

Table 1—Description of each type of information about insect contamination used in this study.

Information type	Description
Type of insect	<i>What is insect contamination.</i> Insects are one of the most common substances contaminating foods. This includes various insects that stray into foodstuffs during manufacturing and storage processes as well as insects that are propagated by feeding on the food. <i>Major insects that contaminate food.</i> The Indian meal moth (<i>Plodia interpunctella</i>) is one of the most commonly reported pests of stored foodstuffs. The Indian meal moth is a moth of the family Pyralidae and is found almost throughout the world. This insect ranges from a few to 10 mm in length.
Contamination processes of insects	<i>Habitat.</i> Insect pests like the Indian meal moth live not only in material storage facilities and manufacturers of foodstuffs, but also in retail facilities and homes. <i>Contamination process.</i> Insect contamination in food can occur at all stages of the food's life cycle including material storage, manufacturing processes, transport, product storage, retailing, and storage in homes. For example, the larvae sometimes pass through the tiny holes of packaging materials, and sometimes reach foods by tearing packing bags. <i>Common insect contamination foods.</i> Whereas foods of potential contamination by insects are various, it is frequently reported that grain and confectioneries are strewn with insect pests.
Safety of contaminated food	<i>Safety.</i> Most insect parts found in food are not harmful. For example, there are insect-eating customs in Japan such as ricefield locusts and wasp larvae simmered in soy sauce. There is little difference in harmful potential between these edible insects and insects that contaminate foods. Thus, there is no need to regard insect-contaminated foods as dangerous. <i>Criteria of safety for the contaminated food.</i> According to the defect action level defined by the U.S. Food and Drug Administration (FDA), the allowable range for natural contamination is, for instance, 32 insect-damaged grains per 100 g of wheat. There have been few cases in which the FDA has required manufacturers to recall foods with natural contamination. There is no legal provision for the allowable range for natural contamination in Japan. <i>Measures for preventing insect contamination at home.</i> It may be effective to store foodstuffs in airtight containers in the refrigerator when you store grain and grain-based products at home.

contamination is large, the residual rate will decrease. Conversely, if there is no decrease in the WTP value due to insect contamination, the residual rate will be equal to 1.0. We conducted a two-way ANOVA for the residual rate of the WTP with the information type and gender as between-participant factors. When significant effects were detected, post hoc multiple comparisons of means were performed using Tukey's honestly significance difference (HSD) test.

We conducted 8 (information type) \times 3 (behavioral intention) chi-square tests by gender to determine whether information type was related to respondents' behavioral intentions toward the contaminated food and the manufacturer, respectively. When significant effects were detected, residual analyses (Haberman 1974) were performed.

All statistical analyses were carried out using Microsoft Excel 2010 for Windows 7 (Microsoft, Redmond, Wash., U.S.A.).

Results

The mean scores and standard deviations (SD) for the 1st and 2nd WTPs, the behavioral intention toward insect-contaminated food, and the attitude toward the manufacturer of the food are presented in Table 2.

The residual rate of WTP value by insect contamination

We found that the main effect of the information type on the residual rate of the WTP was significant ($F(7, 305) = 3.16$, $P < 0.01$, $\eta_p^2 = 0.068$). Post hoc analysis revealed that the residual rates of the WTP for SF, TI/SF, CP/SF, and AI conditions were higher than those for the TI condition ($P < 0.05$). We did not find any significant difference in the residual rate among gender or any interaction among factors.

Consumers' behavioral intentions toward the contaminated food

We found a significant relationship between the information type and behavioral intention in male participants ($\chi^2(14) = 29.9$, $P < 0.01$), but not in female participants. The residual analyses

revealed that the number of choices of "I will not eat the product at all" increased in the TI condition and decreased in the CP/SF condition ($P < 0.01$ and $P < 0.05$, respectively). The number of choices of "I will eat the part of the product without contaminated areas" also decreased in the TI condition ($P < 0.05$).

Consumer attitudes toward the manufacturer of the food

We found a significant relationship between the information type and attitudes toward the manufacturer of the food in male participants ($\chi^2(21) = 36.9$, $P < 0.05$), but not in female participants. The residual analyses revealed that the number of choices of "I think that the manufacturer should suspend operations" increased in the TI condition ($P < 0.01$). The number of choices of "I think that the manufacturer should recall all products made on the same production line as the contaminated product" decreased in the TI/SF and CP/SF conditions ($P < 0.05$).

Discussion

Results demonstrated that the information type affects consumer valuations of, behavioral intentions toward, and attitudes toward the contaminated food.

One may question whether participants assigned appropriate values to the hypothesized food product (5 kg package of polished rice made in Akita, Japan) in the current experimental condition. The actual retail prices of similar products range from 1500 to 2500 yen. The average scores of the 1st WTP task for the hypothetical product (the mean WTP across conditions was 2062 yen) seemed to be within reasonable bounds (see Table 2).

The results of the 1st and 2nd WTP tasks demonstrated that the residual rates of the WTP value due to insect contamination were higher for the information types that included information about the safety of the contaminated food, the SF, TI/SF, CP/SF, and AI conditions, than in the TI condition. The residual rates of value in the information-type conditions with safety information ranged from 44% to 54%, whereas those in the conditions without safety information ranged from 19% to 34%. These results suggest that communication about the safety of the contaminated food had a positive impact among Japanese consumers. Miles and Frewer

Table 2—Mean and SD of the 1st and 2nd WTP, behavioral intention, and attitude of consumers for each condition.

	Information type							
	TI	CP	SF	TI/CP	TI/SF	CP/SF	AI	NI
Female participants								
First WTP (SD)	2049.0 (594.7)	1974.0 (646.4)	2158.0 (579.2)	2026.0 (557.7)	2069.0 (760.4)	2034.0 (817.2)	2068.5 (646.2)	1947.5 (503.1)
Second WTP (SD)	439.0 (719.5)	480.0 (486.4)	874.0 (773.1)	489.0 (666.6)	970.0 (860.3)	943.0 (750.4)	815.0 (635.2)	599.5 (599.8)
Behavioral intention toward the contaminated food (frequency)								
<i>I will not eat the product at all.</i>	12	11	9	13	8	7	7	11
<i>I will eat the part of the product without contaminated areas.</i>	7	9	10	6	11	11	13	9
<i>I will eat the entire product.</i>	1	0	1	1	1	2	0	0
Attitudes toward the manufacturer of the food (frequency)								
<i>I think that the manufacturer should suspend operations.</i>	2	0	3	1	0	1	1	1
<i>I think that the manufacturer should recall all products made on the same production line as the contaminated product.</i>	8	11	7	14	6	9	9	11
<i>I think that the manufacturer should recall only the products that were actually contaminated by insects.</i>	8	8	9	4	11	7	5	6
<i>I think that the manufacturer does not need to take any action for this accident.</i>	2	1	1	1	3	3	5	2
Male participants								
First WTP (SD)	1969.0 (761.8)	2268.0 (852.8)	2060.5 (560.4)	2120.0 (716.7)	2367.0 (665.6)	1804.0 (475.5)	1872.0 (803.9)	2037.0 (685.5)
Second WTP (SD)	339.0 (513.9)	789.1 (866.8)	1014.0 (918.8)	736.9 (736.9)	1209.0 (963.0)	885.5 (735.1)	800.0 (795.0)	796.0 (490.9)
Behavioral intention toward the contaminated food (frequency)								
<i>I will not eat the product at all.</i>	15	7	8	6	6	6	7	10
<i>I will eat the part of the product without contaminated areas.</i>	5	11	12	11	13	12	10	10
<i>I will eat the entire product.</i>	0	2	0	3	1	2	3	0
Attitudes toward the manufacturer of the food (frequency)								
<i>I think that the manufacturer should suspend operations.</i>	8	1	0	1	2	2	4	0
<i>I think that the manufacturer should recall all products made on the same production line as the contaminated product.</i>	7	9	9	7	5	3	6	12
<i>I think that the manufacturer should recall only the products that were actually contaminated by insects.</i>	4	6	8	9	6	11	7	6
<i>I think that the manufacturer does not need to take any action for this accident.</i>	1	4	3	3	7	4	3	2

Abbreviations: TI, type of insects; CP, contamination processes of insects; SF, safety of contaminated food; AI, all information, and NI, no information.

(2001) examined characteristics and concerns associated with 5 specific food hazards (for example, BSE and pesticide residues in food). They found that health was a common concern across types of hazards, whereas most other concerns were unique to specific food hazards.

Results for behavioral intention toward the contaminated food also showed that the responses of a flat refusal of the contaminated food ("I will not eat the product at all") decreased in male participants of the CP/SF condition. Furthermore, results for consumer attitudes toward the manufacturer of the food demonstrated that the responses of a radical attitude toward the manufacturer ("I think that the manufacturer should suspend operations" and "I think that the manufacturer should recall all products made on the same production line as the contaminated product") decreased in male participants of the TI/SF and CP/SF conditions. These results suggest that combinations of 2 types of scientific information about foods with insect contamination, one of which includes safety information, might most effectively meet the needs of male consumers, whereas they are ineffective for female consumers.

On the other hand, respondents in the TI condition displayed explicit rejection of both the contaminated product and the manufacturer. These results suggest that any benefit produced by the communication of scientific information could be lost depending on the type of information communicated. The present results indicate that food risk managers should inform the public about the safety of the food when communicating scientific information related to insect contamination.

