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APPLICATIONS IN ONLINE COMMUNITIES

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S-Conart: an interaction method that facilitates concept articulation in shopping online

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Abstract This study addresses building an interactive system that effectively prompts customers to make their decision while shopping online. It is especially targeted at "purchasing as concept articulation" where customers initially have a vague concept of what they want and then gradually clarify it in the course of interaction, which has not been covered by traditional online shopping systems. This paper proposes information presentation methods to effectively facilitate customers in their concept articulation process, and the framework for interaction design to enable the methods. Specifically, this study builds a system called S-Conart that facilitates purchasing as concept articulation through support for customer's conception with spatial-arrangement style information presentation and for their conviction with scene information presentation, and then makes a set of evaluation experiments with the system to verify that the approach used in building the system is effective in facilitating the purchasing as concept articulation.

Keywords Concept articulation · Decision making · Creative cognition · Interaction · Online shopping

1 Introduction

Today's advanced countries in "the era of oversupply of merchandise" require marketing activities to focus on sensibility issues that greatly affect decision-making by customers (Peppers and Rogers 1993). In addition, online-shopping sites currently being spotlighted need not only make efforts to provide a wide selection of products or reducing prices but also to present information in a way

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that appeals to the customer's sensibility. With this background, the authors are addressing building an interactive system that effectively prompts customers to make their decision in shopping online (Shoji and Hori 2001, 2002). We are especially trying to establish the information presentation method effective for the customers who initially have only a vague concept of what they really want. As a fundamental study for the endeavor, we started with observing communication between customer and salesclerk in actual shops. This observation shows that customer's mental processes in shopping are roughly grouped into two types: "problem solving" and "concept articulation". When customers follow the problem-solving type of purchasing, they initially have clear concept and functional requirements on desired products, and therefore perform their problem-solving in a way that they look for the products which meet their requirements. When they follow the concept-articulation type, on the other hand, they initially only have vague requirements on their wants, and then gradually clarify their requirements through the interaction with salesclerks and so forth.

In spite of the concept-articulation type of purchasing frequently observed in the actual shopping scenes, many existing online-shopping sites assume that customers' requirements have been already determined before they start shopping. That is, they are only targeted at the customers who make a problem-solving type of purchase. Under the circumstances, aiming at building the online shopping systems that can help customers make a concept-articulation type of purchase, this study has developed an experimental system called S-Conart (concept articulator for shoppers). This paper describes the overview of S-Conart, followed by the content and result of experiments made to verify its effectiveness. These two types of experiments have confirmed that S-Conart is effective in facilitating the customer's conception and conviction. Therefore, S-Conart has delivered the interaction that effectively facilitates the concept-articulation type of purchasing.

2 Overview of S-Conart

Considering an effective information presentation method to facilitate purchasing as concept articulation in shopping online, and based on knowledge acquired from the analysis of human behavior in the actual purchase activities (Shoji and Hori 2001), the authors have created an experimental system called S-Conart. Our approach to online-shopping systems focuses on the appropriate information presentation to facilitate the customer's concept articulation instead of the straightforward replacement of human communication with human–computer interaction (HCI) (Shoji and Hori 2002).

Through the analysis of communication between customer and salesclerk, our previous study has proved that "unexpected reaction" by salesclerks can be useful for facilitating customers' shopping as concept articulation (Shoji and Hori 2001). Unexpected reaction is referred to as the reaction that serves as information presentation from a different viewpoint than a customer's current one. Moreover, the result of detailed analysis of the cases where unexpected reaction was effective has showed that there are mainly two things useful for facilitating the customer's concept articulation which include:

Support for conception An unexpected reaction may cause a change of a customer's viewpoint, which in turn triggers a change in their search goal itself to lead to the facilitation of their decision-making process. A capable salesclerk can skillfully leverage an unexpected reaction to facilitate a customer's conception.

Support for conviction In order for a customer to smoothly accept a new viewpoint once they have conceived it via an unexpected reaction by a salesclerk, they need to convince themselves. Capable salesclerks can skillfully explain concrete use scenes and/or usage of product items to facilitate customer's conviction.

S-Conart tries to support both of them using the following approaches:

Support for conception with information presented in spatial-arrangement style S-Conart uses spatial-arrangement style information presentation based on the multi-dimensional scaling (MDS) method to implement a feature that enables the support for the customer's conception (as shown in the *left* part of Fig. 1). In order to verify the effect of spatial-arrangement style information presentation, S-Conart also implements another interface with listing style information presentation for comparison (as shown in the *left* part of Fig. 2).

Support for conviction with scene information S-Conart implements the two functions shown below, presenting scene information suited for user's current thoughts to facilitate their concept articulation.

1. Facilitates user's conviction by allowing them to browse comments that contain scene information on their products of interest (lower parts of Figs. 1 and 2).

