Linek, Stephanie B.

Conference Paper — Published Version

Serious Comics: Influence of Balanced Comic Figures and Subjective Affinities

Proceedings of the 16th International Conference on Education and New Learning Technologies (EDULEARN 2024)

Suggested Citation: Linek, Stephanie B. (2024) : Serious Comics: Influence of Balanced Comic Figures and Subjective Affinities, Proceedings of the 16th International Conference on Education and New Learning Technologies (EDULEARN 2024), ISSN 978-84-09-62938-1, IATED Academy, Valencia, pp. 1755-1764,
https://doi.org/10.21125/edulearn.2024.0531

This Version is available at:
http://hdl.handle.net/11108/626

SERIOUS COMICS: INFLUENCE OF BALANCED COMIC FIGURES AND SUBJECTIVE AFFINITIES

S.B. Linek

ZBW Leibniz Information Centre for Economics (GERMANY)

Abstract

Serious comics are a special form of infotainment, which uses the unique language of conventional comics to present scientific information in an entertaining way. Prior research has shown the value of serious comics. A former study indicated that comic figures have a decisional role: Readers had a better scientific understanding if they favoured a comic figure with a close connection to the scientific content. Thereby, the readers' story-related subjective affinities influenced the choice of the favourite comic figure but had no additional direct influence on scientific understanding.

The study presented here investigated how the situation changes when all comic figures are equally closely connected to the scientific content and the story-related subjective affinities. For such balanced comic figures, the story-related subjective affinities should not matter for the choice of the favourite comic figure, but might directly influence scientific understanding. Further, the favour for a specific comic figure should not influence scientific understanding, but rather specific judgements on the favourite and non-favourite comic figures could be important variables.

The research aim was addressed by the help of an online survey with 75 adult participants. The survey comprised a serious comic about ocean acidification with four balanced comic figures. Overall, the results demonstrated that story-related subjective affinities can directly influence scientific understanding if all comic figures are equally close (balanced) connected to the scientific content. This is a clear difference from prior findings on unbalanced comic figures and thus, strengthens the interpretation that the closeness between the scientific content and the comic figures is a crucial variable. Further, the results on the general attitudes towards serious comics illustrate their benefit for joyful learning.

Keywords: Serious comics, subjective affinities, comic figures, infotainment, life-long learning, informal learning.

1 INTRODUCTION

Science popularization tries to engage the broad public and motivate laypeople to learn about science and recent scientific insights [1]. One of the most important challenges in science popularization is the question of how to attract laypeople who have no prior interest in science. A possible answer to this question is infotainment, i.e., the presentation of scientific information in an entertaining way [2] [3].

A special form of infotainment is serious comics [4] [5]. Serious comics use the unique language of comics [6] [7] to present scientific or educational content in an entertaining way. Prior research has shown the potential of comics to create interest in science [8] [9] [10]. Farinella [8] gives a good overview of the existing approaches. Most of these approaches are rather pragmatic and do not focus on specific design features. In contrast, the term "serious comics" refers to a systematic investigation of specific design features like comic figures or textual parts [4]. Linek and Eckhorst [5] created a serious comic that illustrates what serious comics are.

A pioneering study [11] showed the influence of the readers' subjective affinities and the decisional role of the favourite comic figure, i.e., the comic figure that the reader liked more than the other comic figures. If the favourite comic figure was closely connected to the scientific content (e.g., the favourite comic figure explained scientific principles), this resulted in better scientific understanding. Thereby, the peoples' story-related subjective affinities (e.g., liking dogs when the story was about a dog) influenced the choice of the favourite comic figure but had no additional direct influence on scientific understanding. It is important to note that in the cited study the comic figures were very different from each other: a tall scientist who explained everything, a dog who demonstrated the principles explained by the scientist, and a small naive man who mainly listened to the explanations passively. These comic figures had not only a very different connection to the scientific content but also a very different association with the story-related subjective affinities.

