

**Influence Of Perceived Risk On Core Innovation: The Role Of Social
Influence In Managing Uncertainty**

by

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ABSTRACT

INFLUENCE OF PERCEIVED RISK ON CORE INNOVATION: THE ROLE OF SOCIAL INFLUENCE IN MANAGING UNCERTAINTY

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This paper attempts to investigate how the nature of innovative product attributes can affect consumer innovation adoptions. Specifically, we are interested in how and to what extent peer effects can influence this process. By operationalizing core innovation through changes of core product attributes as extreme incongruity, this research used an experiment design to predict product evaluations and time of adoptions for innovations. A total of 159 participants on-line surveys were collected concerning participants' responses to the bike products, that differed in the changes of novel attributes. According to the results, participants evaluated innovative products with peripheral novel attributes more favourably and intended to adopt earlier than products with core novel attributes. More importantly, social network influence was reported to moderate such influence through the mediation of perceived risk. Based on the research findings, theoretical and managerial implications of this research are discussed. Limitations and future research directions are also acknowledged.

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Influence of Perceived Risk on Core Innovation: The Role of Social Influence in Managing Uncertainty

1.0 Introduction

There has been much debate in the literature about whether consumer adoption intentions of innovative products are positively or negatively affected by the degree of their novelty. Some researchers argue that product innovations (e.g., incrementally new products, often referred to as sustaining or incremental), where consumers have some core knowledge relevant to the product or product category (Hoeffler, 2003), are more likely to lead to product success and increased market size (Sood & Tellis, 2011) due to the additive benefits derived from the products (Mukherjee & Hoyer, 2001). On the contrary, some scholars insist that innovative products (e.g., truly new products, referred to as disruptive or radical innovations), where consumers hardly have any existing knowledge base with which to understand the product's benefits (Dahl & Hoeffler, 2004), may cause lower evaluations, leading to lower adoption intention and keeping consumers from appreciating the benefits of these wholly new products (Christensen, 1997).

The current study suggests an alternative view for investigating adoption decisions of innovative products as a function of attribute characteristics. Specifically, I argue that consumers are less likely to favour and quickly adopt products with novel core attributes as compared existing products or those with novel peripheral features. For the sake of simplicity, core attributes are defined as features that consumers can use as a reference point for making inferences about their intended functions and to determine the

product's membership in a specific product category, whereas peripheral attributes are defined as features with less explanatory power of making inference for intended functions and thus non-defining to the category's membership.

More importantly, I draw upon the schema congruity theory and disruptive innovation literature to suggest that the observed lower product evaluations and late time of adoption can be explained by the perceived risks from the innovative product attributes. In addition, through drawing upon concepts of social contagion and social capital theories, I further postulate that peers' adoption intentions can mitigate risks, in the sense that social networks can make up for missing information and therefore accelerate the process of innovation adoption. Findings from the current study are expected to improve understanding of how consumers make decisions regarding the adoption of products with novel core attributes, and how peer effects and network structure can influence the adoption process through risk management.

The theoretical contributions of the current study exist in two domains. First and foremost, the current study theorizes risks as the underlying reason explaining the effects of schema incongruity. Most of previous studies in schema congruity theory advocate a cognitive interpretation and suggest that limited cognitive resources and capabilities might explain the aversion of extreme incongruity. Schema congruity theory argues that people don't like extreme incongruity because they can't make sense of it; it is too taxing for them to accommodate. It is summarized that the dynamic relationship between arousal level and cognitive tensions, which accompanies increases in incongruity between an object and a schema, accounts for reasons underlying such schema incongruity effect (Mandler, 1982). In this study, core innovations were deemed as

extremely incongruent and induced high perceived risks, because they represented challenges to the fundamental intended functions of a given product category. I thus offer an alternative way to explain the schema incongruity effect by demonstrating a significant mediating role of perceived risk underlying the indirect effect of core innovation on innovation adoption. Specifically, the prominent mediating role of perceived risk suggests that people are less likely to favor and adopt extremely incongruent products because they perceive higher risks associated with these unfamiliar products that they are reluctant to take. In other words, the extreme incongruity of core innovation doesn't necessarily induce lower product evaluations or late time of adoption. It is only those who associate high risks with novel products are more likely to evaluate products as less favorable and delay innovation adoption.

The second implication is that the current study contributes to understand the underlying process of how social network influences on innovation adoptions. Consumer choices (behaviors, attitudes, beliefs, etc.) are inevitably affected by the choices of others within the same social networks. As noted by Borgatti and Halgin (2011), innovation contagion through social influences can be conceptualized as a collection of nodes influencing each other to adopt their traits. Previous research suggests that innovation adoptions don't happen to consumers instantly. Rather, it involves different stages for them to get aware of the existence of new products, to search information and update their beliefs accordingly, to communicate and discuss with their peers who have adopted or potentially will adopt, etc. Although research in network economics has looked at how social structure drives peer effects and behavior (Ballester, Calvo-Armengol, & Zenou, 2006; Galeotti, Goyal, Jackson, & Vega-Redondo, 2010), many essential questions

related to innovation adoption remain unanswered. For example, little is known regarding how and to what extent the nature of novel attributes and social network structures influence their adoption decisions. More specifically, will certain types of innovative products and novel attributes be more subjective to social influences comparing to other types? Likewise, the underlying mechanism(s) explaining social influences upon innovation adoption remain unknown. The current research represents an important step towards addressing these questions.

The discussion of innovation adoption is also relevant to market research and policy making in two major ways. First, one of the main dilemmas for policy makers in both public and private domains is how to accelerate innovation diffusion, especially for promising and environmental-friendly technologies that are currently not competitive. For this, they require accurate behavioral forecasts and estimates of adoption time. However, such innovations generally change the bases of competition by changing the very performance metrics along which firms compete (Danneels, 2004). More specifically, they introduce a secondary dimension of performance along which products did not compete previously (e.g, novel attributes with benefits that were previously non-existent within the market), but underperforms in some primary dimensions that are traditionally valued by mainstream customers (Christensen & Raynor 2003). Therefore, benefits in the products are likely to be underestimated by mainstream markets due to attribute sets that differ from those of existing products, which may ultimately lead to slow adoption processes (Christensen, Anthony & Roth, 2004). This disconnect can be extremely detrimental for the managers and policy makers charged with allocating scarce

public resources. Therefore, a better understanding of how consumer adoption decisions are made of innovative technology is crucial for accurate market forecasting.

To address such questions, I first establish the research questions and, in the context of artifact categorization (Malt & Johnson, 1992), classify product attributes into core and peripheral categories. I then build the theoretical framework by drawing upon schema congruity theory, which suggests that products with novel core attributes are more likely to induce lower product evaluations than products with novel peripheral features. Additionally, I explore the literature of disruptive innovation (Christensen 1997) and innovation diffusion (Rogers 2003) in order to further understand why innovations involving core attribute adjustments induce late time of adoption. The following section describes the literature on consumer preferences related to innovative products and identifies perceived risks as the underlying mechanism explaining lower product evaluations and delayed adoption. Next, I explore how the influence of social interactions upon consumer innovation adoption may vary depending on the nature of the novel attributes. Specifically, I argue that the presence of social influence (exemplified as higher level of peers' adoption intentions) can mitigate perceived risk. Conceptual models and hypotheses are described in the next session, followed by a discussion of methodology and findings from the current study. Finally, I conclude with a section summarizing the contributions and limitations of the current study.

2.0 Literature Review

In this chapter, a review of the extant literature related to the present study is organized as follows. First, I establish the research questions and, in the context of

artifact categorization (Malt & Johnson, 1992), classify product attributes into core and peripheral categories. Then, I build the theoretical framework by drawing upon schema congruity theory, which suggests that products with novel core attributes are more likely to induce lower product evaluations than products with novel peripheral features. Additionally, I explore the literature of disruptive innovation (Christensen 1997) and innovation diffusion (Rogers 2003) in order to further understand why innovations involving core attribute adjustments induce late time of adoption. The following section describes the literature on consumer preferences related to innovative products and identifies perceived risks as the underlying mechanism explaining lower product evaluations and delayed adoption. Finally, I explore how the influence of social interactions upon consumer innovation adoption may vary depending on the nature of the novel attributes. Specifically, I argue that the presence of social influence (exemplified as higher level of peers' adoption intentions) can mitigate perceived risk.

