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ALEIXO, Paul <<http://orcid.org/0000-0002-7745-7469>> and SUMNER, Krystina

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Memory for Biopsychology material presented in Comic book format.

Paul A. Aleixo

and

Krystina Sumner

Address for correspondence:

Dr. P. A. Aleixo
Senior Lecturer
Department of Psychology Sociology and Politics
Sheffield Hallam University
Collegiate Campus
Sheffield
S10 2BQ

Tel: (0114) 2255563
email: p.aleixo@shu.ac.uk

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Running head: Memory for Biopsychology in Comics

This study investigated the influence of format of presentation on memory for undergraduate level Biopsychology material. Ninety participants read either seven comic book pages from Aleixo and Baillon (2008) explaining the rudiments of sleep, the same material presented in text-only format or seven pages where the original images were replaced with random incongruous images. Participants were tested on the material using ten multiple-choice questions. Results showed significantly higher memory scores in the comic condition compared to both the text-only and the incongruous comic condition. Furthermore, the text-only version showed significantly higher memory scores than the incongruous comic condition. It was concluded, that while there were some limitations to the study, the findings provided preliminary evidence to support the general idea of using comic books to create instructional materials. Results also provided some support for dual coding theory (Paivio, 1969, 1972, 1975) as a theoretical basis for the use of comics in educational contexts.

Keywords: Comics, Comic Books, Graphic Novels, Memory, Education, Dual-Coding Theory.

Introduction

The search for pedagogical techniques and tools to improve teaching methods for students is vitally important for the development of education. Much has been made of multimedia and IT solutions as possible improvements for educational experiences (e.g. Druin & Solomon, 1996). However, these solutions tend to be costly and are short-lived due to the fast pace of technological advancements. One alternative approach that has been suggested is the use of comic books which are popular and relatively cheap to produce.

The concept of using comics in education dates back to at least the late 1940s. Hutchinson (1949) reported a study of teacher attitudes towards the use of comics (mainly newspaper strips) in schools. Despite this promising start, the prevailing negative public image of comic books in 1950s USA meant that this type of research waned in subsequent years. However, over the intervening

decades several studies have been published suggesting the possibilities of using comics in educational settings. These have ranged from using comics as tools for teaching different subjects including sociology and descriptive writing (e.g. see Burns, 1999; Snyder, 1997), general comprehension and memory (Brooks, 1977), perceptual skills (Singh, 1981), reading (e.g. Aleixo & Norris, 2007; Millard & Marsh, 2001, Sabbah, Masood & Iranmanesh, 2013) and acculturation (Takashima, 1987) as well as texts published to encourage teachers to use comics for different processes (e.g. Syma & Weiner, 2013). Furthermore, several authors have suggested the positive benefits of using comics to teach children with learning difficulties (e.g. Hallenbeck, 1976). Generally, comics have received more academic attention in a number of other disciplines including areas as diverse as geography (e.g. Dittmer, 2010), linguistics (e.g. Cohn, 2013) and even medical humanities (Czerwiec, Williams, Squier, Green, Myers & Smith, 2015).

There are also many examples of the use of comics as instructional materials (e.g. Aleixo and Baillon, 2008; Hosler, 2008; Hosler, Cannon & Cannon, 2011; Schultz, Cannon & Cannon, 2009). Furthermore, there are strong theoretical reasons for the use of comics in this manner in educational settings. Clark and Paivio (1991) and Paivio (2006) have argued for the application of dual coding theory in educational settings. Dual coding theory (Paivio, 1969, 1972, 1975) proposes that both a visual and a verbal code contribute to cognitive processing and overall comprehension and memorability of textual material.

They argue that presenting educational material in both a verbal and visual manner would improve both the comprehension and memory for that material.

Comic books fit dual coding theory well, given that they have both a visual and a verbal component which interact to produce the finished product. As, for example, Cohn (2013, 2016) argues, the dual modalities of comics interact to produce a great deal of cognitive complexity, unavailable in the individual components. In comics, text and image are interdependent, whereby the finished product and effect is more than simply the combination of images and text that might occur in, for example, an illustrated book. It can therefore be argued that comics present the ideal combination of factors for cognitive processing as described by dual coding theory and thus a potential tool for use in educational instruction.

However, empirical research into the use of comic books for instruction is extremely limited. One well controlled example is by Hosler and Boomer (2011), who investigated the attitudes and comprehension of biological material in college age first-year non-major students using a comic book produced to teach the biology of the visual system. They found that the use of the comic book not only improved comprehension and memorability but that there was also an increased positive attitude towards science in general. A similar comparison was carried out by Mallia (2007), who created a comic version of a Maltese folk tale and compared it to a written version using a sample of Maltese children. He found no significant differences in the material remembered using the two versions but concluded that the comic version interested the children more with

no detriment to information gained. However, while Mallia (2007) claimed that he had quantitative evidence to support the conclusion, no such data were reported.

