SUGISAKA MASANORI

Journal of Robotics, Networking and Artificial Life
Vol. 11(1); June (2024), pp. 40–48
ISSN (Online): 2352-6386; ISSN (Print): 2405-9021
https://alife-robotics.org/jrnal.html

Research Article

Framework of a Disinformation Game Based on the Narrative Warfare in Russo-Ukrainian War

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ARTICLE INFO

Article History
Received 24 December 2023
Accepted 23 August 2024

Keywords
Cognitive security
Computer game
Disinformation
Disinformation game
Fake new
Information warfare
Narrative generation
Narrative warfare
Russo–Ukrainian War
Video game

ABSTRACT
Since Russia invaded Ukraine in 2022, information related to the invasion has increased. This information is spread through social networking services and TV programs. This study proposes a framework for a disinformation game system. In the game, a player spreads disinformation. In particular, we discuss topics related to the Russo–Ukrainian War in February 2022. The game system provides players with mental immunity to disinformation by simulating its spread. Three experiments were conducted in this game. In experiments on the proposed game, people gradually lost their resistance to disinformation by repeatedly receiving disinformation.

1. Introduction

In February 2022, Russia invaded Ukraine's Donbass region. The invasion continued after Russia's annexation of Crimea in February 2014. This invasion is known as the Russo–Ukrainian War. The information related to the war continues to spread through social networking services (SNS) and televisions. Information warfare in this war is based on the Russian view of history and is being attacked and defended in a way that destroys the Russian view of history in Ukraine. North Atlantic Treaty Organization (NATO) reported that Russia has made information-based activities a military operational priority [1]. Ukraine has also established an agency to counter information warfare (https://cpd.gov.ua/).

Maan named warfare such as the aforementioned activities "narrative warfare." In narrative warfare, narratives are weapons that have the power to make opponents surrender without fighting them [2]. Narrative warfare related to the Russo–Ukrainian War has garnered significant attention [3]. Ogata collected discourses on the Russo–Ukrainian War [4], [5], [6], [7], and considered discourses [8]. These studies were conducted from the perspective of narrative generation.

This study proposes a framework for a game system (in the following description, we write "The game system" as "game"). In the game, players spread disinformation. This disinformation is based on the opinions of the disinformation speaker on the list published by Ukraine. The game is intended to support the players' psychological immunity against the influence of disinformation by simulating its spread.

The remainder of this paper is organized as follows: Section 2 defines disinformation and provides examples of the game. Section 3 describes the game mechanism.

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presents the experimental results. Finally, Section 6 concludes the paper.

2. Backgrounds

This study also provides a background for future research on disinformation and related issues. In this section, we first define disinformation and then present examples and research on games related to the disinformation game proposed in this study. Finally, we present the results of the previous study that we conducted.

2.1. What is disinformation?

Human decision making depends on our perception of things. Humans are constantly acquiring various types of information. Human cognition is formed through the acquired information. If we can control the information that a subject receives and form a cognition that is desirable for the person, we can treat the information as a weapon. Koizumi, Kuwabara, and Komiyama positioned the cognitive domain of as a new warfare domain [9].

Ogata considered that falsehood is not the only method to attack an opponent's cognition [8]. One approach is based on an analysis of discourse in social networking and TV news as well as narrative generation, artificial intelligence (AI) relationships, and the use of literature and aid. Ogata proposed "narrative warfare" as a warfare that attacks using narratives. Whether the narratives are false or true does not matter. Ogata examined narrative warfare based on a model of narrative generation and considered the cycle in which narratives create reality, which creates additional narratives.

From a cognitive security perspective [10], three types of information can influence human cognition and distort decision-making. Disinformation, which is the focus of this study, is one such example. Fig. 1 shows the three classifications [11]. Misinformation refers to information that contains errors, but the sender has no malicious intent; disinformation refers to information that contains errors and the sender has malicious intent; and malinformation refers to information that does not contain errors, but the sender has malicious intent.