2.1 Product Categorization: The Core Concepts

2.1.1 Consumer Preference of Product Attributes

One of the prevailing views within the psychology of preference is that people hold subjective values for basic attributes, which combine to define an option as preferences for particular attribute combinations are formulated during the decision process (Fischhoff, 1991; Payne, Bettman & Johnson, 1992; Slovic, 1995). In other words, individual preferences among alternatives arise from consumer preferences for a range of attributes (Oppewal, Morrison, Wang & Waller, 2009). During the process, individuals are confronted with the trade-offs inherent to a choice involving a range of different attributes; as a result, they must determine how to resolve the problem by considering the

relative values they place on those attributes (Amir& Levav, 2008). In such a case, it is clear from studies of consumer preferences among product alternatives that people learn their willingness to trade off attributes, subsequently retrieve previously constructed preferences about attributes and apply them with consistency to evaluate alternatives (Simonson, 2008a). In particular, people who are encouraged to engage in such extensive thinking through assessment of their subjective values of different attributes tend to construct more accurate product appraisals (Castano, Sujan, Kacker & Sujan, 2008; Hoeffler, 2003; Zhao, Hoeffler, & Dahl, 2009; Zhao, Hoeffler & Zauberan, 2011). Therefore, to better understand consumer adoption decisions of innovative products, I believe a closer look of how people process and evaluate product attributes can provide some creative insights.

2.1.2 Prototype and Intentional- Historical Theories: The Core of Artifact Concepts

Previous studies (e.g., Mittal, Kumar & Tsiros, 1999; Muthukrishnan & Kardes, 2001) have explored the associations between product attributes and product performance and product satisfaction. The current study distinguishes itself from previous work by specifically exploring consumer adoption intentions of innovative products as a function of the nature of the attributes. Moreover, the current study is intended to expand upon previous findings by combining both prototype and intentional-historical theories of artifact categorization with the aim of identifying a core of artifact concepts. Such a definition of core artifact contents is essential to any research that seeks to break down product preference into its particular attribute preferences.

Before tentatively defining the artifact concept of “core,” we need to answer a critical question first: do artifact concepts have cores? One prevailing accounts among

scholars of the psychological “core” of artifact membership is that they share a common intended function (e.g., Hall, 1995; Keil, 1989; Rips, 1989), and that function often overrides physical appearance in some artifact domains. Malt and Johnson (1992) proposed this question in the interest of identifying whether there are certain features determining the membership of artifact categories, as well as which features (e.g., functions) account for artifact cores. Attempting to distinguish acceptable from unacceptable variations of standard functions and physical features, their study demonstrated that neither normal functions nor physical features can explain category membership decisions. Though unable to formulate a general account for the basis of artifact membership, they suggested that the hybrid view of *identification-features-plus-core* (Keil & Batterman, 1984; Medin & Smith, 1984) is the most relevant to the common structure of artifact concepts. In other words, core features, while perhaps not defining, are more heavily weighted than other types of features (Rosch & Mervis, 1975). Similarly, some studies (e.g., Kemler Nelson, 1984; Minda & Ross, 2004; Noseworthy & Goode, 2011) showed that, during classification tasks, individuals tend to learn the *criterion attributes* – the diagnostic features based on which people make classification decisions (Chin-Parker & Ross, 2004). For instance, recent study by Noseworthy & Goode (2011) evidenced an important phenomenon, *criterion inferencing*, following the convention of regarding a rule-defined feature as the criterion attribute (Minda & Miles, 2009; Smith, Tracey & Murray, 1993). Together, these previous studies provide ample support for the existence of “core” artifact.

The next relevant question to ask is how core concepts help individuals make decisions, such as category membership decisions. Here, I draw on the literature of

artifact categorization (Bloom, 1996; Malt & Johnson, 1992) in order to classify artifact-product attributes into core and peripheral categories. According to *intentional-historical theory* (Bloom, 2007; Bloom, 1998), a person's categorization of artifacts is rooted in his or her intuitions about the creator's intent. This view is compatible with "essentialist theory," which states that our mental representations of artifact kinds share some deep essence, which in turn accounts for a person's intuitions about the creator's intention (Gelman, 1988; Keil, 1989; Noseworthy, Wang, & Islam 2012). In other words, individuals rely on their intuitions when making inferences about the intentions of artifacts (Levinson, 1989).

However, complete reliance upon intuition judgment for category membership leaves unsolved the critical problem of how intention is assessed. It is thought that intention judgment has to be made from looking into properties of the object and how those features are used to judge intention, rather than how to judge membership directly from intuitions (Malt & Johnson, 1992). Prototype theory, for example, argues that people attempt to make sense from artifacts by comparing feature similarities between the studied object and the prototypical member of a particular category that is represented in their minds (Ashby & Maddox, 2005; Rosch & Mervis, 1975). Accordingly, something is judged to be a member of a category if it possesses features that the prototype of that category possesses. Instead of relying on intuition about intended functions, prototype theory posits that individuals perceptually attend features and make comparisons about feature similarities to distinguish between the artifact to be classified and prototypes of the category membership (Fabrizio & Noseworthy, 2013; Kruschke, 1992; Minda,

Desroches, & Church, 2008; Minda & Ross, 2004; Noseworthy & Goode, 2011; Noseworthy et al., 2012; Nosofsky, 1986).

2.1.3 Product Core: Intended Functions

In the interest of bridging the differences between historical-intentional theory, which focuses on the creator's intention, and prototype theory, which accentuates the direct inferences made based on perceptual feature similarities, I postulate that consumers decide the membership of an object based on those core concepts that are most closely related to the perceived essence of the thing – that is, those with the greatest explanatory power (Medin, 1989). In this way, consumers make inferences regarding the intended functions of the product (Mukherjee & Hoyer, 2001). It implies that absent rule-defined features can lead to rejections of membership, whereas existence of such features promotes acceptance of membership. In other words, the presence of dominant features is crucial to making inferences about a product intended functions, which is, in turn, the basis of categorization decisions.

In such a case, I conclude that core attributes of artifact concepts can be defined as integral features that consumers use to make inferences regarding intended product functions and, following from that, to determine the product's membership in a specific product category. I further postulate that core attributes (e.g., the blades of a fan) behave as rules for the prototype, identifying the intended functions within a given category's membership. In contrast, peripheral attributes (e.g., the fan's ability to run on solar power) are features with less explanatory power in terms of making inferences regarding intended functions and are therefore non-defining with respect to the category's membership.

2.2 The Schema Congruity Effect

2.2.1 Types of Innovative Attributes and Extent of Incongruity

Judgment of category fit is another important concept that needs to be factored into any discussion of product attributes. There is a significant amount of research supporting the theory of schema congruity (Aggarwal & McGill, 2007; Campbell & Goodstein, 2001; Meyers-levy & Tybout, 1989; Noseworthy & Trudel, 2011; Noseworthy, Finlay, & Islam, 2010; Sheinin & Schmitt, 1994; Sujon & Bettman, 1989), the seminal thesis put forth by George Mandler (1982). Schema congruity concerns the extent to which “structural correspondence is attached between the entire configuration of an object and the configuration specified by the schema” (Meyers-levy & Tybout, 1989).

It is postulated that the relationship between incongruity and evaluation operates as an inverted-U (Mandler, 1982). Typically, the schema congruity effect predicts that evaluations generated in response to moderate incongruity will be more favorable than those generated in response to either congruity or extreme incongruity (Mandler, 1982; Meyers-levy & Tybout, 1989; Noseworthy, Cotte, & Lee, 2011; Sheinin & Schmitt, 1994; Stayman, Alden, & Smith, 1992). The dynamic relationship between arousal and cognitive tensions, which accompanies increases in incongruity between an object and a schema, may account for the phenomenon’s effects (Mandler, 1982). When making sense of products, consumers try to resolve the tensions that result from inconsistencies between perceptions and expectations. Whether or not an evaluation is relatively favorable is a function of how readily the inconsistency can be resolved (Meyers-levy & Tybout, 1989).

