

doi: [10.5821/conference-9788419184849.72](https://doi.org/10.5821/conference-9788419184849.72)

VISUALIZING SITUATIONS: COMPARING PIXEL AND VECTOR ART STYLE IN A DINING SITUATION SKETCH

Suomiya BAO^{1a}

^a Faculty of Art and Design, University of Tsukuba, Japan

ABSTRACT

Previous study indicated that the simplicity of a visualized situation could play an important role in comprehension and emotion. However, the effect of the art style was never discussed. As an art style with minimalist aesthetic, pixel art's popularity and value are not well explained. This study is aimed to investigate the difference between pixel and vector art style by comparing one of the visualized situations extracted from previous study and the pixelated counterpart.

166 valid responses were collected (69 males & 97 females). Participants were randomly separated into 2 groups, presented with 2 different art styles. After observing the visualized situation, they filled in a questionnaire asking about their understandings, evoked emotions, how realistic it feels, and how easy for them to picture themselves in the situation. ANOVAs and multiple regression analyses were conducted and results showed that art style did not have a big impact on emotions, whereas for pixel art style, the older the participant is, the easier they could picture themselves being in the situation. Additional analysis using chi-square test found that people tend to believe the situation is in a past era when observing the pixel version. This study revealed the potential impact of pixel art style on people's comprehension, tricking people to believe it is happening in a past era. This phenomenon should be taken advantage of in not only game design but also other media graphic design scenarios.

Keywords: Situation, Pixel, Art style, Comprehension, Emotion

¹ Faculty of Art and Design, University of Tsukuba, Japan. Address: Tennodai 1-1-1, Tsukuba, Ibaraki, Japan, 305-8577. E-mail: bao.suomiya.ka@u.tsukuba.ac.jp

1 INTRODUCTION

1.1 Background

Previous investigation suggested that visualized situations using simple or detailed sketches was an effective way to represent different product usage situations (e.g. dining situations). The more detailed a visualized situation is illustrated, the stronger and specific emotions can it evoke, whereas a simple version of the situation could avoid providing too much information for people to relate to themselves (Bao et al., 2018). It is suggested that a visualized situation should be as simple as possible, with the right level of simplicity that provide just the needed information to the observers. However, no matter how simple a sketch could be drawn, it always has a certain art style. For example, the visualized dining situation in the previous study (Bao et al., 2018) was drawn by hand on paper, with a relatively realistic art style. There is no discussion made on how the art style of these sketches could make an impact on people's comprehension and emotion.

To answer this question, there are many steps to be made. First of all, the definition of "art style" is important to be clarified. An art style of an illustration could be easily associated with the specific drawing style consistently used by any mangaka (professional comic book illustrator). However, any specific art style that recognized by people is a certain combination of various aspects (e.g. lines, colors, shadows, proportions, etc.). For example, for the aspect of proportions, illustrators could create a cuter art style by simply adjusting the proportion of the human bodies and objects. Therefore, among all these basic aspects of art style, it is essential to study on each one of them separately. One of the most basic aspects is the how the dots and lines are drawn. Some art style might use natural lines, while some might take advantage of different pencil strokes. However, there is a more fundamental difference between how the dots and lines are drawn.

A 2D visual illustration is basically either drawn with a vector art style or pixel art style. The simplest difference is, when the lines are continuous, cannot be visually demolished into smaller units, such as dots, it is considered as a vector art style. On the other hand, when the lines are composed by smaller, equal-sized units that are visible to human eyes, it is usually considered as a pixel art style. That being said, pixel art can become vector art, if the pixels are small enough that human eyes cannot recognize them.

