OPEN INNOVATION: IS IT A GOOD STRATEGY IN CONSUMERS' EYES?

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ABSTRACT

Open innovation has become increasingly popular in practice because of its effectiveness in improving firms' financial and innovation performances. As a result, more and more products developed via open innovation are available on the market. However, thus far no empirical study has investigated how consumers evaluate and respond to new products developed through open innovation. In this study, we argue that knowing that a product has been developed via open innovation impacts consumer evaluation and adoption intentions of a new product. Across three studies, we find that consumers perceive new products developed through open innovation to be either more reliable or more technologically advanced than their counterparts developed via closed innovation, depending on which type of open innovation is involved in the product development process. These findings have significant theoretical and managerial implications. The limitations of this study are also discussed.

Keywords: Open Innovation, Product Evaluation, Consumer Perception.

INTRODUCTION

Open innovation has become, and probably will continue to be a prominent innovation practice due to the fierce competition among firms to acquire valuable external human talents (Chesbrough 2003, Rubera, Chandrasekaran and Ordanini 2016). According to Chesbrough (2003), open innovation is defined as "the embracement of external ideas and knowledge in conjunction with internal R&D." An increasing number of firms are exploring beyond their research labs to look for external ideas to enhance their financial and innovation performances. A 2006 Organization for Economic Co-operation and Development (OECD) study of 59 companies in dozens of countries found that most companies were actively involved in open innovation practices: 51% of the companies allocated up to 5% of their R&D budgets outside, while 31% allocated more than 10% of their R&D budgets outside (OECD 2009). In 2010, Procter & Gamble spent more than 50% of its research fund on open innovation activities, up from 30% in 2008. As a result, more and more products developed through open innovation practices are available in today's market for consumers to purchase. For example, new toys resulting from Lego's Shared Vision program, which is essentially an open innovation platform allowing consumers and external suppliers to contribute their new toy ideas, have resulted in significant market success and helped Lego survive a substantial business hardship. 1528-2678

Although much empirical evidence has been collected supporting how open innovation affects firms' innovation and financial performances (West and Bogers 2014, Rubera, Chandrasekaran and Ordanini 2016), little is known about how consumers perceive open innovation and how this perception affects consumer evaluation of products developed through

open innovation, which could have significant influence on product adoption (Dahl and Hoeffler 2004). Studies regarding consumer behavior have shown that consumer perceptions that largely determine product evaluation and adoption intention (Grant and Tybout 2008; Krishna and Morrin 2008) are extremely subjective, so even seemingly irrelevant factors such as ambient light (Xu and Labroo 2014) may indeed influence product evaluation. For example, Hoegg, Alba and Dahl (2010) found that consumers believe that "what is beautiful is good"; thus, a product's aesthetic design impacts consumer evaluation of a product's feature performance, even though aesthetic appeal may have nothing to do with feature performance. Therefore, it is possible that consumers may react differently to open innovation versus closed innovation products.

In this paper, we aim to provide answers to the following two questions: (1) Does consumer perception toward open innovation affect their evaluation of a new product that is developed through open innovation? And (2) If yes, how? We propose that reliability and technological advancement are two important factors that have significant influence on consumer evaluation of new products and different forms of open innovation have different impacts on perceived reliability and technological advancement. Specifically, we divide innovation openness into two types: (1) process openness, which refers to whether external parties (e.g. users, suppliers and independent developers) can contribute to the focal product's R&D process, and (2) platform openness, which refers to whether the focal product can be used as an open platform so consumers themselves can choose the applications to be run on the platform. We argue that consumer perception toward open innovation significantly increases product evaluation because people perceive open-process products to be more reliable and open-platform products to be more technologically advanced.

Our hypotheses are supported by the results of three experiments. Specifically, we found that when both reliability and technological advancement were unknown and thus remained as concerns, consumers used whether the focal product was developed through open innovation or closed innovation to infer the performance of the focal product on these two features, and evaluated products developed through both open process and open platform more favorably than otherwise. This effect was mediated by both product reliability and technological advancement. However, when the manufacturer of the focal product had a strong reputation and thus reliability was not a concern, only platform openness had an effect on product evaluation through technological advancement. By the same token, when technological advancement was not a concern, only process openness had an effect on product evaluation through reliability.