Thus, a moderately incongruent innovation can be successfully assimilated into an existing category schema with little cognitive effort (e.g., Sujan & Bettman, 1989), whereas an extremely incongruent innovation cannot be assimilated – it may only be accommodated by fundamentally changing the existing cognitive structures or by developing an entirely new schema (e.g., a vitamin infused beer). If reconstruction happens, the new schema usually becomes a sub-type, such as an exception or special case (Taylor & Crocker, 1981). The inconsistent information is simply re-categorized under a new subsidiary classification, serving primarily to maintain stereotypic beliefs (Hilton & Hippel, 1996). This is more likely to cause frustration rather than resolution, therefore leading to more negative valuations since the task is too demanding and unrewarding.

This effect is quite relevant to a discussion of the nature of product innovation attributes. As discussed, core attributes can be identified as integral features of products that consumers use to make inferences about intended functions and, following from that, to determine membership in a specific product category. Product innovations often involve adjustments of both core and peripheral attributes that are either congruent or incongruent with the existing product category schema (Meyers-levy & Tybout, 1989). Consequently, innovations related to core attributes typically signal adjustments to the rule-defined features determining the category membership. Thus, such changes can cause fundamental violations regarding products' intended functions, which may be extremely incongruent with the existing category schema. Innovations related to peripheral attributes, on the contrary, involve adjustment of non-rule-defined features that are less likely to be used to determine the category membership. In the later case,

consumers interpret the peripheral-attribute innovations as additive benefits (Mukherjee & Hoyer, 2001) that are only moderately incongruent with the original product category.

2.2.2 Impacts of Innovative Attributes on Product Evaluations

Research by Herr (1989) demonstrated that one important determinant of the extent to which an attribute is accommodated or assimilated is the degree of correspondence between the new attribute and the existing brand. If perceptions of the new attribute do not violate expectations of the original brand, the adjustment is likely to be assimilated within the existing schema. In contrast, if perceptions of the new attribute do violate the expectations, the new feature is likely to be accommodated through restructuring of a new category schema (Nowlis & Simonson, 1996). Similarly, Johnston & Hewstone (1992) indicated that only when the inconsistent objects were seen as moderately rather than extremely incongruent with typical group members did they receive the extra elaborations necessary for assimilation (e.g., subtyping the disconfirming members as a special group representation).

Peripheral adjustments to non-rule-defined features are deemed as moderately incongruent and unlikely to influence consumer inferences about intended functions as they relate to existing membership categories. Thus, such adjustments lead to more stereotypical assimilation of new products into existing category schema (Dijksterhuis, Spears & Lepinasse, 2001). Conversely, core adjustments to rule-defined features are unlikely to be assimilated within the existing schema. In these cases, accommodations are likely to require rule restructuring, since adjustments to rule-defined features may cause confusions when consumers make inferences basing on the original rules.

This assumption is quite consistent with the effect of schema congruity. In this respect, the manipulation of incongruity may be substituted as a manipulation for core and peripheral adjustments. Schema congruity theory contributes the idea that, depending on which of the adjustment attributes are activated, consumers may favor the product more. This raises the question of whether product innovations related to core adjustments will achieve less favorable evaluations. Findings from the current study contribute to the existing research by recognizing not only that congruity levels of attributes can influence product evaluations but, more importantly, the nature of the adjusted attributes can affect overall consumer perceptions of the products. Guided by the schema congruity framework, I argue that core-attribute innovations are perceived as extremely incongruent with existing category schema and give rise to less favorable product evaluations, whereas peripheral-attribute innovations are regarded as moderately incongruent and lead to more favorable evaluations.

2.3 Disruptive Innovation: Underperformance of the Primary Dimension

2.3.1 Model of Disruptive Innovation in Marketing

The discussion of innovation involving core attribute adjustments is especially relevant to firms in light of the rapid technological change. According to Sood and Tellis (2011), technological innovation can create entirely new markets, with new products, new customers and quickly increase demands; misinterpreting such impacts has the potential to cause the demise of existing firms in the marketplace. This potential failure of firms in the face of innovations has been a topic of intense research and debate. An early attempt to understand this phenomenon by Henderson and Clark (1990) posited that

architectural innovations, defined as innovations that change the way in which product components are linked together but leave the core design concepts – and therefore the basic knowledge underlying the components – untouched, and destroy the usefulness of the architectural knowledge already embedded in the information-processing procedures. This sort of destruction is difficult both to recognize and to correct. Similarly, Tushman & Anderson (1986) argued that failure to accommodate technological changes occurred when innovations destroyed, rather than enhanced, the expertise of existing firms. Recently, Schmidt (2004) used the term “low-end encroachment” to capture how innovations can first cater to low-end customers and eventually progress upwards to the high end.

Christensen’s (1997) thesis of disruptive innovations is among the best known and most popular. It posited that disruptive innovations consist of technologies that are simpler than the dominant ones and therefore offer less of what consumers in established markets wanted; as a result, such innovations can rarely find initial value in the market. Alternatively, they provide a different attribute package that is more likely to be valued in emerging and often low-end markets rather than mainstream ones (Christensen, 1997; Govindarajan & Kopalle, 2006). Consistent with Christensen’s thesis, Sood and Tellis (2011) further expanded the drivers of disruption with respect to the innovation characteristics (rather than effects), and defined platform innovation as changes of a unique scientific principle of products.

Previous literature summarized that disruptive innovation is innovation that can take over a category, rendering the previous exemplar obsolete. A good illustration is what smart cellphone did to the digital camera and the traditional cellphone category. By

improving quality of pictures for the newly added function of taking photos, it gradually took over the market of digital camera and traditional cellphone and rendered them to obsolete. Another sound example is how flat TVs revolutionized the expectation for the old, heavy tube TVs. Initially, consumers could hardly appreciate the additive benefit of taking less space offered by flat TVs. However, it improved originally inferior features of picture resolution to match with tube TV's performance, and ultimately substituted tube TV by fundamentally changing people's expectation of the television category.

Two basic assumptions can be drawn from the above argument; each contribute to the underlying premise of "disruptive" and is critical to the concept of core innovation that will be discussed in the following chapters. First, consumer needs vary across groups, such that different groups value different levels of performance as functions of product attributes. Second, disruptive innovations can improve their performances with respect to the primary attributes valued by mainstream consumers, ultimately leading to shifts in demand.

2.3.2 Underperformance in Primary Dimension Lead to Late Adoption

Generally, consumer needs drive consumers to seek certain benefits (e.g., product performance and functions) and form the basis for their choices between product alternatives (Danneels, 2004). The particular benefits sought by customers determine which product attributes they value. However, different consumers (e.g., market segments) may have different needs to satisfy and therefore value different attributes (McGrath & MacMillan, 2000). Products, being combinations of various attributes, provide different levels of performance on varying dimensions supported by their technologies. At any given time, a particular innovation has a performance limit

determined by its attributes (Christensen, 2003). Products of disruptive innovation have different attributes than existing products, such that disruptive innovations initially underperform on the primary attribute dimensions (e.g., core attributes) that are valued by the mainstream market segments, but have higher performance in secondary attribute dimensions (e.g., peripheral attributes) valued by remote or emerging markets. However, performance increases along with improvement of technological innovation and, eventually, the disruptive innovation's performance levels on primary attribute dimensions can exceed the minimum demands of mainstream consumers. In other words, disruption occurs when an innovation initially inferior in the primary attribute dimension improves its performance along that dimension to meet the needs of the mass market (Bower & Christensen, 1995).

Previous research has established a correlation between the consumer perceptions of relative product attributes (relative advantage, compatibility, complexity, trialability and observability) of an innovation (Rogers 2003) and the relative speed with which adoption occurs (see Ostlund 1974; Panopoulos & Sarri, 2013; Rogers & Shoemaker 1971; Tseng, Wang, Chiu, Geng & Lin, 2013). Early works by Labay and Kinnear (1981) have shown that attribute perception is more effective than socio-demographics in predicting category membership of adopters and non-adopters. Ostlund (1974) examined perceived innovative attributes as potential predictors of innovativeness (i.e., early or late adoption) and found that they do a better job of predicting early adoption compared to socio-demographics. More recent studies by Ittersum and Feinberg (2010) extend Roger's framework to a broader context, by linking his five relative attributes to adoption time intent for three new innovations: (a) Advanced Mowers for golf courses, (b) Auto

guidance system for farm equipment operators and (c) GPS Cell phones for students. In addition, M. L. Tseng et al. (2013) proposed an integrated framework to suggest that adoption process of green innovations correlates with the eco-labeling and design innovativeness. Similarly, Panopoulos and Sarri (2013) evidenced a positive correlation between the relative advantage of mentor perceptions and the speed of innovation adoption in the on-going process of E-mentoring.