Furthermore, the results of behavioral intentions toward contaminated food and the manufacturer also demonstrate that there are gender differences in the effectiveness of scientific information about insect contamination in food. In particular, male participants reported more generous attitudes toward contaminated food and the manufacturer than did females when they were exposed to the combinations of 2 types of scientific information about foods with insect contamination, including safety information. One possible reason for this is differences in the disgust sensitivity (DS) between genders (Davey 1994). The DS is how prone an individual is to disgust (Haidt and others 1994) and previous studies consistently indicate a higher level of DS among females compared to males (Davey 1994; Druschel and Sherman 1999; Arrindell 2000; Olatunji and others 2005a, b; Connolly and others 2008). Several studies on psychological disorders have shown a positive relationship between DS and specific phobias including animals, spiders, and contamination fears (Davey 1994; Olatunji and others 2005b; Connolly and others 2008). These findings led us to speculate that there is a possibility that females, who are expected to have relatively higher levels of DS than males, may tend to overestimate the effect of insect contamination on food safety. Further research should obtain a measure of respondents' DS in order to clarify the basis for gender differences in behavioral intentions.

One limitation of the current study is the sample profile: food products were evaluated by Japanese consumers. It is worthwhile to conduct further cross-cultural comparisons because consumer demands for information about food risk may vary cross-culturally

(van Dijk and others 2008). Another limitation of the present study is that the impact of information about insect contamination in food on consumer valuation was examined only for rice. While rice is the major and preferred staple food in Japan (for example, Komatsu 2008; Kimura and others 2010b), further studies that involve various foods, such as vegetables and processed foods, are required to generalize the present findings.

Conclusion

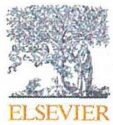
The current study provides the 1st behavioral evidence that the type of scientific information about insect contamination in food affects consumer valuation and attitudes toward that food. The present findings suggest that some combinations of scientific information that include the safety of the contaminated food are effective in reducing the compulsive rejection of insect contamination in food by consumers, especially in men. These findings could serve as an important step toward understanding consumer cognition toward food safety, health, and quality despite some limitations, as mentioned above. The present findings also have implications for the coordination of risk communication strategies, which consider both the effectiveness and limitations of specific types of scientific information about food in relation to consumer cognitive traits. Further research is necessary in order to ascertain communication strategies that will encourage consumers to rationally evaluate food safety.

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References

- Arrindell WA. 2000. Phobic dimensions IV: The structure of animal fears. *Behav Res Ther* 38:509–30.
- Brown SD, Harris G. 2012. Disliked food acting as a contaminant during infancy: A disgust based motivation for rejection. *Appetite* 58:535–8.
- Cannolly KM, Olatunji BO, Lohr JM. 2008. Evidence for disgust sensitivity mediating the sex differences found in blood-injection-injury phobia and spider phobia. *Pers Indiv Differ* 44:898–908.
- Davay GCJ. 1994. Self-reported fears to common indigenous animals in an adult UK population: the role of disgust sensitivity. *Brit J Psychol* 85:541–54.
- Druschel BA, Sherman MF. 1999. Disgust sensitivity as a function of the Big Five and gender. *Pers Indiv Differ* 26:739–48.
- Fallon AE, Razin P, Pliner P. 1984. The child's conception of food: the development of food rejections with special reference to disgust and contamination sensitivity. *Child Dev* 55:566–75.
- Food and Drug Administration (FDA). 1998. Defect levels handbook. The food defect action levels: levels of natural or unavoidable defects in foods that present no health hazards for humans. Washington, DC: U.S. Food and Drug Administration.
- Greenwald AG, McGhee DL, Schwartz JI K. 1998. Measuring individual differences in implicit cognition: the implicit association test. *J Pers Soc Psychol* 74:1464–80.
- Haidt J, McCauley C, Reiss P. 1994. Individual differences in sensitivity to disgust: a scale sampling seven domains of disgust elicitors. *Pers Indiv Differ* 16:701–13.
- Haberman SJ. 1974. The analysis of frequency data. Chicago: Chicago University Press.
- Kimura A, Wada Y, Kamada A, Maeda T, Okamoto M, Goto S, Tsuchi D, Cai D, Oka T, Dan I. 2010a. Interactive effects of carbon footprint information and its accessibility on value and subjective qualities of food products. *Appetite* 55:271–8.
- Kimura A, Wada Y, Okamoto M, Yamaguchi Y, Tsuchi D, Oka T, Dan I. 2010b. Eating habits in childhood relate to preference for traditional diets among young Japanese. *Food Qual Prefer* 21:843–8.
- Kimura A, Wada Y, Tsuchi D, Goto S, Cai D, Dan I. 2008. Consumer valuation of packaged foods: interactive effects of amount and accessibility of information. *Appetite* 51:628–34.
- Komatsu S. 2008. Rice and sushi cravings: a preliminary study of food craving among Japanese females. *Appetite* 50:352–8.
- Martins Y, Pliner P. 2006. "Ugh! That's disgusting!": identification of the characteristics of foods underlying rejections based on disgust. *Appetite* 46:75–85.
- Miles S, Brewer LJ. 2001. Investigating specific concerns about different food hazards. *Food Qual Prefer* 12:47–61.
- National Consumer Affairs Center of Japan. 2000. Food contamination. Available from: <http://www.kakaku.go.jp/pdf/0-2000/125.pdf>. Accessed 2012 April 5. [In Japanese].
- Ohno M, Hatanaka K, Koyoshima M, Kimura K, Nagachi K. 2009. Insects and other macroinvertebrates as foreign substances in foods. *Annu Rep Tokyo Metropolitan Inst Public Health* 60:227–34. [In Japanese with English abstract].
- Olatunji BO, Arrindell WA, Lohr JM. 2005a. Can the sex differences in disgust sensitivity account for the sex differences in blood-injection-injury fears? *Pers Indiv Differ* 39:61–71.
- Olatunji BO, Sawchuk CN, Arrindell WA, Lohr JM. 2005b. Disgust sensitivity as a mediator of the sex differences in contamination fears. *Pers Indiv Differ* 38:713–22.
- Sinaceur M, Heath C, Cole S. 2008. Unrational and deliberate reactions to a public crisis. *Psychol Sci* 16:247–54.
- Van Dijk H, Houghton J, Van Kleef E, Van der Lans I, Rowe G, Brewer L. 2008. Consumer responses to communication about food risk management. *Appetite* 50:340–52.



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Clerk agent promotes consumers' ethical purchase intention in unmanned purchase environment



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ABSTRACT

This study examined the effect of the presence of an artificial individual in a purchase environment on purchase intention for products with fair-trade labels among Japanese consumers. By manipulating the presence of an artificial individual, we assessed consumers' intentions to purchase fair-trade products under two different experimental unmanned purchase environments: the agent condition, in which task instructions were given by a female clerk-like computer graphic agent throughout the task ($N = 118$), and the control condition in which task instructions were given through a text box ($N = 106$). Results demonstrated that participants under the agent condition valued fair trade higher than those under the control condition, although participants in both the agent and the control conditions were instructed that their responses would remain anonymous. These findings suggest that the implication of the presence of an artificial individual, such as a clerk-like agent in an unmanned purchase environment, enhances the ethicality of purchase intentions as with manned purchase environments.

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1. Introduction

With developments in information and communication technology (ICT), unmanned purchase environments such as online shops have become popularized. They provide consumers with a new medium to purchase products and services, and have increased the importance of understanding consumer behaviors while shopping online (Liao, Chen, & Lin, 2011). A major difference between online and real shops from the social psychological perspective may be the presence of other people (Tennie, Frith, & Frith, 2010). In contrast to manned purchase environments, it is less probable that consumer choices are observed by others, including other consumers and sales staff, in unmanned purchase environments.

It is well known in social psychology and socioeconomics that cues from others and potential reputational consequences influence altruistic and generous behaviors (Hoffman, McCabe, & Smith, 1996; Kimura et al., 2012; Piazza & Bering, 2008a,b). For example, Hoffman et al. (1996) demonstrated that the participants playing a dictator game in the role of dictator were more selfish when they

were socially isolated from both the experimenter and their counterparts. Piazza and Bering (2008a) also found that threats of gossip by others encouraged altruistic decision making in a dictator game. Recently, Kimura et al. (2012) demonstrated that the effects of cues from others could also apply to a consumer's intention to purchase food products with ethical labels. They assessed consumers' intentions to purchase fair-trade food products under two different conditions: the observable condition, in which participants' purchase behaviors were observable by others, and the anonymous condition, in which participants' purchasing behaviors could not be observed by others. The effect of six sensory and extrinsic, including fair trade, attributes of hypothetical chocolate bars was examined using conjoint analysis. Kimura et al. (2012) found that participants under the observable condition valued fair trade higher than those under the anonymous condition. These results suggest that reputational concern has an effect on a consumer's intention to purchase a fair-trade-labeled food and also suggest that there is a possibility that a consumer product choice based on altruistic attributes, such as fair trade, is less likely in unmanned purchase environments than in manned ones.

On the other hands, several studies on human-computer interface have suggested that altruistic behaviors could be enhanced not only by potential reputational consequences from real humans,

but also by artificial cues suggesting the presence of others (Bateson, Nettle, & Roberts, 2006; Haley & Fessler, 2005; Izuma, 2012; Mifune, Hashimoto, & Yamagishi, 2010; Rigdon, Ishii, Watabe, & Kitayama, 2009). Haley and Fessler (2005) showed that merely including a stylized eye-like shape on the background of a computer screen was sufficient to enhance cooperation in the dictator game. Even when participants are explicitly made aware of the anonymous nature of their decisions, they may respond to environmental cues of being watched that prime participants to behave differently than they otherwise would. Similarly, Rigdon et al. (2009) demonstrated that even a weak social cue like three dots in a watching-eyes configuration has a positive effect on giving behavior in the dictator game. These findings led us to postulate that artificial cues suggesting the presence of others might enhance a consumer's product choice based on its altruistic attributes such as fair trade.

