) questionnaire, (b) reading comics with eye tracker and (c) comprehension test. The personal information is mainly about the personal experiences of comics (see Section Participant).

¹ The permission to use Fig. 1 has been granted by copyright owners Ulf Keyenburg (Panel a), W. Eisner (Panel b), M. Witzel (Panel c) and Kerry Callen (Panel d).

A Tobii T60 XL eye tracker was used to record participants' eye movements at a frequency of 60 Hz. Although the preciseness of the data is arguable, the system can compensate for head movements and thus provides relatively a comfortable testing situation. All the comics were displayed on a 24-inch monitor at a resolution of 1920 × 1200 pixels. All the participants seated at 60-70 cm distance from the monitor. A 9-point calibration was conducted before participants read the comics. Once the calibration was successful, the experiment would start.



Panel a: Picture comics

Panel b: Text-picture comics

Fig. 2. Panel a shows an example of Balloon AOI (dark grey) and Rest AOI (light grey) in picture comics. Panel b depicts the corresponding AOIs in text-picture comics.

The experiment included a warm-up phase and a main test. The aim of the warm-up phase was to ensure that the participants were familiar with the eye-tracking system and with using keyboards for turning pages. Participants could read as long as necessary on each page. They used space to turn to the next page but they could not go back to the former page. After reading, they were thanked and awarded some sweets. Finally, two out of all the participants were awarded with € 25 comic book voucher.

D. Eye-tracking Method

To examine the cognitive processing during reading, we adopted eye tracking method. Referring to eye-mind hypothesis and immediacy hypothesis (Just & Carpenter, 1980), the information can be immediately processed in the brain after the eye perceives the information. By providing the reading duration (how long), eye tracking method suggests the cognitive processes during reading.

E. Scoring

The AOIs (Areas of Interest) were drawn manually using Tobii Studio software. For picture comics, we drew the balloon AOI and the rest AOI (see panel a in Fig. 2). For text-picture comics, each panel was considered as a Panel AOI, which contained the picture AOI and the text AOI (see panel b in Fig. 2). Later in the comprehension test, participants obtained one point when they answered a question correctly. They could obtain a maximum score of 8 points and a minimum score of 0 point.

IV. RESULTS

A. Questionnaire

Before reading the materials, participants were asked about the difficulty of comics reading by using 1-5 to represent from very easy to very difficult. No difference was shown between experienced readers ($M = 2.17$, $SD = 0.94$) and inexperienced readers ($M = 2.25$, $SD = 0.75$), $p = .85$ (two-sided paired t-test).

We also asked each participant to list the 3 reasons to read comics. Interestingly, experienced comic readers pointed out more attractive perspectives in comics reading than inexperienced readers (see Fig. 3). We separately calculated the frequency of the appeared perspectives in top 1 topic, top 2 topic and top 3 topic among all participants. For instance, the top 1 attractive topics for experienced readers were 33.3% humor, 25.0% fantasy, 25.0% story and 16.7% sketches. 33.3% humor referred to 33.3% of twelve experienced readers reported humor as top 1 attractive topic. The answer from the inexperienced group was rather homogeneous (100% humor). It applied also to top 2 and top 3 attractive topics that experienced readers reported more attractive perspectives than inexperienced readers.

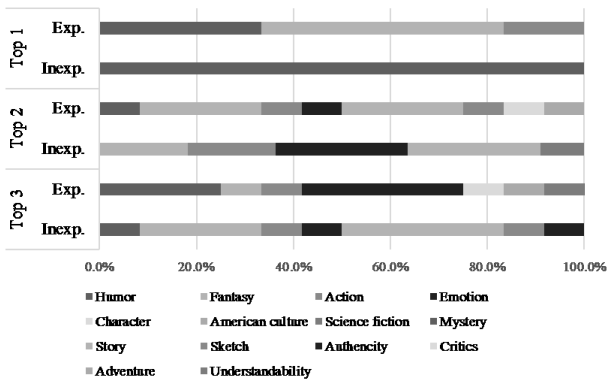


Fig. 3. Questionnaire. The percentage of topics on the top 3 attractive topics when read comics from inexperienced (Inexp.) and experienced (Exp.) comic readers.

B. Eye Movements

The eye movements also distinguished experienced comic readers and inexperienced readers. Fig. 3 gave us a general overview of the allocation of attention in all the four comics. Experienced readers ($M = 22.05$ sec, $SD = 14.67$ sec) had significantly shorter fixation on ALL comic materials than inexperienced readers ($M = 36.77$ sec, $SD = 13.55$ sec), $t(22) = -2.55$, $p = .02$, $d = 1.09$.

