Capturing Users' Perceptions of Artificial Agents by Means of Paul A. Weiss Thought Experiment

Takanori Komatsu (tkomat@meiji.ac.jp)[1] & Lesley Lu (lesley.lu@student.unsw.edu.au)[2]
[1]School of Interdisciplinary Mathematical Sciences, Meiji University, Japan
[2]School of Computer Science and Engineering, University of New South Wales, Australia

Abstract

We conducted two investigations to capture how people perceive the artificial agents introduced into Paul A. Weiss's thought experiment, especially, how they perceived the AI system or the robots that are relatively new technology for us with different description (abstracted or concrete). As a result, we confirmed the followings: 1) generative and conversational AIs were perceived concretely as indispensable tools for our daily live with learning function while AI system was perceived abstractly as having knowledge from past, and 2) even the same robots, cleaner robots was concretely perceived as an useful tool while humanoid was abstractedly as ambiguous entity. Here, the presence or absence of appropriate knowledge with the agents may have led to the different ways of perceptions of agents. Thus, the introducing the agents into Paul A. Weiss thought experiment is an effective methodology to comprehend the users' current perception of these agents.

Keywords: thought experiment; mental image; perception of agents; AI system: robot

Introduction

To achieve smooth interaction between users and artificial agents, e.g., robots or AI systems, it is quite important to understand how users perceive these agents because such recognitions will determine their strategy for interacting the agents. Here, our particular interest lies not in case how an actual agent physically presented in front of users but rather is perceived but rather in how users perceive the concept of agents as a mental image. This is because even when an agent stands in front of them, they will perceive this agent in relation to their mental image of this agent that they already hold in their minds.

Up to now, many studies have been conducted in the field of human-robot interaction (HRI) or human-agent interaction (HAI) to capture how people perceive artificial agents (Bogdanovych et al., 2016; Clark & Fischer, 2023; Epley et al., 2007; Fink, 2012; Gray et al., 2007; Kidd & Breazeal, 2004; Powers & Kiesler, 2006; Trafton et al., 2023, 2024; Waytz, Gray, et al., 2010; Waytz, Morewedge, et al., 2010), and these studies can be roughly divided into two research approaches; One approach is to explicitly ask users about their perception of agents, and the other is to somehow capture their perceptions implicitly.

The typical methodologies of the former approach are the use of questionnaire surveys (Bartneck et al., 2009; Carpinella et al., 2017; Krägeloh et al., 2019; Nomura et al., 2012; Peca et al., 2016) or semi-structured interviews (Abe et al., 2024; Alhouli et al., 2024; Axelsson et al., 2025; Caruana et al., 2023). These methodologies ask participants directly and explicitly about their perceptions of artificial agents. However, they can only extract their consciously perceived impressions, and moreover, these are response biases or response styles that affect their responses (MacDorman et al., 2009; McDonald, 2008; Nunnally, 1978; Patten, 2014; Paulhus & Vazire, 2007).

While the typical methodologies of the latter approach are the use of the nonverbal information of users, e.g., as electroencephalography (EEG) (Liu et al., 2019; Urgen et al., 2013), functional near-infrared spectroscopy (Li et al., 2023; Wang et al., 2024), or their spatial position relative to agents (Mumm & Mutlu, 2011; Takayama & Pantofaru, 2009) during their interaction. However, these approaches require special instruments (or actual agents in some cases) to be prepared to capture the above measures in a controlled environment. Another representative methodology is the use of the implicit association test (IAT) (Greenwald et al., 1998, 2003), which is an assessment intended to detect users' subconscious associations between mental representations of target and control objects. Although the IAT is widely utilized not only in social psychology research but also in HRI or HAI researches (Diana et al., 2023; Pekçetin et al., 2024; Spatola & Wudarczyk, 2021; Wullenkord & Eyssel, 2019), it can only capture the relative differences between target and control objects.

