Chapter 4
Cognitive Mechanism in Selecting New Products: A Cognitive Neuroscience Perspective

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Abstract Potential needs and preferences of consumers are often difficult to evaluate with questionnaires. Numerous studies have indicated that in reality, people do not necessarily recognize the influences on their own preferences and misrecognize the rationale for their preferences. Neuromarketing, which is the application of neuroscientific findings to marketing has been gaining attention as a method of exploring concealed consumer needs. This chapter summarizes research that is representative of neuromarketing (McClure et al. 2004), and then introduces the author's studies exploring the application of findings on the cognitive background of individual differences in behaviors when purchasing unknown products. Furthermore, the chapter discusses the possibilities of neuromarketing as a method of exploring hidden consumer needs and preferences.

4.1 Consumer Needs May Be Misunderstood

Analyzing consumer needs or user trends and applying these findings to next generation products and service development are extremely important for companies. Therefore, every company puts much effort into marketing research to determine consumer needs. Various methods of marketing research, such as quantitative studies using questionnaires, qualitative studies by group interviews and in-depth interviews (one on one interviews), and evaluation grid method[1] have been used in the field. Many of these methods require consumers to somewhat correctly verbalize their needs. In other words, they are based on the assumption that the consumer needs can be verbalized. Is this true? The question arises when those who are in marketing in the business world often say, "we want to apply *the*

[1]See details for Burns et al. (2016).

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consumers' voice expressed by questionnaire surveys for improving and developing products; however, often this technique doesn't work".

A person's own *preference* is the most influential factor when making choices, and this is not only related to making purchases. If people can accurately verbalize their own preferences, we could easily find consumers' needs by using the methods described above; however, numerous recent studies in cognitive and social psychology suggest that individuals do not necessarily recognize factors affecting their preferences and often people misunderstand rationales for their preferences. For example, Wilson and Nisbett (1978) asked people passing by a department store to choose the best pair of stockings from four pairs of nylon stockings. Participants did not know that all the stockings were actually identical. However, many participants (about 40%) chose stocking placed at the right-hand side. Similar studies conducted after Wilson and Nisbett (1978) have also replicated the same results; people more likely to choose products placed at an edge. This phenomenon, which is called the *position effect*, is not recognized by consumers; furthermore, many of them fluently reported their reasons for making their choices.

The phenomenon of blindness for the dissociation between intentions and choice outcomes is known as *choice blindness* (Johansson et al. 2005). In choice blindness experiments, the researcher presents pictures of female facial pairs to 120 participants (70 female) and ask them to choose the most attractive face. After a participant selects a picture, it is hidden and then presented again and the researcher asks participants to state their reasons for choosing the particular picture. Before presenting the picture again, the researcher tricks the participant by using the magic card trick and switch the selected picture with the other picture that participant did not select. When this trick is used, less than 30% of participants realized that the picture presented the second time was different from the one they had selected. Moreover, many participants stated the reason *why they had chosen the picture that they had not chosen*, including it having attractive eyes, having a good hairstyle, and wearing nice earrings, among others. This study suggests that, although they supposedly chose the picture based on their own preferences, they did not realize their own preference, or the dissociation between their intention and the outcome of their choice.

Previous studies in cognitive and social psychology have attributed the dissociation between rationales and outcomes to possible misconceptions about the cause of preferences. Therefore, it is possible that consumer needs extracted by questionnaires do not reflect the true needs of the consumers.

4.2 Unconscious Effects on Consumer Preference

4.2.1 Mere Exposure Effect

In the previous section the possibility of manipulating individual preferences at an unconscious level was discussed. In fact, numerous studies have explored these

possibilities, and the most well known method of controlling preferences is known as the *mere-exposure effect*. The mere exposure effect proposed by Zajonc (1968) suggests that repeated exposure to certain stimuli could alter attitudes toward that stimuli (generally becoming more favorable). Zajonc, in his experiment, showed Turkish words to participants that were naïve to Turkish language. The number of presentations of the words varied from 0 to 25 times, and participants rated their preferences for the words using a seven points scale ranging from 6 (*good*) to 0 (*bad*). Results indicated a positive correlation between the number of exposures and preference. Similar effects have been reported not only for Turkish words, but also for Chinese characters, faces, names, pictures, sounds, paintings and so on (Bornstein 1989).