Although the predicted speed of innovation adoption varies depending the nature of different studies (Goktan & Miles, 2011), the pattern of correlations between product performance and innovation adoption could not be simply overlooked. For example, Molina-Castillo, Jimenez and Munuera-Aleman (2011) studied 197 manufacturing organizations and demonstrated that for new product development especially innovations were made within a relatively limited timeframe, objective performance of novel products is positively correlated with speed to market and increased consumer satisfactions. If this is the case, we could safely arrive at a conclusion that there is a connection between speed-to-market on the one hand, and product objective quality and customer satisfaction on the other (Lukas & Menon, 2004; Yalcinkaya, Calantone, & Griffith, 2007).

Guided under the same framework, since disruptive innovation initially underperforms on primary attribute dimensions (eg. core attributes) valued by the mainstream market, I postulated that the underperformance in the primary attribute dimension negatively influences consumer decisions regarding adoption, which is manifested as late adoption time.

2.3.3 Linking Innovative Core Attributes to Disruptive Innovation

In previous chapters, core attributes are defined as rules and criterion for making inferences about intended product functions within a particular category membership. Consequently, innovations involving adjustment of core attributes may cause confusion with respect to inferring the benefits offered by the product's intended functions. In other words, changing the core attributes for a particular product category is a challenge to the fundamental rules that most consumers have agreed upon in order to define and/or assess that product category. Here, recalling the definition of disruptive innovation, we can readily link this concept to that of core innovations. Core innovations change the bases of competition by changing the performance metrics along which products compete, thus changing the fundamental rules for defining a product category. As a result, consumer confusion may arise from the uncertainty in the intended functions with the fear of inferior performance in originally valued dimensions, ultimately leading to late adoption. In addition, the concept of core innovation is also quite consistent with the notion of platform innovation (Sood & Tellis, 2011) and radical innovation (Sood & Tellis, 2006), changing the unique principle of products in order to suit consumer needs in particular markets. The Table below summarizes the typology of the various types of innovation (mainly drawn from Sood and Tellis 2011).

Overall, I hypothesize that core innovation negatively effects people's adoption intention, as reflected in either lower product evaluations and/or late adoption times, whereas non-core innovations (products with novel peripheral attributes as well as regular attributes) induce more favorable product evaluations and earlier adoption times.

Table of Typology of Innovation

Our Schema			Sood & Tellis (2011,2006) Schema; Henderson & Clark (1990; 2006)			Cristensen's (1997) Schema		
Our terms	Our basis	Our argument	Sood & Tellis's terms	Sood & Tellis's basis	Sood & Tellis argument	Christensen's terms	Christensen's basis	Christensen's argument
Core Innovation	Rules for the prototype defining and classifying all members of the category.	Core innovation will cause unfavorable product evaluation and unstable preference, since such type of change generally extremely incongruent with existing category schema and fundamentally change the previous product function, mediated by the COVIS explicit system.	Platform Innovation	Unique scientific principle	1.Involves both lower and upper attack. 2. Two assumptions: segments with fixed preferences; technologies improve over time. 3. Niche segment provides a demand for the platform innovation.	Sustaining breakthrough Disruptive	Superior on primary but inferior on secondary dimension with platform innovation. Superior on secondary but inferior on primary dimension with platform innovation	Mainstream segment favors the primary dimension delivered by the dominant technology; features wanted by customers in established markets (P15, Christensen, 1997). Niche segment favors the secondary dimension addressed by the new technology; a different package of attributes valued only in emerging markets which is remote from the mainstream (P15, Christensen, 1997).
Peripheral Innovation	Non-defining to the category's membership with less explanatory power of inference making for intended product functions	Peripheral innovation is more likely to be valued and preference associated with such innovation can be largely stable, since it can provide additional consumer benefits, mediated by the COVIS implicit system.	Component Innovation	Materials or parts within same scientific principle	1.Component innovation involves refinements in particular components within the same dominant design. 2.The focus becomes elaboration about existing component knowledge within a framework of stable design knowledge.	Sustaining incremental Disruptive	Small improvement on primary dimension with component innovation Superior on secondary dimension but inferior on primary dimension with component innovation	Mainstream segment favors the primary dimension delivered by the dominant technology; features wanted by customers in established markets (P15, Christensen, 1997). Niche segment favors the secondary dimension addressed by the new technology; a different package of attributes valued only in emerging markets which is remote from the mainstream(P15, Christensen, 1997).

Physical Appearance	Physical layout of	If core innovation paired with radical design (ie. Extremely novel appearance), the newly innovated product is likely to be more favored, relative to the core innovation paired with traditional product design.	Design	Linkages or layout of how components will work together within same scientific principle	<p>1.Essence is the reconfiguration of an established system to link together existing components in a new way.</p> <p>2.Often triggered by a change in a component (etc. size or other subsidiary parameter of the design).</p> <p>3.Creates new interactions and linkages with other components.</p> <p>4. Core design concept behind each component and associated scientific knowledge remain the same.</p>	<p>Sustaining Incremental</p> <p>Disruptive</p>	<p>Small improvement on primary dimension with design innovation</p> <p>Superior on secondary dimension but inferior on primary dimension with design innovation</p>	
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2.4 The Role of Risk When Considering Adoption of Core Innovation

2.4.1 Innovation and Perceived Risk

Previous literature of consumer behaviors and decision making indicates that, when faced with newly launched innovative products, consumers typically make inferences based on the novel attributes in order to understand the additive benefits and performance of products (Mukherjee & Hoyer, 2001). Consistent with this argument, perspectives regarding the resistance to innovation adoption hold that the novel attributes of new products that embody features with unexpected side effects (e.g. technological complexity, high price, newness) can create disruption in consumers' established routines (e.g. Ram and Sheth, 1989; Sheth, 1981; Waddell and Cowan, 2003). This may conflict with the prior beliefs of consumers, resulting in resistance to adoption (Folkes, 1988). When consumers engage in the adoption of new products, they face a dilemma between the desirable and undesirable performance consequences of the adoption, and hence face a risky decision (Mitchellet, Davies, Moutinho & Vassos, 1999; Zinkhan and Karande, 1991). Therefore, perceived risk is a function of the unexpected results of adoption and an outcome that deviates from expectation (Forsythe & Shi, 2003).

The concept of perceived risk most often used by consumer researchers defines risk in terms of the consumer's perceptions of the uncertainty and potential adverse consequences of buying a product (or service). In this way, it is implicitly assumed that both the probability and the outcome of each purchase event are uncertain (Dowling & Staelin, 1994).

As for the current research, I specifically focus on the overall perceived risk and

performance risk, defined as concerns that products will not perform as anticipated (e.g. Carter & Curry, 2013; Stone & Gronhaug, 1993). As noted by Hirunyawipada & Paswan (2006), consumers' perceptions of performance risk are based on their knowledge and cognitive abilities in particular product domains (Ram and Sheth, 1989). Similarly, Hoeffler (2003) demonstrated that learning the link between the attributes of the product and its performances depends on the product's complexity, sometimes termed as *innovativeness*, of the product. Therefore, with increasing innovativeness, consumers may find it increasingly difficult to understand the links between attributes and the performances of those innovative products (Dahl & Hoeffler, 2004; Mukherjee & Hoyer, 2001) and, as a result, may perceive more risk in their adoption (Hoeffler, 2003; Lynch & Zauberaman, 2007). Consumer evaluations regarding such new products are expected to change dramatically from the time consumers report purchase intentions to the moment of acquiring them to make real-life decisions since more innovative products are characterized by more extreme benefits and costs inducing larger extent of perceived risk (Alexander, Lynch & Wang, 2008). In other words, the more innovative products induce a larger degree of risk when consumers attempt to understand the links between attributes and perceived performance (Lynch & Zauberaman, 2007). If that is the case, we can safely conclude that innovations involving changes to core attributes induce greater perceived risks in performance than innovations of peripheral attributes.