Recently, the use of thought experiments has been focused as an alternative methodology for the latter approach (Komatsu, 2024; Komatsu & Shirai, 2025; Komatsu et al., 2021; Malle et al., 2015). For example, Malle et al. (2015) investigated humans' moral judgments toward robots using the "trolley problem." Specifically, participants were asked to make moral judgments about either a human repairman or a repair robot who took one of two actions: "letting five people on the trolley die" or "killing one person on a side track." The results showed that participants did not strongly blame the human repairman regardless of the choice made, whereas they strongly blamed the robot when it chose the action "letting five people die." They then concluded that the participants applied different moral norms to robots and humans. Therefore, introducing artificial agents into thought experiment is quite effective methodology to capture the people's recognitions of the agents implicitly. Because, when people are tackling a thought experiment that makes them hesitate to make a deci-

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sion, most of their cognitive resources and attentions would be spend on their decision-making for this experiment, while they would be not spent on their recognition of the artificial agents. As a result, this approach is considered to enable the extraction of a certain kind of "honest" perception that users hold toward the agent.

Komatsu and Shirai (2025) then focused on the "Paul A, Weiss's thought experiment," which was created by an Austrian-born cell-biologist Paul A. Weiss (Weiss, 1968): *There are three vials, one containing a whole chick embryo, a homogenized chick embryo, and a homogenized and fractioned embryo. The contents of the three vials are the same on the molecular scale, but are their biological systems completely different?* This thought experiment is for considering the relationship between the elements, organization and function of object; that is, after all of an object has been perfectly homogenized (or pulverized), what was lost, and what was not. They focused on three target agents that appear in a story: a "computer," "robot," and "human being." Specifically, the participants were asked to answer the question of "When a person/computer/robot was put through a giant blender and completely homogenized/pulverized, a liquid/powder derived from that person/computer/robot was obtained. What was lost as a result of the target agent being homogenized/pulverized)" in as much detail as possible (Note that this question was presented as text only). Because it was expected that the participants' decisions would be made by focusing on the most important factor that "makes this what it is" among the components or functions that constitute the agents, it was assumed that they could effectively find out implicitly how the target object was perceived. As a result of a text analysis on the participants' answers, they concluded that the participants perceived the robot to be neither a human nor a computer.

In this study, we conducted two investigations to examine whether Paul A. Weiss's thought experiment can capture people's perceptions of an even wider variety of agents. First, we conducted an investigation focusing on four different kinds of agents: the three agents ("computer," "robot," and "human being") examined by Komatsu and Shirai (2025), with the addition of a fourth agent, the "AI system" (Investigation 1). How do people perceive AI systems, which are rapidly becoming widespread in daily life? The aim of Investigation 1 is to capture users' perceptions of AI systems, which are still relatively new technologies, by comparing them with perceptions of computers, which have already become widespread in daily life, and robots, which are well known but not yet fully widespread. Next, the artificial agents examined in Investigation 1 ("computer," "robot" and "AI system") can be considered too ambiguous and broad concepts, so some participants may have found it difficult to form concrete mental image of these agents. We then conducted another investigation replacing these ambiguous agents into more concrete ones (Investigation 2). Specifically, "computer" was replaced into "smartphone" and "laptop PC," "robot" was into "cleaner robot" and "humanoid" and "AI system" was "generative AI" and "conversational AI."

Here, the following two research questions for each investigation would be a guide of this paper.

- **RQ1**: In case of introducing the four agents "computer," "robot," "human being" and "AI system" into Paul A. Weiss thought experiment, how do people perceive these agents, especially "robot" and "AI system" that are relatively new technology for us (Investigation 1).
- **RQ2**: In case of introducing much more concrete agents compared to Investigation 1 (e.g., "computer" is replaced into "smartphone" and "laptop PC"), how do people perceive these agents, especially "robot" and "AI system"(Investigation 2).