Based on these considerations the question arises if and how the situation changes when all comic figures are equally closely connected to the scientific content and to the story-related subjective affinities. In the following such “balanced comic figures” are defined as comic figures that were balanced (i.e., comparable as far as possible) in relation to the scientific content and the story-related subjective affinities. Thus, in the case of balanced comic figures, the story-related subjective affinities should not matter for the selection of the favourite comic figure, because the association of all balanced comic figures with the story-related subjective affinities is equally strong. Rather, the selection of the favourite comic figure should be guided by personal preferences unrelated to the storyline of the comic. Additionally, in the case of balanced comic figures, it should not matter for the scientific understanding which of the comic figures is the favourite one, because all comic figures are equally closely connected to the scientific content. Thereby, it is an open question if story-related subjective affinities might have a direct impact on scientific understanding in the case of balanced comic figures.

Besides, it has to be considered that, similar to movies and conventional comics, the non-favourite comic figures might play an important role, too. For example, each hero needs his/her villains, and screwball comedies are often based on romantic rivalry between several characters. Comic figures, the favourite as well as the non-favourite ones, have usually different attributes and this in turn can influence the overall liking of a comic figure. Besides, some figures can be more interesting than others. Further, the sympathy for a comic figure and the personal identification with a comic figure can depend on features that are unrelated to the storyline, e.g., the physical appearance of the figure. That means, even if comic figures are balanced towards the story-related subjective affinities and the scientific content, they still could be very different in the personal view of the reader for other reasons. Thus, single judgements of the favourite and non-favourite comic figures (e.g., sympathy, identification) might influence the perceived appeal of the serious comic as well as the readers’ motivation and scientific understanding. Beyond this background, the study presented here addressed the following research questions (RQs) on serious comics with balanced comic figures:

RQ1: Which judgements of a (balanced) comic figure are decisional for its selection as the favourite comic figure?

RQ2: If and how do story-related subjective affinities and judgements of the favourite and non-favourite (balanced) comic figures influence the perceived appeal of serious comics, motivation, and scientific understanding?

RQ3: If and how does the appeal of a single serious comic predict future-oriented attitudes towards serious comics in general?

2 METHODOLOGY

2.1 Variables

For the investigation of balanced comic figures, multiple variables were included. Besides the choice of the favoured comic figure, for each of the balanced comic figures, four measurements were made: the overall liking, the sympathy for the comic figure, how interesting the comic figure was, and how much the participants could identify with the comic figure. Based on these judgements on the balanced comic figures, the mean ratings of the favourite and the non-favourite comic figures were calculated as derived variables (details follow in the section results). The investigated story-related subjective affinities included cognitive affinities (e.g., general interest in science, specific interest in chemistry) as well as emotional affinities (e.g., love for animals). A complete list of all measured story-related affinities is depicted in Table 1 in the section on results. As indicators of the appeal of the serious comic, the following seven variables were included: Liking of the comic as a whole, informativeness of the comic, entertainment by the comic, liking of the drawings, liking of the textual parts, liking of the comic figures in general, and involvement. As motivational variables, the motivation to read the comic and the motivation to understand the scientific content were included. Additionally, the actual scientific understanding of the presented scientific topic (i.e., ocean acidification) was included as a variable. Further, there were two variables on the future-oriented attitudes toward serious comics in general: The wish to read further serious comics in the future, and the estimation that serious comics are an appropriate way of scientific knowledge transfer. Control variables were age, gender, education, and prior knowledge.

2.2 Procedure and Measurement Instrument

The variables were measured with the help of an online survey that included also the serious comic "Sauer" ("Acid" in German; the cover page is depicted on zbw.to/seriouscomics) about ocean acidification. The participation was voluntary. The participants were recruited by several mailing lists. The only reward for participation was the possibility to download the comic "Sauer" as private copy (pdf) and to receive the main results of the study by email.