However, it is still unknown whether the presence of an explicit artificial individual causes a similar effect on consumer behavior. Teramoto, Matsuura, and Asai (2012) used the Simon paradigm to suggest that participants feel a sense of being together even in a virtual environment. In this paradigm, one participant presses a key in response to one color and the other participant presses another key in response to a second color. Despite the fact that each participant is performing a go/no-go task, an effect similar to a standard Simon effect occurs if they feel a sense of togetherness. Teramoto et al. (2012) showed that the social Simon effect occurred under the condition where participants could communicate with each other during a 3-min interaction in the virtual environment. Thus, we can assume that the presence of an explicit artificial individual might change consumer response in the same way that virtual communication can generate a sense of togetherness.

Here, we examine the influence of the presence of an artificial individual on purchase intention for fair-trade food products among Japanese young adults. To manipulate the presence of an artificial individual, we asked participants to rate their purchase intent for a presented fair-trade food product in two different situations: one was the agent condition, in which task instructions were given by a clerk-like agent throughout the task, and the other was a control condition, in which task instructions were given through a text box. We used a clerk-like agent as the artificial individual in this study because it seemed more natural for a purchase environment than the eye-like figures used in previous studies of experimental games (Haley & Fessler, 2005; Mifune et al., 2010; Rigdon et al., 2009). We assessed consumers' intentions to purchase fair-trade food using conjoint analysis as performed in Kimura et al. (2012). Conjoint analysis provides a model of consumer utilities for various attributes of multifactor stimuli. The model is built by quantifying respondents' preferences for a set of factorially designed alternatives (Green, 1974). We hypothesized that the relative importance of fair trade among the attributes of food products would be higher in the agent condition than in the control condition.

2. Method

2.1. Design

The experiment was based on a two-independent-groups design (artificial cues from another person: agent vs. control conditions) with consumers' preferences toward eight hypothetical chocolate products as the dependent variable.

2.2. Participants

Data collection was administered by an on-line professional market research agency, Cross Marketing Inc., Japan. Data were

Table 1
Attributes and their levels chosen for conjoint study: chocolate.

Attribute	Attribute level
Fair-trade	Yes: with a fair-trade label No
Price ^a	Low: 150 yen High: 200 yen
The country of manufacturer of the product	Domestic (made in Japan) Imported from France
Taste characteristics	Milk chocolate Dark chocolate
Polyphenol	Rich in polyphenol No information
Caloric contents per pack (100 g)	Low: 390 kcal High: 557 kcal

^a 100 yen roughly corresponded to \$1.13 US or €0.85 according to the foreign currency exchange rate as of January, 2013.

collected in November 2011, among a registrant pool of Japanese consumers with responsibility for their household's daily grocery shopping. The registrants were sent an e-mail invitation, which asked them to participate in a survey on purchasing foods. A total of 118 participants (49.2% females, mean age = 21.6 years, $SD = 2.09$) were assigned in the agent condition and 106 participants (50.0% females, mean age = 21.4 years, $SD = 2.00$) were assigned in the control condition, respectively. Following their participation in the web-based survey, participants received a small reward from the research agency in the form of points that participants can save up for a gift coupon. The study was approved by the institutional ethics committee of Tokyo Denki University.

2.3. Materials and apparatus

We used a chocolate bar as the target product as with Kimura et al. (2012) because it is a major fair-trade product that is sold in Japanese supermarkets, and is a popular and well-consumed snack in Japan. Kimura et al. (2012) selected six product attributes: fair trade, price, country of manufacture, taste characteristics, polyphenol content and caloric content. Similarly, the product attributes for our study were presented as follows: fair trade was labeled as "fair-trade" or not labeled; price, which fell within the price range of actual commercial products, was set at 150 yen or 200 yen (100 yen roughly corresponded to \$1.13 US or €0.85 euro according to the foreign currency exchange rate as of January, 2013); country of manufacture, which reflected that of major commercial products currently available, was set as "domestic" or "imported from France"; taste characteristics were "milk chocolate" or "dark chocolate"; polyphenol levels were labeled as "rich in polyphenol" or not labeled; and caloric content per pack (100 g) was "390 kcal" or "557 kcal." These scores were determined referring to the Standard Tables of Food Composition in Japan (Ministry of Health, Labour and Welfare Japan, 2005). Table 1 contains a full list of the attributes and their levels used to devise the chocolate profiles. This conjoint design was input into the SPSS conjoint analysis package ver. 17.0 (SPSS Inc., Chicago, IL 60611, USA) to create conjoint cards, each of which contained a verbal description of a product in terms of its attributes and their respective levels with schematic illustrations of the corresponding product. Each product was described in terms of six attributes, each containing two levels. Thus, there were theoretically 64 possible attribute combinations. A fractional factorial design was applied, resulting in eight cards for participant evaluation. Fig. 1 exhibits the scheme design for the stimulus cards. All eight stimulus cards were presented simultaneously on the full screen of a color monitor, with a resolution of 800 × 600 pixels.

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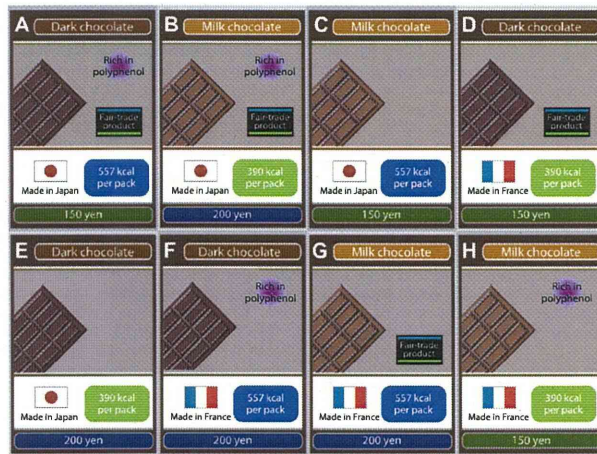


Fig. 1. Examples of eight labels used in this study (Kimura et al., 2012).

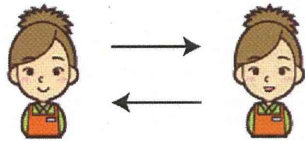


Fig. 2. Scheme design of the female clerk agent used in this study. The mouth of the agent displayed was opened and closed to simulate speaking by presenting the two images alternately.

The illustration of a female clerk extracted from a copyright-free-illustration site¹ was used as the image of the clerk agent in the present study (Fig. 2, left). We also made an illustration of the same agent with her mouth open (Fig. 2, right). By presenting the two images alternately seven times for each paragraph of instructions, we produced a GIF (graphics interchange format) animation of the clerk agent in which she opened and closed her mouth by so as to appear to be speaking (Fig. 2, see also Fig. 3). We used this animation to enhance the attention of participants towards the agent and the authenticity of the interaction between the participants and the agent.

2.4. Procedure

Participants clicked a link, sent to them by email, which took them to a welcome web page that provided a description of the study and instructions. They were instructed that their responses to the survey were being collected anonymously. All participants were then instructed on the general task procedure and on each attribute of the chocolate products used in the conjoint session. Fair trade in this product was defined as "trading cacao and other ingredients based on a fair price in international trades. Buying

fair-trade products contributes to the promotion of the wellbeing of producers in developing countries and to environmental preservation." The computer-based questionnaire comprised 2 parts: part 1 was for the conjoint analysis and part 2 was a general questionnaire pertaining to participants' food purchasing habits and demographics. In the conjoint analysis session, participants were asked to rate the 8 profile cards (Fig. 1) using a ranking method in the manner of choice-based conjoint analysis. They were given the 8 profile cards simultaneously and ordered them from the highest (assigned a ranking of 1) to the lowest (ranking of 8) intention to buy.

After completing the conjoint analysis session, participants were asked to complete a computer-based questionnaire pertaining to their purchase and consumption of foods. Furthermore, participants in the agent condition were asked to rate the explicit effects of displaying a clerk agent on their product choice using a 5-point scale (−2: not at all to +2: very). Demographic information was collected in the final section of the questionnaire.

In the agent condition, instructions for the general task procedure, each attribute of the chocolate products and instructions for the conjoint task were provided by a clerk agent (Fig. 3, left). In the control condition, all instructions throughout the entire experimental session were given through a square text box (Fig. 3, right).

2.5. Data analyses

A fractional-factorial design was used to evaluate the sequence of consumers' preference ratings of the eight hypothetical chocolate products where the six chocolate-related attributes were orthogonally arranged (Tabachnik & Fidell, 2007). Interaction effects among the attributes were assumed to be negligible (Orme, 2010). The significances of the utility scores of the attributes were examined using one-sample *t*-tests against zero for each condition. The resulting *p*-values from *t*-tests were thresholded using the Sidak-Bonferroni procedure (number of tests = 6).