Investigation 1

Method

We conducted Investigation 1 to capture how the participants perceived the four agents; that is, "computer," "robot," "human being" and "AI system." The specific stories under "Paul A. Weiss thought experiment" that featured each of the four agents as follows:

- **Human being**: When a person was put through a giant blender and completely homogenized, a liquid derived from that person was obtained.
- **Computer**: When a computer was put through a giant blender and completely pulverized, a powder derived from that computer was obtained.
- **Robot**: When a robot was put through a giant blender and completely pulverized, a powder derived from that robot was obtained.
- **AI system**: When an AI (Artificial Intelligence) system was put through a giant blender and completely pulverized, a powder derived from that AI system was obtained.

The questions presented for each object were as follows:

- **Human being**: What was lost when the person was homogenized?
- **Computer/Robot/AI system**: What was lost when the computer/robot/AI system was pulverized?

A correspondence analysis on the answers for the four agents was conducted with the free text mining software "KH-Coder"[1], and the parameters of this analysis were set as follows; the minimum number of occurrence was 2, the minimum number of documents was 1, the maximum number of occurrence and documents were not determined. Norm B, verb B, adjective B, adverb B, negative auxiliary verb, and non-independent adjectives were excluded, and up to the top 60 words were the analysis target.

The correspondence analysis is a method of text mining that enable us to visualize how the words used in a text differ depending on the target object (Kumar & Paul, 2016). Specifically, it can represent the relationship between rows

[1] https://khcode.net/en

and columns by creating a cross-tabulation table; in our investigation, the row elements were words extracted from the text of the participants' answers, and the column elements were the four external variables (four agents). External variables with similar descriptions in text are placed in the same location along with the extracted words, while the external variables with different descriptions are placed at a distance from each other, allowing us to understand the relationship between external variables and what kinds of words are used. Therefore, the most important and indispensable words in considering the relationship between elements, organizations and the function of the agents are placed near the agent, so this analysis could clarify the different perceptions of the four agents in our investigation.

Participants

409 participants were recruited via "Yahoo! Japan Crowdsourcing" service (Seaborn & Nakamura, 2025); however, due to meaningless answers, 7 participants were eliminated. Therefore, the data of the remaining 402 participants (288 men, 106 women, and 8 unanswered; 20 – 78 years old, M = 50.80 (SD. = 10.34) were used for analysis. As a reward, they received 50 PayPay point (a popular point program in Japan), which was almost equivalent to 50 Japanese yen (1/3 US dollar). Among 402 participants, 100 experienced the "human being" question, 99 experienced "computer" question, 98 did "robot" and the remaining 105 did "AI system." Therefore, this investigation was done using a between-participants plan.

Result

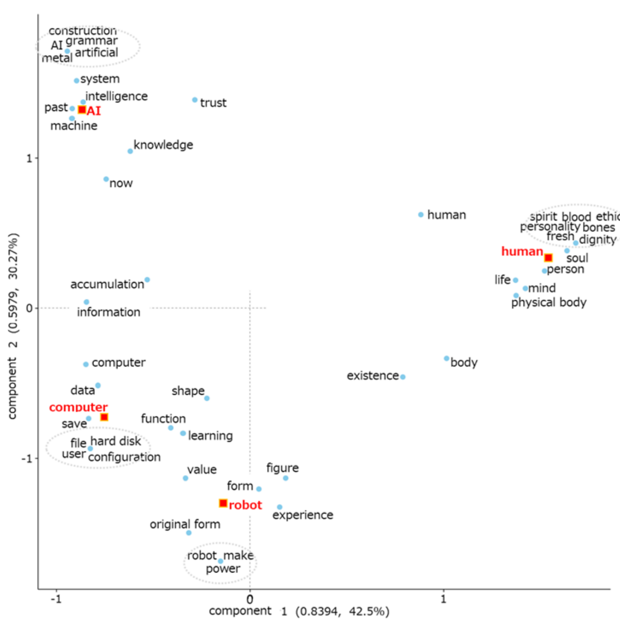

Figure 1: Correspondence analysis of participants' answers for four agents.