2.4.2 Perceived Risk Influence Intended Search Behavior and Cause Delay of Innovation Adoption

Previous literature indicated that uncertainties regarding performance may arise from a lack of product knowledge. For example, Li and Mattsson (1995) reasoned that

respondents have incomplete knowledge of their preference and thus exhibit increased errors during choice making, which they termed as the preference uncertainty reflecting the unknown valuations of options. Likewise, Hoeffler (2003) found that consumers perceive really new products, characterized by limited product knowledge, with increased uncertainty and thus acquire more learning in order to understand them. Similarly, as noted by Krieger, Green, Lodish, Rothey and Thirty (2003), a new domain where consumers hardly have any knowledge requires an “information bridge” between consumers’ current understanding and the “the functionality of new products.” More recent studies suggested that when consumers have less well-informed knowledge towards new products, they perceive higher risk and greater uncertainties regarding product performance; they also feel lower consumer confidence in their abilities to evaluate competing products (Keh and Sun 2008; Mitra, Reiss, & Capella 1999).

Nonetheless, consumers are highly adaptable (Simon, 1955). When they feel confidence in making risky choices, they are motivated to engage search for product information that will compensate for their lack of new product knowledge, thus restoring confidence and reducing perceived risks (Grant & Tybout 2008). Indeed, early research (Beatty & Smith, 1987) noted that there is more search activity in high-risk categories. Later works by Dowling & Staelin (1994) extended those findings to an in-category setting by demonstrating that the intended use of risk-handling activity increases with higher levels of perceived risk, and the relationship is more pronounced after an individual’s acceptable level of risk is exceeded.

Among previous studies of consumer information search, the cost-benefit framework of decision making proposed by Payne, Bettman, and Johnson (1988) has

been most highly praised. They suggest that consumers frequently base judgments on an appraisal of both potential benefit and costs from a product. When processing complex products, consumers attempt to search for diagnostic information that will allow them to discriminate among competing products. The underlying assumption is that people are strategic and efficient in allocating their cognitive resources, and that they can adapt their search strategies when looking for the most relevant information. That is why people pay more attention to attributes that differentiate between the various options, rather than those that are common across options, when assessing competing products (Markman & Medin 1995). Guided by the cost-benefit framework, I therefore postulate that when considering adopting core innovative products, consumers will search for information more extensively than they will when facing peripheral innovative and/or existing products, owing to the increased complexity and less obtainable information for core innovations.

2.4.3 Search Behavior and Delay in Time of Adoption

Recent research indicates that for products with higher complexity, such as core innovations, consumers place more emphasis on the learning-cost aspects rather than potential benefits. Thus, they change their decision accordingly, since cost-related attributes are deemed with higher diagnosticity in this scenario (Mukherjee & Hoyer 2001; Zhao, Hoefller, & Dahl, 2009). Consumer adoption decisions of core innovations will therefore be negatively affected by focusing on cost- rather than benefit-related aspects.

Take as a whole, consumers are highly adaptable and develop coping strategies such as information search in order to reduce the discomfort triggered by perceived

performance risk (Dowling & Staelin, 1994). Since core innovation involves increased complexities and less obtainable information, consumers search more extensively for relevant information when considering core innovative products than they would in the face of peripheral innovative and/or non-innovative products. This tendency may cause negative effects in their adoption decisions, ultimately manifested as late adoptions. In fact, our postulation is quite consistent with previous work by Conchar, Zinkhan, Peters and Olavarrieta (2004), which suggested that perceived risk (Bauer1960) and product newness (Robertson, Zielinski & Ward, 1984) may negatively influence the decision to adopt new products. Recent literature on innovation adoption concludes that the likelihood of product acceptance is inversely associated with perceived risk and product complexity (Moreau, Lehmann,& Markman, 2001; Rogers, 2003; Saaksjarvi & Samiee, 2011). Similarly, studies by Antioco and Kleijnen (2009) suggest that for products of “lack of content,” such as in the current case with high incompatibility and high uncertainty, performance risk can significantly affect adoption intention.

To sum up, it is hypothesized that perceived risk mediates the effect of innovative core attributes on innovation adoption, in such a way that innovative core attributes trigger higher level of perceived risks. Ultimately, this leads to lower product evaluations and/or later adoption. In contrast, innovative peripheral attributes cause lower level of perceived risks, leading to higher product evaluations and/or earlier intended adoption.

2.5 Social Interactions with Perceived Risk

The composition and evolution of networks in general have helped us understand what social networks look like. Networks properties also have implications for how ideas, attitudes, and behaviors spread. As stated previously, a person’s ideas, opinions, attitudes,

beliefs and behaviors are a function of those of his or her social networks (Valente, 2010). Innovation adoption is the process through which new ideas and products spread within and between groups (Rogers, 2003). Previous literature provides considerable evidence to suggest that a person's adoption of new products is strongly influenced by the behavior of their social network (Burt, 1987). Early attempts by Coleman, Katz and Menzel (1966) analyzed the effects of social network upon the behavior of physicians. They concluded that interpersonal communication was the driving factor behind physicians' adoption of a new drug. More recently, Lopez and Sicilia (2013) showed that for innovation adoptions, initiating the process first by launching word of mouth followed by advertising is more effective in communication than the other way around.

Although previous research has established that social interactions within groups is important to the process of innovation adoption (Bass, 1969), many questions remain. For example, why would adopters' behavior be affected by their peers, since adoption provides the opportunity to learn directly about the product's advantages and disadvantages? Are peer influences stronger in groups that are more cohesive or contain more intense social interaction? That is, should we expect a more salient effect of peer influences when social ties are stronger? This study aims to explore these questions by drawing upon the social contagion and social capital theories, respectively. More importantly, I propose a two-stage model of social influence on innovation adoption, with peer effects at one end and network cohesions at the other. Specifically, I argue that peer adoption intentions mitigate perceived performance risks, whereas network cohesions facilitate information communication between members in the network, thus accelerating innovation adoptions.

2.5.1 Network Contagion

In the extensive network economics literature that examines how social structure drives peer effects and behavior, the model proposed by Bass (1969) is the best known. It assumes that the innovation adoption process is affected by interpersonal communication (Valente, 2010). Specifically, Islam (2014) summarized Bass's model that individuals are influenced by a desire to innovate (coefficient of innovation p) and by a need to imitate others in the population (coefficient of imitation q ; also known as contagion or word of mouth).

Contagion happens in social settings when the behavior of a person (ego) is sensitive to the behaviors of other members in his or her network (alters) (Borgatti & Foster, 2003; Borgatti & Halgin, 2011). Contagion underlies the spread of practices among people, which itself is contingent on the specific ways in which particular social structures bring people together (Borgatti, Everett & Johnson, 2013). In the current case, adopting an innovation entails a risk – an uncertain level of perceived performance – and people draw on others to define a socially acceptable interpretation of such risk (Burt, 1987). Therefore, social contagion arises from people who are proximate within a given social structure using one another to manage the uncertainty of innovation. At the heart of social contagion is the interpersonal interaction over which innovation is transmitted. To make decisions regarding adoption requires that people have information on available products, and social contagion can play a role in this information acquisition. Thus, it's important to understand how social contagion can provide each person with the information necessary for making informed adoption decisions (Burt, 2004; Valente, 2012).

There is some debate regarding how contagion contributes to this process. Some

researchers contend that the structural equivalence of people – people who have identical or similar relations with all other individuals in the networks – affects the ego’s adoption intention (Brass, 1992; Burt, 1987; Burt, 2000; Podolny, 1993). Others speculate that it is the cohesive structure, where information flows between group members, that facilitates communication and therefore accelerates the process of innovation adoption (Coleman, 1990; Putnam, 1993; Siisiäinen, 2000). In the following chapter, I will focus on the first of the above explanations and explore how people can rely on others’ adoption intentions to mitigate perceived risk in performance of innovative products.