The present study aimed to further investigate the memorability of University level comic book format educational material. Using the textbook '*Biological Psychology: An Illustrated Survival Guide*' by Aleixo and Baillon (2008), participants read either the comic version, a text-only version or a comic version where the images were replaced by incongruous images before answering a series of multiple choice questions. It was hypothesised that memory for the comic version would be higher than those of the text version and that the incongruous image version would result in the lowest memory scores given that the images would not support the text or *vice versa* and hence issues of cognitive load would occur, whereby participants would have to recall the textual material whilst ignoring the images. In dual coding theory terms, in the incongruent condition, the images and text do not support each other and hence will not result in a facilitation of memory.

Method

Participants

Ninety participants were recruited from a University Campus, a local public house and by advertising on social media. 52 were female and 38 were male. Their age ranged from 18 to 84 with a mean age of 24.4 years (SD=11.17).

Design and Materials

A between participants design was used for this study. 30 participants took part in each of the three conditions of the independent variable: In condition 1 (16 male, 14 female) the information was presented as traditional text. In condition 2 (6 male, 24 female) the information was presented in comic format. In condition 3 (16 male, 14 female) the information was presented in comic format but with incongruent images. Participants were allocated randomly to each condition until the maximum number was reached.

There were two dependent variables which were analysed separately; the first was memory for the appropriate condition material, calculated by the number of correct answers out of 10 multiple choice questions designed to test factual information on biopsychology.

Attitudes to comic books were measured by a Likert Attitude scale. This scale was created for the study and designed to measure attitudes to comic books with scores ranging from 35 (low attitude towards comics) to 175 (high attitude towards comics). This measure was used as a check to ensure that the three groups were not disproportionately made up of individuals with either positive or negative attitudes towards comics and hence the comparisons between the three groups were justified.

Stimulus Materials (Conditions 1 to 3)

All three conditions were composed from *Biological Psychology, an Illustrated Survival Guide* (Aleixo & Baillon, 2008), published by John Wiley and Sons. This is a textbook written in comic book format aimed at introducing

biological psychology to undergraduate psychology students. The test material came from pages 177 to 184 which comprised the first seven pages of the chapter on *Sleep and Biological Rhythms*.

Condition 1 consisted of the *text only* condition. This was created by taking the text in captions and balloons in the comic book version and presenting it in continuous prose (see figure 1):

- Figure 1 about here -

Condition 2 was the *comic format* condition and this consisted of the original unchanged pages from the textbook (see figure 2):

- Figure 2 about here -

Condition 3 was the *incongruent images* condition where the original images from the textbook were replaced by incongruous random images. For example, an original image of a clock was replaced by that of a pizza. The remaining text captions and word balloons remained intact and in the same spatial location on the page. Panel borders (boxes) were also kept the same as in the original textbook (see figure 3):

- Figure 3 about here-

Attitude Scale

Attitudes to comic books were measured using a specially constructed Likert Attitude scale. This scale was constructed from an original scale containing 40 statements concerning attitudes towards comic books with response choices

from 1 indicating 'strongly disagree', to 5 indicating 'strongly agree'. Pre-testing of Likert item analysis using Pearson's r correlations revealed that 37 of the statements were significantly correlated with the total score ($p < 0.05$) and hence could be considered strong discriminators of the attitude object being measured. The final scale consisted of 37 items and scores ranged from 37 (low attitude towards comics) to 185 (high attitude towards comics). Example statements can be seen in figure 4.

- Figure 4 about here -

Memory Test

After reading the stimulus materials, participants completed a series of 10 multiple-choice questions testing factual knowledge of the biopsychological information presented in the test material. All questions required one correct answer from a possible three. Scores ranged from 0 to 10. See Figure 5 for example questions.

- Figure 5 About here -

Procedure

The study was carried out in small groups of no more than five in a quiet location. During the testing, each participant was seated at a table. Following presentation of an information form which detailed confidentiality and issues of informed consent, participants signed a consent form. Participants then completed a brief questionnaire requesting demographic information and completed the Attitude Scale before being allocated to one of the three

conditions of the independent variable. Participants were instructed to carefully read the material presented in their own time. No time limit on reading was imposed; participants were allowed to take as much time as they required but were only allowed to read the material once. Following this, participants were given the memory test to complete in their own time. At the end of the testing procedure, participants were issued with a debrief form.