Pixel art could be found and traced back to the very early age of human civilization, such as mosaic art from Pompeii (El-Din & Kheshen, 2021). Our ancestors used small, equal-sized tiles to draw arts on floors and walls. Later in the history of fine arts, as an iconic art style, pixel art was also a successor to cubism and constructivism (Gintere, 2019). However, in modern period, it is much more popularized thanks to the boom of computer and digital graphics, and the rise of the game industry. Game designers were "forced" to create a graphics with pixel art, because of the limited resolution of display and low processing power of the computers back in the very early days of video games. Two well-known examples are two of the oldest video games, Space Invaders (1978) and Pac-Man (1980). In 2000s, with the rapid development of computer graphic technology, game designers were released from the restriction of pixel art. Thanks to advanced technology, visual graphics in video games became more and more realistic and rich in

presentation. Although astonishing graphics are easily achievable by game developers nowadays, pixel art style did not fade away. In fact, it is getting even more popular in recent years. Pixel art is becoming an artistic choice for game designers (Rocket Brush Studio, 2021). In the Game Award 2018, a video game using pixel art style, called *Celeste* (2018), was even nominated as a candidate for the Game of the Year Award, alongside other AAA titles. What is the value in pixel art style?

It is said that there is a difference in the aesthetic values derived from pixel art (El-Din & Khshen, 2021). As a defining art style of gaming, pixel art not only brings nostalgia, but also attracts people with its minimalist style that fill the blank of imagination (Byford, 2014). Pixel art games require the players to “fill the gaps” with their imagination, to make sense of it with the little information, and this additional effort is enjoyable, like reading a book compared to watching a movie (Rocket Brush Studio, 2021).

1.2 Questions and Objectives

This study intends to investigate the difference between art styles in a visualized situation, in terms of comprehension and emotion. Moreover, when a visualized situation being used as a visual stimulus, it is important to be perceived as realistic and not difficult for people to picture themselves being in the situation. Therefore, how realistic the situation is and how difficult to picture oneself being in the situation are investigated.

As the most fundamental aspect of art style, pixel and vector art style were chosen as the target of this study. Based on the literature review, pixel art style could evoke a more nostalgic emotion, and trigger imaginations. Here we consider that imagination is important in how realistic a situation feels, and how easy to picture oneself being in the situation. The nostalgic emotion might be stronger for older people, since younger generations might have less experience with pixel art style in the early period of computer graphics. Therefore, age could play a role specifically for pixel art style. If a visualized situation is drawn in pixel art style, it might be easier for people to “fill the blank/gaps”, perceive it as a realistic situation, and picture themselves being in the situation. In addition, such effect might be stronger for older people.

the objectives of the study are below:

1. To explore whether any of the emotions evoked by a visualized situation would change between pixel and vector version.
2. To test *Hypothesis 1*: people perceive a situation as a more realistic one, and can picture themselves in the situation more easily when presented with the pixel version of the situation. (*H1*)
3. To test *Hypothesis 2*: in a pixel version of the situation, it is easier for older people to perceive it as a realistic one, and picture themselves being in it, whereas there won't be such effect of age in the vector version. (*H2*)

2 EXPERIMENT

2.1 Method

2.1.1 Stimuli

Among the 6 typical dining situations summarized in the previous study (Bao et al., 2018), one situation was selected because of the strong responses in emotion. Afterwards, since the sketch was already drawn in the vector art style, the pixel art style version was created using Adobe Photoshop. The canvas was adjusted to make sure the general line thickness is 1 pixel but not too much thicker or thinner than the vector version. Finally, two sketches were adjusted to fit the screen in the same size (Figure 1).



Figure 1. Pixel and vector versions of the dining situation sketch

2.1.2 Questionnaire

A questionnaire was created including questions that investigate the comprehension and emotions on a situation. According to the 5 basic cues of a situation ((i) persons, relationships and social interactions; (ii) objects; (iii) events and activities; (iv) locations; (v) time) (e.g. Mehl & Robbins, 2012; Pervin, 1978; Saucier et al., 2007), the questions for comprehensions were composed by 5 simple questions. (Rauthmann et al., 2015, Bao et al., 2018). Questions for emotions were based on previous study (Hirai & Okamoto, 2005, Bao et al., 2018), collecting the major 15 emotional responses of participants on dining situations using 5-point Likert scale. In addition, 2 questions (1. How realistic is this illustration? 2. To what extend are you able to picture yourself in this situation?) with 5-point Likert scale were also included in the questionnaire. The age and gender of the participants were also collected (Table 1).