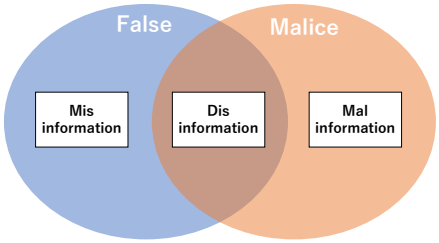

Fig. 1 Categories of information that distorts the cognitive ability of a person

2.2. Examples of games related to a disinformation game

With improvements in computer technology, expressive techniques in video games have also significantly improved, and simulating environments that closely resemble reality has become possible.

2.2.1. Games as a media tool

With the development of computer technology and the spread of video game culture, the public has become increasingly exposed to video games with complex expressions. Consequently, video games have come to be used as a method of expressing messages in the same way as a writer writes a novel using a pen. During the Russo–Ukrainian War, video games were also used as media tools to express message/propaganda [12]. For instance, *Ukrainian War Stories* is a game inspired by real events during the Ukrainian War [13].

2.2.2. Games as a simulator

Video games imitate various aspects. 1972's "Pong" represented table tennis. The monochromatic world comprised simple rectangles and squares. Later, as technology developed, complex processing became possible and video games had the potential to simulate human social activities. A video game known as *World of Warcraft* exists. In this game, a bug caused an epidemic that developers did not intend to spread throughout the virtual world. Lofgren and Fefferman suggested the possibility of simulating human behavior during an actual pandemic based on player behavior [14]. Some games simulated an epidemic. *Plague Inc.* [15] is a simulation game. Players select and spread the type of epidemic. The goal of the game is to exterminate humans. Players can enter the fake news mode.

Game studies have also addressed disinformation. Roozenbeek and Linden experimented on fake news using a game that positions a player on fake news speaker and found that the game provides "cognitive resistance against fake news strategies" for the players [16]. *Bad News* [17] is a browser game. In this game, players spread fake news in the virtual world. The game focuses on fake news circulating on SNS. Fake news includes falsehoods that distort people's perceptions of sensational or conspiratorial content. The game provides instructions and events to the player who selects fake news. Consequently, the players' influence on public opinion gradually increases. Appropriate fake news about an event effectively increases player influence.

2.3. *Related studies*

Nagaoka and Ogata focused on non-player characters (NPCs) in computer games. NPCs are characters directly controlled by players using control devices in games. In their concept, NPCs have "accumulation of information," "actions based on their own criteria (personality and emotions)," and "changes in criteria owing to contact with others." We attempted to change the story through interactions between PCs and NPCs [18].

Ono and Ogata developed a prototype of a surprise-based story generation mechanism [19], [20] and further proposed a disinformation game based on the framework of the prototype system [21]. In this game, the player is positioned as a person who opposes the disinformation. Ono and Ogata proposed the concept of a narrative generation game based on the Russo–Ukrainian War [21], [22].

3. Mechanism of the Proposed Game

Section 3.1 describes the purposes of the players in the game. Next, we describe the underlying mechanism. Finally, the disinformation used in the game is introduced.

3.1. *Purpose of a player in the proposed game*

In the proposed game, a player spreads disinformation on Ukraine. The disinformation change factions as shown Fig. 2. The player's purpose is to change more Ukrainian faction to the Russian faction ("faction" in this study does not indicate a particular political party. The term implies people who support a certain country). In the game process, the game provides player events related to the Russo–Ukrainian War. The player selects disinformation according to the event. The Ukrainian faction comprises NPCs, and each NPC has "trust." The "trust" is the amount of trust for Ukraine, and selected disinformation fluctuates trust. NPCs in Ukraine change to those of Russia based on the decrease of "trust."

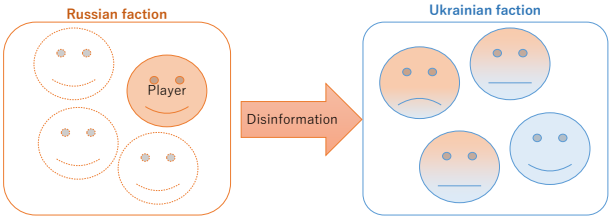

Fig. 2 Changes in a faction by disinformation

This study did not address misinformation or problems with SNS based on biased information. However, these factors are important for simulating the spread of information. This issue will be addressed in future studies. Moreover, we did not differ in terms of disinformation or malinformation. We focus on the malicious intent of the sender and treat both types of information as disinformation.

