Consumers’ Abductive Inference Error as Cognitive Impairment

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Abstract

This study examines cognitive impairment, which is one of the results from social exclusion and leads to various cognitive deficits such as logical reasoning disorders. This study also investigates how cognitive errors called abductive inference error occur due to cognitive impairment. This study was performed with 81 college students. Participants were randomly assigned to a group who experienced social exclusion and a group who did not experience social exclusion. We analyzed how the degree of error of abductive inference differs according to the experience of social exclusion by t-test. The group who experienced social exclusion had a higher level of abductive inference error than the group who did not experience it. The abductive condition inference value of the group who experienced social exclusion was higher in the group with the deduction condition inference value of 90% than in the group with the deduction condition inference value of 10%, and the difference was also significant. This study extended the concepts of cognitive impairments, escape theory, and cognitive narrowing, which are used to explain addiction behavior to human cognitive bias. Also this study confirmed that social exclusion experience increased cognitive impairment and abductive inference error. Implications and future research directions are discussed and suggested.

Keywords: Abductive Inference, Social Exclusion, Cognitive Impairments

JEL Classification Code: D11, D12, M31

1. Introduction

Abductive conditionals have not yet been investigated in the probabilistic truth table task paradigm. Abductive conditionals can be conceived as reversed causal conditionals, characterized as follows: the effect is located in the conditional’s antecedent and the cause is located in the conditional’s consequent. For example, if your headache disappeared, then you took aspirin. Abductive inferences are also known as inferences to the best explanation (for philosophical and psychological overviews on abduction see, e.g., Douven, 2016; Lombrozo, 2012, respectively). Like indicative and causal conditionals, abductive conditionals can be formulated in indicative and in subjunctive mood (Pfeifer & Tulkki, 2017).

Explanatory judgments are central to abductive reasoning, that is: inferring to the available hypothesis that can best explain the evidence. Understanding what determines the explanatory power of a hypothesis is of crucial importance for researchers in different fields: for cognitive psychologists, who study the principles of human reasoning (e.g., Oaksford & Chater, 2000); AI researchers, who use abduction for belief revision, knowledge representation and fault diagnosis; for philosophers of science and epistemologists, who investigate the rationality of abductive inferences, and their relation to probabilistic inference (Douven, 2011).

Expanding on a growing body of literature in the philosophy and cognitive psychology of explanation, we investigated (i) how explanatory power relates to other features of a hypothesis with respect to an explanandum, such the hypothesis’ degree of confirmation, its causal relevance, logical relations, and the sense of understanding it provides; and (ii) how probabilistic information affects explanatory judgment (Colombo, Postma, & Sprenger, 2016).

Social cooperation and support is essential for an individual to survive. In order to secure the skills and resources necessary for survival, people want to belong to groups and adapt their actions and ideas in the way society wants them to. Everyone has a basic desire to belong to a
certain group, which is a fundamental and necessary human needs. Therefore, if an individual is excluded or rejected from the group he wishes to belong to, the individual will be greatly shocked. In addition to being psychologically frustrated and stressed, cognitive thinking ability can be impaired.

In recent years, as the complexity and diversity of society increases, it is often found that the exclusion and discrimination of other members’ increase and become more common, rather than acknowledging and respecting the existence and value of each member. This means that the number of people who have experienced exclusion, discrimination and rejection is increasing, and as a result, more people are also suffering from negative emotions and cognitive impairment.

Kahneman and Tversky (1973) found that the basal rate error, which is the cause of the abductive reasoning error, occurs due to the limitation of cognitive ability of many people, and mainly when the system 1 operates. Unlike previous studies on abductive error, this study aims to find the condition of system 1 in which abductive reasoning error occurs in cognitive impairment caused by social exclusion.

This study examines the characteristics of cognitive narrowing, which is one of the strategies for overcoming the negative emotions resulting from social exclusion, and how cognitive errors called abductive inference errors occur due to cognitive narrowing. In other words, this study explores how cognitive impairment caused by social exclusion experience can be explained through cognitive narrowing and how it affects consumer’s judgment and reasoning and result abductive inference. This study is expected to be useful for the study of social exclusion and the resulting consumer behavior, in particular, the error of consumer decision making and the company’s marketing strategy.