The design of the serious comic "Sauer" was analogous to conventional comics. It had several panels per page with colourful pictures and dialogues in speech bubbles. The scientific content on ocean acidification was presented in a playful way as part of an adventurous short story with four balanced comic figures as the main actors. The two protagonists were a young female backpack tourist (Monika) and a young male skateboarder (Sven). Further, a young PhD student (Antoine) and a female professor (Professor Lisa Larson) had important parts. All four comic figures delivered the reader scientific information in the form of explanations, questions for understanding, practical examples, simplified repetitions, or small mnemonic aids. All comic figures were (as far as possible) equally closely connected to the scientific content. Further, all comic figures were humans and had similar story-related idealistic values and interests (e.g., animal lovers, interested in science). The roles and genders of the comic figures were equally distributed: There were two non-scientists, one female (Monika) and one male (Sven), and two scientists, one female (Professor Lisa Larson) and one male (Antoine). Besides these balanced features of the comic figures, the comic figures were designed as such that they represented different personality types and thus, provided sufficient variance for various individual preferences of the readers. The pictures and dialogues were designed in a funny way and with some additional jokes to avoid boredom. Overall, the serious comic "Sauer" had 16 pages (including the cover page) with altogether 106 pictures. The interested reader can contact me (the author) for a free private copy (pdf) of the serious comic "Sauer".

The online survey with the serious comic was presented page after page. The participants could spend as much time on the single pages as they wanted but turning back was not possible. The participants were free to skip the survey (and the included comic) whenever they wanted. The variables of the study were measured by selections, multiple-choice questions (MC-questions), or ratings. All ratings were done by the help of a 7-point Likert scale. For every question, there was also the answering option "I don't know", or the option to omit the answer. The survey started with a short introduction to the study. Afterwards, gender, age, and education were assessed, and the participants had to rate the 15 story-related subjective affinities from 1 (very low) to 7 (very high). Subsequently, the serious comic "Sauer" was presented. It started with a short instruction to read the comic mindfully because the participants should answer some accordingly questions afterwards. By clicking the forward button, the participants could start the reading. After the comic, the questions on the serious comic and the comic figures were presented. First, the participants were asked to rate the following aspects of the appeal of the comic "Sauer" from 1 (not at all) to 7 (very much): overall liking of the comic, informativeness of the comic, entertainment by the comic, liking of the drawings, liking of the textual parts, liking of the comic figures in general, and involvement. Further, also the motivation to read the comic, and the motivation to understand the scientific content were measured by an analogous rating. Then the participants had to indicate (selection) which of the comic figures was their favourite one. Next, prior knowledge on ocean acidification, and how much new was learnt, was measured by a self-rating from 1 (nothing) to 7 (very much). On the same page, the participants had to indicate if they want to read further serious comics in the future (from 1 = absolutely no to 7 = I would love to), and if they think that serious comics are an appropriate way of knowledge transfer (from 1 = not appropriate at all to 7 = very appropriate). On the next page, the participants had to give for each comic figure (Monika, Sven, Antoine, Professor Lisa Larson) separate ratings on the overall liking, interest, sympathy, and identification with the comic figure (from 1 = not at all to 7 = very much). Afterwards several questions on the narration (storyline) and the scientific content of the comic were presented. Thereby, the participants had to answer also some open questions that served as validity check that the participants had no language problems, were real humans, and gave valid answers. Then the participants had to answer five MC-questions on the narration of the comic (e.g., "Why did the skater Sven promise never eating chewing gum again?"), and five MC-questions on the scientific content (e.g., "What does a high pH-value indicate?"). For each of the MC-question more than one answering alternative could be correct, and there was also the explicit answering option "I don't know". There was no feedback about the correctness of the given answers. The MC-questions on the narration served as quality check of the comic "Sauer". The MC-questions on the scientific content served as basis for the measurement of the actual scientific understanding. At the end of the survey, the participants had the possibility to download the serious comic "Sauer" as pdf and

to leave their email address for receiving a short information about the results. The study closed with a thank you and farewell.