In the next sections, we first review the relevant literature to build up our hypotheses and then we report the results of the three experiments. Finally, we discuss the practical implications and the limitations of this study.

CONSUMER PROCESSING OF FEATURE INFORMATION ABOUT NEW PRODUCTS

When evaluating products, consumers may selectively process information regarding a subset of product features, depending on which features happen to be salient at that time due to the influence of factors such as consumers' current goals and expectations (Briley and Wyer 2002; Feldman and Lynch 1988). For instance, a consumer on a diet probably cares greatly about the calorie count of a food item she is considering but not as much about whether it is organic.

Product type can also affect which features consumers pay attention to (Peracchio and Tybout 1996). It is common that consumers associate different types of products with different

schemas on the basis of their direct or indirect experience of interacting with those products. A schema is a stored framework of cognitive knowledge that represents information about a topic, a concept, or a particular stimulus, including its attributes and the relations among the attributes (Fiske and Linville 1980). Schemas can inform consumers of the possible benefits and drawbacks of a certain product. Therefore, consumers may pay special attention to a subset of features that the corresponding schemas suggest are important. If, for instance, a consumers' schema of cameras informs him that a camera's resolution is the most important feature to determine picture quality, he may evaluate a camera based primarily on its resolution parameters, possibly at the risk of overlooking other important features. In contrast, his schema of computers may suggest that CPU speed is the most important feature. In this case, he would not pay much attention to the resolution parameter.

Similarly, consumers may also develop a general schema toward the newness of a product. In general, new products, whether radically new or incrementally new, are supposed to provide newer and/or better functionalities than existing products (Alexander, Lynch and Wang 2008). However, purchasing a new product rather than an existing one involves higher risk so consumers also want the new product to be reliable (i.e., to do what it is supposed to do reliably) (Alexander, Lynch and Wang 2008; Hoeffler 2003). Therefore, when the focal product is new, consumers will consider two important product features: (1) whether the new product can provide new functions and (2) whether it can work reliably. That is, a new product has to be more technologically advanced than existing ones. Otherwise, consumers will turn to the latter so they can get the same or similar functionalities without being exposed to any extra risk. In addition, the product must be reliable. The new functions cannot be enjoyed if the focal product cannot work in a dependable way. To summarize, when evaluating a new product, consumers will consider at least two of its features: technological advancement and reliability.

Open Innovation and Consumer Evaluation

Innovation openness can be seen as a continuum. At the one end, innovation activities are totally closed so that firms themselves can execute all innovation-relevant activities, such as developing ideas and deciding on technological details. At the other end, innovation activities are totally open so that all external parties can be involved in all relevant activities and the focal firm coordinates the different parties' activities and efforts to ensure the effectiveness and efficiency of the R&D activities. As a result, one apparent difference between open innovation and closed innovation is how many external parties can possibly become involved in the innovation practice (Dahlander and Gann 2010). Usually, more people are involved in an open innovation project than in a closed innovation project.

Innovation openness can be categorized into two subfields: (1) process openness and (2) platform openness. Process openness refers to the degree to which external parties (e.g. users, suppliers, and retailers) are involved in the innovation process, while platform openness refers to the extent to which the focal product can be used as an open platform (e.g. for commercialization purpose) (Rubera, Chandrasekaran and Ordanini 2016). Therefore, if a product is an open platform, consumers can modify the system based on their needs, which means they can use applications produced by external developers rather than only using those developed by the focal firm that also provides the platform.

When considering buying a new product, consumers face uncertainties that may

negatively affect adoption (Alexander, Lynch and Wang 2006; Hoeffler 2003). We conceptualize that consumers may infer, based on their lay theories about the strength of group work (vs. individual work), that innovation openness generates more reliable and innovative products, given that not only the focal firm but also other knowledgeable external parties contribute to the development of the focal product. We elaborate on this point in the next section.

Current Conceptualization

Consumers' beliefs, whether correct or incorrect, have a significant impact on their evaluation of products or services (Labroo and Mukhopadhyay 2009; Tsai and McGill 2011). For instance, Yeung and Soman (2007) found that, due to consumers' belief that service duration positively correlates with service quality, consumers evaluated a locksmith and the service he provided more favorably if the time used to open the lock was longer than otherwise. Similarly, Cho and Schwarz (2006) found that people have a lay theory that "if it is difficult to process, it must be new and good." Therefore, difficulty of processing leads to higher perceived innovativeness of a product and thus higher evaluation.