As mentioned in 3.1 Participants, we separated participants into experienced comic reader group and inexperienced comic reader group. In order to test whether reading patterns are similar although comics readers are different, we submitted the accumulated fixation data into a three-factorial $2 \times (4 \times 2)$ ANOVA including 2 reader type (experienced vs. inexperienced) as between-subject factor, 4 story (2 picture vs. 2 text-picture comics), 2 attention allocation (balloon vs. rest) as within-subject factors (see Fig. 4). A main effect of *reader type*, $F(1, 22) = 6.52$, $p = .02$, $\eta_p^2 = .228$, indicated that experienced comics readers ($M =$

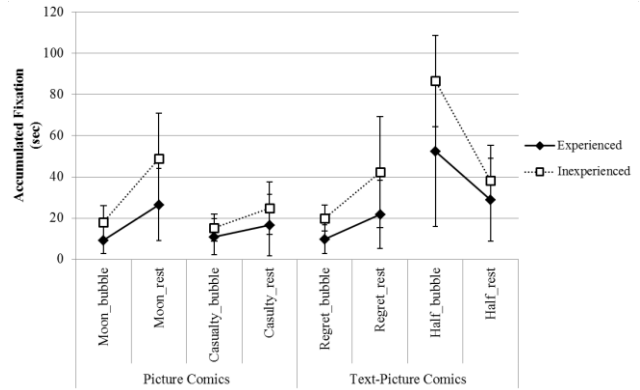


Fig. 4. Accumulated fixation in seconds between experienced readers and inexperienced readers for all the four comics. Moon refers to one way to the moon. Casualty is the casualty. Regret is I should not eat so much. Half is Half full. Balloon refers to the dialogue balloon in picture comics. Rest refers to the rest areas without dialogue balloon. Text refers to the textual information in the dialogue balloon. Picture refers to the rest areas without textual information. Error bars refer to the between-subject standard error of the mean.

22.05 sec, $SD = 14.67$ sec) needed much less time to read than inexperienced comics readers ($M = 36.77$ sec, $SD = 13.55$ sec). A main effect of *story*, $F(1.51, 33.24) = 90.40$, $p < .001$, $\eta_p^2 = .804$ Greenhouse-Geisser corrected, suggested different reading time for different stories. No effect of attention allocation was found, $F < 1$. The interaction of *reader type* and *story*, $F(1.51, 33.24) = 4.04$, $p = .037$, $\eta_p^2 = .16$, indicating that experienced readers had larger difference in reading time on text-picture comics and picture comics than inexperienced readers. A three-dimensional interaction of *reader type*, *story* and *attention allocation* was found, $F(1, 22) = 7.45$, $p = .01$, $\eta_p^2 = .253$. As Table 1 illustrated, experienced readers showed different effect of comics type, attention allocation than inexperienced readers. No other effect was found.

Table 1. Means and standard deviations of accumulated fixation (sec) for balloon vs. rest areas of interest for experienced and inexperienced readers in reading picture comics and text-picture comics.

Variables	Experienced <i>M (SD)</i>	Inexperienced <i>M (SD)</i>
Balloon		
Picture comics	10.13 (7.17)	16.67 (6.45)
Text-picture comics	31.05 (21.32)	53.30 (13.96)
On average	20.59 (13.83)	34.99 (9.90)
Rest		
Picture comics	21.65 (15.84)	36.80 (16.77)
Text-picture comics	25.38 (17.63)	40.31 (20.80)
On average	23.51 (16.49)	38.55 (18.44)

C. Comprehension Test

After reading the 2 picture comics and 2 text-picture comics with an eye tracker, participants had comprehension test for the 4 stories. As shown in Table 2, experienced

comic readers had as many correct answers in text-picture comics as in picture comics, $t(11) = 0.43, p = .67, d = 0.26$. Inexperienced comic readers had 97.9% ($SD = 14.4\%$) correct answers in text-picture comics, which was much better than in picture comics, $t(11) = 3.02, p = .01, d = 1.82$. No difference was shown in average scores for all comics among two reader groups, for experienced readers and inexperienced readers, $t(22) = .56, p = .66, d = .23$.

Participants rated the difficulty of the comic reading by using 1-5 to represent from very easy to very difficult as well. No difference in reading difficulty was shown between experienced readers and inexperienced readers, $p = .94$ (two-sided paired t-test). However, experienced readers and inexperienced readers rated text-picture comics significantly easier than picture comics, $t(11) = -4.07, p = .002, d = 1.55$ for experienced readers and $t(11) = -3.74, p = .003, d = 1.47$ for inexperienced readers respectively (see Table 2).