The mere exposure effect has also been observed for product preferences (Janiszewski 1993; Obermiller 1985; Bornstein 1989). For example, it has been demonstrated that the repeated presentation of a product logo can shape preferences to that product. Moreover, people that do not recognize this effect, attribute their product choice to other factors, regardless that the preference was induced by repeated presentation of the logo. Yamada and Toyama (2010) demonstrated that people develop strong preference for a product when they use reasons to justify their preferences. They prepared laundry detergents with a product logo and a product effects message. At first, they repeatedly presented two detergents to participants for differing numbers of times: the high and low exposures detergents. Then, participants were asked to select the detergent that they were most likely to purchase. There were two conditions, one in which the detergent had only a logo and one in which it had a logo and a message. Finally, participants were asked for the reason for their choices. The results indicated that the high exposure detergent was better preferred by participants than the low exposure detergent. This finding confirmed the mere exposure effect. Furthermore, the effect was more salient when the detergent had a product effects message. Moreover, the participants did not necessarily realize the effects of exposure frequency, and they responded that they chose the product based on the content of the message.

4.2.2 Effects of Product Naming

There is a proverb, “names and natures do often agree”, meaning, “names of things and people often accurately depict their characteristics”. From the perspective of cognitive science and cognitive psychology, this proverb reflects the effects of naming on behavior and thinking. There are many examples in the field of marketing; the Japanese clothing company, Renown Inc. changed the name of their men’s antibacterial deodorant socks from “fresh life” to “tsuukin kaisoku (meaning fresh feet for commuting in Japanese, homophone for an express train that office workers use for commuting)” and the first year sales of the product increased from about a hundred million yen to 1.3 billion yen and the second year to 4.5 billion yen. The naming of the bottle green tea by Ito En, Ltd., the Japanese beverage

company, is another example. Name of the green tea was changed from "sencha (name of one type of green tea)" to "o-i, ocha (meaning, 'hey, tea')", which yielded four billion yen in sales, six times the original. These sales figures of course include the effects of advertising in addition to the effects of the name change. Nevertheless, these cases illustrate how naming of products not only serves as a mere label of distinction, but also greatly affects unconscious thinking and behavior.

Previous studies in cognitive science and social psychology have also reported an interesting phenomenon in which names affect our thinking and behavior at an unconscious level. For example, Pelham et al. (2002) reported that many dentists' names in the U.S. start with D and lawyers names with L. Moreover, Nelson and Simmons (2007) reported that baseball players in major leagues in the U.S. whose name starts with K tend to have more strikeouts (strikeouts are recorded as K in baseball score books). Other interesting studies on the effects of names include the fact that cover letters with Caucasian names get more interviews than those with names of black people, regardless of their achievements (Bertrand and Mullainathan 2004). Moreover, the easiness of pronouncing a name affects impressions regarding people (Laham et al. 2012).

An interesting perspective of the Japanese language is that notation in Japanese can take three formats: Chinese, Katakana, and Hiragana characters. Therefore, the authors examined whether differences in Japanese notations of particular Chinese and Katakana characters affected thinking (categorization) by using city names (Honda et al. 2016). It was found that the typical bias, regional bias, was observed for the city names written in Chinese characters, indicating that regional information about cities affect categorization. Here the regional bias means the psychological tendencies that cities close in location to each other are simultaneously seen in newspaper texts and so on than those far apart in geographical distance and that people tend to group cities by region. In contrast, the regional bias was attenuated for the city names written in Katakana. Since city names are typically written in Chinese characters, it is possible that city names might reduce regional biases when written in Katakana characters.