3.2. *Flow in a game play*

A player influences the trust of NPCs through disinformation and leads NPCs to the Russian faction. The game flow included several turns. This turn comprised the following three steps: The first step is "the occurrence of an event," the second step is "the selection of disinformation," and the third step is "the evaluation of the effect of selected disinformation." Fig. 3 illustrates the game flow and its components. Each turn was repeated as many times as the number of events in the story. A single turn included (i) the occurrence of an event, (ii) dissemination of disinformation, and (iii) evaluation of the effect of the selected disinformation. The selected disinformation influences the parameters of all NPCs. The score of the player is the total number of trusts in NPCs.

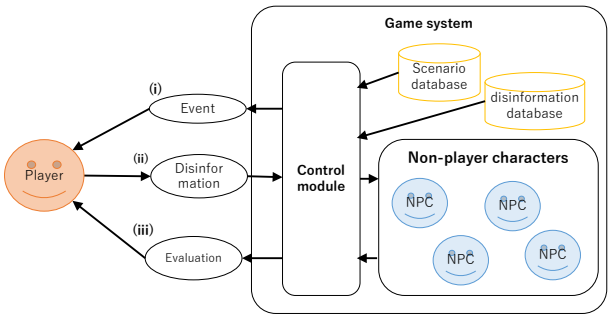

Fig. 3 Flow of the game system

3.3. *Elements of the disinformation game*

In this study, the disinformation game included events, NPCs, and the same disinformation patterns without a player. The component parameters were used to calculate trust.

Non-Player Character (NPC)

An NPC is an element that represents the Ukrainian faction and has two parameters. In this game, the Ukrainian faction included more than one NPC member. The details of the parameters are as follows:

- Trust: The parameter is a value. If trust is 0, the NPC loses trust in Ukraine. Moreover, trust is used to resist disinformation.
- Characteristics: This parameter refers to the personality trait of NPCs. If the parameter indicates "nil," the NPC does not have characteristics. If the parameter is "conspiracy theorist," the NPC tends to believe the conspiracy theory.

Event

Events occur in a story. In this study, events based on actual events occurred during the Russo–Ukrainian War.

- Characteristics: The parameter is a type of content. If the parameter matches the "Characteristics" of disinformation, disinformation more influence NPCs.

Disinformation

Disinformation is the information selected by the player during "the disinformation selection step. In this study, all disinformation was based on Russian propaganda published in Ukraine. Details are presented in Section 3.4, where disinformation has three parameters.

- Strength: The power of effect to influence trusts.
- Reality: The degree to which disinformation is realistic indicates the possibility that the NPC will believe it. If reality is low, the possibility of acceptance is small.
- Characteristics: Type of disinformation. If a player selects appropriate disinformation from an event, it strongly influences trust in the NPC.

The impact of disinformation is based on the parameters of the three components. The trust decreases according to Eq. (1) and Eq. (2). Fig. 4 illustrates the means of the equations. Eq. (1) calculates the probability of disinformation influencing an NPC. If "P" in Eq. (1) was 100, trust decreased. If "P" is 0, trust does not decrease. In Eq. (2), the game calculates its degree of influence. If the NPC holds conspiracy theories, the game calculates the value of the trust of the NPC as half in two calculations as follows:

$$P = 100 + (R - T) \quad (1)$$

$$A = S - T/4 \quad (2)$$

P: Probability of decreasing trust, A: Amount of trust decreases, R: Reality in selected disinformation, T: Trust that the NPC has, S: Strength in selected disinformation

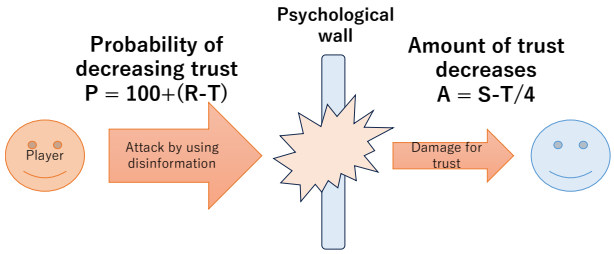

Fig. 4 Illustration of effects of the formula

3.4. Disinformation in Russo–Ukrainian War

Ukraine lists speakers who disseminate Russian propaganda and published *СПІКЕРИ, ЯКІ ПРОСУВАЮТЬ СПІВЗВУЧНІ РОСІЙСЬКІЙ ПРОПАГАНДІ НАРАТИВИ* (*Speakers who promote narratives that are in tune with Russian propaganda)*[*]. This list compiles the people in each country who transmit opinions in favor of Russia and the opinions transmitted by each person. We reorganized these opinions without distinguishing between senders. The disinformation that a player can select is a reorganized opinion. Note that the list published by Ukraine was revised once, and both the pre-revision and revision are treated here.