2. Literature Review

2.1. Abductive Reasoning

Abduction, a term first introduced by philosopher Charles Sanders Peirce, is a unique way of inferring a cause or reason from an outcome. If deduction is to infer certain consequences, and induction is to create a valid rule until the opposite is found, then abduction can be seen as inferring a plausible but still uncertain cause. Deductive reasoning and abductive reasoning both require conditional statements, if x represents the cause and y indicates the result, the causal term “y” can be expressed in p(y|x), which is used in deductive reasoning. On the other hand, a derivative conditional statement that “if there is a result of y” can be expressed in p(x|y), which is used for abductive inference. It can be seen that the constitution of the conditional statements of abductive and deductive reasoning is reversed. That is, while deductive reasoning is to draw conclusions from the given evidence, abductive reasoning is the opposite of deductive reasoning in the sense that abductive reasoning should determine the probability of the hypothesis in the given evidence, as well as the conditional statements between the hypothesis and evidence (Josang, 2008). Moreover, because people generally think of deduction reasoning more naturally than abductive reasoning, they tend to make causal reasoning in most reasoning situations where abductive reasoning is required. In other words, there is a situation where abductive and deductive reasoning are often confused, which causes a base rate fallacy (Josang, 2008).

According to the representative heuristic, the probability of event A being true given event B is calculated based on how similar events A and B are. For example, if event A is found to be very similar to event B, the probability of condition in event A is very high when given event B. In other words, the representative heuristic is based on the assumption that the representativeness of a category in the real world consists of the most common and important features existing among the members of the category (Nilsson, Olsson, & Juslin, 2005). Representative heuristics often lead to accurate and useful predictions, but they also risk overlooking important things if you become overly dependent on them. One thing that may be overlooked is the prior probability or base rate of the result. No matter how many new products are similar to successful ones, the new products can still fail if the industry itself has a very low success rate (Kardes, Cronley, & Cline, 2008).

Therefore, base rate error or base rate neglect is a logical error that occurs when probabilistic judgment is made by using inappropriate information while ignoring the empirical statistics called prior probability or base rate. Kahneman and Tversky (1973) analyzed the basal rate error in a systematic experiment and found that the basal rate error is due to representative heuristics. In other words, basal rate errors were viewed as a reflection of their dependence on representative heuristics (Evans, Simon, David, & Perham, 2002).

As we saw earlier, the base rate error occurs in the process of evaluating the conditional probability of y given some evidence x without considering the base rate for the hypothesis y. That is, the base rate error results from the incorrect assumption that p(y|x) is equal to p(x|y) (Josang & O’Hara 2010).

In other words, many people fall into the inverse error that confuses causal and derivative conditions, which makes it difficult to make accurate inferences and judgments about the cause even when it is necessary for inferential reasoning. This error of abductive inference can be expected to occur in the case of cognitive impairment and cognitive narrowing where the cognitive working range is consciously and unconsciously reduced. Cognitive narrowing to overcome
negative emotions resulting from social exclusion can lead to false attribution and lack of causal thinking, which can be expected to lead to cognitive errors called abductive inference errors.

2.2. Cognitive Impairment

Social exclusion refers to the process by which individuals are blocked (or denied full access) to the various rights, opportunities and resources that are generally available to members of other groups and are essential for social integration and human rights compliance within certain groups (Silver, 1994). Social exclusion, also called social marginalization, in the sense of being degraded to the periphery of society and experiencing social disadvantage, is a term that has been generally used in Europe since it was first used in France. Social exclusion is used in many fields, including pedagogy, sociology, psychology, politics and economics (Peace, 2001).

Since maintaining a stable social relationship is so important for human survival and safety, the desire to belong is one of the most important motivations (Smith, Murphy, & Coats 1999). Thus, studies have shown that what is accepted and rejected by social groups has a wide range of effects on individuals. Health, happiness and well-being are closely related to whether people are accepted or denied, and those who are deprived of close social ties have more negative physical and psychological consequences than those with strong social networks (Cacioppo, Hawkley, & Berntson, 2003). Social exclusion can also cause physiological side effects, such as elevated blood pressure, pain-related brain areas being activated (Eisenberger, Lieberman, & Williams, 2003), and negative effects on psychological well-being.