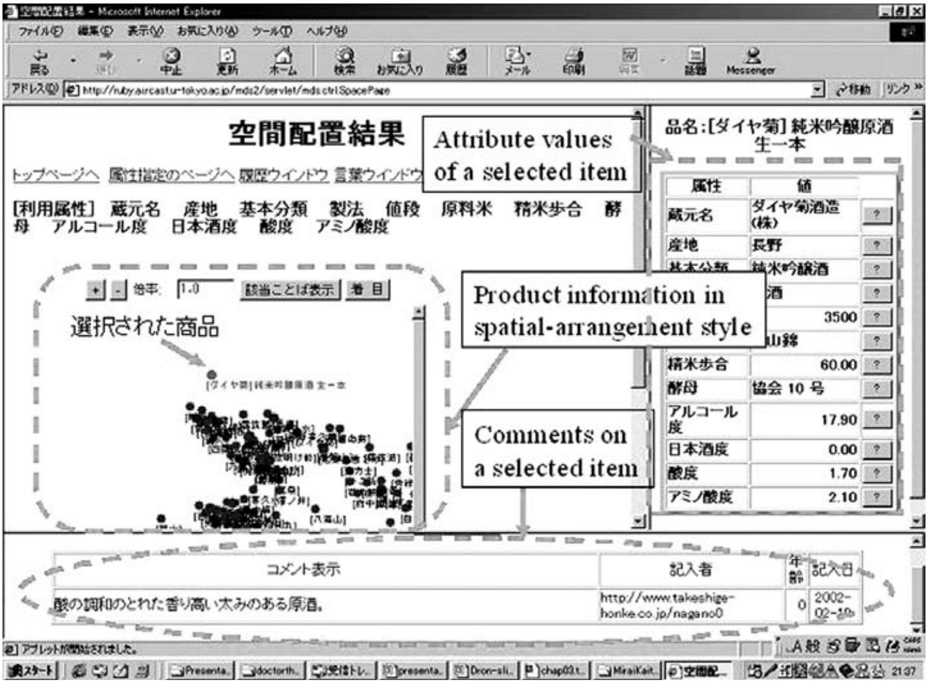

Fig. 1 Spatial-arrangement style interface in S-Conart

Fig. 2 Listing style interface in S-Conart

2. Facilitates user's concept articulation with the ''scene information window'' presenting of words extracted from comments on all the products in both graph and tree styles (Fig. 3).

3 Experiments on effects of spatial-arrangement style information presentation on user's conception

3.1 Overview of experiments

3.1.1 Hypotheses to be verified

Two experiments described in this paper are intended to verify that S-Conart is effective in facilitating purchasing as concept articulation. At the beginning, this section describes the first experiment and discusses the effects of the support for user's conception with spatial-arrangement style information presentation used by S-Conart.

Hypothesis 1 When there are a wide variety of goods available, the spatial-arrangement style information presentation, which represents the relationship between items as a spatial image, is effective in prompting a user to conception. The conception helps user's concept articulation.

Previous studies have verified that spatial-arrangement style information presentation is useful for creativity support (Hori 1997; Nakakoji et al. 1999; Sugimoto et al. 1994). Therefore, also in the domain of online shopping,

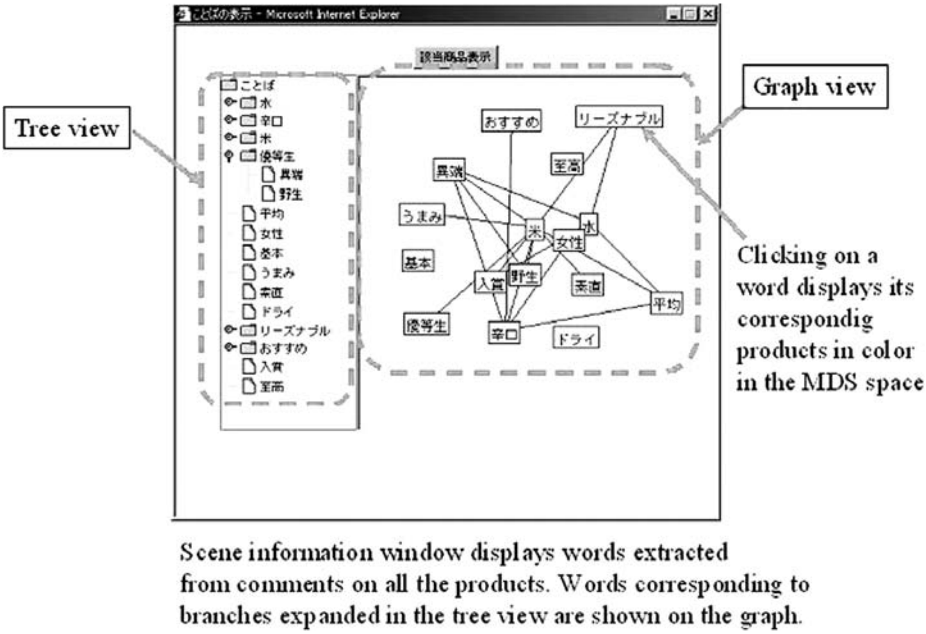

Fig. 3 Scene information window in S-Conart

information presented in spatial-arrangement style is expected to promote user's decision-making during their purchasing. This expectation has motivated the authors to build S-Conart.

This section describes the experiment conducted to validate hypothesis 1. Specifically, through the experiment of choosing Japanese sake items, we examined how the human cognitive process varies with the information presentation style, which is one of spatial-arrangement and listing styles. The former style represents the relationship between items indirectly via a spatial image, while the latter presents information on each item in a list. The following sections describe the overview and result of this experiment and include discussions.

3.1.2 Experimental subjects

The experiment was performed for eight subjects. These subjects are grouped as shown below based on the familiarity with computer/interface and the interest in and knowledge of sake as a target item. These criteria were categorized from responses to the pre-experiment questionnaire.

– Group 1 (subjects 1 and 2): very familiar with computer/interface; very interested and knowledgeable about sake as a target item
– Group 2 (subjects 3 and 4): limited familiarity with computer/interface; very interested and knowledgeable about sake as a target item
– Group 3 (subjects 5 and 6): very familiar with computer/interface; limited interest and knowledge about sake as a target item

– Group 4 (subjects 7 and 8): limited familiarity with computer/interface; limited interest and knowledge about sake as a target item

3.1.3 Procedure of experiment

Each subject was given a document describing the content of the experiment and assignments and then followed the procedure shown below to perform their respective experiment.