The above discussion clarifies how naming can greatly affect our thinking and behavior at an unconscious level, and thus it is highly possible that product names also affects our purchasing behavior. We might mistakenly buy products thinking that a product is of good quality, because the naming of the product emphasizes its quality. Such behavior again points to possible misconceptions about rationales for our choices.

4.3 What Is the Voice of the Consumer?

4.3.1 Consumer Attitudes Affect Preferences

As has been discussed above, people do no necessarily recognize actual factors affecting their preferences and often misrecognize the rationale for their preferences.

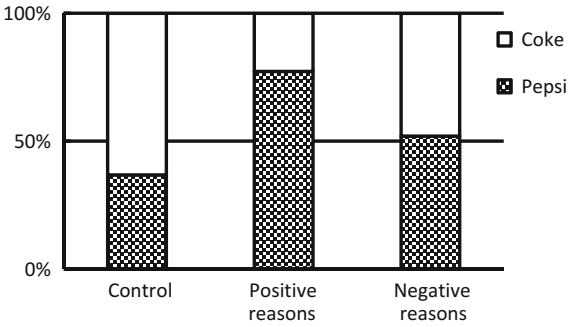

Fig. 4.1 Preference ratio for each type of cola in control, positive reason analysis, and negative reason analysis groups. This is a partially modified version of Fig. 2 in Yamada et al. (2014)

This suggest that *consumer's voice* might not be reliable. Moreover, the authors have shown that people may be dominated by their own voices or attitudes during consumption" (Yamada et al. 2014). Of particular, the effects of consciously analyzing one's preference for beverage were examined by utilizing two types of cola drinks, Coke and Pepsi. Participants were randomly divided into three groups: the positive reason group in which participants analyzed their reasons for liking a cola, the negative reason group in which participants analyzed their reasons for disliking a cola, and the control group that did not conduct any analysis. Then, all participants tried Coke and Pepsi and chose the cola that they liked the best. Results indicated that participants in the control group tended to select Coke more often than Pepsi, whereas participants in the positive reason group showed a strong preference for Pepsi. Moreover, the negative reason group did not show differences in preferences between Coke and Pepsi (Fig. 4.1). Furthermore, reasons for liking Pepsi seemed easier to describe than reasons for liking Coke, but there were no differences in reasons for disliking Coke, or Pepsi. These results indicate that outcomes can differ from intuitive evaluations when people consciously analyze their taste preferences. Moreover, easiness of describing reasons affects fluctuations in evaluations. That is, the easiness of describing evaluation criteria possibly works as a bias that distorts preferences and tastes. As discussed, previous studies have shown that consumers might have difficulties in accurately verbalizing their needs and desires, thus validating the statement made by marketing researchers described above.

4.3.2 Meaning of User Innovation

Then, is it merely a dream to develop products and services based on consumer's potential needs?

User Innovation often happens when users of services and products cause innovation to achieve their goals, instead of suppliers, research centers of enterprises, or product development teams making the innovations. Von Hippel first

pointed out this phenomenon.[2] He described that most initial developments and important changes to technically novel and commercial successful physical and chemical appliances are produced by advanced users called *lead users*. He has shown that one important source of ideas for such new industrial goods (B2B or Business-to-Business goods) might be the users, and not the suppliers. Furthermore, the authors found that user innovations could also take place for consumer goods (B2C or Business-to-Consumer goods), and that ideas for new products tended to be generated by *early adopters*, who are those users that adopt new products and services relatively early, after (but not right after) the products are put in the market (Ueda et al. 2010). Their ideas could include new or unconventional ways of using existing products, which are often beyond the imagination of suppliers. The authors have called this "*unexpected product usage*". In other words, the potential needs of users are expressed as actual actions of using products, or unexpected uses for existing products, not as written answers in questionnaire surveys. For this reason, it is difficult to examine the potential needs of consumers and users by using a questionnaire (linguistic method).