Table 2. Means and standard deviations for comprehension test and difficulty reports from experienced and inexperienced readers in reading picture comics and text-picture comics.

Variables	Experienced <i>M (SD)</i>	Inexperienced <i>M (SD)</i>
Comprehension scores		
<u>Picture comics</u>	91.7% (27.9%)	83.3% (37.7%)
<u>Text-picture comics</u>	93.8% (24.4%)	97.9% (14.4%)
On average	92.7% (26.1%)	90.6% (29.3%)
Difficulty scale (1= easy, 5= difficult)		
<u>Picture comics</u>	3.00 (1.11)	3.00 (1.71)
<u>Text-picture comics</u>	1.67 (0.49)	0.83 (0.92)
On average	2.33 (1.08)	2.35 (1.04)

V. DISCUSSION

Comics are a literature genre presented by pictures and sometimes with words in a visual and sequential way (McCloud, 2006). It was once considered as “Junk” in 1950s as they associate with children and uneducated. However, the status of comics has significantly improved in the last decades. Educators even apply teaching materials in comic formats to motivate learning in academics. There are two types of comics: picture comics and text-picture comics. As little is known about how comics expertise and comics types influence comics reading, we therefore conducted the eye-tracking study. We have mainly two findings.

A. Comics Expertise

Consistent with Prediction a, experienced comic readers had significantly shorter fixations on all comic materials than inexperienced readers. This finding corresponds to Cohn (2013) that experienced comic readers do not explore everything in comics and they are efficient readers. Likely, experienced comic readers can tell necessary from unnecessary information in comics and focus at the start, whereas inexperienced readers are hesitant what to read

first, text or picture. The interaction of reader type and story indicate that experienced comic readers are more efficient in reading especially in picture comics than inexperienced comic readers. It can be due to the lack of graphical literacy, which is an ability to extract graphical information into meaningful concepts (Duesbery, Werblow, & Yovanoff, 2011). Due to the frequent comics reading experience from childhood until now, experienced comic readers can better select, make inferences, transfer to and integrate with verbal information in the pictorial channel compared to inexperienced comic readers.

With regard to readers’ previous comic experiences, we found that experienced comic readers exhibited equivalent comprehension performance for picture comics and text-picture comics. Inexperienced comic readers however demonstrated better comprehension for text-picture comics than picture comics. This finding again supports our prediction that inexperienced comic readers may have difficulties in processing information in the pictorial channel and in conjoint processing of text and pictures into the mental model. Presumably inexperienced comic readers are unaware of visual conventions that portray distracted by details in the artwork when text is not present.

Although no reading difficulty difference between two groups was shown in the questionnaire and in the comprehension test, experienced comic readers reported more perspectives of comic reading than inexperienced comic readers. As illustrated in Fig. 3, experienced readers reported humor, fantasy, story and sketches as the top 1 attractive reasons. All inexperienced readers only reported humor. Experienced readers know that comics are not restricted to only humorous illustrations. Comics can be vividly displayed by sketches to narrate fantasy, story, and motion on serious issues. Conversely, inexperienced readers have the prejudice that comics are primarily for entertainment. The comic studies on children show that they favour comic strips due to rich elements of adventure and excitement (Witty, 1941; Witty, Smith, & Coomer, 1942), our study shows that adults seem to have completely different tastes. Both groups suggested humor as the most attractive topic in comic reading.

B. Picture Comics versus Text-picture Comics

In line with Prediction b, picture comics were more difficult than text-picture comics for readers to understand. In the comprehension test, participants had better scores for text-picture comics than picture comics, especially for inexperienced readers. Two groups reported that text-picture comics were significantly easier than picture comics to comprehend. It can be due to the different cognitive functions of texts and pictures (Schnotz & Wagner, 2018). Texts have priority in expressing abstract meanings. They can assist pictorial displays in a symbiotic relationship (Barton, 2016). Owing to the textual guidance, readers can more easily create their mental model from verbal and pictorial channels. As our working memory has limited capacity, information cannot be easily blocked because information is not only processed in the pictorial channel but also in textual channel. Pictures, conversely, can visualize the information directly and metaphorically. They are thus advantageous in directly displaying the object,

background of the events and characters of figures (Schnotz, 2014).