1. Fill in an advanced questionnaire before starting the experiment (15 min maximum)
2. Use listing or spatial arrangement style representation to do assignment 1 (30 min maximum)
3. Have an interview and respond to a questionnaire regarding assignment 1 (60 min maximum)
4. Break (10 min)
5. Use a different style from the one used in step 2 to do assignment 2 (30 min maximum)
6. Have an interview and respond to a questionnaire regarding assignment 2 (60 min maximum) Two kinds of assignments were used in the experiment. The subjects were given the instructions describing the purpose, procedure, notes and so on of the experiment as well as the assignment descriptions shown below.

What happened during assignments was shot with a video camera. When each subject had an interview regarding their assignments, after viewing this video and their operation history stored in the system, they were asked to give an explanation as detailed as possible about why they performed each operation and what they had in their minds at that time. What they answered was recorded and used for the protocol analysis.

Assignment 1 Choose appropriate Japanese sake for your home party with your friends of your generation (about six people including yourself, both men and women). Suppose it is in winter and strongly seasoned Ishikari-nabe is scheduled for a meal. Choose three bottles of sake in total such that the amount is within 10,000 yen.

Assignment 2 Suppose that a welcoming party will be held in your office (your lab or seminar if you are a student) in April, choose appropriate Japanese sake for the occasion. About 15 people will attend the party. Suppose that there will be a wide range of participants in terms of age and taste, ranging from those who are sake drinkers to those who don't drink it at all. The budget is 15,000 yen. The number of bottles is not specified, however, buy at least three bottles considering the number in attendance.

3.2 Analysis

3.2.1 Method of analysis

The examination of how information presented by S-Conart and interaction with S-Conart affects user's decision-making during their item selection requires detailed analysis of the user's mental process. For this purpose, a cognitive scientific approach must be used. Currently, one of the most important issues in the domain of cognitive science is detailed analysis of the effects that the difference in the information representation method has on the human cognitive process (Schoen 1983; Suwa et al. 1998; Zhang 1997).

Referring to a protocol analysis technique used by Suwa et al. (1998) for the cognitive process in the architectural design domain, this study divided the cognitive process during shopping into the four levels of conceptual, functional, perceptual, and physical to define the unit cognitive processes shown in Table 1. Using these unit cognitive processes, the behavior of subjects when they used the spatial arrangement and listing style interfaces was analyzed microscopically to draw the transition diagram of their cognitive process. Then, the difference in the processes when using the two styles was examined through the diagram.

3.2.2 Analysis of using listing-style interface

Figure 4 is a transition diagram to show a part of a subject's cognitive process while completing their assignment using the listing style interface. A subject must first plan what items to select according to what policy (PlanHowToSelect). The subject shown in Fig. 4 thought that "inexpensive and popular Ginjo-shu would be better for the casual party." Once he has determined the plan for selection, he first selects attributes according to the plan. Cycle (1) in Fig. 4 represents the process (LookAtAttributes, SetAttribute). After setting the attributes, they confirm them (ConfirmAttributes) and have the result displayed (DisplayList). Next, viewing the resultant list (LookAtList), the subject clicks the names of items of interest to browse the item data and make a comparative examination. Cycle (2) in Fig. 4 represents the process whereby viewing several item data (SelectItem, ReadData), the subject compares them (CompareData) to search for promising item data (InvestigateData).

The subject chose to buy nothing yet (DecideNotToSelect) because "nothing favorite was found in spite of viewing several item data". And, they thought "Ginjo-shu is expensive and hard to meet the criteria", so they decided to "loosen the criteria and search for other sake than Ginjo-shu as well" (PlanHowToSelect) and then returned to the attribute selection screen to redo the task (LookAtAttributes, SetAttribute).

3.2.3 Analysis of using spatial-arrangement style interface

Figure 5 is a transition diagram to show part of a subject's cognitive process while completing their assignment using the spatial-arrangement style interface. The subject shown in Fig. 5 decided that "reasonable Ginjo-shu from northern regions should be focused" (PlanHowToSelect). Once the policy has been established, attributes are first selected accordingly. Cycle (1) in Fig. 5 represents the attribute selection process.

Next, viewing the space displayed (LookAtSpace), the subject clicks the names of items of interest to browse these item data and make a comparative examination of them. Cycle (2) in Fig. 5 represents the process where viewing

Table 1 Summary of cognitive processes used in protocol analysis

Category	Name	Description	Example of unit cognitive process	Description of unit cognitive process
Conceptual	Plan	Plans an action to take	PlanHowToSelect	Plans how to select items
	Decide	Decides an action to take	DecideToSelect	Decides on an item to buy from the current choices
Functional	Compare	Compares between objects	CompareData	Compares attribute data for items
			CompareComments	Compares comment information about items
			CompareWords	Compares words on the scene information window
	Investigate	Investigates an object	InvestigateData	Investigates attribute data for an item
			InvestigateComment	Investigates comment information about an item
			InvestigateWord	Investigates a word on the scene information window
	Remember	Remembers an object	RememberAttribute	Remembers attributes of an item previously shown
			RememberComment	Remembers comment on an item previously shown
			RememberWord	Remembers a word previously shown on the scene information window
	Confirm	Confirms an object	ConfirmAttributes	Confirms attributes of an item
			ConfirmWords	Confirms a word on the scene information window
	Relate	Relates one object with another	RelateWordToItem	Relates a word on the scene information window with an item
Perceptual	Look	Look at an object	LookAtSpace	Looks at the product space
			LookAtList	Looks at the product list
			LookAtItem	Looks at a dot and a name for an item
			LookAtScene	Looks at the scene information window
	Read	Reads an object	ReadData	Reads attribute data for an item
			ReadComment	Reads comment about an item
Physical	Select	Selects an object	SelectItem	Selects an item via either dot or name
			SelectWord	Selects a word on the scene information window
	Set	Sets a value	SetAttribute	Sets a value range of a selected attribute
	Display	Displays a result	DisplaySpace	Displays the product space
			DisplayScene	Displays the scene information window
	Explore	Explores within the display screen	ExploreSpace	Drags the mouse to explore within the product space
			ExploreScene	Drags the mouse to explore within the scene information window