To test whether the utility scores for the attributes were different between the agent and control conditions, we performed

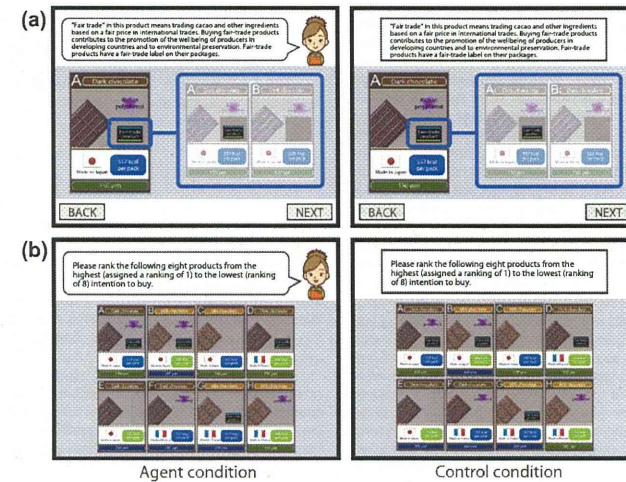


Fig. 3. Scheme design of the task screen for the agent and control conditions; (a) an example of the explanation of each attribute of the chocolate products and (b) instructions for the conjoint task.

unpaired *t*-tests with cues from another person as a between-subject factor on the utility scores for each attribute. The resulting *p*-values from *t*-tests were thresholded using the Sidak-Bonferroni procedure (number of tests = 6).

Furthermore, in order to examine the significances of the explicit effects of the clerk-agent on consumers' purchase intention, we performed one-sample *t*-tests against zero on the scores of explicit effects in the agent condition.

3. Results

3.1. Conjoint analyses

Pearson's *R* and Kendall's *T*, the utility scores (part-worth) for each attribute's category, and the relative importance for the conjoint analysis with each condition are shown in Table 2. The conjoint models of the agent and control conditions were adequate based on their respective effect sizes (Pearson's *R* and Kendall's *T*), implying that the chocolate attributes properly accounted for the preference ratings of the eight chocolate products.

In the agent condition, the utility scores were significantly different from zero for the attributes of fair trade ($t(117) = 9.76, p < .01$), price ($t(117) = 8.68, p < .01$), country of manufacture ($t(117) = 9.76, p < .01$), polyphenol ($t(117) = 9.76, p < .01$) and caloric content ($t(117) = 9.76, p < .01$), based on one-sample *t*-tests with Sidak-Bonferroni corrections. On the other hand, the taste characteristic attribute was not associated with consumers' purchase intentions in the agent condition ($t(117) = 0.48, n.s.$).

In the control condition, the utility scores were significantly different from zero for the attributes of fair trade ($t(105) = 3.67, p < .01$), price ($t(105) = 7.56, p < .01$), country of manufacture ($t(105) = 6.85, p < .01$), polyphenol ($t(105) = 3.11, p < .01$) and caloric content ($t(105) = 3.43, p < .01$), based on one-sample *t*-tests with Sidak-Bonferroni corrections. On the other hand, the taste charac-

Table 2
Utility scores and relative importance of each chocolate attribute in agent and control conditions.

Attributes & levels	Artificial individual	
	Agent condition (n = 118)	Control condition (n = 106)
Fair-trade		
Yes	0.633 ^a	0.285 ^a
No	−0.633 ^a	−0.285 ^a
Relative importance (%)	17.9%	14.5%
Price		
Low	0.619 ^a	0.637 ^a
High	−0.619 ^a	−0.637 ^a
Relative importance (%)	18.9%	19.9%
The country of manufacturer		
Domestic	0.373 ^a	0.512 ^a
Imported from France	−0.373 ^a	−0.512 ^a
Relative importance (%)	18.0%	17.9%
Taste characteristics		
Milk chocolate	0.053	0.068
Dark chocolate	−0.053	−0.068
Relative importance (%)	23.3%	25.7%
Polyphenol		
Rich in polyphenol	0.282 ^a	0.179 ^a
No information	−0.282 ^a	−0.179 ^a
Relative importance (%)	10.7%	11.6%
Caloric contents per pack		
Low	0.284 ^a	0.200 ^a
High	−0.284 ^a	−0.200 ^a
Relative importance (%)	11.3%	10.4%
Pearson's <i>R</i>	0.994	0.945
Kendall's <i>T</i>	1.000	0.786

^a $p < 0.05$.

^a When compared to zero in a two-tailed *t*-test.

teristic attribute was not associated with consumers' purchase intentions in the control condition ($t(105) = 0.50, n.s.$).

¹ Free graphics Puchitchi, Website: <<http://puitchy.com/index.html>>. Visited November 2011 [in Japanese].

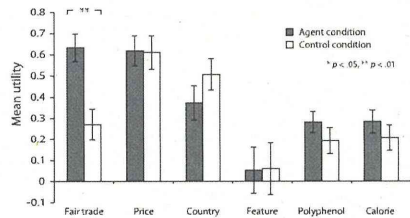


Fig. 4. Effects of the artificial individual on a factor's importance of chocolate purchasing intent. Error bars indicate standard error ($N=118$ for the agent condition, $N=106$ for the control condition).

3.2. Effects of the presence of an artificial individual on the estimated utility scores of attributes

Unpaired t -tests with cues from another person (agent vs. control conditions) as a between-subject factor on the utility scores for each attribute revealed significant effects of the artificial individual on the utility scores of fair trade ($t(222) = 3.70, p < .05$). The utility scores of fair trade were higher in the agent condition than in the control condition (Fig. 4).

3.3. Explicit effects of the clerk-agent on consumers' purchase intention

The mean score of the explicit effects of a clerk-like agent on participants' product choice in the agent condition was -1.3 ($SD = 0.92$). One sample t -test against zero revealed the scores of explicit effects to be significantly different from zero ($t(117) = 14.1, p < .01$).

4. Discussion

The objective of the current study was to examine whether the presence of an artificial individual would have an effect on consumers' purchase intentions for fair-trade food products. As predicted, the results of conjoint analysis demonstrated that participants in the agent condition valued fair trade more highly for their overall purchase intention than those in the control condition. Fair trade accounted for 17.9% of the respondents' purchase intents in the agent condition and 14.5% in the control condition (see Table 2).

4.1. Consumers' purchase decisions under anonymity

We would like to discuss the validity of the results of the control condition. In the control condition, the participants' purchase intentions were significantly affected by price, country of manufacture, fair trade, polyphenol content and caloric content per package. Based on the order of relative importance (RI), taste characteristics (RI = 25.7%), price (RI = 19.9%) and country of manufacture (RI = 17.9%) were most important for participants in the control condition, whereas RI of fair trade was 14.5% (see Table 2). These results are consistent with the anonymous condition in Kimura et al. (2012) in which experimental settings of observability and tasks were the same as the control condition in this study, and with previous studies which have found the importance of taste characteristic, price and country of manufacture in consumers' intentions to purchase food products (e.g., Haddad et al., 2007; Kimura et al., 2011; Prescott, Young, O'Neill, Yau, & Stevens, 2002; Schnettler, Ruiz, Sepúlveda, & Sepúlveda, 2008). Further-

more, the intentions to purchase of respondents in the control condition were significantly influenced by fair trade (Table 2). This tendency is also consistent with previous findings, which have demonstrated that consumers value fair-trade foods based on their general attitudes and ethical motives (De Ferran & Grunert, 2007; Dowd & Burke, 2013; Kimura et al., 2012; Kirezli, Kuscu, 2012; Zander & Hamm, 2010). Thus, the current results of the control condition are considered reasonable and imply that consumers value fair trade but not as much as taste characteristics, price, and country of origin in their intention to purchase chocolate, at least when their responses are recorded anonymously.

4.2. Effects of the presence of an artificial individual on intention to purchase fair-trade products

On the other hand, participants' purchase intentions in the agent condition were more highly affected by fair trade than those in the control condition. In the agent condition, RI of fair trade (17.9%) was as high as those of price (RI = 18.9%) and country of manufacture (18.0%; see Table 2). Un-paired t -tests with the effect of an artificial individual on the utility scores for each attribute demonstrate that the utility scores for fair trade were higher in the agent condition than those in the control condition whereas there were no differences in the utility scores for any other attributes between conditions. These results suggest that consumers valued fair-trade-labeled products more highly when their food choices were performed on the screen with the clerk-like agent. Previous studies showed that altruistic and pro-social behaviors were enhanced by artificial cues of the presence of other individuals, such as eye figures (e.g., Bateson et al., 2006; Haley & Fessler, 2005; Mifune et al., 2010; Rigdon et al., 2009). In line with those altruistic behaviors, in economic games, consumers' ethical consumption, such as purchasing fair-trade products, might be promoted when their decision is performed in front of a screen with subtle cues of being watched by others.

Interestingly, participants in the agent condition were not aware of the effects of the artificial individual on their pro-social decision. The results of one-sample t -tests against zero revealed that the mean scores for the explicit effects of an agent on one's own purchase intention (-1.3) were significantly lower than neutral (zero). These results suggest that participants in the agent condition believed that the display of a clerk-like agent had no effect on their decision-making. One possible explanation of why displaying a clerk-like agent has a positive impact on participants' pro-social purchase decisions, despite the fact that they were not aware of the effect, lies in the automatic process of reputation in the cognitive system (Izuma, 2012; Tennie et al., 2010). In particular, Izuma (2012) argued that the uniquely human link between eye figures and pro-social behavior might be derived from the evolutionary mechanism of indirect reciprocity (Alexander, 1987; Nowak & Sigmund, 1998, 2005). In the indirect reciprocity theory, helping behaviors toward others from which no payback can be expected are explained by the indirect reciprocity strategy in which the cooperative individual benefits in the long term through increased cooperation from others (Nowak & Sigmund, 1998, 2005; see also Tennie et al., 2010). This mechanism would facilitate cooperation in a larger population than in the case of direct reciprocity because unacquainted individuals could cooperate with each other (Masuda, 2012). Recently, there were evidences concerning the origins and ontogenesis of indirect reciprocity from research with infants (Hamlin, Wynn, Bloom & Mahajan, 2011; Meristo & Surian, 2013). For instance, Meristo and Surian (2013) found that 10-month-old infants were sensitive to the fact that the reciprocator was confirming or violating the principle of indirect reciprocity. The implicit and indiscriminant pro-social behaviors were

interpreted as a result of these automatic processes of reputation in the cognitive system.