There are conflicting studies on how people who have experienced social exclusion react. According to the theory of the social monitoring system, social exclusion also makes it difficult for individuals to belong to a group and therefore motivate individuals to find social clues that can be included in the group again (Pickett and Gardner 2005). Thus, they are interested in creating new sources of social relations and social ties (Maner, Dewall, Baumeister, & Schaller, 2007), or are very sensitive to social acceptance (DeWall, Maner, & Rouby, 2009), and consume more products symbolizing group membership (Mead, Baumeister, Stilman, Rawn, & Vohs, 2011).

On the other hand, social exclusion can increase antisocial behavior, which is the opposite of pursuing compliance. Those who have experienced social exclusion are more aggressive (Buckley, Winkel, & Leary, 2004), and are less likely to contribute and cooperate less with others (Twenge, Baumeister, Dewall, Ciarocco, & Bartels, 2007). It has also been shown to reduce prosocial behavior and lead to an increase in self-defeating behavior (Twenge, Catanese, & Baumeister, 2002). Those who experience rejection show more antisocial behavior and less willingness to perform altruistic and self-sacrificing behaviors, such as helping others, all of which involve self-regulation failure.

Exclusion from social groups has been shown to impair the cognitive function. Those who experience social exclusion have been shown to distort time perception, to emphasize the present rather than the future, to show lethargic passivity, and to avoid self-awareness (Twenge, Catanese, & Baumeister, 2003). Exclusion from social groups can lead to anxiety or other forms of emotional distress that can lead to short-term impairments of cognitive function, resulting in various cognitive deficits such as logical reasoning disorders (Baumeister, Twenge, & Nuss, 2002).

When people discover the possibility of social exclusion, they may be able to suppress their emotional responses, which will preempt human self-regulatory systems. If the resources of the self are all used to suppress emotions, they will not be enough to control the cognitive process. Thus, more automatic cognitive processes can be operated relatively intact, but controlled processes can be difficult to operate. In other words, social exclusion monopolizes some of the resources of the self-execution function, in particular undermining the controlled process. Eventually, they will have less impact on relatively automatic (less efficient and less controlled) tasks, but damage can be found in tasks that require active thinking, such as reasoning and logic.

2.3. Cognitive Narrowing

The Escape Model is based on the theory of comparing the ideal self with the realistic self and has been applied to explain self-destructive behaviors such as binge eating and suicide (Heatherton & Baumeister, 1991). Self-awareness can sometimes be burdensome for people, especially when their standards are very high or when they are characterized by perfectionism and when they fail to meet their goals or ideals (Duval & Wicklund, 1972). In other words, the escape model is a theoretical framework that looks at how people can escape from their hateful and negative emotional states. One way to reduce negative emotions is to reduce self-awareness, making the discrepancy between self and related criteria no longer pronounced (Duval & Wicklund, 1972). This reduction of self-awareness, in other words, cognitive narrowing, is one of the important types of escapes considered in escape models.

In the case of cognitive narrowing, the focus of attention is narrowed by focusing only on current ideas at hand, specific and low-level ideas, and refusing to think broadly and meaningfully (Baumeister, 1990a). In other words, evidence of cognitive narrowing or cognitive dissolution may include concrete thoughts, immediate goals, and cognitive rigidity. In particular, there are many black and white logics
that are characteristic of cognitive rigidity. But escape from these negative emotions also triggers a number of self-destructive behaviors, such as binge eating, and efforts to escape unpleasant emotions through cognitive narrowing can result in disrupting the usual restraint associated with food and committing irrational thinking. The more people try to avoid meaningful thinking, the less likely they are to be rational and less critical, and the more likely they are not to find any doubts of beliefs or conclusions.

The reason for irrational thinking or irrational cognition is that the normal pattern of reasoning was interrupted, resulting in a kind of mental void (Bauer & Anderson, 1989; Butterfield & Leclair, 1988). When a person is reluctant to think meaningfully, it becomes inefficient to critically evaluate new ideas as compared to everyday situations. Several cognitive distortions found in binge eaters, including faulty attributions, personalization, magnification, dichotomous thinking, filtering, overgeneralization, and magical thinking (Johnson, Connors, & Tobin, 1987). Cognitive narrowing also prevents us from considering the long-term meaning of certain behaviors, for example causal thinking (Faver, 2004).

While cognitive impairment refers to time distortion, lethargic passivity, and avoidance of self-awareness caused by social exclusion, cognitive narrowing means focusing only on low-level phenomena by reducing the range of attention to avoid negative emotions. Both are common in avoiding or reducing self-awareness, but cognitive impairment is broader than cognitive narrowing in cause and phenomenon.