Previous studies have identified that evaluation and adoptions of new products are not only functions of the inherent nature of the product (e.g. its features and price) (Bearden and Shimp 1982; Nowlis and Simonson 1996) but are also affected by many contextual factors (Castaño, Kacker and Sujan 2008; Herzenstein, Posavac and Brakus 2007; Wood and Moreau 2006). Two conclusions can be drawn from these studies: (1) product adoption intention is quite malleable and thus subjective to the influences of many perceptual factors and (2) uncertainty is one of consumers' most important concerns when determining new product adoption (Alexander, Lynch and Wang 2008; Hoeffler 2003). Together, these two conclusions suggest that innovation openness may actually affect consumer evaluation of new products.

We propose that consumers will infer that products developed through an open process will be more reliable while those developed as open platforms will be more technologically advanced. The reason for the first proposition is that many relevant parties are involved in the development process. A focal product needs to go through the critiques and evaluation of those involved agents. In addition, external people contribute their knowledge and ideas to resolve problems that the focal product may have. Therefore, a product developed through an open process is probably more reliable than the one developed through a closed process.

The reason for the second proposition is that if the focal product is developed as a platform, many external developers, likely those who work on the Android system, can provide their own solutions for specific functionalities. Applications developed by external developers compete with one another (e.g. many developers work independently to provide the same functionality for the open platform). Therefore, consumers can select the one that works the best for them. On the contrary, if the product is a closed platform, consumers have to use the product "as is." It is hard to infer whether a closed platform fulfills consumers' needs in the best way. Relative to a closed platform, an open platform may enhance consumers' perceived technological advancement of the focal product. This in turn, will then increase product adoption.

We further proposed that a combination of open platform and open process produces the most favorable evaluation. Previous studies show that consumer evaluation of different features can intertwine. In other words, consumers may infer the favorableness of one feature from that of the other one and vice versa. Therefore, consumers' overall evaluation of the focal product can

backfire or be exaggerated, depending on whether the feature information turns out to contradict or to comply with their inferences. For instance, consumers may perceive a car to be safe to drive (e.g. because of its size), but meanwhile they tend to infer it to be gas-inefficient. If the mileage parameter actually suggests this car is also gas-efficient, their evaluation of this car will become more favorable than otherwise. Along this line, Aaker, Vohs and Mogilner (2010) found that consumers perceive warmth and competence to be two negatively associated features so that they tend to evaluate non-profits as being warmer but less competent than for-profits. However, when consumers perceive a focal firm as having high levels of both competence and warmth, their perception towards it becomes even more favorably. By the same token, we argue that consumers may infer a new product's technological advancement from its reliability, and vice versa. Specifically, consumers may have a tendency to regard a functionally new product to be less reliable and a more reliable product to be less technologically innovative. So in an open process and open platform situation, if consumers find that the focal product is also reliable even when it is technologically advanced, their evaluation would increase, compared with the other situations. We form our hypotheses officially below:

> H1 *Process openness and platform openness together lead to more favorably product evaluation than the other three open innovation situations.*

> H2a *Perceived reliability mediates the effect of process openness on consumer evaluation. Specifically, products developed through open process will be perceived to be more reliable. Accordingly, consumers will evaluate them more favorably than otherwise.*

> H2b *Perceived technological advancement mediates the effect of platform openness on consumer evaluation. Specifically, products developed as an open platform will be perceived to be more technologically advanced. Accordingly, consumers will evaluate them more favorably than otherwise.*

EXPERIMENT 1

Participants in Experiment 1 were asked to read an independent preview of a new e-book reader and provide an evaluation of it. A total of 143 subjects located across the country completed an online questionnaire in exchange for a monetary reward ($2.00 per person). Of the total, 87 of the subjects were male and their mean age was 34.25 (*s.d.* =11.20).

Participants were randomly assigned to one of a 2 (platform: open vs. closed) × 2 (process: open vs. closed) experimental design. In the experimental groups, besides information about the product features, participants were given the definitions of process openness and platform openness and told that in the product's R&D process, the process and the platform were either open or closed.