On the other hand, the current results also suggest that the indirect reciprocity theory provides a partial, not full, explanation for the relationship between reputational concerns and the consumer's intention to purchase fair-trade products. The present results show that the RI of fair trade in the agent condition was 17.9%, and was not the highest among attributes, whereas those in the observable condition (high reputational concern derived from real observers) of Kimura et al. (2012) was 20.7%, and was the highest of the attributes. These results imply that the degree of reputational concerns induced varies with whether a participant is potentially being observed and are hard to explain with only the framework of indirect reciprocity. However, the observer-related difference of impact on the consumers' pro-social behavior might also be explained by the social impact theory (Latané, 1981). This classical theory proposes that social influences on individuals depend on the strength and immediacy of the source of impact as well as the number of observers. Participants (university students) in the observable condition in Kimura et al. (2012) were instructed that their responses in the experimental session would be videotaped and used as material for discussion in classes on marketing and consumer behavior in order to lead participants to be self-conscious about how they may appear to friends and acquaintances in their university. This experimental setting could have a relatively high impact on reputational concerns among participants because the opinions of friends and acquaintances in their university may have a strong and immediate impact on their reputation. To elucidate the influence of social impact on consumers' pro-social behavior, further experiments controlling the relationship between participants and the potential observers are required. In order to perform these experiments, the use of agents as potential observers would be useful because agents are likely more effective for controlling the observer's role and relationship to participants than are eye-figures used in previous studies.

4.3. Limitations and future research

The present results are subject to some limitations. The influence of artificial cues on consumers' purchase intention for food products with ethical labels was examined for only one specific label: fair trade. While fair trade is a major ethical label on food products, further studies that involve various ethical and environmental labels such as rainforest alliance, animal welfare and carbon footprint are required to generalize the present findings. In addition, our findings are based only on self-reported purchase intention rather than actual purchase behavior. As mentioned by Kimura et al. (2012), actual behavior might be different from intentions. Further research should examine how self-reported purchase intention affects actual buying behavior.

5. Conclusion

The current results are consistent with previous studies that have shown that an individual's altruistic behavior is influenced by artificial cues of an individual (Bateson et al., 2006; Haley & Fessler, 2005; Izuma, 2012; Mifune et al., 2010; Rigdon et al., 2009), and further provide evidence that displaying artificial cues of the presence of others has a positive effect on the consumer's pro-social purchase decisions. These findings could serve as an important step towards understanding the social aspects of human-agent interaction and consumer behaviors in online shops. As argued by Tennie et al. (2010) and Izuma (2012), the importance of reputation management is ever increasing in the modern world, where trading via the Internet is becoming increasingly common

and people interact with strangers on a daily basis. The approach and methodologies of social and evolutionary perspectives may be useful for understanding human behavior in a computer-mediated environment (Piazza & Bering, 2009). Further research is necessary in order to make clear the social psychological values of agent systems that influence consumers' pro-social behaviors.

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References

- Alexander, R. D. (1987). *The biology of moral systems*. New York: Aldine de Gruyter.
- Bateson, M., Nettle, D., & Roberts, G. (2006). Cues of being watched enhance cooperation in a real-world setting. *Biology Letters*, 2, 412–414.
- De Ferran, F., & Grunert, K. G. (2007). French fair trade coffee buyers' purchasing motives: An exploratory study using means-end chains analysis. *Food Quality and Preference*, 18, 218–229.
- Dowd, K., & Burke, K. J. (2013). The influence of ethical values and food choice motivations on intentions to purchase sustainably sourced foods. *Appetite*, 69, 137–144.
- Green, P. R. (1974). On the design of choice experiments involving multifactor alternatives. *Journal of Consumer Research*, 1, 61–68.
- Haddad, Y., Haddad, J., Olabi, A., Shuqra, M., Haddad, T., & Toufeik, I. (2007). Mapping determinants of purchase intent of concentrated yogurt (Labneh) by conjoint analysis. *Food Quality and Preference*, 18, 795–802.
- Haley, K. J., & Fessler, D. M. T. (2005). Nobody's watching? Subtle cues affect generosity in an anonymous economic game. *Evolution and Human Behavior*, 26, 245–256.
- Hamlin, J. K., Wynn, K., Bloom, P., & Mahajan, N. (2011). How infants and toddlers react to antisocial others. *Proceedings of the National Academy of Sciences of United States of America*, 108, 19931–19936.
- Hoffman, E., McCabe, K., & Smith, V. L. (1996). Social distance and other-regarding behavior in dictator games. *The American Economic Review*, 86, 653–660.
- Izuma, K. (2012). The social neuroscience of reputation. *Neuroscience Research*, 72, 283–288.
- Kimura, A., Kuwazawa, S., Wada, Y., Kyutoku, Y., Okamoto, M., Yamaguchi, Y., et al. (2011). Using conjoint analysis to assess purchase intent of fermented soy product (natto) among Japanese housewives. *Journal of Food Science*, 76, 5217–5224.
- Kimura, A., Mukawa, N., Yamamoto, M., Masuda, T., Yuasa, M., Goto, S., et al. (2012). The influence of reputational concerns on purchase intention of fair-trade foods among young Japanese adults. *Food Quality and Preference*, 26, 204–210.
- Kirezli, O., & Kuscu, Z. K. (2012). Exploring fair trade attitude and fair trade behavior of Turkish consumers. *Procedia Social and Behavioral Sciences*, 58, 1316–1325.
- Latané, B. (1981). The psychology of social impact. *American Psychologist*, 36, 343–356.
- Liao, S.-H., Chen, Y.-J., & Lin, Y.-T. (2011). Mining customer knowledge to implement online shopping and home delivery for hypermarkets. *Expert Systems with Applications*, 38, 3982–3991.
- Masuda, N. (2012). In-group favoritism and intergroup cooperation under indirect reciprocity based on group reputation. *Journal of Theoretical Biology*, 311, 8–18.
- Meristo, M., & Surian, L. (2013). Do infants detect indirect reciprocity? *Cognition*, 129, 102–113.
- Mifune, N., Hashimoto, H., & Yamagishi, T. (2010). Altruism toward in-group members as a reputation mechanism. *Evolution and Human Behavior*, 31, 109–117.
- Ministry of Health, Labour and Welfare Japan (2005). *Standard tables of food composition in Japan (Fifth revised and enlarged ed.)*. Ministry of Health, Labour and Welfare Japan (in Japanese).
- Nowak, M. A., & Sigmund, K. (1998). Evolution of indirect reciprocity by image scoring. *Nature*, 393, 573–577.
- Nowak, M. A., & Sigmund, K. (2005). Evolution of indirect reciprocity. *Nature*, 437, 1291–1298.
- Ogino, B. (2010). *Getting started with conjoint analysis: Strategies for product design and pricing research* (2nd ed.). Madison, Wisconsin: Research Publishers LLC.
- Piazza, J., & Bering, J. M. (2008a). Concerns about reputation via gossip promote generous allocations in an economic game. *Evolution and Human Behavior*, 29, 172–178.
- Piazza, J., & Bering, J. M. (2008b). The effects of perceived anonymity on altruistic punishment. *Evolutionary Psychology*, 6, 487–501.

- Piazza, J., & Bering, J. M. (2009). Evolutionary cyber-psychology: Applying an evolutionary framework to internet behavior. *Computers in Human Behavior*, 25, 1258–1269.
- Prescott, J., Young, O., O'Neill, L., Yau, N. J. N., & Stevens, R. (2002). Motives for food choice: a comparison of consumers from Japan, Taiwan, Malaysia and New Zealand. *Food Quality and Preference*, 13, 489–495.
- Rigdon, M., Ishii, K., Watabe, M., & Kitayama, S. (2009). Minimal social cues in the dictator game. *Journal of Economic Psychology*, 30, 358–367.
- Schnettler, B., Ruiz, D., Sepúlveda, O., & Sepúlveda, N. (2008). Importance of the country of origin in food consumption in a developing country. *Food Quality and Preference*, 19, 372–382.
- Tabachnik, B., & Fidell, L. (2007). *Experimental design using ANOVA* (3rd ed.). Belmont, California: Thompson Books/Cole.
- Tennie, C., Frith, U., & Frith, C. D. (2010). Reputation management in the age of the world-wide web. *Trends in Cognitive Science*, 14, 482–488.
- Teramoto, W., Matsuura, Y., Asai, N. (2012). Measurements of a "sense of being together" in virtual environments. *IEICE Technical Report, IEICE-HIP2012-33* (pp. 1–5) (In Japanese with English abstract).
- Zander, K., & Hamm, U. (2010). Consumer preferences for additional ethical attributes of organic food. *Food Quality and Preference*, 21, 495–503.