3 RESULTS

3.1 Participants and Descriptive Statistics

Overall, 104 people started the study, but only 75 participants (28 male, 42 female, 2 divers, 3 no answers) completed the survey. (Most of the dropouts skipped the survey during the questions after the comic. Only 3 people skipped while reading the comic.) As already mentioned, the participants were free to omit single questions. Thus, the number of valid cases was partly lower.

At average, the 75 participants of the study were 34 years old (M = 33.61; SD = 11.64). Their educational level was rather high. The majority of 38 participants had finished university, 27 had a high school degree, and 9 participants had a PhD. The participants estimated their prior knowledge on the 7-point Likert scale on a medium level (M = 3.83, SD = 1.64, n = 75), and gave a medium to high estimation of how much new was learnt (M = 4.62, SD = 1.53, n = 74). None of these control variables changed the pattern of findings reported below.

The participants reported relatively high story-related subjective affinities (see Table 1). Most of the mean ratings of the story-related subjective affinities were above 5 on the 7-point Likert scale. That means, at average the participants were highly interested in the topic of the comic “Sauer” and its elements like science, animals, and engagement for environmental protection. Only the three specific science-related affinities (interest in biology and ecology, interest in chemistry, and interest in economics) received lower ratings.

Table 1. Descriptive statistics of the story-related subjective affinities.

Story-related subjective affinities:	***M***	***SD***	***n***
Interest in science in general	5.60	1.20	75
Interest in biology and ecology	4.47	1.49	75
Interest in chemistry	3.07	1.40	75
Interest in economics	4.41	1.61	75
Trust in science	6.01	0.91	75
Engagement and fun with cognitive challenges	5.41	1.26	75
Fun with understanding complicated topics	5.69	1.21	75
Preference for topics that inspire to think about	5.76	1.17	75
Love for animals	5.36	1.66	75
Love for the sea and the underwater world	5.37	1.35	75
Curiosity and pleasure when discovering new things	6.03	1.15	75
Thirst for knowledge	5.91	1.12	75
Engagement for environment protection	5.15	1.28	75
Pleasure of reading in general	6.29	0.90	75
Pleasure of reading comics	5.73	1.70	75

The indicators of the appeal of the serious comic “Sauer” were rated rather positive (see Table 2). All ratings were in the upper half of the 7-point Likert scale. The informativeness of the comic received the highest rating, followed by the overall liking.

Table 2. Descriptive statistics of the appeal of the serious comic "Sauer".

Appeal of the serious comic "Sauer":	*M*	*SD*	*n*
Overall liking of the comic	4.97	1.38	75
Informativeness of the comic	5.77	1.21	74
Entertainment by the comic	4.31	1.49	75
Liking of the drawings	4.96	1.51	75
Liking of the textual parts	4.45	1.68	75
Overall liking of the comic figures	4.36	1.53	75
Involvement	4.05	1.77	74

The four balanced comic figures (Monika, Sven, Antoine, and Professor Lisa Larson) received on average medium to high positive judgements. (The interested readers can contact me for the full descriptive statistics on the four balanced comic figures.) These ratings served as basis for the calculation of the derived ratings on the favourite and the non-favourite comic figures. The according details and descriptive statistics follow in the section with the results on RQ1.

The motivation to read the comic (M = 4.89, SD = 1.64, n = 75) and the motivation to understand the scientific content (M = 5.37, SD = 1.34, n = 75) was rated on a medium to high level. Also, the future-oriented attitudes in the form of the wish of future reading of further serious comics (M = 5.21, SD = 1.69, n = 73) and estimation of the general appropriateness of serious comics for scientific knowledge transfer (M = 6.17, SD = 1.27; n = 75) received high ratings.