Among the various cognitive distortions caused by cognitive narrowing, the false attribution and the lack of causal thinking are particularly prominent, which is related to the error of abductive inference. In other words, the false attribution caused by cognitive impairment can be expected to lead to the cognitive error, such as error of abductive inference. In this study, the following hypothesis is set up to explore.

**Hypothesis:** Groups that have experienced social exclusion will have a higher degree of abductive inference errors than those who do not.

### 3. Research Methods

This study was conducted with 81 college students in Seoul. Participants were randomly assigned to a group who experienced social exclusion and a group who did not experience social exclusion. We analyzed how the degree of error of abductive inference differs according to the experience of social exclusion.

The manipulation of social exclusion experiences has utilized scenario manipulation methods for applying for membership (Wan, Xu, & Ding, 2014). Participants were given a story and asked to read it carefully, and emphasized the importance of getting into the character’s role and emotions while reading the story as if in the same event in real life. The scenario shows that the main character preparing for employment is eager to join SUCCESS, a job preparation club that provides solid information and effective learning strategies and boasts high employment success rates. It contains that the main character has submitted a membership application to the job preparation club ‘SUCCESS’. Under social exclusion, the main character was contacted by the club a few days later that his application was denied. And under social inclusion, the main character was informed that the application was approved. Participants were asked to describe in detail their feelings after reading the story (Rucker, Dubois, & Galinsky, 2011). Next, participants were asked to respond to manipulation check question about feelings of exclusion or neglect while describing the experience (1 = strongly disagree, 7 = strongly agree). The participants were then presented with a task related to abductive inference and asked to resolve.

Abductive inference reasoning was measured by the following procedure. First, participants were asked to read the following materials.

“In September, the Korea Consumer Protection Agency surveyed electronics stores in downtown Seoul and found that wireless earphones sold at electronics stores differed significantly in quality and price. In general, the quality of wireless earphones depends on their performance and weight. According to the Consumer Protection Survey, when purchasing a high-end wireless earphone, the probability of the price being 100,000 won is about 90 percent. And when you buy wireless earphones that are not of the highest quality, the probability of the price being 100,000 won is about 8%.”

The data suggest probabilities for ‘deductive condition inference’. In other words, the probability that the price is 100,000 won when purchasing high-end wireless earphones (= P (100,000 won|high-end wireless earphones)) and the probability that the price is 100,000 won when purchasing non-high-end wireless earphones (= P (100,000) |¬ high-end wireless earphones) are presented in sentence format expressed as %. Deductive condition inference consisted of '90%' and '10%' and subjects were randomly assigned to the two levels. Subjects who had read the above data were asked the following questions about inferential condition inference.

When you purchased a 100,000 won wireless earphone at an electronics store in Seoul, what do you think is the probability that the wireless earphone is of high quality?

In other words, if you purchased a wireless earphone for 100,000 won, what is the probability that the wireless earphone is a high-end wireless earphone? (=P (high-end wireless earphone|100,000 won)). Answers to the question of “abductive inference” were required to mark on the choices in 10% increments, from 0% to 100%.
Inverse error means to confuse conditional probability with its inverse probability. This can be said to be influenced by deductive condition reasoning in the situation where abductive conditional reasoning is needed by confusing the value of abductive reasoning and deduction reasoning. Therefore, if all other conditions are the same, if the value of the abductive inference required by the task differs according to the presented deductive condition inference, and the difference in the value is statistically significant, it can be considered that the inverse error has produced that is affected by the deductive condition reasoning. Since the base rate information is not presented in this study, various threshold condition probability values can be presented as answers depending on how the subjects estimate the base rate value. However, if the value of deductive conditional reasoning is 10% and 90%, respectively, M10% and M90%, then ⊱ indicates the relationship of M10% < M90% ⊱ and the difference between these values is statistically significant, the abductive condition inference value is influenced by the deductive condition inference value and can be interpreted as an inverse error occurrence. On the other hand, if M10% and M90% do not have the above relationship or the difference is not statistically significant, it can be interpreted that no inverse error has occurred.

4. Research Results

Participants’ responses to the manipulation check question for social exclusion were averaged to form a manipulation check score (Wan, Xu, & Ding, 2014). As expected, participants who were rejected (vs. accepted) by the job preparation club felt more excluded (M=4.74 vs. M=2.05; t(79)=-15.039, p<.001), confirming the success of the manipulation of social exclusion.