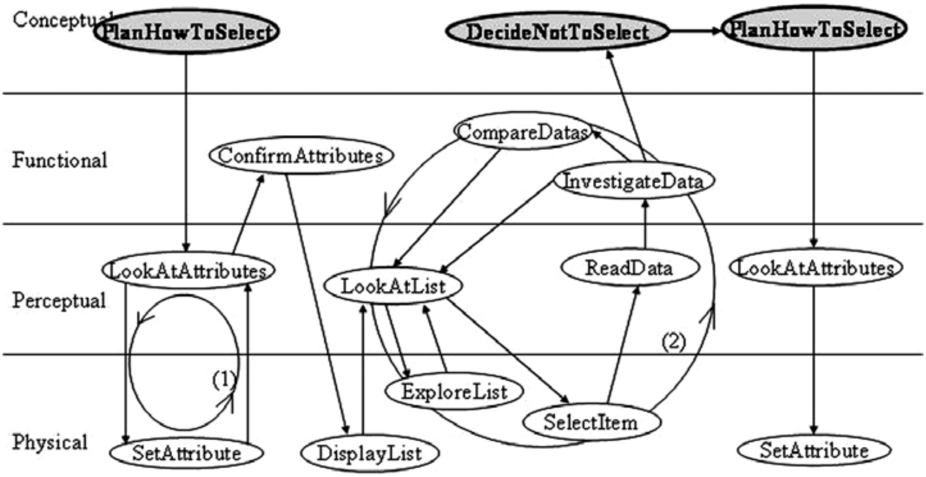

Fig. 4 A part of cognitive process of a subject using listing-style interface

several item data (SelectItem, ReadData), the subject compares them (CompareData) to examine for promising item data (InvestigateData). The subject decided to try to display with a focus on Junmai-shu (PlanHowToSelect), because while looking at items colored orange in the focused view, an item (colored blue) not corresponding to the current view caught their attention (LookAtItem) and then clicking on it to view the data (SelectItem) showed that it is Junmai-shu, which inclined him/her toward Junmai-shu. Thus, they returned to the attribute selection screen to redo the task (LookAtAttributes, SetAttribute).

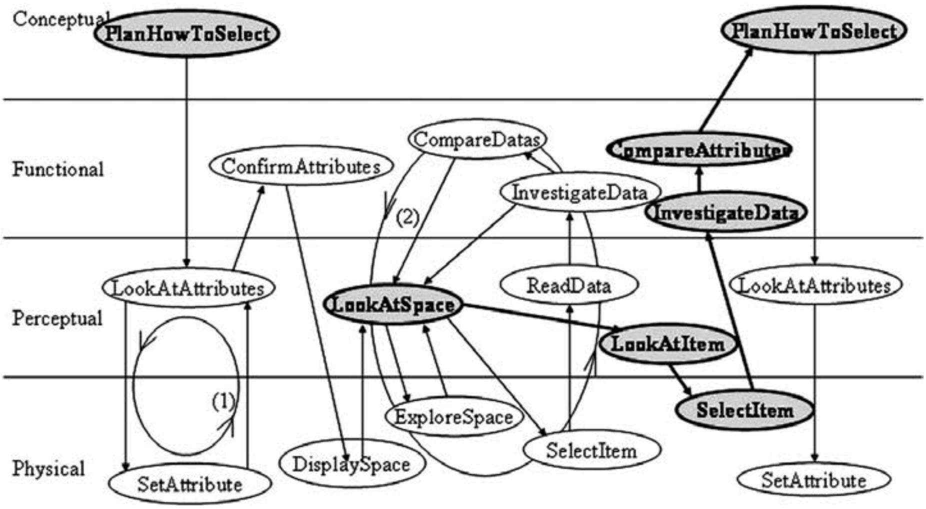

Fig. 5 A part of cognitive process of a subject using spatial-arrangement style interface

3.3 Discussion: effectiveness of spatial-arrangement style information presentation

With spatial-arrangement style interface, information which happens to catch a subject's attention triggers a mental leap from their routine mental loop (a cycle labeled (2) in Fig. 5) based on their current viewpoint. This mental transition at the perceptual level exactly means "conception" defined by this study. In other words, using transition diagram representation in the analysis with unit cognitive processes, "conception" can be represented as a phenomenon that "breaks a routine mental loop at the perceptual level". Additionally, if this phenomenon is frequently observed with spatial-arrangement style information presentation, our hypothesis 1 described above is validated.