The overall score for scientific understanding was based on the answers to the MC-questions on ocean acidification. The participant received one point for each answering option of the five MC-questions that was correctly indicated or correctly not indicated. If the participant selected the option "I don't know", he/she received zero points for the complete MC-question to eliminate the effect of guessing. The possible maximum score was 29 points. At average, the participants reached 21 points (M = 20.89, SD = 6.52; n = 75), which indicated a medium to good scientific understanding.

3.2 Pre-Analyses on the Comic Figures and Manipulation Check

The selection of the favourite comic figure was analyzed by Chi²-test to receive first insights in the participants' preferences. The results showed that most participants (n = 24) favoured the female young hero (Monika). This was significantly more (Chi^2 = 9.035; p = .029) than Sven (n = 10), Antoine (n = 11) and Professor Lisa Larson (n = 12). There were no significant differences for the gender of the learner or the gender of the comic figure (tested in additional Chi²-tests).

The basic prerequisite of the stated RQs was the equally close connection of all balanced comic figures to the story-related subjective affinities and to the scientific content. Therefore, a manipulation check was made with the help of a MANOVA with the chosen favourite comic figure (i.e., Monika, Sven, Antoine, or Professor Lisa Larson) as an independent factor. The tested dependent variables were the story-related subjective affinities, the perceived appeal of the serious comic, the motivation to read the comic, the motivation to understand the scientific content and the actual scientific understanding. These control analyses showed that all four comic figures were indeed balanced towards the story-related subjective affinities, the appeal of the serious comic, the motivational indicators, and the scientific content. The interested reader can contact me (the author) for detailed statistics of the manipulation check.

3.3 Results on the Research Questions

3.3.1 RQ1 – Favourite versus Non-Favourite Comic Figures

For the comparison of the favourite versus non-favourite comic figures, derived ratings of the judgements of the favourite and non-favourite comic figures were calculated. These derived ratings were based on the judgements of the four balanced comic figures (Monika, Sven, Antoine, and Professor Lisa Larson) in combination with their individual selection as favourite comic figure.

For the ratings of the favourite comic figure, the judgements (overall liking, interest, sympathy, and identification) of the selected most preferred figure (e.g., ratings of Monika) were re-coded as judgements of the favourite figure. The judgements of the non-favourite figures were calculated as mean-ratings of the accordingly judgements of all not-selected figures (e.g., means of the ratings of Sven, Antoine, and Professor Lisa Larson). This resulted in four judgements (overall liking, interest, sympathy, identification) of the favourite figure and four judgements of the non-favourite figures.

The differences between the judgements of the favourite versus non-favourite comic figures were analysed by single ANOVAs for repeated measurements with the independent factor favourite versus non-favourite comic figure and the four judgements (overall liking, interest, sympathy, and identification) as dependent variables. The descriptive statistics of the favourite and non-favourite comic figures and the results of the ANOVAs are depicted in Table 3.

Table 3. Comparison of the judgements of the favourite versus non-favourite comic figures: Descriptive statistics and results of the ANOVAs (with repeated measurements).

Judgements	***Comic figures***	***Descriptive Statistics***			***Results ANOVA***		
		M	***SD***	***n***	***F***	***p***	***partial Eta²***
Overall liking	Favourite	5.76	0.95	54	155.961	<.001	0.746
	Non-favourite	4.32	0.89	54			
Interest	Favourite	5.36	1.16	55	70.299	<.001	0.566
	Non-favourite	3.99	1.08	55			
Sympathy	Favourite	5.81	1.03	52	74.53	<.001	0.594
	Non-favourite	4.29	1.00	52			
Identification	Favourite	4.96	1.43	53	63.286	<.001	0.549
	Non-favourite	3.42	1.02	53			

All judgements of the favourite comic figure (overall liking, interest, sympathy, and identification) were significantly higher than the judgements of the non-favourite comic figures. This indicated that there was not an isolated decisional judgement that influenced the selection of the favourite comic figure. Rather, the favourite comic figure was valued in all judgements higher than the non-favourite comic figures.