METHOD

Procedure

At the beginning of this study, participants were told that this experiment was essentially a product evaluation survey. They needed to imagine that they had encountered an independent preview of a new e-book reader while they were reading a magazine. Their task was to read the

preview and evaluate the e-book reader accordingly. The preview described the main features of the reader as well as its R&D process. In the open process condition, it was stated that this product's R&D team had modified an open source operating system for use as the e-book reader's core operating system, and they had co-operated closely with internal and external partners on all other activities (e.g. working out the technical details). In the closed process condition, however, it was stated that the R&D team co-operated closely with internal partners on all activities and developed all components. In the open platform condition, it was stated that this e-book reader only pre-installed a few applications but it was open for customers to install or uninstall applications on their own. On the contrary, in the closed platform condition, it was stated that the e-book already had many applications installed on it so it could do all the things that similar products could do but customers could not modify the system (e.g. install or uninstall applications).

After reading the preview, participants reported their overall evaluation of this e-book reader. Then they rated their perceptions toward how technologically advanced this product is and how reliable it is. Later, they responded to several manipulation check items and reported their affective status. Finally, they indicated their demographic statistics (e.g. gender and age).

Measures

Two items were used to measure participants' overall evaluation of the e-book reader. The first one was "How desirable do you think this e-book reader is?" from 1 (very undesirable) to 7 (very desirable), and the second one was "How good do you think the overall quality of this e-book reader is?" from 1 (not good at all) to 7 (very good). Another two items were used to measure the technological advancement of this e-book reader. The first one was "How technically advanced do you think this e-book reader is relative to similar products?" from 1 (not advanced at all) to 7 (very advanced), and the second one was "How sure are you that this reader is more advanced than other products like it?" from 1 (not sure at all) to 7 (very sure). To measure perceived reliability, we used "How reliable do you think this e-book reader would be?" from 1 (not reliable at all) to 7 (very reliable) and "How dependable do you think this e-book reader would be?" from 1 (not dependable at all) to 7 (very dependable). All the above items were highly correlated with the other item that was supposed to measure the same construct (in both cases, $r>0.60$), so a single index was created by averaging the corresponding two items. The two manipulation check questions are "To what extent do you think the development process of this e-book reader depends on external resource?" from 0 (not to the least extent) to 7 (completely) and "To what extent do you think the system of this e-book reader could be modified to meet consumers' specific needs?" from 0 (not to the least extent) to 7 (completely). Items used to measure participants' affective status are "How positive did you feel when you were evaluating the product?" from 0 (not positive at all) to 7 (very positive) and "How negative did you feel when you were evaluating the product?" from 0 (not negative at all) to 7 (very negative).

RESULTS

Manipulation Check

Participants' perceptions toward the openness of the target product's R&D process were significantly different between the open process condition (M=4.94) and the closed process condition (M=3.93), t (141)=4.67, p<0.001. And participants' perceptions toward the openness of the platform were also significantly higher in the open platform condition (M=5.80) than in the closed platform condition (M=4.15), t (141)=6.20, p<0.001.

Mood Check

Participants' reports of their mood were each analyzed as a function of the process and platform openness conditions. No effects were significant in either analysis (F<1). Thus, the reported results cannot be attributed to differences in the use of affect as a basis for judgments.

Evaluation of the Product

Evaluation of the e-book reader was analyzed as a function of process and platform conditions (Figure 1, for all cell means). The two-way interaction between process and platform openness was significant, F (1,139)=6.48, p<0.02. Besides, both the main effect of process openness and platform openness were significant, F (1,139)=5.45, p<0.03 and F (1,139)=5.94, p<0.02, respectively. Post hoc comparison showed that the overall evaluation in the open process and open platform condition ($M_{open\ process\_open\ platform}$=5.69) were significantly higher than in the other three conditions ($M_{open\ process\_closed\ platform}$ =4.68, $M_{closed\ process\_open\ platform}$ =4.70 and $M_{closed\ process\_closed\ platform}$=4.72), all p<0.05 and the latter three conditions did not differ from one another, all p>0.90. That is, participants in the open process and open platform condition rated the e-book reader more favorably than people in the other three experiment conditions, and participants in the other three experiment conditions rated the product similarly.