Table 1. Questionnaire Summary

Comprehension	Emotion items			Other
Who and what relationship	Joy	Coldness	Quietness	How realistic is this Illustration
What objects are in there	Liveliness	Refreshment	Boredome	To what extend are you able to picture yourself in this situation
What kind of event or affair	Happiness	Weirdness	Loneliness	
What period is it	Peacefulness	Freedom	Crampedness	Age
Where is it happening	Warmth	Emptiness	Togetherness	Gender

2.2 Experimental Procedure

The experiment used a between-subject design, participants were randomly assigned to 2 groups, one being the pixel group and the other being the vector group. Firstly, they were asked to observe the dining situation sketch. Afterwards, they were required to answer the questionnaire.

2.3 Analysis

First, responses on comprehension were used to validate participants' basic understandings of the dining situation. Afterwards, ANOVAs (Analysis of Variance) with 2x2 factorial design (IV: "Art style" and "Gender", DV: emotional responses) were conducted to determine whether there were significant effects of art style and gender in each evoked emotion. ANOVAs (IV: "Art style" and "Gender", DV: "realistic" and "picturing oneself") were also conducted to test *H1*. Finally, multiple regression analyses (IV: "Age", "Gender", DV: "Realistic" and "Picturing oneself") were conducted respectively on the 2 groups (pixel art and vector art) to test *H2*.

3 RESULT

3.1 Basic Descriptive Statistics

After discarding questionnaire responses with invalid answers (e.g., random typing in the answer box), 173 total responses remained. In addition, in the comprehension questions, almost all participants correctly understood the basic cues of the situation, answering that the dining situation was about a family, having food together at home. Except for a few participants thought they were friends and waitress eating in a restaurant. 2 participants thought that a lady was trying to sell a purse in the situation. After excluding these outlier answers, in the end there were 166 total valid responses (69 males & 97 females) that understood the situation correctly. Analyses were done on these 166 responses. The average age of participants was 37.43 years ($SD = 12.38$), ranged from 20 to 60 years old.

3.2 ANOVAs on Emotions

ANOVAs (IV: "Art style" and "Gender", DV: emotional responses) were conducted on all emotion items in Table 1. According to Armstrong's (2014) suggestion on when to use Bonferroni correction, since the first objective of the study is an exploratory investigation with no hypothesis, and it was not imperative to avoid a Type I error, Bonferroni corrections should not be applied to these ANOVAs. Among all the results from ANOVAs, there were no significant main effects of art style on emotions. On the other hand, significant main effects of gender were found on emotion items such as "Refreshment" ($F(1, 164) = 5.31, p = .022$), "Quietness" ($F(1, 164) = 5.07, p = .026$), "Loneliness" ($F(1, 164) = 5.73, p = .018$), and "Crampedness" ($F(1, 164) = 4.49, p = .029$). Several significant Interactions were also found on "Happiness" ($F(1, 164) = 3.92, p = .049$), "Refreshment" ($F(1, 164) = 6.24, p = .013$), "Freedom" ($F(1, 164) = 4.52, p = .035$), and "Togetherness" ($F(1, 164) = 4.44, p = .037$).

3.3 ANOVAs on “Realistic” and “Picturing”

ANOVAs (IV: “Art style” and “Gender”, DV: “Realistic” and “Picturing oneself”) were conducted to test *H1*. No significant main effect of either art style or gender was found. No interaction between them was found, either.

3.4 Multiple Regression Analyses on “Realistic” and “Picturing”

Multiple regression analyses (IV: “Age”, “Gender”, DV: “Realistic” and “Picturing oneself”) were conducted respectively on the two groups with different art style. For the vector version of the dining situation, there was no significant relationship between predictors (“Age” and “Gender”) and response variables (“Realistic” and “Picturing oneself”). However, for pixel version of the dining situation, a significant relationship between “Age” and “Picturing oneself” was found ($p = .011$). Specifically, it is found that there is a .028 increase ($\pm .011$, in a 5-point Likert scale) of the ease of picturing oneself being in the situation, for every 1-year increase in the age of the participants. There was a minor but very close to medium effect size (Cohen’s $f^2 = .10$) for this relationship.

4 DISCUSSION

First of all, results supported previous study (Bao et al., 2018), showing that gender plays a big role in evoking emotions in a visualized dining situation. Compared to gender, there was no significant main effect of art style on any of the emotional responses on the dining situation. This suggests that simply by changing the art style of a visualized dining situation from vector to pixel might not provide much effect on the emotions that related to the dining situation.