According to the analysis of the abductive inference, In the case of group that experienced social exclusion, it was shown that there was an abductive inference error, but in the case of groups that did not experience social exclusion, there was no abductive inference error.

In other words, as shown in Figure 1, in the group that did not experience social exclusion, the abductive condition inference value was found to be greater in the group with the deductive condition inference value of 90% than in the group with the deductive condition inference value of 10%, but the difference was not significant (M_{10%}=44.67 vs M_{90%}=49.26; t (40)=-.742 p>.1).

On the other hand, as shown in Figure 2, the abductive condition inference value of the group who experienced social exclusion was higher in the group with the deduction condition inference value of 90% than in the group with the deduction condition inference value of 10%, and the difference was also significant (M_{10%}=30.40 vs M_{90%}=47.86; t (37)=-2.031, p<.05). Therefore, the hypothesis that groups experienced social exclusion were expected to have a higher degree of abductive inference error than those who did not experience social exclusion was supported.

5. Conclusions

This study found that the incidence of error of abductive inference in the group that experienced social exclusion was higher than that in the group that did not experience social exclusion.

Consumers try to pursue rationality in the decision-making process, but for many reasons they often fail to make rational decisions and make irrational decisions and judgments. Many studies focusing on these irrational aspects of consumers have various opinions on the causes and characteristics of consumers making irrational decisions and
judgments. While there are views that the irrational aspect of consumers appears to be due to the inherent limitations of human cognitive ability (Kahneman & Frederic, 2002; Kahneman & Tversky, 1982), there are also views that the appearance of irrational human beings actually has its own rationality (Gigerenzer, 2008). The former view explains that human efforts to make rational judgments and decision-making are often biased due to human cognitive limitations. Here, one of the theories explaining why humans fall into cognitive error despite human deliberate effort is the dual process model. According to this model, if System 1 of the two virtual brains or minds of human beings is activated, humans are more likely to fall into cognitive error. This model is known to form the basis on which System 1 can operate depending on the nature of the task to be processed, and the motivation of the person handling the task. Unlike previous studies on abductive reasoning, this study confirmed that cognitive impairment due to social exclusion can lead to defects in logical reasoning.

In this study, it was expected that cognitive error will occur when System 1 operates when cognitive narrowing occurs to overcome consumers’ social exclusion experiences and negative emotions. In other words, this study focused on the experience of exclusion or rejection of consumers as well as the cognitive response strategy as a condition under which System 1 can operate. Previous studies have focused only on the fact that the negative emotions of consumers can cause cognitive narrowing, and this cognitive narrowing brings about various cognitive errors or cognitive distortions. This study was intended to anticipate and identify the mechanism by which error or bias would be in the operation of System 1. As shown in the results of this study, if the social exclusion experience causes cognitive narrowing and this causes cognitive errors through the operation of System 1, the occurrence of various cognitive biases in addition to the error of inferencing reasoning, social exclusion and cognitive biases. It seems to be explained by cognitive narrowing.

Therefore, this study can find theoretical implications in that it extends the concepts of evasive self-awareness, escape theory and cognitive narrowing used to explain addiction behavior such as obsessive buying to consumer’s cognitive bias. In addition, the other theoretical implication is to identify the processes and mechanisms of individuals experiencing social exclusion through cognitive narrowing and dual process models.

In practice, consumers who are expected to experience substantial of social exclusion due to weak social ties and connections may be unable to infer the exact cause due to abductive inference error. In this case, a marketing communication strategy can be considered to provide consumers with a definite basis for the results by providing deductive condition inferences that emphasize only the results from one cause, without mentioning the other causes that may result. In addition, a strong social tolerance means that an individual has the ability to control himself in a way that preserves himself and promotes his or her own interests in the long run, including performing a smooth cognitive activity in a positive emotional state. Social inclusion is also an important issue related to the health and welfare of individuals as well as the entire society. Therefore, various efforts will be needed to reduce social exclusion, discrimination and rejection to maintain a healthy social community as well as rational and sound consumer activities.

This study has limitations: the sample was collected only from college students, not consumers of various ages and occupations, and did not compare social exclusion and other measurement tools for cognitive narrowness. Also, this study only examined the effects of social exclusion and cognitive narrowing on abductive inference error, however future studies need to explore various types of cognitive errors.

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