Figure 1
PRODUCT EVALUATION IN THE DIFFERENT CONDITIONS OF EXPERIMENT 1

Mediation

A mediation analysis was conducted to determine whether perceived reliability and technological advancement mediated the findings above. At first, a regression analysis showed that perceived reliability and technological advancement predicted product evaluation (β=0.52, t=9.68, p<0.001 and β=0.45, t=8.49, p<0.001, respectively). Second, a MANOVA analysis showed that process openness and platform openness had a significant impact on reliability and technology advancement. Specifically, process openness and platform openness had a marginally significant interaction effect on reliability, F (1,139)=3.55, p<0.07. Besides, process openness had a main effect on reliability, F (1,139)=6.29, p<0.02, while the main effect of platform openness did not affect reliability, F (1,139)=1.47, p>0.20. The interaction effect of process openness and platform openness on technology advancement was also marginally significant, F (1,139)=2.69, p<0.10. In addition, platform openness had a main effect on technological advancement, F (1,139)=12.23, p=0.001, but the main effect of process openness was not significant, F (1,139)=2.35, p>0.12. Third, introducing perceived reliability and technological advancement as covariates reduced the effect of process and platform on product evaluation. Specifically, when perceived reliability and technology advancement were included, the interaction of process and platform became insignificant, F (1,137)=0.71, p>0.40.

The same was true for the main effect of process openness and platform openness, F (1,137)=0.25 and F (1,137)=0.013, respectively, both p>0.60. As a result, we can conclude that both perceived reliability and technological advancement were the mediators of the effect of open innovation on product evaluation.

DISCUSSION

Experiment 1showed that whether an innovation is developed through an open or a closed practice does affect its consumer evaluation. Specifically, when both the process and the platform are open, consumers evaluate the focal product more favorably than otherwise. In addition, we found that perceived reliability and technological advancement mediated this finding. In other words, whether a focal product is developed through an open process and whether it can be customized for use affect consumer perception of its reliability and technological advancement. As a consequence, product evaluation changes.

One ambiguity still exists as to the mediation effect tested in Experiment 1. Although it seems that the two mechanisms could take effect simultaneously, it is reasonable to assume that in certain circumstances only one concern (reliability or technological advancement) is salient. Needless to say, in those cases we will find that process openness and platform openness will have different effects on product evaluation. Experiments 2 and 3 aim to test those expected effects.

EXPERIMENT 2

Experiment 2 has two goals. First, we would like to test how consumer perception of open innovation affects evaluation when reliability is not a concern (e.g. the manufacturer has a

strong reputation for producing reliable products). According to our proposition, in this case, consumers may only care about technology advancement. Consequently, technology advancement would be the sole mediator in this case. Second, we would like to respond to a recent call from Brexendorf, Bayus and Keller (2015), who proposed that the relationship between brand and innovation is understudied, and thus more research in this area is needed. Therefore, in this study we aim to examine the effects of brand names on moderating the findings revealed in Study 1. Unlike Gürhan-Canli and Maheswaran (1998) did by comparing a positive brand (e.g. Sony) with a negative brand (e.g. Sanyo), we decided not to manipulate brand names directly, because consumers tend to associate brand names with multiple meanings (Keller and Lehmann 2006) and the activation of different meanings may intervene the inference process elicited by innovation openness. Instead, we only manipulated the competence dimension of a brand (e.g. whether consumers perceive the brand to be reliable, responsible, dependable and efficient) (Aaker 1997).

The procedure and the materials used in Experiment 2 were similar to those in Experiment 1, except that a different product was adopted for the purpose of enhancing the generalization of our findings. Specifically, participants in Experiment 2 were asked to read an independent preview of a tablet PC. A total of 294 subjects from a major mid-west university participated in exchange for extra credits. Of the total, 174 of them were male, and their mean age was 22.3 (*s.d.*=2.9). They were randomly assigned to one of the eight conditions of a 2 (manufacture's reputation: high vs. low) × 2 (platform: open vs. closed) × 2 (process: open vs. closed) factorial design.