Then, from protocol data for all of the eight subjects, we extracted and counted the cases to show a direct transition from a subordinate-level cognitive process to the next plan before reaching a decision at the conceptual level. Table 2 shows the result. This shows that if spatial-arrangement style presentation is used, "another item which happens to catch a subject's attention while they are looking at the space (LookAtSpace)" often triggers a shift to a different plan in every subject's mind in every group. Therefore, this result suggests the validity of our hypothesis 1. It shows, in other words, that spatial-arrangement style information presentation is effective in support of user's conception and thus promotes their concept articulation. With listing style presentation, it could be a matter of course that such an effect is less frequently observed because only items matching the criteria are presented; however, it is of significance that the conception support effect of the spatial-arrangement style information presentation could be recognized as a difference in transition pattern of the unit cognitive processes in terms of whether or not the decision at the conceptual level is undergone.

Table 2 also shows that the conception support effect of spatial-arrangement style presentation is more frequently observed in subject groups 1 and 2, whose members are much interested in and knowledgeable about target goods. Therefore, this leads to a conclusion that a subject more interested and knowledgeable about target goods is more frequently prompted to concept articulation with the "conception support effect". On the other hand, the difference in their familiarity with system interface, including knowledge of MDS, seems to have no effect. Subjects who are very interested and knowledgeable

Table 2 Count of plan changes by "conception effect" (summary per triggering cognitive process)

Location	Look At Attributes	Look At List	Read Data	Read Help	Read Log	Total
(a) Listing style interface						
Group 1	0	0	2	1	0	3
Group 2	0	0	1	2	0	3
Group 3	0	0	0	2	0	2
Group 4	0	0	0	1	0	1
(b) Spatial-arrangement style interface						
Group 1	0	5	1	0	0	6
Group 2	0	6	0	2	0	8
Group 3	0	2	1	1	0	4
Group 4	0	2	0	1	0	3

about target goods can straightforwardly convince themselves with their own knowledge as a background once they have become aware of triggering information. In contrast, even if any information happens to catch their attention, subjects who have less knowledge cannot leverage it to prompt themselves to conviction. This experiment does not cover the conviction support effect of S-Conart, but is intended only for its conception support effect.

4 Experiments on effects of scene information presentation on user's conviction

4.1 Overview of experiments

4.1.1 Hypothesis to be verified

This section describes the second experiment and discusses the effects of the support for user's conviction with scene information presentation. A hypothesis to be verified in this experiment is as follows:

Hypothesis 2 In order for a customer to smoothly accept a new viewpoint once they have conceived it, they need to convince themselves. Presenting "scene information" such as image and use scenes of product items is effective in promoting user's conviction, which facilitates their concept articulation.

A study by Ishino et al. (2000) on concept articulation of consumer goods has relevance concerning the effectiveness of scene information. Their study showed that conceptual information on "product concepts" such as concrete scenes of living is deeply related to the consumer's potential eagerness for purchasing and the information presentation which allows them to be conscious of this conceptual information has the effect of rousing their eagerness for purchasing. "Conceptual information" as referred to in their study is almost equivalent to "scene information" described in our study. That is, their study suggests that scene information is effective in concept articulation. In the domain of marketing, it is well known that providing consumers with an explanation of functions, characteristics, and benefits of merchandise, that is tied to their life styles and sense of value, is generally an effective means of appealing to their sensibility to rouse their eagerness for purchasing. Because scene information is intended to give them a concrete example of product concept, it is useful especially for their conviction. This consideration brought the authors building S-Conart to the assumption that scene information is effective in facilitating the customer's conviction. Specifically, S-Conart implements the two features shown below and provides users with appropriate information for their current thinking to try to facilitate their concept articulation.

I. Presenting comment information including scene information When a user selects a product item in the product space, S-Conart shows its attribute data as well as comments containing scene information on the item.

II. Displaying the scene information window This facilitates user's conviction with both graph and tree style presentation of words extracted from comments on all the products. They can specify an item and then show the relevant words, or conversely specify words in the scene information window and then show the relevant items in the product space.

In order to verify hypothesis 2, this study conducted the second experiment on choosing Japanese sake items to examine how the human cognitive process varies with the information presented, which is either comment information only corresponding to method I or comment information plus the scene information window corresponding to method I + II. Since the first experiment described in Sect. 3 has already confirmed the effects of spatial-arrangement style information presentation on user's conception, the second experiment made no comparison with the listing style presentation, and examined the effects of scene information added to the spatial-arrangement style interface. The following sections describe the overview and result of this experiment and include discussions.

4.1.2 Experimental subjects

Similar to the first experiment described in Sect. 3, the second experiment was performed for eight subjects placed into four groups with two members each, as shown below. The criteria and method of grouping is the same as in the first experiment. The subjects were numbered from 9 to 16 because they must be distinguished from those in the first experiment. The subjects were five men and three women in their 20s to 30s.

- Group 1 (subjects 9 and 10)
- Group 2 (subjects 11 and 12)
- Group 3 (subjects 13 and 14)
- Group 4 (subjects 15 and 16)

4.1.3 Procedure of experiment

Each subject was given a document describing the content of the experiment and assignments and then followed the procedure shown below to perform their respective experiment. The assignments were the same as those used in the first experiment.

1. Fill in an advanced questionnaire before starting the experiment (15 min maximum)
2. Use "method I" to do either assignment 1 or 2 (30 min maximum)
3. Have an interview and respond to a questionnaire regarding the assignment done in step 2 (about 60 min)
4. Break (10 min)
5. Use "method I + II" to do an assignment different from the one in step 2 (30 min maximum)
6. Have an interview and respond to a questionnaire regarding the assignment in step 5 (about 60 min)

4.2 Analysis

4.2.1 Method of analysis

Analysis of the experiment was made using the same method as in the first experiment described in Sect. 3. Using the unit cognitive processes defined in

Table 1, the behavior of subjects when they used "method I" and "method I + II" was analyzed microscopically to draw the transition diagram of their cognitive process. Then, the difference in the cognitive process between both methods was examined through the diagram.