4.4 Neuromarketing

If verbalization of desires and needs of consumers is difficult, is it possible to manifest these concealed needs of consumers using brain or physiological measurements? This idea has lead to the field of neuromarketing which has currently gained much attention. Neuromarketing is a field of research that examines consumer psychology and mechanisms of purchase behaviors from the perspective of brain science, by measuring brain activities and physiological changes in consumers, and applying the findings to marketing.[3]

The study by McClure et al. (2004), which utilized the Pepsi challenge, and which is probably familiar as a TV commercial, made neuromarketing famous. The participants made a choice between Coke or Pepsi, and the study examined how label information (which is a kind of brand information) influenced their choice. Chemical ingredients of Coke and Pepsi are similar, making them optimal for examining the effects of brand information on consumer choice. When the participants were made to drink Coke or Pepsi with the labels hidden, they chose either one with equal probability with no bias in their choice. Also, no bias was seen when participants were given two cups of Pepsi, one with the Pepsi label and the other without the label, (participants did not know that both cups contained Pepsi). However, when participants were given two cups of Coke in the same situation, one cup with the Coke label on and the other without the label, (participants again did not know that the contents of the both cups were identical, Coke) they showed a

[2]See von Hippel (2006) for more details.

[3]For further readings about neuromarketing, see Ramsøy (2015).

strong bias for choosing the cup with the Coke label. Therefore, Coke and Pepsi were chosen with the same probability from the pure perspective of taste, but the Coke label had a strong influence on people's choice, demonstrating that people have a strong preference for the Coke brand.

Further, McClure et al. (2004) compared brain activities using functional magnetic resonance imaging (fMRI)[4] when the participants drank Coke and Pepsi with and without labels. In short, the results indicated that participants who preferred Coke based on the taste showed a significantly higher activity in the ventromedial prefrontal cortex, which is related to the reward prediction, when the Coke label was presented than when the Pepsi label was presented. This indicates that taste preference is related to the reward system in brain activities. Furthermore, the comparison of brain activities when participants drank Colas after providing label information and without providing label information indicated that brain activities differed between with and without providing label information for Coke but not for Pepsi. Of particular, when the participants were presented the Coke label, brain regions related to higher cognitive function and memory was activated. These results indicate that brand information is associated with memory images and higher cognitive functions affecting the reward system. Therefore, it is possible that a brand functions as a type of reward.

The above study suggested that Coke has a successful brand strategy compared to Pepsi because cultural familiarity created by advertisements affects memory and higher cognitive functions as well as essentially affects people's choices. The study by McClure et al. (2004) has gained attention as a study showing the quality of a brand strategy by using brain activities. However, the ventromedial prefrontal cortex that was focused on in their study is strongly activated not only by physical reward prediction, but also by the prediction of familiar products. Thus, higher brain activities might have been observed due to the familiarity of Coke and not because of its successful brand strategy. We do not have to again mention the mere exposure effects discussed in the Sect. 4.2.1 to infer that people tend to choose products with high familiarity, which is a well known concept in the marketing. Therefore, it is difficult to directly apply the findings of McClure et al. (2004) to practical marketing.

4.5 Meaning of Choosing a Novel Product

4.5.1 Which Is More Important: Exploitation or Exploration of Knowledge?

Although many of the products sold in the world are highly familiar to consumers, some products are unknown to consumers, for example, consumers are rather naïve

[4]fMRI is a technique to visualize the brain blood flow on the image obtained by MRI. It is frequently used to measure brain activities since it is non-invasive.

to novel products. As mentioned earlier, people tend to prefer familiar products. So, why do new products get sold even temporarily?