Figure 1 shows the results of the correspondence analysis on the participants' answers for the four agents regarding "what was lost." We can observe that the external variables "human being," "AI system" and "computer/robot" are placed corresponding to the vertices of an equilateral triangle around origin. This figure then clearly show that the four agents can be categorized in to three groups: that is, "human being" group, "AI system" group and "computer and robot" group.

In a correspondence analysis, words used commonly among all agents are placed near origin, whereas those used characteristically when referring to a certain agent are placed near the agent. A close examination of this figure from this perspective reveals that around the agent "human being," words about human physical components (blood or flesh), about human inner thoughts and personalities (spirit or life) and about human rights (dignity or ethics) were used characteristically. Around the agent "computer," we confirmed the words about computer's function (save or configuration) and ones about computer parts (file or hard-disk). Around the agent "robot," we confirmed that words about appearance of robots (original form or figure) and ones about function of robots (power or experience). And around the "AI system," we confirmed that words about AI's intelligent functions (grammar, intelligence or knowledge).

And the between the agents "human being" and "robot," we confirmed the words about physical body (body or existence), and between "computer" and 'AI system," we confirmed the words about information processing (information or accumulation). Moreover, between "computer" and "robot," we also confirmed the words "value" and "learning," and the word "learning" was used quite interestingly in the participants' answers, like *"Memories, data, experiences, values, and other knowledge that a robot has acquired by learning on its own"* or *"Information that a computer acquired by learning and stored via the Internet."* From these, we could confirm that the agent "computer" was perceived as the agents acquiring the data and knowledge from learning, and the agent "robot" was as the one acquiring the knowledge from learning and its experiences.

The agents "AI system" and "computer" were perceived as one with information processing, we found that the word "past" was uniquely used in the participants' answer for "AI system," like *"Accumulated information from the past" or "Various forms of human wisdom and knowledge accumulated from past."* Therefore, we could confirm that the agents "AI system" was perceived as the agent utilizing the information accumulated from past. The agents "computer" and "robot" were perceived as dynamically acquiring the data and knowledge from learning, while the agent "AI system" was perceived as statically utilizing the data and knowledge accumulated from the past. Such perceptual differences between these three agents are reflected as the different position of the AI systems and computer/robot.

To sum up, based on the correspondence analysis on the participants' answers from four agents, we could confirm that the participants perceived the agent "AI system" was different compared to the other three agents and as statical intelligent agent utilizing the data and knowledge accumulated from the past. And we also could confirm that they perceived the agent "robot" was different from "AI system" or "human being" and as dynamical agent acquiring the data and knowledge by learning and experiences on its own.

Investigation 2

Method

We replaced the agents "computer," "robot" and "AI system" used in Investigation 1 into much concrete agents, and conducted the same investigation with Investigation 1. Specifically, "computer" was replaced into "smartphone" and "laptop PC," "robot" was into "cleaner robot" and "humanoid" and "AI system" was "generative AI" and "conversational AI." We then conducted Investigation 2 to capture how the participants perceived the above six agents with agent "human being" (totally, seven agents), The specific stories used in Investigation 2 were completely the same with ones in Investigation 1 just replacing the name of the agents. In case of the agents "generative AI" and "conversational AI," we added the following sentences with specific application names for each story; "Generative AI: AI systems that can newly generate images, text, audio, and other content (e.g., ChatGPT, Google Gemini)" and "Conversational AI: AI systems that can engage in natural conversations with humans (e.g., Apple's Siri on the iPhone, Google Assistant)."

Participants

620 participants were recruited via "Yahoo! Japan Crowdsourcing" service, however, due to meaningless answers, 14 participants were eliminated. Therefore, the data of the remaining 606 participants with the data of 100 participants in "human being" question in Investigation 1 (474 men, 223 women, and 9 unanswered; 20 – 87 years old, M = 51.03 (SD. = 11.91) were used for analysis. As a reward, they received 50 PayPay point. Among 606 participants, 104 experienced the "smartphone" question, 102 experienced "laptop PC" question, 102 did "cleaner robot," 96 did "humanoid," 105 did "generative AI" and the remaining 97 did "conversational AI" Therefore, this investigation 2 was also done using a between-participants plan.