3.3.2 RQ2 – Influence of Comic Figures and Story-Related Subjective Affinities

The influence of the comic figures and the story-related subjective affinities on the appeal of the serious comic “Sauer”, motivation, and scientific understanding was analysed by stepwise multiple regression analyses. Thereby for each of the dependent variables a stepwise linear multiple regression analyses with the identical tested predictors was calculated. The tested predictors of the regressions analyses were the judgements of the favourite and non-favourite comic figures, and the story-related subjective affinities. Dependent variables were the indicators of the appeal of the serious comic as well as motivational indicators (motivation to read the comic, motivation to understand the scientific content) and the actual scientific understanding. The results of the regression analyses on the appeal of the serious comic are listed in table 4. The results of the regression analyses on the motivational indicators and the actual scientific understanding are depicted in table 5.

Overall, the results showed that most of the dependent variables were influenced by the judgements of the comic figures as well as by the story-related subjective affinities. Thereby, the judgements of the comic figures influenced all dependent variables except scientific understanding. The story-related subjective affinities influenced all dependent variables except liking of the drawings and liking of the textual parts of the comic.

Table 4. Stepwise linear multiple regression with comic figures and story-related subjective affinities as predictors of the appeal of the serious comic "Sauer".

Dependent variables	Significant predictors	Coefficients of the regression		
		B	SE B	R^2 Adjusted
Overall liking comic				0.499
	Non-favourite figures: Overall liking	0.745	0.147	
	Fun with complicated topics	0.299	0.109	
	Love for the sea / underwater world	0.291	0.115	
Informativeness				0.528
	Love for animals	0.402	0.071	
	Pleasure of reading in general	0.336	0.114	
	Non-favourite figures: Sympathy	0.315	0.110	
Entertainment				0.331
	Non-favourite figures: Interest	0.622	0.142	
	Curiosity	0.345	0.161	
Liking drawings				0.131
	Non-favourite figures: Overall liking	0.690	0.236	
Liking textual parts				0.312
	Non-favourite figures: Interest	0.852	0.175	
Overall liking figures				0.401
	Non-favourite figures: Interest	0.804	0.163	
	Love for animals	0.240	0.117	
Involvement				0.326
	Non-favourite figures: Interest	0.711	0.173	
	Interest in biology and ecology	0.319	0.124	

Table 5. Stepwise linear multiple regression with comic figures and story-related subjective affinities as predictors of motivation and scientific understanding.

Dependent variables	Significant predictors	Coefficients of the regression		
		B	SE B	R^2 Adjusted
Motivation to read the comic				0.575
	Non-favourite figures: Overall liking	1.115	0.155	
	Pleasure of reading comics	0.343	0.079	
Motivation to understand the scientific content				0.454
	Love for animals	0.311	0.086	
	Non-favourite figures: Overall liking	0.336	0.153	
	Interest in chemistry	0.245	0.093	
	Pleasure of reading in general	0.292	0.138	
Scientific understanding				0.142
	Interest in biology and ecology	1.684	0.554	

The results on the influence of the comic figures showed a remarkable pattern: None of the judgements of the favourite comic figure was a significant predictor of any of the dependent variables. However, the judgements of the non-favourite comic figures were important factors of influence for nearly all

dependent variables except scientific understanding: The liking of the non-favourite comic figures was a significant predictor of the overall liking of the comic, the liking of the drawings, the motivation to read the comic, and the motivation to understand the scientific content. The interest in the non-favourite comic figures predicted the entertainment by the comic, the liking of the textual parts, the overall liking of the comic figures, and involvement. Additionally, the sympathy for the non-favourite comic figures was a significant predictor of the judgement of the informativeness of the comic.

The most influential story-related subjective affinity were the love for animals, and the specific scientific interest in biology and ecology. The love for animals was a significant predictor of the judgement on the informativeness of the comic, the overall liking of the comic figures, and the motivation to understand the comic. Most remarkably, the interest in biology and ecology (which is the specific scientific topic of the comic "Sauer") was not only a significant predictor of involvement, but also the only significant predictor of scientific understanding.