One-way between participants analyses of variance (ANOVA) for memory scores across the three conditions were calculated. In addition, one-way between participants Analyses of Variance were calculated on attitude scores and age across the three conditions.

Results

-Table 1 about here -

Table 1 shows the means and standard deviations for each condition. One-Way between participants analyses of variance showed that memory scores in the comic format condition were significantly higher than both text-only condition ($F(2,89)= 32.525, p<0.001$) and comics with incongruent images condition ($F(2,89)= 32.525, p<0.0001$). Furthermore, mean memory scores for the text-only condition were significantly higher than those for the incongruent condition ($F(2,89)= 32.525, p<0.0001$).

One-way between-participants analyses of variance were calculated on attitudes and age across the three test conditions. Tables 2 and 3 show the means and standard deviations for attitudes and age across the three conditions.

- Table 2 about here -

- Table 3 about here -

No significant differences were found across the three conditions in either attitudes ($F(2, 88)=0.442, p>0.05$) or age ($F(2, 89)=0.609, p>0.05$).

Discussion

As hypothesised, memory scores were significantly higher in the Comic condition than in the Text-only condition. This provides tentative support for both Hosler and Boomer (2011) and Mallia (2007). Given that the textbook used is aimed at Undergraduate level students and that the participant sample comprised a majority of such students, the results further support the concept that the comic book format is suitable for disseminating educational material at undergraduate level.

Memory scores for the incongruous condition were significantly lower than both the comic condition and the text-only condition. This suggests that the unique aspect of comic books of combining relevant images and text create the maximum memorability for the material. This is largely supportive of Dual Coding theory (e.g. Paivio, 1969, 1972, 1975) where both verbal and relevant visual stimuli interact to improve the memorability of the material. Thus, it can be argued that comics can be used to improve learning and thus support the suggestions of Clark and Paivio (1991) and Paivio (2006) to incorporate dual-coding theory into education.

Attitudes towards comics in the samples used were also largely positive with means in all three conditions around 130 out of a possible 185. This is contrary to the general belief that comics have generally a poor reputation particularly in an educational context (see for example Millard & Marsh, 2001).

There were also no significant differences in attitudes towards comics across the three conditions indicating that the groups comprised of participants that were similar in their attitude to comics. Hence, it is more likely that the significant differences in memory scores resulted from the manipulations of the independent variable rather than individual differences across the conditions. Age was also a non-significant difference across the three conditions, showing, again, that the groups were equivalent on this variable.

However, caution must be exercised in interpreting the data since there are a number of limitations to this study. Firstly, only a small amount of information was covered in the stimulus material. Secondly, despite the significant results that were hypothesised, there was no control or measure of prior knowledge of biopsychology. Had this been a confounding variable, it would have been expected to have affected the overall memory scores but this was not the case so it is possible that this did not affect the results. Thirdly, there was an uneven gender split in the comic condition. Given that it is generally understood that comics are largely consumed by males, this could have affected the results. However, this may be largely theoretical as the results were in the predicted direction. Furthermore, the study did not control for length of time spent reading the material. Therefore, the larger memory scores in the comic condition may

have been due to participants spending more time reading the material given that the text condition was much shorter in comparison.

Finally, it needs to be pointed out that in order to achieve a relevant comparison in the material presented; the text-only condition was taken directly from the comic book condition. This certainly made the comparison and the memory test more accurate but it is less comparable to a traditional textbook and hence the ecological validity of the material is lower than would ideally be required.

Overall, the present study has provided some preliminary support for the notion that the comic book format is suitable for disseminating educational material and appears to be superior to a text-only version. However, given the exploratory nature of this study, caution needs to be observed in making overarching conclusions without further study. Larger scale comparisons over a longer time period where readers use material in studying would go some way to exploring further the possibilities inherent in comic books as instructional materials. In the meantime, it is sufficient to conclude that the format is worth exploring further.

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Figure 1

Condition 1 - Example of text-only condition

- This chapter is all about those rhythms that are very prevalent in our lives. The most common of which is sleep. Sleep is a behaviour that happens in an approximate 24 hour cycle. It may surprise you to know that a lot goes on in the brain when you are asleep! And the best way to investigate this is to go to sleep! Research into sleep is carried out using a piece of equipment known as an electroencephalograph or EEG for short. This records the electrical activity of the brain from electrodes attached to a person's scalp. All that needs to happen now is to go to sleep. So good night to you all!