These lists include 89 speakers after excluding duplicates. In this study, if the same speaker publishes the same opinion in the pre-revision and revision stages, the two opinions are integrated into single content. If different speakers publish the same content, the two opinions are treated differently. These opinions were organized as the disinformation used in the game through a bottom-up process. Examples of this breakdown are summarized in the Appendix.

The following list contains all classifications of disinformation: "~~~" denotes a blank to fill a word. The words are "the U.S.," "NATO," "Ukraine," or "Zelensky." Note that opinions classified as "other" are not considered here. However, some interesting opinions exist in the "Other" category. For instance, the opinion of the Japanese speaker, "Honorable surrender of Ukraine is important to save lives," is an opinion not found in other countries.

1. ~~~ is provoking (inspiring) Russia
2. It is a proxy war between ~~~ and Russia
3. The West is running a propaganda campaign
4. Russia-hatred (Russophobia)
5. NATO expansion is bad
6. Ukraine is suppressing Russian speakers in the country
7. Ukraine (Zelensky) wants war
8. Ukraine is committing acts against humanity
9. The massacre in Bucha is a fake
10. Ukraine has a biological weapons laboratory
11. We should not give arms to Ukraine
12. Ukraine started war before February 24 (Maidan Revolution)
13. Ukraine is a Nazi
14. Ukraine should make concessions
15. Ukraine did not comply with the Minsk agreements
16. Russia will win the war
17. Sanctions are not getting through to Russia
18. Russia has not attacked civilians
19. ~~~ should negotiate with Russia (Putin)
20. ~~~ should not blame Russia (Putin)

[*] https://cpd.gov.ua/reports/spikery-yaki-prosuvayut-spivzvuchni-rosijskij-propagandi-naratyvy-2/, However, it is not currently available to the public.

21. ~~~ should not hunt down Russia
22. Crimea is Russian territory
23. Russia has freedom of speech

4. Experiments of Game Play

This section describes the three experiments. Table 1 summarizes the experimental results. Stories based on *the invasion of Ukraine in chronological order* [23]. (A Japanese newspaper published and updated the article on a web page. We used the timeline from February 24, 2022, to April 31, 2022.)

Table. 1 Summary of experiments

	First	Second	Third
Number of NPC	5	1000	1000
Number of conspiracy theorist	1	1	100

4.1. First experiment

The following shows an experiment on game play: The first experiment involves five NPCs. One NPC tends to believe conspiracy theories. The story comprises six events. The following list presents the timeline of the first experiment. "Event" refers to an event that occurred in the time. "Selection" refers to disinformation that is selected by a player.

- Time 1
  - Event: "Russia have launched an invasion."
  - Selection: "The U.S. is provoking (inspiring) Russia."
- Time 2
  - Event: "Russia occupied a city."
  - Selection: "Russia has not attacked civilians."
- Time 3
  - Event: "A massacre occurred."
  - Selection: "The massacre in Bucha is a fake."
- Time 4
  - Event: "The war continues."
  - Selection: "Ukraine (Zelensky) wants war."
- Time 5
  - Event: "The war continues."
  - Selection: "Russia will win the war."
- Time 6
  - Event: "Russia has retreated."
  - Selection: "The U.S. should not hunt down Russia."

Table 2 lists changes in trust during the gameplay experiment. "Time" corresponds to the above list. "No" corresponds to each NPC. Item 1 is a conspiracy theorist. "Total" and "Average" show total trust of all NPCs and the average in each time. Fig. 5 shows the changes in trust during the first experiment.