4.2.2 Analysis of using comment information

Figure 6 is a transition diagram to show part of a subject's cognitive process while completing their assignment using method I, i.e., using comment information. Although transition diagrams in Sect. 3 started with selecting attributes, the diagram illustrated here starts with an entry into the "routine mental loop" where they are thinking in line with their current concept while looking at the product space. This is because this experiment is intended to examine additional effects by adding comment information to spatial-arrangement style interface instead of making a comparison with listing style interface.

This subject has set a plan for item selection based on some concept, and is currently looking at the screen and thinking about the availability of goods that meets their concept. The cycle indicated with a circle shown in the left part of Fig. 6, i.e., a loop in the hatched region, represents the process of repeating this task. While looking at the space displayed (LookAtSpace), the subject clicks on an item name of interest (SelectItem) to browse its product data (ReadData) and make an investigation and comparison of product data (CompareData, Inves-

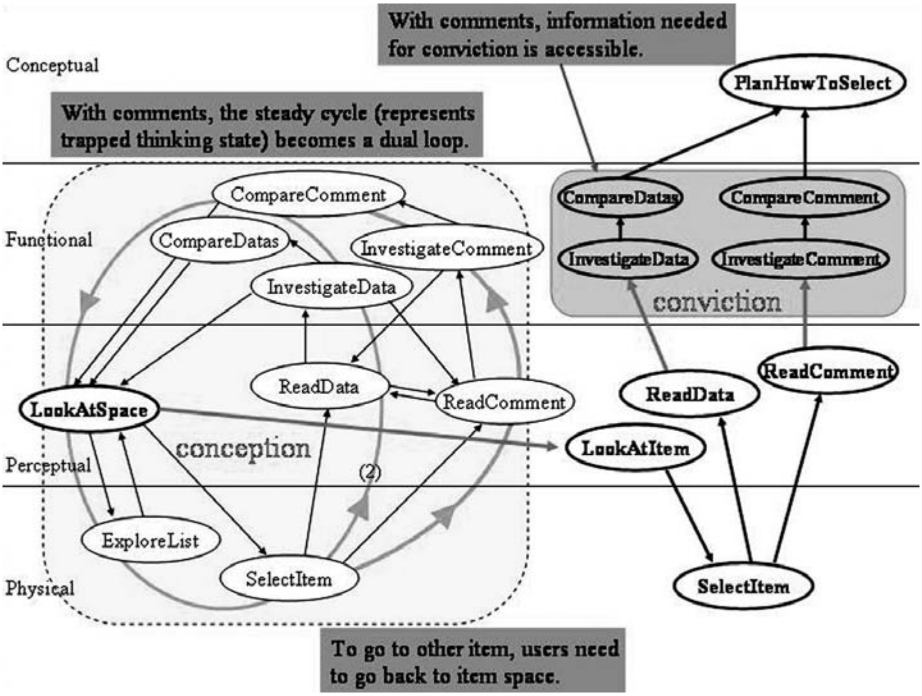

Fig. 6 Part of the cognitive process of a subject—method I

tigateData). Alternatively, they click on an item name of interest (SelectItem) to read comments on the item (ReadComment) and make an investigation and comparison of the content of the comments obtained (InvestigateComment, CompareComment). Comparing to Fig. 5 where only spatial arrangement of product items is used, Fig. 6 shows that a loop to represent the routine mental cycle partly has a dual structure. In other words, this cycle characteristically consists of two processes: one for thinking based on attribute data of a selected item, and the other for thinking based on comments on a selected item. In addition, this subject clicks on an item (colored blue) not corresponding to the current view (SelectItem), because it has happened to catch their attention (LookAtItem) while looking at the product space. Also in this case, balancing one item with another by reading the comments on them (InvestigateComment, CompareComment) can help the subject have a better understanding and make the next plan.

4.2.3 *Analysis of using comment information plus scene information window*

Figure 7 is a transition diagram to show part of a subject's cognitive process while completing their assignment using method I + II, i.e., using comment information as well as the scene information window. Compared to using method I only, shown in Fig. 6, the structure of a region for the routine mental cycle becomes more complicated. Similar to using method I only, there is a loop