Figure 2
Condition 2 - Example of Comic book (page 1)



Figure 2
Condition 3 - Example of Comic book with incongruent images

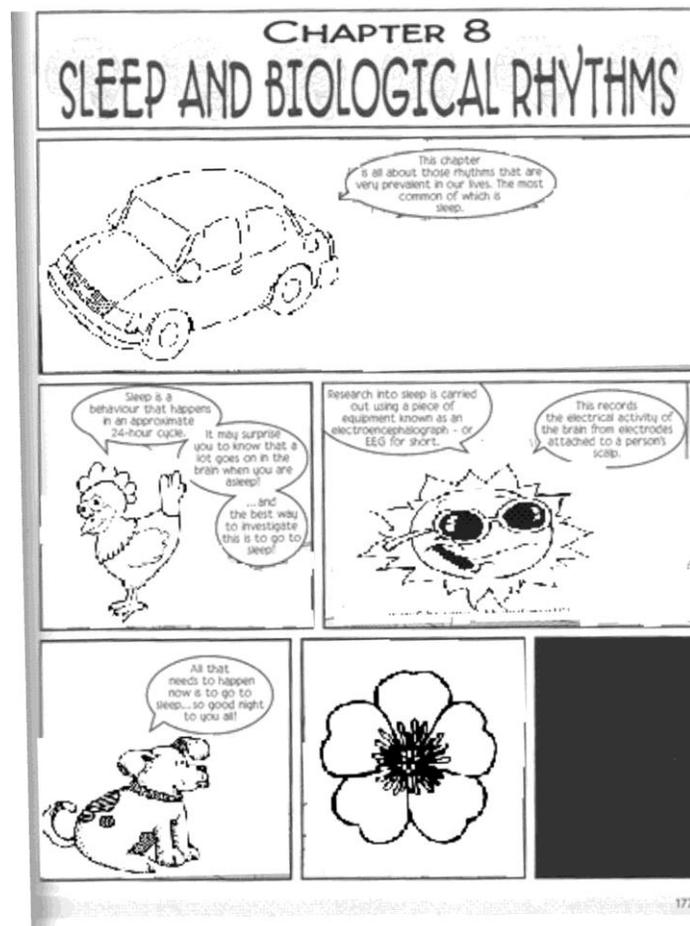


Figure 4
 Example Questions from the Likert Attitude Scale

1. Comics are juvenile

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

2. Comic books make difficult information seem simpler

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

3. The pictures in comics distract from the words

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

4. Comics are creative

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

5. Comics are not appropriate for education

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Figure 5
Example Memory Test Questions

Please read the questions carefully. Each question has a multiple choice answer, to indicate your answer, circle the letter next to the statement that you believe is correct.

1. How long is the sleep-wake cycle?
 - A) 8 hours
 - B) 12 hours
 - C) 24 hours
2. What is the acronym for the name of the equipment used to research electrical activity of the brain during sleep?
 - A) EEG
 - B) ECG
 - C) REM
3. What do the letters REM stand for?
 - A) Rapid Eye Movement
 - B) Rapid Eye Monitoring
 - C) Random Eye Movement
4. How many sleep stages are there?
 - A) 4
 - B) 6
 - C) 2
5. When people are woken during REM, what percentage report that they were dreaming?
 - A) 60%
 - B) 70%
 - C) 20%
6. Why is full body paralysis necessary during REM sleep?
 - A) To prevent people sleepwalking
 - B) To prevent people acting out their dreams
 - C) To prevent people falling out of bed
7. How long does REM sleep last for?
 - A) 15 minutes
 - B) 30 minutes
 - C) The entire sleep cycle
8. What happens to rats if they are prevented from sleeping?
 - A) Hallucinations
 - B) Paranoia
 - C) Death
9. What is the longest length of time a human has gone without sleep?

- A) 21 days
 - B) 11 days
 - C) 28 days
10. Why do herbivores sleep for a shorter amount of time compared to carnivores?
- A) More at risk from predators
 - B) Use more energy in the day
 - C) Less at risk from predators

Table 1. Means and Standard Deviations for Memory Question Scores in each Condition

Condition	Mean (N)	Standard Deviation
1. Traditional Text	6.97 (30)	1.20
2. Comic Format	8.20 (30)	1.03
3. Comic with Incongruent Images	5.37 (30)	1.75

Table 2. Means and Standard Deviations for Total Attitude Scores in each Condition

Condition	Mean (N)	Standard Deviation
Traditional Text	129.03 (29)	25.76
Comic Format	131.23 (30)	26.91
Comic with Incongruent Images	135.43 (30)	27.13

Table 3. Means and standard deviations for Age in each Condition

Condition	Mean (N)	Standard Deviation
Traditional Text	24.87 (30)	12.15
Comic Format	22.63 (30)	6.68
Comic with Incongruent Images	25.73 (30)	13.63