When applying a visualized dining situation in various scenarios, it is considered that how realistic the situation feels and how easy to picture oneself being in it are very important. Results showed no difference among the two art styles and two genders, indicating that no matter pixel or vector, male or female, the level of “how realistic it feels” and “how easy to picture oneself being in it” might not change. Changing the art style from vector to pixel wouldn’t make people feel more realistic on the situation, and wouldn’t make it easier for people to picture themselves being in the situation. *H1* was not supported. Although it is being said that pixel art style could invite more imagination to “fill the gaps/blank” (Byford, 2014, Rocket Brush Studio, 2021), simply by pixelating the lines might not work. It could be more due to the simplicity of the visual stimuli, since the difference between pixel games and other games are usually not just the art style, but also the simplicity regarding many visual aspects.

When taking the age of participants into consideration, it is found that when observing the pixel version of the dining situation, it is easier for older people to picture themselves being in it, and such result was not found for the vector version. This partially support *H2*, saying that the pixel art style indeed makes older people relate themselves more. However, since this effect of pixel art style was not found for “Realistic”, it cannot prove that older people actually can imagine more because of their experience with pixel art compared to younger generation. No matter how old the person is, he/she sees no difference on the level of how realistic it is between pixel and vector version of the dining situation. Therefore, a new question is: why can older people picture

themselves more easily in the dining situation, but not necessarily feel it more realistic than younger generation when observing a pixel version of the dining situation?

In order to answer this question and understand this difference between the perception of older people and younger people on the pixel art style, additional analyses were conducted. When screening the valid responses and removing “bad” answers, the most important criterion was whether the response showed that the participant actually understood the basic cues of the situation (based on the questions on comprehension in Table 1). For example, in the first question “Who and what relationship?”, responses with the answer of “family” or “relatives” were considered valid, however responses with the answer of “friends” were eliminated. In general, all responses showed agreement among the 5 questions, except for the fourth question: “what period is it?”. The ambiguity of this question caused participants understood the question in different ways. Among all 166 responses, 53 responses answered the questions with the period of different eras, such as either past era (it looks like in the 70s/80s, etc.) or modern era (it looks like modern time, etc.), whereas 113 responses answered the question with the different period of time of a day, such as dinner time, evening, morning, etc.. Since the dining situation was not illustrated with any intention to represent a specific time (although “dinner” seems more appropriate, answers with “morning” were not considered incorrect), all these answers were considered valid and were not eliminated. However, in order to understand how people perceive pixel and vector versions of the dining situation differently, the first group of responses (53) with the answer of either past era or modern era were summarized in Table 2. As can be seen by the frequencies cross tabulated in Table 2, there is a significant relationship between art style and perceived era, $\chi^2(1, N = 53) = 7.67, p = .006$. People in the pixel art group were more likely to perceive it happening in a past era than were in the vector group. This might be one of the main reasons why older people were able to relate to themselves, imagine themselves being in the situation, without necessarily feeling more realistic about it. Since the pixel version of the situation actually looked “older”, the older participants could associate themselves to it more, because they have been living in the past era compared to younger ones. Younger people could also think the situation is a realistic one, it is just more difficult for them to picture themselves being in the situation because it looked like something happening in the past era when they were not born yet. It could be clearly seen in Table 2 that the dining situation itself is not “old” at all, since people in the vector art group believed that it was more likely happening in a modern era. It is just the art style of pixel made it looked “older”.

Table 2. Cross table of the responses with the answer of question “What period is it”

Art style	Past era	Modern era
Pixel Art	14	9
Vector Art	7	23

It is widely known in the game industry that pixel art style would make a game look more “retro” and “nostalgic”. However, these feelings are not clearly explored and defined. In general, a retro game usually means it is made in the past era, it is an “old” game. It does not necessarily

mean we also think what is happening in the game is also in a past era. In this study, it is found that simply by pixelating the dots and lines of a dining situation sketch, it could lead to a tendency that people might perceive it happening in a past era, then lead to older people feeling easier to picture themselves being in the situation.