Table. 2 Changes in trust at each time

Time	No.1	No.2	No.3	No.4	No.5	Total	Average
1	82	95	95	95	95	462	92.4
2	62	88	88	88	88	414	82.8
3	9	50	88	50	50	247	49.4
4	0	32	80	32	32	176	35.2
5	0	10	70	10	10	100	20.0
6	0	0	57	0	0	57	11.4

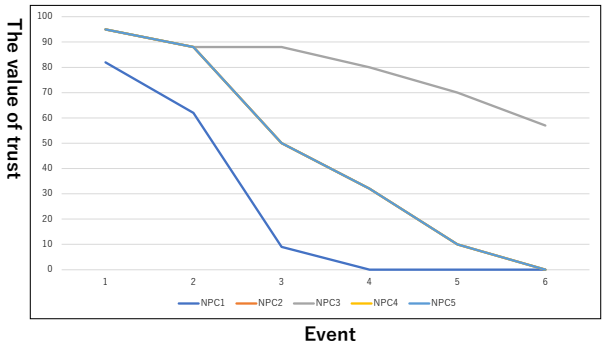

Fig. 5. Changes in trusts in the first experiment

4.2. Second experiment

Using the same story as in the first experiment, the number of NPCs was set to 1000. One of the NPCs is a conspiracy theorist. The player only selects "The U.S. is provoking (inspiring) Russia." In this experiment, the mean of trust varies between 94.9, 87.9, 79.959, 69.943, 56.943, and 40.959. Fig. 6 illustrates the changes in trust during the second experiment. Blue represents the number of NPCs' trusts; if all NPCs' trusts are zero, blue is not represented. The color position does not represent anything. The NPCs gradually change into a Russian faction.

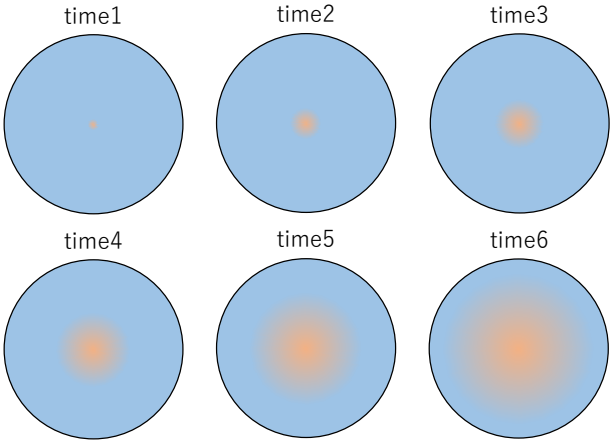

Fig. 6 Changes in trusts in the second experiment

4.3. *Third experiment*

The same story used in the first experiment was used. The number of NPCs was set to 1000. A total of 100 conspiracy theorists exist in the NPCs. The player only selects "The U.S. is provoking (inspiring) Russia." In this experiment, mean trust varied between 93.7, 85.4, 75.9, 64.3, 51.3, and 36.9. Fig. 7 illustrates the changes in trust during the third experiment. The results of the second and third experiments were not significantly different.

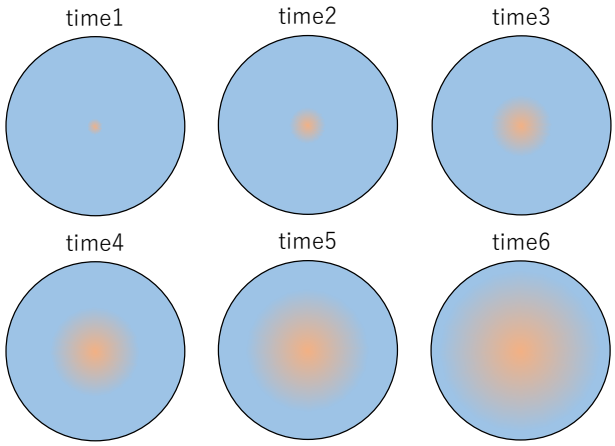

Fig. 7 Changes in trusts in the third experiment

5. Discussions and Future Works

This section discusses each of the experiments presented in Section 4 and then refers to future plans.