METHOD

Procedure and Material

To manipulate participants' concerns about reliability, we provided different information about the manufacturer's reputation. In one condition, participants were told that the manufacturer has established a great reputation in the industry and always produces reliable products. In the other condition, participants were told that the manufacturer is a newcomer and its reputation has yet to be established. According to our conceptualization, in the first condition, participants' concerns about whether the product is reliable will be eliminated. However, in the second condition, they may still consider reliability as a diagnostic factor. As a result, we predicted that in the reputation-unknown condition, the findings in Experiment 1 should be replicated. One new item was included to detect how participants perceived the manufacturer's reputation ("How good do you think the reputation of the manufacturer of this tablet PC is?" from 1 [not good at all] to 7 [very good]). The manipulation of process openness and platform openness and all other measures were the same as in Experiment 1, except that items measuring reliability and technological advancement were dropped in this study.

RESULTS

Manipulation Check

Participants' perceptions toward the openness of the target product's R&D process were significantly different between the open process condition (M=5.02) and the closed process condition (M=4.42), F (1, 292)=14.79, p<0.01. Similarly, their perceptions toward the openness of the platform were also significantly different between the open platform condition (M=5.18) and the closed platform condition (M=3.74), F (1, 292)=13.37, p<0.001. As we expected, participants also rated the manufacturer to have a better reputation in the great-reputation condition (M=4.84) than in the reputation-unknown condition (M=4.31), F (1,292)=8.66, p<0.01.

Mood Check

Participants' ratings of their mood were each analyzed as a function of the reputation, process, and platform conditions. No effects were significant in all analyses (F<1).

Evaluation of the Product

Mean evaluation of the tablet PC was analyzed as a function of reputation, process and platform conditions (Figure 2, for all cell means). The three-way interaction among reputation, process and platform was significant, F (1,286)=6.93, p<0.01. More importantly, further analyses showed that when the reputation of the manufacturer was high, only the main effect of platform openness was significant ($M_{open\ platform}$=4.75 vs. $M_{closed\ platform}$=3.41), F (1,286)=18.00, p<0.001. On the contrary, when the reputation of the manufacturer was unknown, there was a significant interaction between process openness and platform openness, F (1,286)=9.00, p<0.01. Besides, both the main effect of process openness and platform openness were significant, F (1,286)=8.29, p<0.01 and F (1,286)=20.54, p<0.001, respectively. Post hoc comparison showed that the results in the brand name unknown cell replicated the findings in Experiment 1. Specifically, the overall evaluation in the open process and open platform condition ($M_{open\ process\_open\ platform}$=4.96) was significantly higher than those in the other three conditions ($M_{open\ process\_closed\ platform}$=3.44, $M_{closed\ process\_open\ platform}$=3.77 and $M_{closed\ process\_closed\ platform}$=3.46), all p<0.01 and the latter three conditions did not differ from one another, all p>0.60.
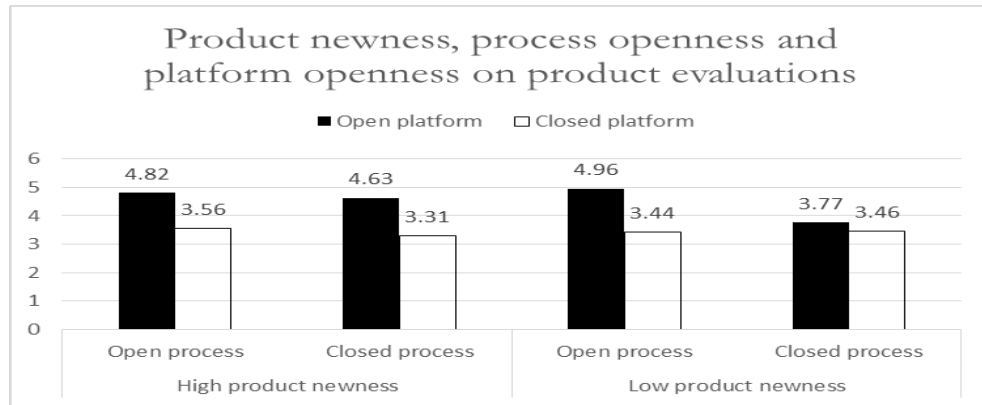
Figure 2
PRODUCT EVALUATION IN THE DIFFERENT CONDITIONS OF EXPERIMENT 2

EXPERIMENT 3

In Experiment 3, we tested how consumer perception of open innovation affected evaluation when technology advancement is not a concern (e.g. the product is rated as a radically new product by an independent reviewer). According to our proposition, consumers may only care about the reliability in this case, and consequently, this factor would end up being the sole mediator. As a result, we expected a main effect of process openness.