Result

Figure 2 shows the results of the correspondence analysis on the participants' answers for the seven agents. We can observe an equilateral triangle structure around the origin by the four agents, that is "human being," "smartphone/laptop PC" and "cleaner robot." Moreover, the agents "generative AI" and "conversational AI" were placed between "human being" and "smartphone/laptop PC" but more near to "smartphone/laptop PC," and the agent "humanoid" was placed around the center or gravity of the triangle and keep certain distances from the other six agents. This figure then clearly show that the seven agents can be categorized in to four groups: that

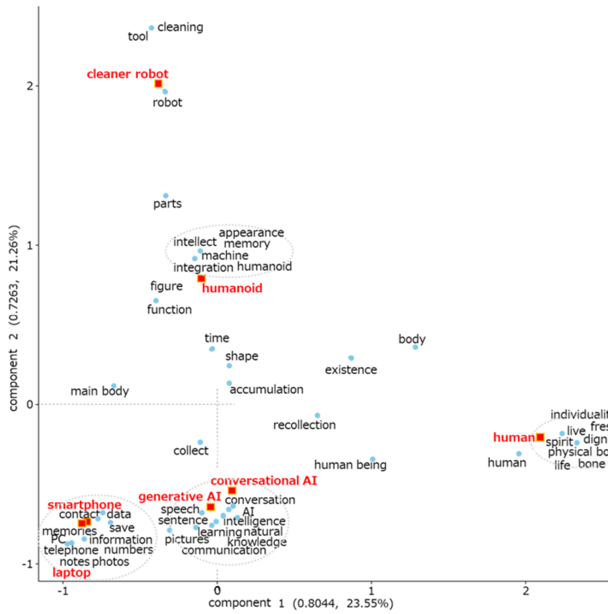

Figure 2: Correspondence analysis of participants' answers for seven agents.

is, "human being" group, "smartphone/laptop PC/generative AI/conversational AI" group, "cleaner robot" group and "humanoid" group.

As close examination of this figure which kinds of words were used in the agents, around the agents "smartphone" and "laptop PC," we confirmed that the words about stored data (numbers, photos, or memories) and the ones about functions of these agents (contact or save). Specifically, because these words were used together with adjectives expressing emotional attachment like *"memorable photos," "important data" or "long-standing contacts,"* so we could confirm that these agents are perceived as extremely important tools in our daily lives.

Right next to these agents, around the agents "generative AI" and "conversational AI," we confirmed that the words about generated information of these AIs (pictures, speech, or sentences) and the ones about intelligence of these AIs (knowledge or learning). These words were used like *"natural dialogue," "artificially generated text and images," or "learned text and audio,"* so it appeared that the participants already have a lot of experiences of using these AIs. It can be said that the answers for the agents "generative AI" and "conversational AI" clearly reflected that these AIs are also perceived as important tools in our daily lives as well as the agents "smartphone" and "laptop PC." Therefore, these four agents are placed in almost same location in Figure 2 and constitute as the same group.

Around the agent "cleaner robot," we confirmed that the words about the concrete function of cleaner robot (tool or cleaning), while around the agent "humanoid," we confirmed that the words about appearance of robots (appearance or figure) and ones about function of robots (integration or function) similarly observed around the agent "robot" in Investigation 1. Specific answers for cleaner robot were like *"cleaning functions" or "a tool for cleaning"* while the ones for humanoid were like *"existence of a humanoid," "its constituent components," or "data and functions acquired through learning."* Here, the agent "cleaner robot" was concretely perceived just as a tool for cleaning, while the agent "humanoid" was perceived as similar with the agent "robot" in Investigation 1. These two agents can be categorized as the same agent "robot," but the placed position in Figure 2 was completely different. Moreover, the agent "humanoid" was placed around the center or gravity of the triangle and keep certain distances from the other six agents, so this "humanoid" was perceived as still quite ambiguous and broad concept, and neither "human being" nor "cleaner robot" as useful tool nor "smartphone/laptop PC/generative AI/conversational AI" as indispensable tool for users.