2.5.2 Network as Social Capital

In this chapter, I will draw upon the theory of social capital to further discuss how social networks can encourage innovation diffusions. The cited perspectives on social capital are diverse in origin and style. For example, early works such as Bourdieu (1980) identified social capital as the resources that result from social structure. Coleman (1990) further defined social capital as a function of social structure that produces advantages. Grounding his influential work in Coleman’s metaphor, Putnam (1993) preserved the focus of social organization, such as trust, norms and networks – factors that can improve the efficiency of society by facilitating coordinated actions.

Perhaps the metaphor proposed by Burt (2000) can be used to best illustrate the concept of social capital. It is believed that certain people or groups have connections to certain others. Those that thrive are those that are better connected within their social networks; in turn, these individuals can trust and are obligated to support certain others, and also depend on exchange with these others. Holding a certain position within the structure of these exchanges can be an asset in its own right; in essence, that asset is

social capital. Thus, social capital is a competitive advantage for certain people within the social network that gives them an edge in pursuing their ends; better connected individuals enjoy better returns on their efforts (Burt, 2001).

It should be noted that, when exploring social networks, the concept of cohesion is quite relevant to the discussion of how networks can reduce the perceived risks of innovation adoptions. Although research on cohesion has been plagued by vague and difficult-to-operationalize definitions (Moody & White, 2003), many past definitions share a common perspective that centers on how well a group is “held together.” For example, Festinger, Schachter, and Back (1950) postulated that cohesion is a “field of forces that act on members to remain in the group.” Similarly, Gross and Martin (1952) identified cohesion as the “resistance of a group to disruptive forces.” Additionally, Mizuchi (1992) argued that cohesion is an objective characteristic of social structure involving shared normative sentiments. Here, I draw upon the definition (termed as network closure) proposed by Coleman (1988, 1990) and Burt (2000): a social network in which everyone is connected, such that no one can escape the notice of others, which in operational terms usually means a cohesive network which creates advantage by lowering the risk of cooperation.

Relating Coleman’s definition of cohesion to the concept of social capital, cohesion is perceived as a source of social advantages since people are better connected within a dense network (Burt 2001, 2000; Siisiainen, 2000). Network cohesion generally assumes that communication takes time, so prior relationships affect who knows what early. As a result, people are not simultaneously aware of opportunities in all groups. The fact that

the spread of new ideas and behaviors require an interval of time means that individuals informed early or more broadly have an advantage.

2.5.3 Network Contagion and Prominence: Informational Influence

Network prominence has long been regarded as an advantage for people (Brass, 1992) and organizations (Podolny, 1993). Researchers in this area suggest that the network prominence can be defined as individual advantages in that social structure facilitates the transmission of beliefs and practice between certain people (Bourdieu, 1998). As suggested by Burt (2001), network replacement happens when market information is so ambiguous that people use network structure as the best available alternative to fill the void left by the missing market information. For example, Everett & Borgatti (1994) argued that competition among producers is more accurately modeled as imitation when information is so ambiguous, since that ambiguous information cannot be used to make a clear, informed decision (e.g., White & Reitz, 1983). According to this framework, producers deal with the ambiguity of market information by focusing instead on their position relative to other producers. More generally, the assumption of ambiguous market information underlies social contagion-based explanations of why people are more likely to undertake an entrepreneurial venture if others they know are doing so (Abell, 1996), and why firms adopt policies imitating those of other firms (Burt, 1987).

The question that follows from this is why people within a social network imitate the behaviors and practices of one another. Previous research identified that peer influence leading up to social contagion in customer behavior can be both informational and normative (Bearden, Netemeyer & Teel, 1989; Deutsch and Gerard 1955, Van den Bulte

& Joshi, 2007). Informational influence occurs when information obtained from peers serves as evidence about reality, thus changing one's beliefs about the true state of the world. Specifically, informational influence can be viewed as the process through which social contagion affects awareness or beliefs about products' risks (Iyengar, Van den Bulte, & Valente, 2011a). If that is the case, we can conclude that the network (e.g., the alters' adoption intentions) has informational influence on people's adoption intentions, primarily via mitigation of the perceived risks associated with innovative products.

The notion of risk management through peer effects when facing risky choices is consistent with much of the previous literature (e.g., Currarini, Fumagalli, & Panebianco, 2012; Currarini, Jackson, & Paolo, 2009; Iyengar et al. 2011a). For example, Goldenberg, Han, Lehmann and Hong (2009) postulated that social hubs following innovators in a network are more likely to be trustworthy and can therefore affect people's adoption consideration. Similarly, work by Iyengar et al. (2013) suggests that trials of new products, especially those presenting substantial risk, can be subject to social contagion through informational peer influences. Furthermore, researchers suggests that customers with central positions in the social network (Hinz, Skiera, Barrot & Becker, 2011; Van den Bulte, 2010), as well as experts or follower hubs (Goldenberg et al. 2009), have a disproportionate influence on others' adoptions since they are considered to be reliable sources of information mitigating perceived risks. Delayed acceptance of the risky innovation until others have demonstrated its feasibility through prior adoption has been identified as the "system delay" (Becker, 1970).

2.5.4 Role of Peer Effects on Innovation Adoption of Core Innovation

To sum up, we have drawn upon social contagion theory in order to identify that network prominence can substitute for market information when that information is unclear and unreliable. Furthermore, alters' adoption intentions can mitigate the ego's perceived risks associated with innovative product adoption, decreasing the ego's adoption time as a result.

The discussion about risk management through peer effects is quite relevant to the study of adoption intentions for core innovations. As identified in previous chapters, core innovation involves changes of the intended functions, and challenges the fundamental rules defining the particular product category. In such cases, customers lack information to assess the perceived risks of the core innovation and therefore must look to others adoption intentions in order to assess the potential benefits and costs of adoption. On the other hand, innovations involving peripheral features are unlikely to challenge the fundamental rules defining the particular category. In the later case, consumer should have little difficulties with such changes, assimilating innovative products with relative ease into existing product prototypes.

Linking innovative features to peer effects and social influences, I thus postulate that there is a conditional, indirect effect of core innovative attributes on innovation adoptions at values of social influence (e.g., peers' adoption intentions) through the mediation of perceived risks of innovations, such that consumers perceive significant higher risks in core innovations than in peripheral innovations or regular products when peers' adoption intentions are relatively low; however, the differences in in risks won't be significantly

different among different innovative attribute levels when peers' adoption intentions are relatively high.

2.6 Summary of Research Gap

In light of the above literature review of research on schema congruity, perceived risks and social contagion theories, we can conclude that although the effect of social influence on innovation adoption has been examined pretty thoroughly, there are still a number of unresolved issues. This chapter will further consider opportunities to address these issues and thus expand understanding within this area.

First of all, most of previous research studying schema congruity effect advocate a cognitive interpretation and postulate that limited cognitive resources might explain aversion of extreme incongruity. Specifically, the dynamic relationship between arousal level and cognitive tensions, which accompanies increases in incongruity between an object and a schema, were summarized to account for reasons underlying such effect (Mandler, 1982). However, following studies have evidenced important constraints moderating the effect of schema congruity. For example, Campbell and Goodstein (2001) demonstrated that under the scenario of high perceived risks, the effect of preference on moderate incongruity can be reversed. Moreover, they postulated that the limiting effect of perceived risks were due to consumers "preference for the norm" under high risks conditions. The current study attempts to reexamine the relationship between schema congruity and perceived risks, and thus to offer explanation of aversive attitudes towards extreme incongruity by suggesting a significant mediating role of perceived risks between novel attributes and product evaluations.

Secondly, past research identified several reasons for social contagion. For example, people may be informed by others' behavioral change (in the current case, others' adoption intention) and update their own beliefs about the benefits and costs of behaviors and ideas in response; this is known as the informational influence of peer effects (Iyengar et al. 2013). Social influence may also occur through normative pressure (Van den Bulte & Wuyts, 2007), such that people experience discomfort when they do not behave in line with the expectations of their peer group. Status considerations and competitive concerns are other potential factors contributing to the effect of social contagion. According to Burt and his colleague (e.g., Burt, 1987), it is the level of competitiveness between the egos and their counterparts of structural equivalence that triggers the ego's behavioral changes. Structural equivalence exists when two people have similar relations with others and are identically positioned in the flow of communications in the networks. Thus, egos may be threatened by counterparts with whom they occupy similar positions in the social network, since the counterparts have the potential to replace their role relations if they were removed from the social structures.