The procedure and the materials used in Experiment 3 were similar to those in Experiments 1 and 2, except that a different product was adopted for the purpose of enhancing the generalization of our findings. Specifically, participants in Experiment 3 were asked to read an independent preview of a smart TV. A total of 234 subjects from a major mid-west university participated in exchange for extra credits. Of the total, 147 of them were male, and their mean age was 23.4 ($s.d.$=3.1). They were randomly assigned to one of the eight conditions of a 2 (technology newness: radically new vs. control) × 2 (platform: open vs. closed) × 2 (process: open vs. closed) factorial design.

METHOD

Procedure and Material

To manipulate participants' concerns about technology advancement, in one condition they were told that this product was rated a radically new product by an independent third party, so it could provide unique functions that no other existing products could. In the control condition, participants did not receive any information on how advanced this product was in terms of its technology. According to our conceptualization, in the first condition, participants' concerns about whether the product had advanced technology should be eliminated so that platform openness will no longer have an effect. However, in the second condition, it may still be considered as a diagnostic feature. Therefore, we predicted that in this condition, the findings in

Experiment 1 would be replicated.

One new item was included to detect how participants perceived the technology advancement ("How much do you think this smart TV features advanced technology?" from 1 [not much at all] to 7 [very much]), while the item used to measure participants' perception of the manufacturer's reputation in study 2 was dropped. The manipulation of process openness and platform openness and all other measures were the same as in Experiment 2.

RESULTS

Manipulation Check

Participants' perceptions toward the openness of the target product's R&D process were significantly different between the open process condition (M=5.04) and the closed process condition (M=4.75), t (229) =1.83, p<0.04. Similarly, their perceptions toward the openness of the platform were also significantly different between the open platform condition (M=5.22) and the closed platform condition (M=3.96), t (229) =6.29, p<0.001. As we expected, participants also rated the focal product to be more innovative in the radically new condition (M=4.49) than in the control condition (M=3.77), t (229) =5.27, p<0.01.

Mood Check

Participants' ratings of their mood were each analyzed as a function of the reputation, process and platform conditions. No effects were significant in all analyses (F<1).

Evaluation of the Product

Mean evaluation of the smart TV was analyzed as a function of product innovativeness, process and platform conditions (Figure 3, for all cell means). The three-way interaction was significant, F (1,226)=7.45, p<0.01. More importantly, further analyses showed that when the smart TV was described as being radically innovative, only the main effect of process openness was significant, F (1,226)=65.31, p<0.001. On the contrary, when its innovativeness was unknown and thus still remained to be a concern, there was a significant interaction between process openness and platform openness, F (1,226)=14.62, p<0.001. Besides, both the main effect of process openness and platform openness were significant, F (1,226)=38.44, p<0.001 and F (1,226)=23.69, p<0.001, respectively. Post hoc comparison showed that the results in this cell replicated the findings in Experiment 1. Specifically, the overall evaluation in the open process and open platform condition ($M_{open\ process\_open\ platform}$=5.29) was significantly higher than in the other three conditions ($M_{open\ process\_closed\ platform}$=3.47, $M_{closed\ process\_open\ platform}$=3.19 and $M_{closed\ process\_closed\ platform}$=2.97), all p<0.01, and the latter three conditions did not differ from one another, all p>0.30.
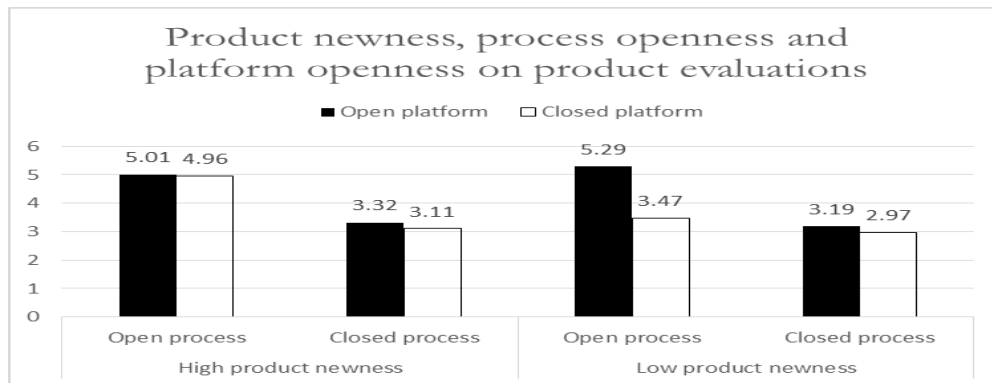
Figure 3
PRODUCT EVALUATION IN THE DIFFERENT CONDITIONS OF EXPERIMENT 3