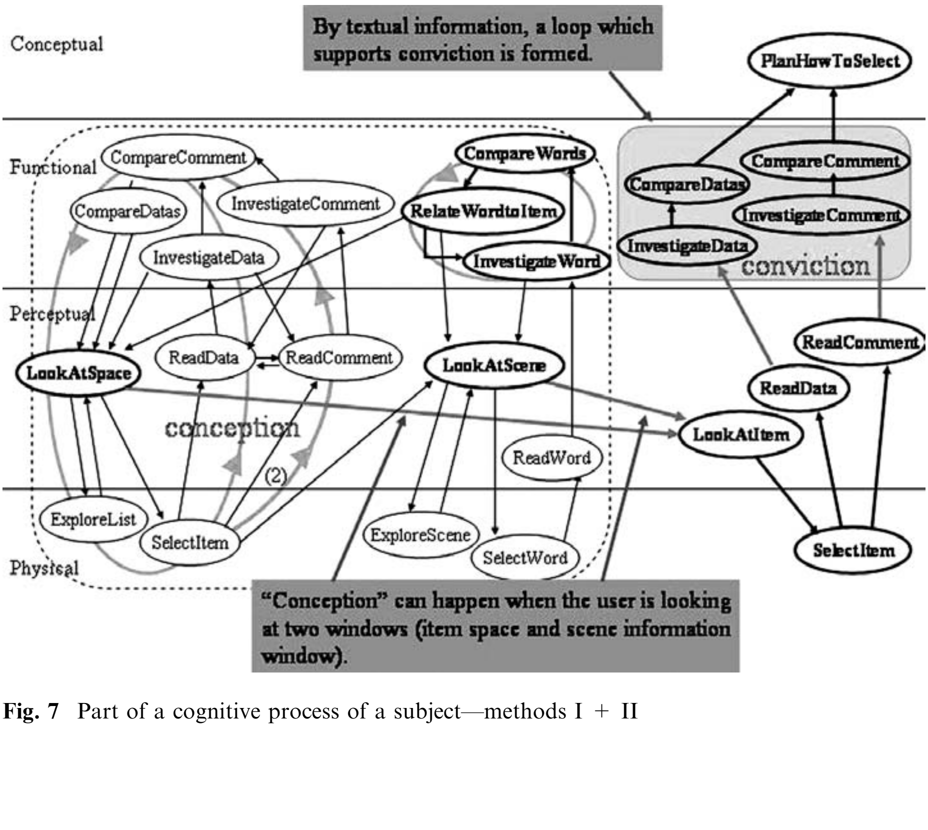

Fig. 7 Part of a cognitive process of a subject—methods I + II

with a partial dual structure; however, this part shows a state for playing around while looking at the product space. Added to the right of the loop is another one of a smaller size, which shows a state for playing around with the meaning of words and the relationship with products. In other words, a subject is thinking by switching between the product space (the world of products organized based on their attributes) and the scene information window (the world of words). Because the world of words rather requires a user to think about the meaning of words (from subject's comments), unit cognitive processes at the functional level more frequently appear than ones at the physical level (word selection and window operations) and ones at the perceptual level (looking at the scene information window).

The subject shown in Fig. 7 gets interested in the word "yogurt" which seems irrelevant to Japanese sake (LookAtWord) while looking at the scene information window. Thus, when clicking on the word "yogurt" then returning to the product space (LookAtSpace), several items whose comments contain the word are shown in pink. They click on each of them one by one (SelectItem) and then read its comments and attribute data (ReadComment, ReadData) to understand that sake with a yogurt flavor seems to be to my taste (InvestigateComment, InvestigateData). And then, this subject makes a plan to speculate about the desired items based on the concept of "yogurt flavor" (PlanHowToSelect). Observation of the entire behavior of this subject has found that their conception occurred during looking at the product space (LookAtSpace) and the scene information window (LookAtScene).

4.3 Discussion: effectiveness of scene information presentation

As discussed in Sect. 3, conception can be represented as a phenomenon that "breaks a routine mental loop at the perceptual level". Unit cognitive processes corresponding to conviction after conception can be described as balancing, and other processes (InvestigateData, CompareData, etc.) observed at the functional level immediately after conception occurred by breaking the routine loop at the perceptual level.

Therefore, in order to examine the "conviction support effect" of methods I and I + II, the authors counted how frequently conviction was facilitated to lead to a change in the subject's plan from the routine loop after conception occurred while looking at the product space (LookAtSpace). From protocol data for all of the eight subjects, we extracted and counted the cases to show a direct transition from a cognitive process at a subordinate level to the next plan before reaching a decision at the conceptual level via "balancing and other processes observed at the functional level immediately after conception occurred". Table 3 shows the result, and because the experiment using method I + II observed the cases as well where conception occurred during looking at the scene information window (LookAtScene), they were included in the table. In addition, Table 3 includes data for using spatial-arrangement style interface only, as materials for investigating the conviction support effect of presenting comment information. It is difficult to make a rigorous comparison with these data because different subjects were used; however, they can serve as a reference to determine the general trend including the difference in subject between groups.

Table 3 Relationship between "conviction effect" and count of plan changes

Condition Location	Only spatial	Spatial + I	Spatial + I + II		
	LookAtSpace	LookAtSpace	LookAtSpace	LookAtScene	Total
Group 1	5	7	6	2	8
Group 2	6	9	8	3	11
Group 3	2	6	6	2	8
Group 4	2	6	7	1	8

Table 3 shows that the experiment using spatial-arrangement style interface, described in Sect.3, frequently observed the concept articulation effect only for the subjects who are very interested and knowledgeable about target goods (groups 1 and 2); whereas the experiment using methods I and I + II respectively, described in this section, observed the concept articulation effect at the same levels for subjects in all groups. Subjects who are very interested and knowledgeable about target goods can straightforwardly convince themselves with their own knowledge as a background once they have become aware of triggering information. In contrast, even if any information happens to catch their attention, subjects who have less knowledge cannot leverage it to prompt themselves to conviction. Presenting comment information—method I and furthermore using the scene information window as well—method I + II, can help even users with less expertise convince themselves. The experiment using the scene information window in method I + II observed the cases where subject's conception that occurred during looking at the scene information window (LookAtScene) served as a trigger for them to select items and read the corresponding comments and/or data to convince themselves, resulting in a change in their plan; however, more frequently observed was a sequence of conception that occurs during looking at the product space, followed by conviction, and finally change in plan. The authors think that the scene information window plays a greater role in facilitating potential conviction in the routine mental process during a run-up of conception (as shown in Fig. 7 as a smaller *circle*) than bringing about the conception effect by the spatial arrangement of words.