Discussion

In this study, we conducted two investigations to capture how people perceive the agents introduced into Paul A. Weiss's thought experiment, especially, how they perceived the AI system or the robots that are relatively new technology for us. At the beginning of this paper, we set the following two research questions for each investigation.

- **RQ1**: In case of introducing the four agents "computer," "robot," "human being" and "AI system" into Paul A. Weiss thought experiment, how do people perceive these agents, especially "robot" and "AI system" that are relatively new technology for us (Investigation 1).
- **RQ2**: In case of introducing much more concrete agents compared to Investigation 1 (e.g., "computer" is replaced into "smartphone" and "laptop PC"), how do people perceive these agents, especially "robot" and "AI system"(Investigation 2).

As a result of the Investigations 1 and 2, we could answer to the above two RQs.

- **Answer to RQ1**: The participants perceived the agent "AI system" was different compared to the other three agents and as statical intelligent agent utilizing the data and knowledge accumulated from the past. While they perceived the agent "robot" was different from "AI system" or "human being" and as dynamical agent acquiring the data and knowledge by learning and experiences on its own (Investigation 1).
- **Answer to RQ2**: The participants perceived the agents "smartphone," "laptop PC," "generative AI" and "conversational AI" as indispensable tool in our dairy lives, and the agent "cleaner robot" as a tool for cleaning. While they perceived the agent "humanoid" still quite ambiguous and broad concept, and neither human being nor "cleaner robot" as useful tool nor "smartphone/laptop PC/generative AI/conversational AI" as indispensable tool for users. (Investigation 2).

The only difference between Investigations 1 and 2 was just whether the name of the artificial agents were ambiguous (e.g., computer) or concrete (e.g., laptop PC). Even with this minimal manipulation, we could confirm that the participants' perceptions of AI systems and robots differed substantially between these investigations.

In case of perception of AI system, in Investigation 1 using the name "AI system," the word "learning" was not used in the participants' answers while the word "past" was characteristically used. The AI system was then perceived as statical intelligent agent utilizing the data and knowledge accumulated from the past, and the agent "AI system" was placed in different position with the agent "computer" that the word "learning" was frequently used in the participants' answers (Figure 1). On the other hand in investigation 2 using the name "generative AI" and "conversational AI," because the word "learning" was frequently used in their answers, these agents were placed in similar position with the agents "smartphone" and "laptop PC" (Figure 2). As a reason of this phenomenon, we considered that the participants had appropriate knowledge about "generative AI" or "conversational AI" but insufficient one about "AI system." In particular in Investigation 2, we added the representative application names of generative and conversational AIs, such as ChatGPT or Apple's Siri, and it was assumed that the most participants already had enough knowledge and experiences that these AIs do actually learning. On the other hand, the name "AI system" was so ambiguous and abstract that it would be difficult for most participants to form a mental image of what kind of system it was and how it would behave. Consequently, their answers were likely based on stereotypes acquired from commonly encountered phrases such as "AI does..." in social media articles and posts. In other words, we considered that the presence or absence of appropriate knowledge acquired through concrete experiences with the agent may have led to the different ways of perceptions of agents.

In case of perception of robots, "the presence or absence of appropriate knowledge about agent" can also explain why the participants perceived the agents "cleaner robot" and "humanoid" differently in Investigation 2. About the agent "cleaner robot," the words "cleaning" and "tool" were frequently used in the participants' answers, so it was assumed that they already had appropriate knowledge about the cleaner robot and this was clearly and concretely perceived as a tool of cleaning. On the other hand, about the agent "humanoid," the words about appearances of robot (appearance or figure) or ones about abstracted functions (integration or intellect) were used in their answers, so it seemed that the participants did not concretely understand what kind of robot it was and how it would behave. Therefore, we considered that they perceived the agent "humanoid" still quite ambiguous and broad concept, and neither human being nor "cleaner robot" as useful tool nor "smartphone/laptop PC/generative AI/conversational AI" as indispensable tool for users.