Buying new products can be considered as a part of the psychology of pioneering[5] and pioneering consumers might value gaining new information. In animal psychology, the idea of gaining new information is considered to be advantageous for gaining food in the future, and therefore this concept has been traditionally investigated. Of particular, making correct decisions is important when information changes quickly while looking for new food and new places to search for food. That is, *exploration* becomes important, though explorers have to use information that they already have. Thus, *exploitation* also becomes necessary. This problem is called *the dilemma of exploration and exploitation*. Studies have focused on how people solve this dilemma and when they give priority to exploration. The authors hypothesized that people who tend to buy new products have a higher tendency for exploration and conducted brain measurements as well as psychological experiments.

4.5.2 *Analyses of the Bandit Task and the Water Selection Task*

The bandit task is often used to assess whether a person is exploration dominant or exploitation dominant (Daw et al. 2006). The participants choose a slot machine under a condition in which multiple slot machines change reward rates with time. When the environment (in this case reward given by slot machines) is stable and reward by a selected slot machines were higher, a person would continue selecting the same slot machine by using that information. However, when the environment changes and there is no guarantee that the slot machine with a high reward rate would continue to be the same, then the person must also look at other slot machines, which requires exploring for information. The bandit task examines the degree of information seeking behavior, and it is expressed as parameter β.[6] Notice that smaller is β stronger would be the exploration tendency.

In our experiment, the participants at first engaged in the four-armed bandit task, and we estimated the value of parameter β. Next, participants engaged in a water selection task, in which they chose one bottle of mineral water among four bottles. The brands of water bottles ranged from familiar brands in Japan, such as Evian and Volvic, to unknown brands that are not usually seen in retail stores. The four brands of the four water bottles consisted of one to three familiar brands (or moderately familiar brands) with the rest being unknown brands. We calculated the rate of selecting unknown brands by each participant. Then, we examined correlations

[5]Other perspectives of psychology of buying new products are omitted here.

[6]It corresponds to the inverse temperature parameter in reinforcement learning. See Sutton and Barto (1998) for more details in reinforcement learning.

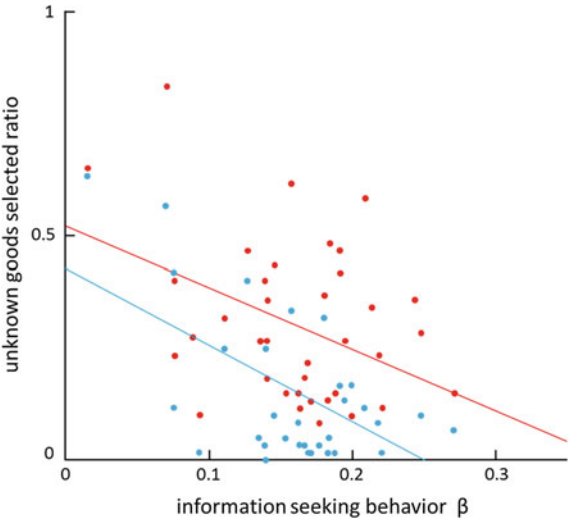

Fig. 4.2 The relationship between the ratio of selecting unknown goods and information seeking behavior (parameter β). *Red circles* denote the ratio of selecting unknown goods among well-known goods whereas *blue circles* denote the ratio of selecting unknown goods among moderately familiar goods. Both *red* and *blue lines* indicate respective regression lines

between exploration parameter β in the bandit task and the rate of selecting unknown brands in the water selection task. The correlation coefficient for the condition in which the participants chose unfamiliar bottle of water among familiar one was −0.52, and for the condition in which they chose from moderately familiar bottles was −0.39 (Fig. 4.2), which were significantly correlated. The negative correlation coefficients suggest that smaller was the exploration parameter β, higher was the exploration tendency of selecting unfamiliar products.

4.6 Conclusion

The findings presented in the Sect. 4.5 indicate that, in the daily task of choosing of products, selecting unfamiliar, new products is a choice that is made to obtain information to maximize future rewards. This finding from the perspective of psychology and brain science supports market theory suggesting that consumers who like to explore new information are open to new brands, and to new fields.