協力態度を示すエージェントを用いたシステム継続利用

- 協力の原理によるエージェントデザイン指針 -

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A Method to Foster Continuous System Use through a Cooperative Animated Agent - Agent Interface Design by Cooperative Principle -

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あらまし 本研究では、エージェントが示す協力態度により、システムを継続的に利用するようユーザを誘導する手法を述べる。この手法は、人とエージェントの間の協力の原理に基づいたエージェントデザイン指針に基づく。これまでにインタフェースを改善すべくエージェントが付与されたシステムが実用化してきているが、エージェントの不適切な動作により嫌悪感を抱いてしまいシステムの利用を止めてしまう可能性もある。一方で、エージェントの見た目や動作のデザインを適切にすることで、システムを継続的に活用できる可能性もある。しかしながら、そのデザイン指針は明らかにされていない。そこで本研究では、エージェントが協力態度を示すことで「また今後も期待できそう」などと思込ませ、ユーザに活用を促すエージェントデザイン指針を提案する。実験結果より、エージェントが示す協力態度により、システムの継続利用が促せる可能性が考えられた。協力態度を示すエージェントを用いたデザイン指針は将来のインタラクションデザインに有用と考える。

キーワード 擬人化エージェント, インタラクション, キャラクタ, ヒューマンインタフェースデザイン

1. はじめに

人が機械を易しく扱えるようにするための対話インタフェースとして、擬人化エージェントが広く研究されてきた[1, 2, 3]. さらに擬人化エージェントは、駅の券売機、銀行の ATM 等のシステムにおけるインタフェースとして、挨拶程度ではあるが実用されてきている。たとえば、フォーマルな服装で案内役として登場し「ありがとうございます」とお辞儀をすることで安心感や親近感を出している。従来の券売機や ATM 等に比べて、人に易しいヒューマンインタフェースとして有用と考えられる。

しかしながら、エージェントがシステムの代行として用いられてきているものの、エージェントの見た目

や動作について、そのデザイン指針が十分であるとは言えない。指針が無いままでは、エージェントが不適切に用いられ、ユーザが嫌悪感を抱き利用を途中で止めてしまう可能性もある[4, 5]. 一方、不適切なエージェントの動作によってシステムの継続利用を止めてしまうだけでなく、逆にエージェントのデザインを適切にすることで、システムを継続的に活用できる可能性もある。しかしながら、そのデザイン指針は明らかになっていない。

そこで、本研究ではシステムの継続利用をユーザに促すために、エージェントが協力態度を表出するデザイン指針を提案する。これにより、タスク実行時にエージェントの協力態度がユーザに示されれば、たとえタスクの実行結果が不十分であっても、システムを継続して使いたい等と促すことを狙う。

本論文では、実験により「エージェントの協力態度」が継続利用を促進できる可能性があるかを検証する。また実験結果に基づき、人がエージェントに見出す「協力しようとする態度」がエージェントデザイン

に極めて重要である可能性を議論する。

2. 協力態度を示すことによる継続利用

2.1 協力の原理によるエージェントデザイン指針

人には生来「皆と協力する」という対等性や社会的協力が備わっており、人を人たらしめる重要な原理と考えられ、様々な分野で人に備わる協力の原理が説明されている[6][7][8]. 著者らも、相手の協力や態度が人同士の様々な関係の維持に寄与すると考える。この根拠を順に挙げていく。

まず、「人の集団」において集団内に居続けるためには協力態度が重要である[9][10]. たとえば、共同作業するグループでのメンバーの協力関係や企業の雇用関係でたえることができる。グループでやるべき作業に協力しようと努力する態度が見られる者はグループに居ることができるが、グループの作業に協力しないメンバーは除外されてしまう。企業であれば、企業の利益に協力する者は雇用を継続できるか、そうでない者はやがて解雇されるだろう。これらは、一緒に問題を解決しようとする努力や協力関係(パートナーシップ)をより良くすることが関係継続に繋がるためである。

また、経済学や数学において長らく研究されてきたゲーム理論において、関係性を維持するために人には協力する性質があることが主張されている。これまでの研究で囚人のジレンマや最後通牒ゲームに代表されるように、非協力的に振舞って多くの金銭や利益を得ることができる場面であっても、人は協力的、献身的な行動を選択する傾向があることが知られている[10][11][12]. Henrich らの研究では世界中の民族で金銭ゲームを実施したところ、やはり協力する傾向があることを見出し、人には関係を維持するために、自然に協力的に振舞う性質があることが述べられている[12][13].

さらに、会話においても協力と維持関係の大切さが述べられている。Grice は、たとえ見知らぬ人から「郵便局はどこですか」とたずねられたときであっても、「遠くはないです」とは外れた答はせず、「その角を右に曲がります」と相手の求める答を適切に返す「協調の原理」があることを述べている[14]. これは、会話を維持するための性質、人同士の関係を維持するために自然に協力的に振舞う人の性質と考えられる。これに基づき、湯浅らは会話において人同士は相手が

どのように振舞っているかを観察し、もし相手が話したそうならば話をさせてあげる、といった協力をしていると主張している[15]. 図1は二者間の会話と態度表出および会話の継続を示したものである。なお、ここでの態度とは「話したい態度(話したような表情や口元、しぐさの変化)」を指す。二者は発話を交替させながらも(話し手になったり聞き手になったりしながらも)互いの様子を観察し、「話したい」という態度が表出されていないかを確認している。もし話したい態度が表出されるとそれに合わせて話をさせてあげるように振舞う(発話を交替する)。この振る舞いは会話では「互いに話せるようにするための協力」である。協力し合うことで適切なタイミングで発話が交替でき、その結果として二者間の会話が継続される。

以上のように、集団の共同作業のような長期的な活動、ゲーム(実験)のような一時的な取引、会話のような瞬間的なやり取りの例をあげたが、いずれにおいても相手の協力や態度が関係性の維持(仲間はずれにならないようにする、会話を継続していく等)に寄与していることが分かる。また、本来、この協力関係と継続性の関係は人同士のものであるが、同様の事をエージェントに見出している可能性がある。たとえば、エージェントを相手に囚人のジレンマのゲームを実施した研究では、たとえ相手がエージェントであっても協力的に振舞うことが示されている[16][17]. よって、人が関係継続のため自然に協力的に振舞う性質は、よりよいエージェントデザイン指針とできる可能性がある。本論文では、エージェントが協力する態度を示すことで無理なくユーザがエージェントの協力を理解しシステムを継続するように促すことを実験で確かめ議論する。

お互いの態度が表出(双方向のインタラクションモデル)

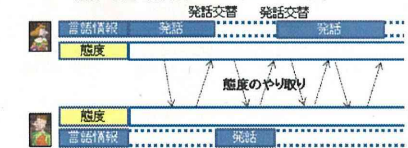


図1 会話における態度のインタラクション[15]
(ここでの態度とは「話したい態度(話したような表情や口元、しぐさの変化)」)

Figure 1 Interaction of Attitude during Conversation

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2.2 原因帰属の理論を用いたシステム継続

友人が待ち合わせ時間に現れないとき、人は理由をあれこれと考える。ハイダーは行動理由を知りたくなる心理作用を原因帰属とし、原因を「個人の性格や気質のせいである」とする内的帰属と「行動が行われた周囲の状況である」とする外的帰属があることを示した[18]。また、他者の行動については、内的な性質が要因であると過大評価する傾向があることも調べられている[19]。そこで、たとえば、もしシステムのタスクをエージェントが代行しているとき、システムの不具合の原因をエージェントに帰属させて（他者行動は内的帰属しやすいため）、システムそのものの印象は悪くさせないことができればと考える。

本研究では、タスクの要因をエージェントに正確に帰属させるため、エージェントがタスクを行っていることを示すアニメーションを用いることを提案する。エージェントがタスクをこなしているように思いつくことで、システムの不具合と思わせないようにして、ユーザの継続利用を促すこともできると考える。

たとえば、エージェントが付与されたソフトウェアをユーザが気に入ってくると、「あのソフトを起動しよう」という言い方だけでなく、「あの便利なネコを呼び出そう」とエージェントが振舞っているように感じて、エージェントのほうを気に入ってソフトウェアを何度も利用していく場合がある。別の例では、たとえば、販売サイトの案内に「かわいい猫エージェント」を用いるとする。もしユーザが満足できる買い物をした際に、「猫のおかげで良いものが買えたのかも、猫が気に入ったので、またサイトを利用したい」とエージェントが買い物の手助けをしてくれたように感じて、エージェントのほうを気に入って、再度買い物をすることがある。このようにエージェントを用いていないときよりも利用することになるかもしれない。別の例では、新規に作られ、動作に不具合が残るサイトがあるときに「きまぐれな猫エージェント」をサイトに付与した場合、たとえ不具合が発生しても、「猫のきまぐれなのかも」と思わせ、「このエージェントの能力ならば仕方ないか、次にコイツの能力程度に頼めそうなときに頼もう」と思わせることができるかもしれない。猫エージェントが思いどきよりも継続利用は良くなるかもしれない。以上のようにエージェントの能力に原因帰属をする場合が人にはある。このような原因帰属と継続利用性の関係に本研究では着目する。

2.3 適応ギャップとインタラクションの継続

小松・山田らは人間がエージェントに抱く印象や期待する挙動と実際の印象や挙動とのギャップを適応ギャップと定義した[20,21]。適応ギャップの差が開きマイナスになるとインタラクションを停止することを説明している。そして、エージェントへの主観的な思い込み、認知的な特性が人間とエージェントの間にあることを示した。本研究でも、エージェントの期待とのギャップによってインタラクションを停止してしまうことを扱う。しかしながら、小松らの研究では、どのようにインタラクションを継続させ、また、ユーザをどう誘導させるべきかまでは扱っていない。本研究では、湯浅[22]のようにエージェントの挙動によって、印象や思い込みを変化させ、ユーザの継続利用を促すことを探る。