Nevertheless, innovation adoptions don't happen to consumers instantly. Rather, it involves several different stages: becoming aware of the existence of new products, searching for information and updating their beliefs accordingly, communicating and discussing with their peers who have adopted or potentially will adopt the innovation, etc. One important question is whether these different factors impact innovation adoption equally or if their influences vary according to the nature of the innovative attributes. More specifically, will certain type of innovative products and novel attributes be more subjective to social influences comparing to other types? In the current case, it is possible

that, since core innovations are radically new to markets, hardly anyone would have informative knowledge about such products; as a result, people would be more subjective to social influences when facing such poorly known innovations.

A third question we might ask in our efforts to better understand social influence regards the contingency in susceptibility to social influence, a topic that has received little research attention. Differences in susceptibility to social influence is a fundamental issue that needs careful consideration, and which, if better understood, can shed light on the nature of the influence mechanism at work (Aral & Walker 2012; Aral, Muchnik, & Sundararajan, 2009). In other words, systematically investigating how various characteristics of products and network structures can modulate and constrain the impact of social influence represents one route to explore the mechanism of social contagion in spreading ideas and products.

2.7 Conceptual Framework

To give coherence to our inquiry, I attempt in the current section to connect all the constructs identified in the literature discussion.

This paper attempts to investigate how the nature of innovative product attributes can affect consumer innovation adoptions. Specifically, I am interested in how and to what extent peer effects and network cohesion can influence this process. To identify the theoretical framework that underlies the influence mechanism of social interaction on innovation adoption, I first classify product features into core and peripheral categories. then I argue that innovation involving changes to core attributes will fundamentally challenge the intended functions of the particular product category, which has already been largely accepted within the existing product knowledge scheme. Additionally, I

discussed schema congruity theory to establish the relationship between novel attributes and product evaluations.

I further link core innovations to the concept of disruptive innovation. By doing so, I hope to explore how the nature of novel product attributes can affect time of innovation adoptions. Specifically, it is postulated that consumers are less likely to favour and more likely to delay adoption of innovative core attributes, whereas consumers are more likely to favour and less likely to delay adoption of innovative peripheral attributes or existing products. The reasoning behind such arguments lies in the potential perceived risks associated with innovative core attributes, which are proposed to be the mechanism underlying lower product evaluations and delayed adoption times.

Finally, I draw upon social contagion and social capital theories in order to theorize that characteristics of the individual's network can affect how perceived risks are addressed. Peers' adoption intentions (known as "peer effect") can mitigate uncertainties induced by innovative product attributes when people utilize others' adoption intentions in place of limited and unclear product information.

3.0 Research Hypotheses

In order to set up the conceptual links described above, the following hypothesis build on previous findings and discussed in detail in this chapter.

3.1 Main Effect of Innovative Attributes

H1a: There will be a main effect of type of product attribute (core- vs. non-core) on innovation adoptions, such that time of adoption will be relatively later for innovations

with changes in core attributes and relatively earlier for products in the non-core condition.

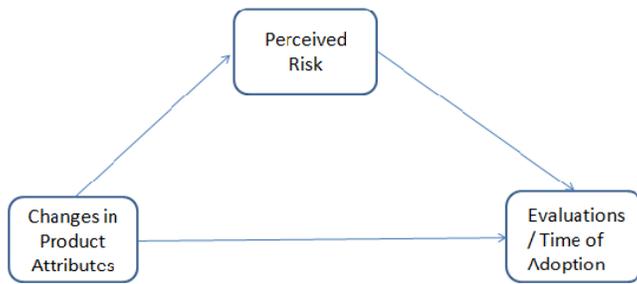
H1b: There will be a main effect of type of product attribute (core- vs. non-core) on evaluations, such that products with innovations in core attributes will be less favored, whereas products without innovations in core attributes (that is, products in the non-core condition) will be more favored.



3.2 Mediating Role of Perceived Risk

H2a. There will be a significant indirect effect of type of product attribute (core- vs. non-core) on innovation adoption, fully (partially) mediated through the perceived risks (high vs. low). Thus, products with innovative core attributes will trigger higher levels of perceived risk, ultimately leading to later intended adoption, whereas products in the non-core condition will cause lower levels of perceived risk, leading to earlier intended adoption.

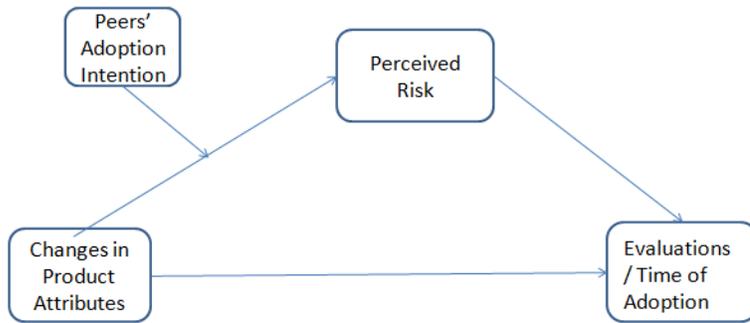
H2b. There will be a significant indirect effect of type of product attribute (core- vs. non-core) on evaluations fully (partially) mediated through the perceived risks (high vs. low), such that products with innovative core attributes will trigger higher levels of perceived risk, ultimately leading to lower product evaluations, whereas products in non-core condition will cause lower level of perceived risk, leading to higher product evaluations.



3.3 Moderated Mediation

H3a: There will be a conditional indirect effect of type of product attribute (core- vs. non-core) on innovation adoptions at values of social influence (e.g., peers’ adoption intentions) through the mediation of perceived risks of innovations (high vs. low), such that, when alters’ adoption intentions are relatively low, consumers will perceive significant higher risks in core innovations, ultimately leading to later intended adoption than in products from non-core condition. In contrast, when alters’ adoption intentions are relatively high, there will be no significant differences in perceived risk between the core and non-core conditions.

H3b: There will be a conditional indirect effect of type of product attribute (core- vs. non-core) on evaluations at values of social influence (e.g., peers’ adoption intentions) through the mediation of perceived risks of innovations (high vs. low), such that, when alters’ adoption intentions are relatively low, consumers will perceive significantly higher risks in core innovations, ultimately leading to lower product evaluations than in products from non-core conditions. In contrast, when alters’ adoption intentions are relatively high, the differences perceived risks between the core and non-core conditions will not be significant.



4.0 Main Study

In this section, we outline a systematic approach used to test the above hypotheses. This chapter also includes a detailed discussion of research findings from current study. The main study is designed to establish the foundation for a thorough examination of the impact of features of novel product attributes, which can be operationalized into core-attribute and peripheral-attribute types of innovation. One of the main objectives of the project is to test whether and how characteristics of novel attributes can influence consumer evaluations and time of adoption of innovative products. Another objective is to investigate the possible factors within the context of social interactions moderating the magnitude of effects for novel attributes, which can shed lights on the nature of the mechanism underlying such influence process.

4.1 Method

To anticipate our findings, the present study used general survey and experimental design. First, descriptive and quantitative research instruments were used jointly in the pilot study to check whether or not novel core attributes selected in main study were perceived as defining rules largely accepted within the existing category scheme. More

importantly, the main study was designed to test whether adopting core innovation is less favored and more remote, whereas adopting peripheral innovation and non-innovative products are relatively more favored and more recent. I also examined whether or not the perceived risk can mediate the effect of novel attributes on adoption decisions. In addition, the current study also explore that whether or not magnitudes of the mediating role of perceived risks depends on social influences (exemplified as peers' adoption intentions).

4.1.1 Participants and & Design

Undergraduate students were recruited from the MCS research pool at the University of Guelph. They were informed about this research through an announcement posted on the SONA system, as well as in their course links. Subjects participated in this study in exchange for credit, as required for a research component in the undergraduate marketing courses. There was no restriction in terms of participant gender, age, or educational level. The innovative attribute manipulation and dependent measures were administered electronically in a behavioral lab.