Based on the results of Investigation 2, the agents "generative AI" and "conversational AI" were perceived as indispensable tools for our daily lives as well as the agents "smartphone" and " laptop PC," and the agent "cleaner robot" was also perceived as useful cleaning tool. We considered that this is because the participants already had appropriate knowledge about these agents. On the other hand, the agent "humanoid" was perceived as ambiguous ones, and we considered that this is because they did not have appropriate knowledge about the humanoid and it would be difficult for them to form a mental image of what kind of system it was and how it would behave. Here, if this ambiguous perception of the agent is stemming from the fact that it has not yet become widespread in everyday life, the results of Investigation 2 can be interpreted as reflecting the current situation in which generative and conversational AIs are more widespread in our daily lives than humanoids.

Throughout Investigations 1 and 2, the agents "computer." "smartphone" and "laptop PC" were placed in almost same position in the Figures 1 and 2. This clearly showed that these three agents have been already widespread stable and deeply in our daily lives. On the contrary, the position of the agents of AI systems and robots were unstable throughout two investigations, so this might reflect that these agents are still on the ways of widespread. Thus, the introducing the agents into Paul A. Weiss thought experiment is an effective methodology to comprehend the users' current perception of these agents.

Conclusions

We conducted two investigations to capture how people perceive the agents introduced into Paul A. Weiss's thought experiment, especially, how they perceived the AI system or the robots that are relatively new technology for us.

As a result of Investigation 1 introducing four agents (human being, computer, robot and AI system), the participants perceived the agent "AI system" was different compared to the other three agents and as statical intelligent agent utilizing the data and knowledge accumulated from the past. While they perceived the agent "robot" was different from "AI system" or "human being" and as dynamical agent acquiring the data and knowledge by learning and experiences on its own.

And as a results of Investigation 2 introducing seven agents that were more concrete ones compared to Investigation 1, the participants perceived the agents "smartphone," "laptop PC," "generative AI" and "conversational AI" as indispensable tool in our dairy lives, and the agent "cleaner robot" as a tool for cleaning. While they perceived the agent "humanoid" still quite ambiguous and broad concept, and neither human being nor "cleaner robot" as useful tool nor "smartphone/laptop PC/generative AI/conversational AI" as indispensable tool for users.

From these two investigations, we considered that the presence or absence of appropriate knowledge acquired through concrete experiences with the agents may have led to the different ways of perceptions of agents. Specifically, it assumed that most participants alread had appropriate knowledge about ChatGPT or Siri, so the agents "generative AI" and "conversational AI" were perceived as indispensable tools for our daily live as well as "smartphone" and "laptop PC" while they did not have appropriate knowledge about "AI system" and it would be difficult for them to form a mental image of what kind of system it was and how it would behave, so the agent "AI system" was not perceived as the same ways for "generative AI" and "conversational AI." This can explain about the perception of robots why the agent "cleaner robot" was perceived as a useful tool while the agents "humanoid" was perceived as ambiguous entities. Thus, the introducing the agents into Paul A. Weiss thought experiment is an effective methodology to comprehend the users' current perception of these agents.

However, there are still issues that must be carefully examined with this research approach. Specifically, because the participants are asked to answer to presented scenarios by verbalizing their judgments, it could be argued that the proposed method does not truly capture participants' perceptions of agents in an implicit manner. To address this issue, we believe it is essential first to combine this method with explicit measurement approaches such as the implicit association test, questionnaire-based surveys, and semi-structured interviews in order to clarify what kinds of information can be extracted by each approach in a given investigation.

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