2.4 本研究の狙い

本研究では、「エージェントの協力態度」がユーザとの協力関係を向上させるという指針を提案し、継続利用できるシステムの開発を目指している。以降の実験により、システム使用者が感じるエージェントに対する「協力態度」とシステムの継続的利用の関係を調査する。

3. エージェントを付与したオノマトペ検索システムによる実験

提案内容を検証するために実施した実験を述べる。エージェントの選出、オノマトペ検索システムの作成、協力態度を示す映像の準備を説明する。

3.1 エージェントの選出

実験で用いるエージェントについては、その抽象度を統一する必要がある。写実的であるエージェントと抽象度が高いエージェント（線画や顔文字等）では、その受け取り方（印象や認知）は異なってしまうためである[22,23]。また、見た目からその性質や特性が統一的に予測しやすいものを選ぶ必要がある。本研究では、市販グッズに用いられている動物キャラクターを参考に用いることとした。抽象度が統一されていることと、「犬であれば従順」「猫であれば勝手気まま」というような思い込みも利用できるためである。さらに、実験で用いるキャラクターは絞る必要があり、キャラクターから感じる性質や特性に基づいて選出することを検討した。社会心理学では対人印象評価や性格評価等があるが自己や他者関係について述べているの

み[10]で仕事を依頼するエージェントには当てはめにくい。そこで、様々な企業における人事評価や自己評価を WEB から収集し検討した[24,25]。それらには、信頼性、正確性、責任性、規律性、積極性などの評価指標があった。今回の実験の場合、信頼性は「継続利用性」に対応する（「人事評価における信頼性は「仕事の対応が十分であり、お客様から再度の指名があるなど、評判が高かった」を指す）。責任性は課せられた仕事をこなしたか、正確性は検索結果が適切であったかであり、これらの二つは「検索結果の精度」に対応すると考えた。規律性はユーザの命令を遵守するか、積極性はどのような姿勢で取り組んだかに値し、これらはエージェントの振る舞いに対応すると考えた。なお、規律性は予備実験の際、実験協力者に分かりにくかったため、「従順性」と呼び変えた。以上から「従順性」と「積極性」の二軸の評価にすることとした。

実験協力者の大学生 14 名に動物エージェントの静止画(16 個)をランダムで見てもらい、エージェントが「依頼した仕事に対して積極的か」「ユーザに対して従順か」を 5 段階評価した結果を図 2 に示す。「積極性」「従順性」に特徴があった 4 つのエージェント(図 3 および図 4 の A,B,C,D)を選出した。

さらに 4 つキャラクターに対する印象を自由記述する追試も行い、A~D のキャラクターを下記のように特徴づけた。

- A: 従順性が高く、かつ積極的。
- B: 従順でなく、積極性は中程度。
- C: あまり従順でなく、かつ消極的。
- D: やや従順で、積極性は中程度。

以上から特徴の際立った 4 つエージェントが選択できたと考え、実験に用いることとした。

3.2 実験システム

実験ではエージェント付きの対話システムとして、オノマトペ検索システムを試作した。図 4 は検索時の流れであり「検索語の入力」「検索中」「検索結果表示」と遷移する。たとえば「笑う」を入力すると、エージェントが走ってオノマトペを探しに行くアニメーションが表示された後、「ゲラゲラ」等のオノマトペが表示される。なお、本システムは実験に準備した仮の検索システムであるため、あらかじめ定められた言葉のオノマトペしか表示できないが、後述する実験課題は問題なく実施できるものになっている。

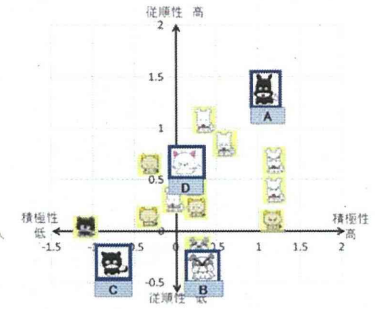


図 2 エージェントの選出
Figure 2 Choice of Animated Agents

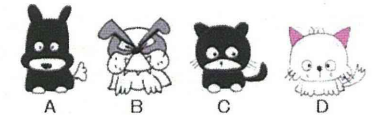


図 3. 実験システムに用いたエージェント(著者らによるイラスト ※1)

Figure 3 Animated Agent for Experimental System

このシステムに前節で説明した 4 体 (A, B, C, D) のエージェントを用いた。それに加え、今回の実験では「エージェントの協力態度」によって継続利用性に変化が起きるかを検証するために「協力態度弱」と「協力態度強」の 2 種類の映像（検索中の画面に表示）を用意した。図 5 に示したとおり、「協力態度強」の映像には、エージェントの走る動作に汗が出るアニメーションが付加してあり、「協力態度弱」の映像には汗がないといった違いがある。なお、事前に本実験の協力者ではない者に、走るアニメーションのみを提示し、懸命に仕事をしているように見えるかを何

※1論文掲載に際し、エージェントは著者らのイメージで描きなおした。実際の実験ではオリジナルの CG キャラクターを加工し利用した。本論文中で説明している動物キャラクターは、ソニー・クリエイティブプロダクツのものである。（「うちのタマ知りませんか？」タマ&フレンズ ©Sony Creative Products Inc.）

度か確認し調整したアニメーションを作成した。

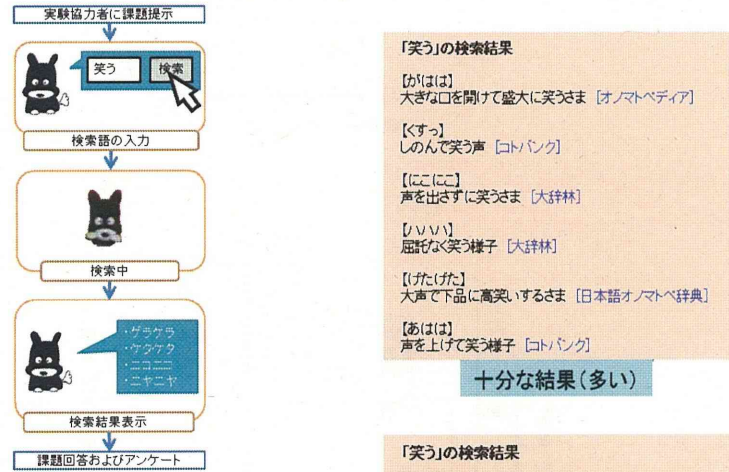


図4 検索システムの画面遷移と実験手順

Figure 4 Transition of retrieval system and experimental procedure

「笑う」の検索結果

[[かほほ]]
大きな口を開けて盛大に笑うさま [オノマトベ辞典]

[[くすっ]]
しんて笑う声 [ロトバンク]

[[はこはこ]]
声を出さずに笑うさま [大辞林]

[[いひい]]
屈託なく笑う様子 [大辞林]

[[げたげた]]
大声で下品に高笑いするさま [日本語オノマトベ辞典]

[[あはは]]
声を上げて笑う様子 [ロトバンク]

十分な結果(多い)

「笑う」の検索結果

[[ほっほ]]
大きな声で区切るように笑うさま [大辞林]

[[えへらえへら]]
不適切な時に閉まりなく笑う様子 [日本語オノマトベ辞典]

不十分な結果(少ない)

図6 検索結果の例 (十分/不十分な結果)

Figure 6 Result of retrieval (enough / not enough)

本実験にて、既存の検索システムを用いず、オノマトベ検索システムを用いている理由は、どの実験協力者にとってもシステムの性能を知らない状態で実験に臨んでもらうためである。既存の検索システムを用いると、その精度や仕組みをある程度知っている実験協力者がいた場合、検索結果をエージェントに原因帰属をせず、システム（やアルゴリズム）に原因を求めてしまい実験協力者間に差が出てしまう。システムの検索結果をエージェントになるべく帰属させて統一的に実験するために、実験協力者には性能が分からない自作のシステムでの課題とした。

また、検索システムを用いる場合、検索精度が十分に良ければそれだけで継続利用性は高く、不十分ならば低くなり、検索精度の十分性も継続利用性に影響を与える。そこで、検索結果が多く結果が表示されるものと、あえて少なく結果が表示されるものを用いて

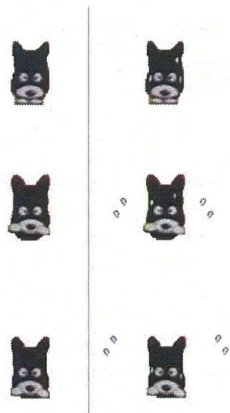


図5 検索中に表示される映像 (協力態度弱/強)

Figure 5 Animation during searching word (with / without sweat)

比較する。図6に2種類のオノマトベ検索結果を示す。

3.3 実験協力者への課題

実験協力者にオノマトベの課題(検索された個数や適切なオノマトベを書き出させるもの)を出し、解かせた。用いた課題の例を下記に示す。

Q1. 「笑う」について検索した結果(オノマトベのみ)を書いてください

Q2. 検索結果の中から会話で使えそうなものを4つ書いてください (検索されなかったら空欄)

Q3. 検索結果の中から「声をあげて笑うようす」を表すオノマトベがあれば書いてください (検索されなかったら空欄)

.....