5.1. *Discussions for each experiment*

In Section 4.1, trust in the conspiracy theorist (NPC No.1) rapidly decreases, and the NPC quickly reverses. Nos. 2, 4, and 5 were also finely reversed. NPC No. 3 continued to trust the Ukrainian factions. Consequently, we observed a rapid growth of suspicion in the Ukraine faction. An NPC continuously receives disinformation, and its influence gradually increases. Even those with a strong resistance to disinformation become mentally exhausted by continually receiving false information, and their resistance to such disinformation declines. In the proposed game, when trust begins to decline, the player rapidly leans toward the opposing faction.

When the number of NPC is small, trust in a faction decreases rapidly. Conversely, for NPCs, the overall impact is small. The case in Section 4.2 is that with several people in the Ukrainian faction. The result is a loss of confidence of 60%, but the mean does not drop as quickly as in the case of Section 4.1. If the number of NPCs increases, the total amount of trust decreases.

Unless a large group of NPCs are conspiracy theorists, the number of conspiracy theorists does not significantly impact the overall loss of trust. In Section 4.3, if the number of NPCs increases, the decrease in the total amount of trust will be smaller. However, because the prototype game system does not consider the interaction between NPCs, the decrease in trust would be accelerated if each NPC spreads false information to the others.

5.2. *Possibility of interactive effects in a group*

In this study, the mechanism is such that the information reaches all targeted persons simultaneously. Disinformation affects all NPCs. Some information never remains in circulation within the community. Therefore, the ability of the players to communicate information is unrealistic. However, depending on the SNS, information that is rapidly increasing in number of views is likely to attract the attention of several humans. Consequently, more people view information from segments of the population that would not normally be seen. The discussion thus far has been limited to cases in which no interaction was present. If we assume that NPCs whose trust falls below a certain value become autonomous disinformation speakers, then the number of times an NPC is affected by disinformation increases rapidly. Under this assumption, the number of conspiracy theorists can significantly influence the overall trust value. Even if an NPC who is a conspiracy theorist is less receptive to disinformation, the value of trust in the NPC will rapidly decrease.

Consequently, they are more likely to become speakers of disinformation. Subsequently, they significantly influence NPCs who are not conspiracy theorists. The first disinformation speaker spreads information with malicious intent, but a speaker born from that spread may spread information with good intent. Different categories of information can be considered and compared to the three categories of information (misinformation, disinformation, and malinformation). The information does not contain errors and the sender has no malicious intent.

5.3. *Comparison of existing games*

We compare the proposed disinformation game to *Bad News* and *Plague Inc.* These games are characterized by the players' positioning and goals. Furthermore, the quality of the selectable disinformation and the targets of the attacks vary. In the proposed game, the player is a disinformation speaker whose goal is to polarize Ukrainians against Russians. The disinformation that we consider is information circulating worldwide.

Bad News [16] and [17] focus on fake news. Players are not able to adhere to a particular ideology, but to

increase their influence as influencers. The players' scores are expressed in terms of their public influence. The game teaches players eight fake news techniques, step-by-step. The game also uses SNS to spread fake news. Selectable fake news topics span various areas, including politics and medicine. The events and fake news considered in the game are fictitious. The process of selecting fake news in this game is similar to that in the proposed disinformation game. First, an event occurs in which a player selects fake news.

Plague Inc. [15] considers epidemics. Fake news mode is an additional feature. Fake news is characterized as an epidemic. The player is not a speaker of disinformation. The player is information as a meme. In this game, the player targets the entire planet for an attack. One topic for fake news to spread exists, and players determine the parameters of their fake news by first selecting the characteristics of the fake news. In addition, as the game progresses, players can enhance the nature of the fake news they are spreading. The various phenomena and techniques in the spread of fake news are represented by the characteristics that players select to use.

5.4. Future works

Nagaoka and Ogata represented the interaction between players and NPCs in their system [18]. This system can be considered as a simulation of an artificial society. The proposed game simulates an artificial society. However, this approach has not been implemented yet. This interaction is not currently being implemented. Strategies for selecting disinformation must also be considered. For instance, we would like to introduce a system such as the "illusion of truth effect illusory truth effect" [24], [25] to introduce the repeated influence of information and the interaction of groups.