5 CONCLUSION

When pixelating the lines of a visualized situation, the pixel art style could possibly trick people to believe that the situation is happening in a past era of time. This might lead to older people feeling easier to picture themselves being in the situation. It suggests that the “retro” characteristic of pixel art style does not simply mean that the content looks like being made in a past era, it might also influence what we comprehend on the “story” of the content. Designers and illustrators should take advantage of this phenomenon in game design and media graphic design. Researchers are recommended to conduct future studies to explore this phenomenon.

There is no clear evidence that pixel art style could stimulate more imagination and “fill the gaps/blank” compared to vector art style. The simplicity of the visuals might be a more important factor. This needs to be further discussed in experiment using pixel art style and vector art style with different level of simplicity.

ACKNOWLEDGMENTS

This study would not have been possible without the participation and support of all individuals who agreed to share their time and opinions.

REFERENCES

- Armstrong., R.A. (2014). When to Use the Bonferroni Correction. *Ophthalmic Physiological Optics*, 34, 502-508. Doi: 10.1111/opo.12131
- Bandai Namco Entertainment Inc. (1980). *Pac-Man*. Bandai Namco Entertainment Inc. From: <https://www.pacman.com/en/history/>.
- Bao, S., Koyama, S., & Yamanaka, T. (2018). Visualizing Situations: Comparing Comprehension and Emotion between Simple and Detailed Dining Situation Sketches. In: Lokman, A., Yamanaka, T., Lévy, P., Chen, K., Koyama, S. (eds) *Proceedings of the 7th International Conference on Kansei Engineering and Emotion Research 2018. Advances in Intelligent Systems and Computing*, 739, Springer, Singapore. https://doi.org/10.1007/978-981-10-8612-0_33
- Byford, S. (2014). *Pixel art games aren't retro, they're the future*. The Verge. Retrieved on May 16, 2022, from <https://www.theverge.com/2014/7/3/5865849/pixel-art-is-here-to-stay>
- El-Din, G. & Kheshen, E. (2021). Pixel Art as a Visual Stimulus in Graphic Arts. *Journal of Art & Architecture Research Studies*, 2(3), 142-156.
- Gintere, I. (2019). A New Digital Art Game: The Art of the Future. *International Scientific Conference “Society, Integration, Education” Proceedings At: Rēzekne Academy of Technologies*.
- Graphic-Sha. (2019). *Pixel Vistas: A Collection of Contemporary Pixel Art*. Graphic-Sha.

Hirai, S., & Okamoto, Y. (2005). The Relationship between Parent-Child Psychological Connection and Factors of Meal Scenes of Elementary School Students. *Journal of Home Economics of Japan*, 56(6), 273-282

Mehl, M. R., & Robbins, M.L. (2012). Naturalistic Observation Sampling: The Electronically Activated Recorder (EAR). In Mehl, M. R., & Conner, T. S. (Eds.), *Handbook of research methods for studying daily life*, 124-143, New York, NY: Guilford Press

Pervin, L. A. (1978). Definitions, Measurements, and Classifications of Stimuli, Situations, and Environments. *Human Ecology*, 6, 71-105

Rauthmann, J. F., Sherman, R. A., & Funder, D. C. (2015). Principles of Situation Research: Towards a Better Understanding of Psychological Situations. *European Journal of Personality*, 29(3), 363-381, doi:10.1002/per.1994

Rocket Brush Studio. (2021). *Why Pixel Art Games Have Become Widely Popular*. Retrieved on Aug 2, 2022, from <https://rocketbrush.com/blog/pixel-art-games-popular>

Saucier, G., Bel-Bahar, T., & Fernandez, C. (2007). What Modifies the Expression of Personality Tendencies? Defining Basic Domains of Situation Variables. *Journal of Personality*, 75, 479-504

Silber, D. (2017). *Pixel Art for Game Developers*. CRC Press.

Taito Corporation. (1978). *Space Invaders*. Taito Corporation. Retrieved on Aug 2, 2022, from <https://spaceinvaders.jp/history.html>

Thorson, M., & Berry, N. (2018). *Celeste*. Matt Makes Games. Retrieved on Aug 2, 2022, from <http://www.celestegame.com>.