However, the study described in the Sect. 4.5 has a limitation in that participants merely selected the bottles of water; they were neither going to purchase the water with their own money nor actually drink it. The limitation is the study design that did not involve an actual purchase. Therefore, the findings presented in the Sect. 4.5 needs to be further investigated for their application to actual purchase behavior. Neuromarketing would finally become a worthwhile pursuit when we are able to identify causes of phenomenon that marketing personnel are interested in knowing, from the perspective of brain science by using the actual data on purchasing behaviors.

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References

Bertrand M, Mullainathan S (2004) Are Emily and Greg more employable than Lakisha and Jamal? A field experiment on labor market discrimination. Am Econ Rev 94(4):991–1013. doi:10.1257/0002828042002561

Bornstein RF (1989) Exposure and affect: overview and meta-analysis of research, 1968–1987. Psychol Bull 106(2):265–289. doi:10.1037/0033-2909.106.2.265

Burns AC, Veeck A, Bush RF (2016) Marketing research, 8th edn. Pearson, Boston

Daw ND, O'Doherty JP, Dayan P, Seymour B, Dolan RJ (2006) Cortical substrates for exploratory decisions in humans. Nature 441:876–879. doi:10.1038/nature04766

Honda H, Matsuka T, Ueda K (2016) Connecting the same regions or bridging different regions: difference in Japanese script induces different categorization (under review)

Janiszewski C (1993) Preattentive mere exposure effects. J Consum Res 20(3):376–392. doi:10.1086/209356

Johansson P, Hall L, Sikström S, Olsson A (2005) Failure to detect mismatches between intention and outcome in a simple decision task. Science 310:116–119. doi:10.1126/science.1111709

Laham SM, Koval P, Alter AL (2012) The name-pronunciation effect: why people like Mr. Smith more than Mr. Colquhoun. J Exp Soc Psychol 48(3):752–756. doi:10.1016/j.jesp.2011.12.002

McClure SM, Li J, Tomlin D, Cypert KS, Montague LM, Montague PR (2004) Neural correlates of behavioral preference for culturally familiar drinks. Neuron 44:379–387. doi:10.1016/j.neuron.2004.09.019

Nelson LD, Simmons JP (2007) Moniker maladies when names sabotage success. Psychol Sci 18 (12):1106–1112. doi:10.1111/j.1467-9280.2007.02032.x

Obermiller C (1985) Varieties of mere exposure: the effects of processing style and repetition on affective responses. J Consum Res 12(1):17–30

Pelham BW, Mirenberg MC, Jones JT (2002) Why Susie sells seashells by the seashore: implicit egotism and major life decisions. J Pers Soc Psychol 82(4):469–487. doi:10.1037/0022-3514.82.4.469

Ramsøy DR (2015) Introduction to neuromarketing & consumer neuroscience. Neurons Inc., Holbæk

Sutton RS, Barto AG (1998) Reinforcement learning: an introduction (Adaptive computation and machine learning). The MIT Press, Cambridge

Ueda K, Washida Y, Arita A, Shimizu T (2010) The important role of information and cognitive features in idea generation for innovation (in Japanese). Cogn Stud 17(3):611–634.doi:10.11225/jcss.17.611

von Hippel E (2006) Democratizing innovation. The MIT Press, Cambridge

Wilson TD, Nisbett RE (1978) The accuracy of verbal reports about the effects of stimuli on evaluations and behavior. Soc Psychol 41:118–131

Yamada A, Toyama M (2010) Choice based on plausible reasons (in Japanese). Jpn J Pscyhol 81 (5):492–500. doi:10.4992/jjpsy.81.492

Yamada A, Fukuda H, Samejima K, Kiyokawa S, Ueda K, Noba S, Wanikawa A (2014) The effect of an analytical appreciation of colas on consumer beverage choice. Food Qual Prefer 34:1–4. doi:10.1016/j.foodqual.2013.11.008

Zajonc RB (1968) Attitudinal effects of mere exposure. J Pers Soc Psychol 9:1–27

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