GENERAL DISCUSSION

Based on the results of three studies, this research provides insights about how knowing whether a product is developed via open innovation or closed innovation impacts consumer evaluation of new products. Unlike other papers that investigate how open innovation influences the financial and innovation performances of firms (Rubera, Chandrasekaran and Ordanini 2016; Almirall and Casadesus-Masanell 2010), this research instead examines how such practice impacts consumer perception of open innovation products and thus consumer evaluation of the products.

The findings of this study provide three important insights regarding how perceptions toward open innovation impact consumer evaluation of new products developed via open innovation practice. First, we revealed that different forms of open innovation (process openness vs. platform openness) impact new product evaluation through different mechanisms. Specifically, we found that process openness leads to higher consumer ratings on product reliability, whereas platform openness leads to higher consumer ratings on technological advancement. Second, we found that consumers perceive technology advancement and product reliability to be negatively correlated so that when they receive information suggesting that the focal product is not only technologically advanced but also reliable their evaluation of the focal product becomes significantly more favorable than otherwise. Third, we found that other factors such as brand reputation and product newness moderate the effects of open innovation on consumer perception. Specifically, we found that when brand reputation is strong, consumers are not typically concerned about the product's reliability. Therefore, process openness, although it could impact consumers' perceived reliability of the focal product, does not have additional effects on the evaluation of an open process product. Similarly, when consumers have other cues to realize that the product is new in terms of technology, whether a product is developed through the platform openness does not change its evaluation.

The findings of this paper suggest that open innovation, as an increasingly popular innovation practice, not only impacts firms' financial and innovation performances on the supply side of the market but also impacts consumer product evaluation on the demand side of the market. Consumers' using lay theories such as "two heads are better than one" (Claire and McGill 2011) to infer the quality of important product features actually bring advantages, rather

than disadvantages, to firms practicing open innovation. Depending on their product equity and other marketing signals, such as whether the focal product has been rated by a third party as technologically new, firms may indicate in their marketing communication messages how the product was developed (e.g., via open vs. closed process innovation) to leverage the power of lay theories in consumers' minds. When consumers do have concerns about both the reliability and the technological advancement of the focal product, publicizing the open innovation practice a firm used to develop the focal product could bring more favorable reactions from potential consumers and thus faster product adoptions.

This paper has certain limitations. First, many other factors impact consumer perception toward reliability and technological advancement of a new product (Maheswaran 1994; Berens, Riel and Bruggen 2005). These factors, such as country of origin, may interact with process or platform openness investigated in this study and eventually impact product evaluation. In this paper, we did not consider such interactions. Future studies may draw a more comprehensive figure about how these different factors work together to impact new product evaluation. Second, the findings of this paper are from the results of three experiments. Given that experiments have usually high internal validity but low external validity, researchers and practitioners alike should be cautious when applying these findings in other product categories and settings. It is possible that the main effects and the moderating effects found in the current study do not hold in different conditions. Future research may overcome these two limitations and provide a more comprehensive view on how consumers see products developed via open innovation. Third, a caveat of our conceptualization is that we do not take the newness of the product into consideration. Brexendorf, Bayus and Keller (2015) discussed the innovation performance of two branding strategies, namely branded house and house of brands. Their discussion suggests that if the underlying innovation is disruptive or totally new, a house of brand strategy is more appropriate than a branded house strategy. So it is possible the findings from our study are moderated by the newness of the underlying technology. We hope that in the future other researchers will respond to the call by Brexendorf, Bayus and Keller (2015), and provide more data to examine how different branding strategies impact the perception towards open innovation products.

ACKNOWLEDGEMENT

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