The explosive development of generative AI technology is expected to produce not only fake information but also new disinformation techniques that utilize this technology. Therefore, we focus on the generative AI technology in the games that we developed. Disinformation speakers would use generative AI to forge photos and videos. For instance, examples in Japan already exist in which images of disasters such as floods and earthquakes have been disguised using generative AI. In addition to the dangers of image generation, disinformation speakers use generative AI for text generation to create robots that can narrate dangerous narratives.

6. Conclusion

In this study, we presented a framework for a disinformation game system related to the Russo–Ukrainian War and developed a test version of the game. We examined the patterns of disinformation about the war in the game. The prototype included a player and an NPCs. The goal of the game was to change the NPCs from a Ukrainian faction to a Russian faction by spreading disinformation. The player obtained the power to resist the influence of disinformation through game play. Three experiments were conducted using the prototype game. Each experiment varied in the number of NPCs and conspiracy theorists. NPCs gradually lost their resistance to disinformation by repeatedly receiving it. In future studies, we intend to expand the functions of this game. In particular, we will focus on the interaction between NPCs, various disinformation techniques, and generative AI.

Acknowledgement

This research was supported by JSPS KAKENHI (JP21K17870).

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Appendix: The types of disinformation

The following categories are based on the *СПІКЕРИ, ЯКІ ПРОСУВАЮТЬ СПІВЗВУЧНІ РОСІЙСЬКІЙ ПРОПАГАНДІ НАРАТИВИ* (*Speakers who promote narratives that are in tune with Russian propaganda*,). This list is information published by the Center for Countering Disinformation. The Center for Countering Disinformation (https://cpd.gov.ua/) is a state agency established on March 11, 2021 by the National Security and Defense Council of Ukraine, which publishes the results of investigations into various forms of disinformation and propaganda. The following contents are examples of breakdowns in the category of disinformation.

- The U.S. and Ukraine have actively provoked Russia into aggression.
- The U.S. and Ukraine have aggressively provoked Russia into aggression.
- Putin has been humiliated and Russia persecuted for decades.
- The West provoked Russia into war with Ukraine.
- Zelensky provoked Russia into launching special operations against it.
- The U.S. has provoked Putin for years.
- The events in Ukraine are a provocation by the U.S. and NATO.
- The U.S., through NATO, provoked Russia to war in Ukraine. NATO and the U.S. provoked Putin. NATO provoked Putin. NATO provoked Russia The West provoked Putin.
- The West provoked Russia.
- The U.S. provoked Russia.
- The West provoked Putin.
- Arming Ukraine provokes Russia.
- Zelensky is provoking Putin.
- NATO has crossed the "red line."
- The U.S. and UK have crossed Putin's "red line."
- For eight years, Ukrainians have been provoking Russia.
- Putin's decision to invade Ukraine was NATO's fault.
- NATO intentionally deployed on the Russian border.
- The U.S. and Europe provoked the Russian president.
- The U.S. is responsible for Russia's attack on Ukraine.
- The U.S. needs to stop the madness in Ukraine provoked by the U.S.

Following contents are "Other."

- Ukraine's Honorable Surrender Critical to Saving Lives
- Ukraine was considering the force method of invading Donbass and seizing Crimea
- Europe must admit its historical mistake in tolerating the Ukraine crisis.
- Ukraine crisis threatens Europe's autonomy
- The EU should abandon its strategic compass and its crazy idea of winning the war in Ukraine
- The US and Europe, unlike Russia, do not want peace in Ukraine

- Ukraine joining the EU would be madness
- Russia will not back down.
- Civil war continues in Ukraine
- Ukraine-Russia crisis
- Americans are paying in vain for “democracy”
- Ukraine is guilty of war

Authors Introduction

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He received his bachelor’s degree from the Faculty School of Software and Information Science, Iwate Prefectural University in 2010. He received his MS and PhD from the Graduate School of Software and Information Science, Iwate Prefectural University in 2014 and 2018, respectively. He has worked as an information and communication technology instructor at the Vocational School of Digital Arts Sendai since 2018. He is interested in the interdicsiplinary field including computer game technologies, AI, cognitive science, and narrative generation system.

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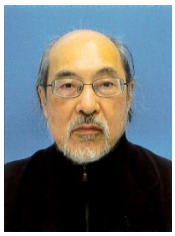

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