Q1. 「浮く」について検索した結果(オノマトベのみ)を書いてください

Q2. 検索結果の中から日常で使えそうなものを4つ書いてください (検索されなかったら空欄)

Q3. 検索結果の中から「水に浮遊するようす」を表すオノマトベがあれば書いてください (検索されなかったら空欄)

「笑う」「浮く」のように特定の言葉について検索をしてもらい、複数のオノマトベを列挙してもらったり回答してもらったりする。検索結果が図6下のように少ない場合はアンケートに十分に回答ができない。たとえば、実験協力者に課した課題は「“検索結果の中から「声をあげて笑うようす」を表すオノマトベがあれば書いてください」「浮く」に関連するオノマト

ベを調べて、検索結果の中から日常で使えそうなものを4つ書いてください」とオノマトベを複数個、書かないとならない課題である。このように課題を設定することで、検索結果の数が少ないと「声をあげて笑うようす」をあらわすオノマトベが書けなかったり、浮くに関連するオノマトベが2つしか書けなかったりする。このように、不十分な検索結果では回答がうまくできず課題の回答欄の空欄も埋まらないようにわざと設定することで、検索結果に不満を抱くようにしている。

この自作したオノマトベ検索システムを用い、十分な結果あるいは不十分な結果を制御することで、継続利用性を検証することとした。

3.4 実験計画

三要因混合計画を採用し、要因1：検索中映像2水準、被験者間計画)、要因2：エージェント(4水準、被験者内計画)、要因3：検索結果(2水準、被験者内計画)で実験を行う。同じ被験者が「協力態度強」と「協力態度弱」を見て比較して実験上の重要な狙いがばれてしまうことを防ぐため、要因1は被験者間計画とし「協力態度強を映像を見た人」と「協力態度弱を見た人」を分けている。

実験協力者は32人の大学生(男子学生23人、女子学生9人)で、エージェントの協力態度強の条件と協力態度弱の条件に二分し、検索システムを1人8回(検索中映像1種×エージェント4種×検索結果2種)使ってもらい、検索後に「システムを再度使いたい(継続利用性)」を5段階評価するアンケートを行い、理由も記述してもらった。

4. 実験結果

アンケートにおける継続利用性の平均値を図7に示す。図の上部が「十分な結果」、下部が「不十分な結果」を示し、検索結果の良し悪しによって2群に大きく分かれた。また、「協力態度強」映像を見た人の継続利用性が「協力態度弱」映像を見た人よりも高くなる傾向がある。

これらの結果に有意な差があるのか検証するため、3要因混合計画(AsBCタイプ)の分散分析を行った。分析の結果、検索結果要因(十分/不十分な結果)に主効果($F(1,30)=101.59, p<0.01$)が見られた。またさらに3要因の交互作用については、エージェント要因と検索中映像要因(協力態度強/弱)との交互作用($F(3,90)=2.44, p<0.10$)に有意傾向が見られた。

検索中映像要因とエージェント要因の交互作用を分析した結果、検索中映像要因の単純主効果は C エージェント条件で有意であった ($F(1,30)=10.97, p<.01$)。またエージェント要因の単純主効果は「協力態度弱」条件で有意であった ($F(3,3)=3.76, p<.05$)。

また、エージェント要因の各水準の平均を LSD 法によって多重比較した結果、C エージェント < A エージェント、C エージェント < D エージェントに有意差があった(共に $MSe=0.6816, p<.05$)。この結果より、C エージェントについては、協力態度が弱いときには継続利用性が他のエージェントよりも著しく低いものの、協力態度が強ければ(努力があれば)、継続利用性が高くなり他のエージェントと大差が無くなること分かった。しかしながら、努力さえあれば継続利用

性が高くなり、「不十分な結果」を覆すほどの影響力を持つことはなかった。

これらの結果からいえる結論は下記である。

1, 継続的な利用に対して、もっとも効果的なものはシステムが十分な検索結果を返すことである。不十分な検索結果では継続利用を向上させることまでは望めない。かつ、十分な検索結果ではエージェントごとに継続利用性に有意な差はない。

2, 不十分な検索結果において、特定のエージェント (C エージェント) については、協力態度が弱いと継続的な利用が極めて低いが、協力態度が強いと他のキャラクタと同程度になる傾向がある。

以上が結果である。

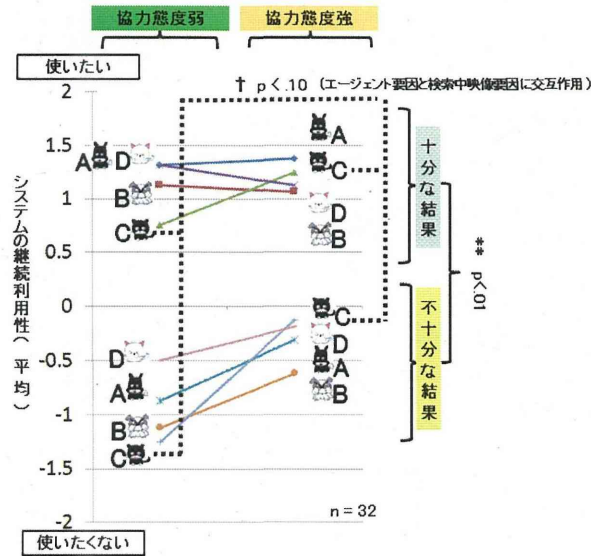


図7 システムの継続利用性
Figure 7 Degree of Continuous System Use

5. 考察

5.1 エージェントの見た目と協力態度

まず、継続的な利用に対して、もっとも影響する要因は「検索結果」であり、十分な検索結果を返すときに継続利用性が高くなる。また、十分な検索結果を返す場合においては、どのようにエージェントを動作させるかとしたエージェントデザイン指針は今回の実験内においては説明できるものはないと考えられる。

次に、不十分な検索結果を返す場合を考える。このときには、検索中映像要因とエージェント要因の交互作用に有意傾向があり、極めて低い評価であったエージェントが協力態度を示すことで、他のエージェントと同程度の効果になる可能性があることがわかった。なお、差は10%と有意傾向ではあるが、さらにエージェントの見た目やアニメーション動作を変更していくことで有意な差を得られるかもしれない。しかし、ここでは見た目や動作の詳細を考えるのではなく、「エージェントが協力態度を示す」という我々のデザイン指針に可能性があるかに注目する。そのため、次にアンケートの理由欄からも差が生じる理由を考察する。

アンケートの理由欄より、「協力態度強」の実験協力者のみに見られた回答を抜粋すると、「一心不乱に働いている」「必死そう」「頑張っている」「焦っている」といった回答が見受けられた。また、検索後のインタビューから、「協力態度強」を見た実験協力者は「かなり急いでいる」「どれも頑張っている」「一生懸命」「焦っている」という回答が得られたが、「協力態度弱」を見た実験協力者からは「30%~50%の力でやっている」「めんどくさそう」「不信感」等のマイナスイメージの回答が得られた。これらのことから、映像にあった「汗」がエージェントの「一心不乱さ」や「頑張り」を生み出したことが継続利用に影響した可能性が検索後のインタビューからうかがえる。

また、C エージェントと A エージェントや D エージェントのはじめの見た目を比較すると、C エージェントはそっぽを向いているので「システムのユーザに協力しようとする姿勢」が見られないと考えられる。その裏付けとして、アンケートの理由欄から「次回も同様に仕事をしてくれるか不安」といった回答があった。

さらに、C エージェントと他のエージェントの従順性や積極性を比較すると、C エージェントは他のエージェントに比べて従順性や積極性が低くなっている。

このため、見た目のみでは従順性と積極性の低さから、C エージェントは仕事をしてくれそうなのか、とやはり不安要素があることがうかがえる。

これらのことから、はじめに期待がされていなかった C エージェントが汗を流し努力しているときにはより協力的に見られて、「結果は良くなかったががんばった」というような帰属がされた可能性がある。一方、努力がないときには極めて非協力的に見られてしまうため、二つの映像の継続利用性に差が生まれたと考えられる。

以上から、考えられるエージェントデザイン指針は下記である。

- ・継続的な利用は、「検索結果」が主要因であるため、十分な検索結果を返す場合においては、どのようにエージェントを動作させるかのデザイン指針は今回の実験においては説明できるものはない

- ・不十分な検索結果を返す場合、協力態度が弱いときに継続利用性が低いエージェントであっても、協力態度を強く示すことで、他のキャラクタの継続利用性に及ぶ可能性がある

上記のことから、従来までのようにエージェントの見た目に注目したエージェントデザインを考えるだけでなく、特定の条件下では、協力態度を示すデザインを用いることで継続利用性を変化可能であることが考えられた。

5.2 協力態度による評価の変化

小松、山田らはエージェントへの期待と実際の挙動との差である適応ギャップの研究において、エージェントの見た目の違いやタスク結果といった客観的情報よりも、ユーザが抱くメンタルモデルで構築されたエージェントへの主観的な思い込みが、印象に影響を及ぼす認知的な特性が人間とエージェントの間にあることを示した[20, 21]。本実験も、検索結果が不十分であるという客観的に見て明らかにマイナスの情報が存在しても、検索中の映像によって主観的な評価が変化するという認知特性を示したものである。エージェントの見た目だけでなく動作も含めた認知特性の一端を示し、小松らの結果と同種であると考えられる。

5.3 HAI における協力の原理

2 章で述べたように、人は様々な事柄について、協力しようとする性質があると考えられる。グライスの協調の原理に代表されるように、これまでは会話やコミュニケーション研究、また社会心理学で「人同士の協調の原理」は注目されてきたが、エージェントを