Further, the pleasure of reading in general influenced the rating of the informativeness of the comic and the motivation to understand the scientific content of the comic. Other subjective affinities that reached significance, predicted only one of the dependent variables: The fun with understanding complicated topics and the love for the sea and underwater world were significant predictors of the overall liking of the comic. The pleasure of reading comics was a significant predictor of the motivation to read the comic. The interest in chemistry was a significant predictor of the motivation to understand the scientific content.

3.3.3 RQ3 – Appeal of a Serious Comic as Predictor of Future-Oriented Attitudes towards Serious Comics in General

The influence of the appeal of a single serious comic on future-oriented attitudes towards serious comics, in general, was analysed by a stepwise linear multiple regression. Dependent variables were the wish to read further serious comics in the future (future reading) and the estimation of serious comics as an appropriate way of scientific knowledge transfer (appropriateness). The tested predictors were the seven measured indicators of the appeal of the serious comic (i.e., liking of the comic, informativeness of the comic, entertainment by the comic, and involvement). The statistical results of the stepwise linear multiple regression are listed in Table 6.

Table 6. Stepwise linear multiple regression with the indicators of the appeal of the serious comic "Sauer" as predictors of future-oriented attitudes towards serious comics in general.

Dependent variables	***Significant predictors***	***Coefficients of the regression***		
		B	***SE B***	***R^2 Adjusted***
Future reading				0.463
	Overall liking of the serious comic	0.609	0.150	
	Involvement	0.240	0.116	
Appropriateness				0.115
	Overall liking of the serious comic	0.428	0.127	
	Liking of the textual parts	-0.226	0.103	

Involvement and the overall liking of the serious comic were significant positive predictors of future reading of further serious comics. The overall liking of the serious comic was also a positive predictor of the appropriateness-estimation of serious comics in general. Additionally, the liking of the textual parts was a significant predictor of the appropriateness-estimation, however with a negative sign, that means, the more people liked the textual parts of the current serious comic the less they thought that serious comics in general are an appropriate way of knowledge transfer.

4 CONCLUSIONS

Overall, the findings show that story-related subjective affinities can have a direct influence on the scientific understanding if all comic figures are balanced towards the closeness to the scientific content and the story-related subjective affinities. This is a clear difference to findings with unbalanced comic figures (i.e., figures with differently close connection to the scientific content and story-related subjective affinities), and thus strengthen the interpretation that the closeness between the scientific content and the comic figures is crucial for scientific understanding.

Most remarkably, the interest in the concrete scientific content (biology and ecology) directly influenced scientific understanding whereas neither the indicators of the favourite nor the indicators of the non-favourite comic figures influenced scientific understanding. Nevertheless, the single judgements of the balanced comic figures were significant predictors of the appeal of the serious comic and the motivational indicators. Interestingly, the judgements of the favourite comic figure did not matter whereas the judgements on the non-favourite comic figures were important predictors. This indicates that the non-favourite comic figures play an important role, too. However, an alternative interpretation could be that there were statistical ceiling effects due to the very high ratings of the favourite comic figure, which in turn biased the influence of the favourite comic figure.

The overall liking of the serious comic “Sauer” was a significant predictor of future reading of further serious comics, and predicted also the positive estimation of serious comics as an appropriate way of knowledge transfer. This suggests that each serious comic is an advertisement for serious comics in general. Similar to prior research, also involvement seems to be an important factor of influence on future-oriented attitudes towards serious comics. The negative influence of the liking of the textual parts of the serious comic on the appropriateness-estimation of serious comics seems a bit paradox at first glance. A possible interpretation could be that some textual parts of the comic “Sauer”, namely those on the complex chemical formulas of ocean acidification, were unusual for comics that normally have a rather simple and easy language. Future studies on single parts and textual variations of serious comics are needed for deeper insights. Therefore, thinking-aloud protocols could be a fruitful method.