In line with Levin's (1971) suggestion, experienced readers performed similarly in comprehension test in picture comics and text-picture comics. The inexperienced readers are strongly affected by the picture comics. Studies on children (Cooney & Swanson, 1987; Rusted & Coltheart, 1979) show that experienced readers may have more difficulties than inexperienced readers in assessing the meaning of the words. They thus benefit more with pictorial displays to remedy insufficient information from verbal channel (Mayer, 2001). Yet, our subjects, who study or work at a university, have less difficulty than middle school children in text processing. Our results may indicate that inexperienced readers have difficulties in processing information in the pictorial channel and in integrating verbal and pictorial information into the mental model. Displaying the instruction mainly in images (like IKEA furniture) may cause confusion or difficulty for readers, who have less experience in text-picture reading.

C. Limitations of this Study

Some limitations should be acknowledged when interpreting the results from the study. At first, the results can be biased due to the limited sample size. The combination of multiple data sources, like think-loud protocol, can better explain the cognitive processes of reading (Mason et al., 2014). The chosen comics have different length (e.g. One Way to the Moon has 6 pages and Half Full has 8 pages). It can be disputable to compare speech balloons and rest in picture comics and text-picture comics. Although these outcomes are promising, further research is necessary to be done in focusing on understanding why experienced and inexperienced comics readers differ in their specific comprehension processes and attentional focus (with similar types of comics) and how these individual differences operate in determining comprehension of comics.

VI. CONCLUSION

This study examines how comics expertise and comics type influence comic reading. Results showed that experienced readers had shorter fixations than inexperienced readers in comic reading. Two groups reported that picture comics were more difficult to read than text-picture comics due to the lack of textual guidance. Inexperienced comic readers showed better comprehension scores in text-picture comics than picture comics likely due to low graphical literacy. The study provides us first evidence for understanding experienced and inexperienced adult comics readers in the context of picture vs. text-picture comics. It might be relevant to indicate educational implications in comics reading and suggestions for comics design. Using comics as teaching materials are become more popular (Klavir & Gorodetsky, 2001; Tversky, 2011). Our results suggest that picture-only materials are more difficult to understand than text-picture materials.

APPENDIX

1) List of Picture Comics

W. Eisner. (2007) the Casualty. In D. Kendall (Ed.). *The mammoth book of best war comics*. London: Robinson. pp. 393-398.

U. Keyenburg. (2000). One way to the moon. In Ulf Keyenburg, *Tango de la Mort* (4 pages). Wuppertal: Ed. 52.

2) List of Text-Picture Comics

K. Callen. (2003). Halb voll. In K. Callen, *Halo and Sprocket*. Brandenburg: Eidalon. pp. 5-12.

Witzel, M. (2007). Wie ich mal nichts mehr zu essen hatte. In M. Witzel, *Action Sorgenkind* (3 pages). Berlin: Reprodukt.

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REFERENCES

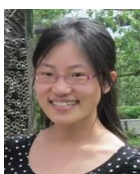
- [1] E. Arizpe (2013). Meaning-making from wordless (or nearly wordless) picture books: what educational research expects and what readers have to say. *Cambridge Journal of Education*. 43(2). pp. 1-30.
- [2] S. Barton (2016). *Visual devices in contemporary prose fiction: Gaps, gestures, images*. Basingstoke: Palgrave Macmillan.
- [3] D. Carrier (2000). *The aesthetics of comics*. University Park: Pennsylvania State University Press.
- [4] N. Cohn (2013). Navigating comics: An empirical and theoretical approach to strategies of reading comic page layouts. *Frontiers in Psychology*, 4.
- [5] N. Cohn (2014a). The architecture of visual narrative comprehension: The interaction of narrative structure and page layout in understanding comics. *Frontiers in Psychology*, 5.
- [6] N. Cohn (2014b). *The visual language of comics: Introduction to the structure and cognition of sequential images*. London: Bloomsbury Academic.
- [7] S. Dowhower (1997). Wordless Books: Promise and possibilities, a genre comes of age. In K. Camperell, B. L. Hayes, & R. Telfer, *Yearbook of American Reading Forums* (S. 57–79).
- [8] L. Duesbery, J. Werblow, & P. Yovanoff (2011). Graphical literacy moderates the interaction of decorative dimensionality and cognitive demand in computer-based graph comprehension. *Journal of Educational Computing Research*, 45(1), 75–93.
- [9] D. Duffy (2016). *Educational hypercomics: Learners, institutions, and comics in E-Learning interface design*. University of Illinois at Urbana-Champaign, Urbana, Illinois.
- [10] M. Griep, J. J. Miller (2016). Comics and graphic novel sales up 5% in 2016, a resource for comics research. [Online]. Available: <http://www.comichron.com/yearlycomicsales/industrywide/2016-industrywide.html>
- [11] T. Groensteen (2007). *The system of comics*. (B. Beaty & N. Nguyen, translated). Jackson, MS: University Press of Mississippi.
- [12] R. C. Harvey (2001). Comedy at the juncture of word and image: the emergence of the modern magazine gag cartoon reveals the vital blend. In *the Language of Comics: Word and Image*, R. Varnum & C. T. Gibbons, Ed. University Press of Mississippi.
- [13] U. Hochpöchler, W. Schnotz, T. Rasch, M. Ullrich, H. Horz, N. McElvany, & J. Baumert (2013). Dynamics of mental model construction from text and graphics. *European Journal of Psychology of Education*, 28(4), pp. 1105–1126.