The result obtained here shows the same tendency as findings by Suwa et al. (1998). Suwa et al. (1998) analyzed a process where an architect interacts with a sketch made by themselves, and demonstrated that when an unexpected discovery occurs, there is a tendency of a high F-P correlation, i.e., a successive occurrence of cognition at the functional level after that at the perceptual level. We usually tend to think that "discovery" is triggered by cognition at the perceptual level; however, mere conception does not always lead to concept articulation. It is not until conviction at the functional level is delivered that conceived information does make sense. Suwa further evolved his study of the F-P correlation to propose the concept of "constructive perception". Interestingly, this is similar to an idea presented by this study that "conception" and "conviction" constitute a framework for concept articulation.

5 Related Work

The retrieval of information useful in decision-making and/or problem-solving from among a flood of information accumulated requires a user to describe their information requirement accurately and pass it along to a system. In an early stage of problem-solving or decision-making, however, they often have unclear requirements for necessary information and only a vague idea on what they want to find out from the information. Especially in the case of searching for information by trial and error, information requirements are often gradually being made definite or even changing as searching progresses (Bates 1989). In this case, a user will collect useful information for their decision-making or problem-solving with the gradual elicitation of their own information requirements through repeated interaction with their system. The interaction with a system is preferably to be supportive of the elicitation of user's information requirements.

The existing endeavors of the information retrieval community to deal with vague information requirements as described above include frameworks for interactive search that allow a user to present their system with the search result from the system matching their interest or concern, based on which the system can make a search again or classify the result. For example, the relevance feedback technique used in the SMART system (Salton et al. 1993) and others allow a user to give the system their feedback about whether or not the search result or a set of relevant keywords provided by the system meets their own information requirements. Based on the feedback, the system modifies their parameters to search for the information more appropriate to the user's requirements and then present it to the user again. Repeating this interaction enables the user to obtain more precise search results.

As another example, the Scatter/Gather technique (Hearst and Pedersen 1995) does interactive clustering of a large amount of information such as the search result to support user's searching. This technique automatically classifies the search result into several clusters and then presents their user with a summary of each cluster to let them select the ones of interest to them. The system gathers the selected clusters together, classifies them into another set of clusters, and then presents the user with them again. Repeating this interaction enables the user to start their search even with vague information requirements. This technique focuses on refining user's vague information requirements by allowing the user to choose among information presented by the system.

The RABBIT system (Williams et al. 1982) tries to support information searching by their users, based on the "retrieval by reformulation" paradigm. This system presents the instances (including those of superordinate concepts) that serve as examples, for each partial query input by a user. The instances presented by the system can help its user determine appropriate attributes for searching. In other words, the user figures out a model for information accumulated in the system, such as what instances are composed of what attributes, by looking into the instances presented by the system, and then reformulates their query adjusting it to the model.

Any one of conventional studies as presented here aims at the articulation in the sense of searching for appropriate words or examples for describing information requirements. In other words, it assumes a situation with information searching where the user is conscious of characteristics shown by data or what the data mean, but does not know the information requirements to describe them properly. These studies focus on a vagueness level of information requirements that involves clear understanding and difficulty in articulation of the content, and do not cover the "vagueness with fluctuating thoughts". On the other hand, our study exactly endeavors to help human beings clearly articulate their vague thoughts through interaction with their information environment.

6 Conclusion

This paper has addressed information presentation methods to effectively facilitate purchasing as concept articulation, and proposed the framework for HCI design to enable the methods. Specifically, this study built a system called S-Conart that facilitates purchasing as concept articulation through support for customer's conception with spatial-arrangement style information presentation and for their conviction with scene information presentation, and then made a set of evaluation experiments with the system to investigate its effectiveness. These experiments verified that the approach used in building the system is effective in facilitating the purchasing as concept articulation. Creativity support studies of recent years have shown that everyone can sometimes display their creativity. However, these traditional studies have been only targeted at specialized activities such as designing and paper writing. The authors have shown in this paper that creative thinking is observed also in everyday activities such as online shopping. Our study could be a first step toward building a system that allows many customers to do their creative thinking.

Recently, the number of Internet users is skyrocketing and individuals have more and more occasions for using the Internet. For example, we use the Internet on a daily basis to search for information, buy online, or have a chat. In so doing, individual users, in some cases, may not be able to get satisfactory information regardless of the availability of overabundant information on the Net and the certain existence of necessary information somewhere. It is about time for all the providers of information environments on the Internet to know not only techniques for providing useful information or features such as information retrieval and communication but also how individual users interact with information and online communities on the Net and how they make their decision or problem-solving through the interaction, and to aim at the environment for providing truly valuable information for them. In particular, an inevitable challenge for extending the potential of information navigation on the Internet is to facilitate the process where a user leverages available information to articulate their thoughts starting with their initial unclear requirements for or image of their wants. This is because only a few technologies have so far been provided to deal with the vagueness of thoughts although not many studies and technology development have already been made for information presentation to users with their initial definite requirements in mind. This is not in line with the actual situation where quite a few users initially have only unclear requirements in mind.

Considering these circumstances, this paper provided an overview of the significance, approaches, and findings of the studies particularly on the process of vague thoughts being clarified and articulated, among engineering studies focusing on the vagueness of thoughts. The findings from our study discussed herein on the interaction design for facilitating user's articulation of their vague and fluctuating thoughts can help in opening up the possibility of social navigation over the Internet in the future. When people acquire ability to build up dynamically and use their own knowledge through the interaction with plenty of information on the Internet, the Internet will be exactly the place for the creation of social intelligence. This study serves as the initial step toward it.

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