For practical design recommendations on serious comics, it is worth notable that more than half of the participants did *not* choose the female young hero as their favourite comic figure. Even though the female hero was the most popular comic figure, a substantial part of the participants chose one of the other comic figures. This finding indicates that in practice it is a good idea to use balanced comic figures because in the case of balanced comic figures, it does not make a difference for scientific understanding which of the comic figures is the favourite one. Thus, nobody will be left behind, but all readers will profit equally, regardless of his or her individual preferences. On the other hand, if a serious comic is designed as such that one comic figure is indeed “everybody’s darling”, then the story and the textual parts should be developed in a way that this comic figure has also the closest connection to the scientific content.

Due to regimentations of privacy and data protection, the sample of the reported study consisted of adult people. Furthermore, the vast majority of the participants had a high educational level. Future studies with teenagers with disadvantaged educational backgrounds are necessary to reveal the full potential of serious comics for different target groups. Thereby, it is worth mentioning that even adults with a high level of education and medium prior knowledge of ocean acidification reported that they have learnt on a medium to high level. Thus, it remains also an open question for future research if a basic level of prior knowledge is necessary to profit from serious comics, or contrariwise, if people with low (or even no) prior knowledge profit even more by acquiring completely new scientific insights. That means, for people with no prior knowledge the scientific understanding might be more fundamental and could essentially broaden their perspective of knowledge.

Overall, the findings deliver new insights in the influence of story-related subjective affinities, and support prior research on the crucial role of comic figures and involvement. Furthermore, the value of serious comics for informal learning and scientific knowledge transfer was illustrated and strengthened.

REFERENCES

[1] A. Noruzi, “Science popularization through open access (Editorial),” *Webology*, vol. 5, no. 1, 2008. Retrieved from http://webology.org/2008/v5n1/editorial15.html

[2] F. Corona, F. Perrotta, E. T. Polcini, and C. Cozzarelli, “The new frontiers of edutainment: the development of an educational and socio-cultural phenomenon over time of globalization,” *Journal of Social Sciences*, vol. 7, no. 3, pp. 408-411, 2011.

[3] S. K. Yeo, A. A. Anderson, A. B. Becker, and M. A. Cacciatore, “Scientists as comedians: The effects of humor on perceptions of scientists and scientific messages,” *Public Understanding of Science*, vol. 29, no. 4, pp. 408-418, 2020.

[4] S. B. Linek and M. Huff, “Serious comics: A new approach for science communication and learning,” *Proceedings of the 12th International Technology, Education and Development Conference (INTED 2018)*, pp. 3883-3890, 2018.

[5] S. B. Linek and T. Eckhorst, *Serious comics.* ZBW: Kiel, 2021. Retrieved from https://zenodo.org/records/4692311

[6] W. Eisner, *Graphic storytelling and visual narrative.* W. W. Norton & Company, 2008.

[7] S. McCloud, *Understanding Comics.* HarperCollins, 1994.

[8] M. Farinella, “The potential of comics in science communication,” *Journal of Science Communication*, vol. 17, no. 1, 2018. Retrieved from https://doi.org/10.22323/2.17010401

[9] A. N. Spiegel, J. McQuillan, P. Halpin, C. Matuk, and J. Diamond, „Engaging teenagers with science through comics,” *Research in Science Education*, vol. 43, no. 6, pp. 2309-2326, 2013.

[10] M. Tatalovic, “Science comics as tools for science education and communication: a brief, exploratory study,” *Journal of Science Communication*, vol. 8, no. 4, A02, 2009. Retrieved from https://doi.org/10.22323/2.08040202

[11] S. B. Linek and M. Huff, “Serious comics for science popularization: impact of subjective affinities and the crucial role of comic figures,” *Proceedings of the 16th International Technology, Education and Development Conference (INTED 2022)*, pp. 517-526, 2022.