- [14] W. Iser, & F. Schalk (1970). Dargestellte Geschichte in der europäischen Literatur des 19. Jahrhunderts [Illustrated history in European literature of the 19th century.]. Frankfurt am Main: Klostermann.
- [15] M. A. Just, & P.A. Carpenter (1980). A theory of reading: From eye fixations to comprehension. *Psychological Review*, 87(4), pp. 329–354.
- [16] R. Klavir, & M. Gorodetsky (2001). The processing of analogous problems in the verbal and visual-humorous (cartoons) modalities by gifted/average children. *Gifted Child Quarterly*, 45(3), pp. 205–215.
- [17] D. Kunzle (1973). *The history of the comic strip*. Berkeley, CA: University of California Press.
- [18] M. Massironi, & N. Bruno. (2009). *The psychology of graphic images seeing, drawing, communicating*. New York: Psychology Press.
- [19] R. E. Mayer. (2005). *The Cambridge handbook of multimedia learning*. Cambridge, U.K.; New York: Cambridge University Press.
- [20] S. McCloud. (2006). *Making comics: Storytelling secrets of comics, manga and graphic novels*. New York: Harper.
- [21] D. S. McNamara. (2007). *Reading comprehension strategies: Theories, interventions, and technologies*. New York: Lawrence Erlbaum Associates.
- [22] P. Mellini. (1991). The history of the comic strip: The nineteenth century by David Kunzle. *A Quarterly Journal Concerned with British Studies*, 23(4), pp. 774–775.
- [23] H. Miodrag. (2013). *Comics and language: Reimagining critical discourse on the form*. Jackson, MS: University Press of Mississippi.
- [24] E. O. Plauen, & J. Rottenberg. (2017). *Father and son*. New York: New York Review Comics.
- [25] V. Richey, & K. Puckett (1992). *Wordless/ almost wordless picture books*. Englewood, CA: Libraries Unlimited.
- [26] W. Schnotz. (2014). Integrated model of text and picture comprehension. In *the Cambridge handbook of multimedia learning*. Cambridge, UK: Cambridge University Press. pp. 72–103.
- [27] W. Schnotz, & I. Wagner. (2018). Construction and elaboration of mental models through strategic conjoint processing of text and pictures. *Journal of Educational Psychology*.
- [28] B. Seipel, S. E. Carlson, & V. E. Clinton. (2017). When do comprehender groups differ? A moment-by-moment analysis of think-aloud protocols of good and poor Comprehenders. *Reading Psychology*, 38(1), pp. 39–70.
- [29] D. Todorovic. (2008). Gestalt principles. *Scholarpedia*, 3(12), pp. 5345.
- [30] B. Tversky. (2011). Visualizing Thought. *Topics in Cognitive Science*, 3(3), pp. 499–535.
- [31] J. E. Twomey. (1955). The citizens' committee and comic-book control: A study of extra governmental restraint. *Law and Contemporary Problems*, 20, pp. 621–629.
- [32] T. A. van Dijk, & W. Kintsch. (1983). *Strategies of discourse comprehension*. New York: Academic Press.
- [33] P. Witty. (1941). Children's interest in reading the comics. *Journal of Experimental Education*, 10, pp. 100–104.
- [34] P. Witty, E. Smith, & A. Coomer. (1942). Reading comics in grades VII and VIII. *Journal of Educational Psychology*, 33(3), 173–182.
- [35] F. Zhao, W. Schnotz, I. Wagner, & R. Gaschler. (2014). Eye tracking indicators of reading approaches in text-picture comprehension. *Frontline Learning Research*, 2(4), pp. 46–66.



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