Using G-Power, the necessary sample size was calculated for each group, in order to achieve an effect size of 0.568, is 50. Given that the current study had three conditions in total (core, peripheral, and non-innovative), we need a total of at least 150 participants.

The main study was based on three components of experimental studies. First, the product stimuli was used as pretested in pilot study, involving three different levels of innovative attributes (core vs. peripheral vs. non-innovative). Specifically, participants were asked questions about product evaluations and time of adoption. In the second

section, questions to measure perceived risk were asked. Finally, social influences were measured as peers' adoption intentions.

4.1.2 Product Stimuli

The operationalization of innovative features began with the selection of core and peripheral attributes given by the pre-determined product categories (bicycle and/or printer). Given that the purpose of this study is to explore the impacts of changes to types of product attributes – where innovative core attributes entail fundamental changes in the existing category's norms/functions -- it is imperative to select exploratory attributes with the necessary explanatory power to define product categories (e.g., bicycle and/or printer).

A pre-test was conducted among undergraduate students ($n = 77$) to determine the attributes used in the main study to represent the product categories (bicycle). Participants were asked to compare groups of attributes (collected from the internet) and determine which attributes in each set are the most important features to the product category -- those features so important that their absence would cause consumer confusion in product understanding. For the bicycle, five different attributes were tested: pedals, GPS navigation device, saddles, handlebars and spoke. Among the 77 participants, 53 participants chose pedals as one of the most important attributes defining the bike category, followed by 52 choosing handlebars, 43 selecting saddles, 19 preferring spoke, and lastly 3 selecting GPS devices. The combined results provided insight into the relative importance of each attribute: the top rated attribute, pedals, was chosen to represent the core feature of the bike product, whereas the last rated attribute, GPS devices, was chosen to represent the peripheral feature of the bike category.

The stimuli used in the current study were designed as combinations of features from the pre-test. For the bike product, the core innovation condition consisted of an image of an innovative bicycle without pedals (because the pre-test identified this attribute as the core one); the peripheral innovation condition used the same image as in the core adjustment condition, but added back a pair of pedals to the original picture and additionally added the function of GPS navigation (GPS having been identified to be a peripheral feature). Details on each of these products can be found in Appendix 1. Each of these products was accompanied by a brief product introduction.

4.1.3 Procedure

The main study used a three-group (core innovation; peripheral innovation; control group) between-subject design. Participants were informed through an announcement posted on SONA system that provided general information about this study. After registering via the system, they received an email notifying them of the time and location for participating. All three studies were administered electronically in a behavioral lab. Participants were randomly assigned to one of experimental conditions for different on-line surveys. They were told that the purpose of the exercise was to evaluate a new product, and they were to review the product at their own pace and then complete a brief questionnaire.

The first section of the questionnaire consisted of 9 items. Three of the items (anchored: 1 = *not at all*; 9 = *extremely*) were used to capture participants' perceived typicality (is typical; is novel [reverse coded]; is likely; Campbell & Goodstein, 2001; Noseworthy, Wang, & Islam, 2012). One item (is likely to perform functions of the target product category; anchored: 1 = *extremely poor*; 7 = *extremely good*) captured

participants' functionality expectations regarding the bicycle and/or printer (Gregan-Paxton, Hoeffler & Zhao, 2005; Noseworthy, et al., 2012). Four of the items (anchored: 1 = not at all; 7 = extremely) captured participants' overall attitude towards the innovations (would evaluate; is desirable; is appealing; left a favourable impression; Malaviya, 2007). As for the time of adoption, participants were asked to indicate how many years from now they will adopt the target product, and the choices range from "six months from now" to "more than five years from now" with half a year apart from each options (Islam, 2013).

Subsequently, twelve items were used to capture participants' opinion (anchored: 1 = *strongly disagree*, 7 = *strongly agree*), including three indicators for overall risks, three indicators for performance risks, three indicators for financial risks and three for physical risks respectively (Dowling & Staelin, 1994).

In the third section, participants were then asked to provide five candidates they would talk to about the products (Borgatti, Everett & Johnson, 2013). They also indicated how likely they believe each candidate will adopt / have adopted the products (anchored: 1 = *very unlikely*, 7 = *very likely*). Finally, they were asked to indicate, for each candidate, which of the other four candidates that particular candidate would talk to (they were able to choose multiple candidates or "none" if none of the candidates would talk to each other at all).

4.1.4 Manipulation Check and Dependent Measure

The current main study was developed through attribute selection, manipulation for changes of innovative attributes, operationalization of dependent measures, operationalization of perceived risk measures, and operationalization of social

interactions. The first of the above tasks was accomplished in the pilot study, providing the basis for the main study design. The other aspects will be described in this section.

Manipulation Check for Core Violations

As predicted, changes in core attributes violate the category norms/rules that define how product functions/performs within the existing category, thus causing less favorable evaluations and/or delays in time of adoption. Hence, the typicality expectations of target products were tested as discussed in previous procedure section to see whether or not changing the core can violate category beliefs in typicality. Higher number indicated greater typicality aligning with product category, whereas lower ratings denoted significant atypical instances violating the existing schema.

Additionally, participants were asked to predict how likely it is that the products they just reviewed will perform the functions ascribed to that product (in this study, bicycle). Higher numbers indicated superior product functionality, fitting the existing category expectation, whereas lower number indicated violations of product functionality, challenging the existing category rules. It was predicted that changes in types of product attributes influence how people perceive fundamental functions of innovative products within the existing category schema. In line with this prediction, I expected to see higher number in the peripheral adjustment condition than in the core adjustment condition, demonstrating that changing core attributes actually can violate functionality expectations of product category.

Dependent Measures of Product Evaluations and Time of Adoption

Participants were randomly assigned to one of the three conditions (core, peripheral and control) in an on-line survey that consisted of images and product introductions, as

shown in appendix 2. They were told that the purpose of the exercise was to evaluate a new product and that they were to review the product at their own pace and then complete a brief questionnaire. The innovation adoption was operationalized as: 1) evaluations; and, 2) time of adoption for the target innovations. Four of the items (anchored: 1 = not at all; 7 = extremely) captured participants' overall attitude towards the innovations (would evaluate; is desirable; is appealing; left a favorable impression; Malaviya, 2007). As for the time of adoption, participants were asked to indicate how many years from now they will adopt the target product, by ticking one time period listed in the answer (Islam & Meade, 2013).

Operationalization of Perceived Risk Measures

To construct the perceived risks derived from innovative products, twelve 7-point items were used to capture participants' opinion (anchored: 1 = *strongly disagree*, 7 = *strongly agree*): three indicators for overall risks, three indicators for performance risks, three indicators for financial risks and three for physical risks (Dowling & Staelin, 1994). This scale has been validated by Stone and Gronhaug (1993), who used it to inquire 177 students about computer products. The original item questions were adapted to suit the product categories.

Operationalization of Social Interactions Measures

The current study operationalized the influence of social interactions through investigating peer effects. Specifically, questions exploring peers' adoption intentions were adopted. For study two, participants were asked to provide five candidates they would talk to about the products (Borgatti, Everett & Johnson, 2013). They were then asked to indicate how likely they believed it was that each candidate would adopt / have

adopted the products (anchored: 1= *very unlikely*, 7= *very likely*), with higher ratings representing stronger adoption intentions of peers.

4.2 Data Analysis

Product Evaluation as Dependent Variable To test mediation and moderation effects, I used the PROCESS model (Preacher, Rucker, & Hayes, 2007). PROCESS can be used to analyze path-based moderation and mediation, as well as their combination as a “conditional process model” (Hayes, 2012). It generates direct and indirect effects in mediation models, conditional effects in moderation models, and conditional indirect effects in moderated mediation models with a single or multiple mediators. PROCESS can also offer various tools for probing 2 or 3 way interactions, which were adopted for moderated moderation analysis, since individual paths can be estimated as moderated by one or two variables either additively or multiplicatively.

Specifically, for the mediation test, the PROCESS model 4 (Hayes, 2012; Preacher, Rucker & Hayes, 2007) was used. The indirect effect of X on Y through M (the mediator) is denoted by formula

$$M_j = a_{1j} b_{1j} \quad (1)$$

where a_1 and b_1 are the model coefficients for the x variable in the model of the m variable (including covariates) and for the m variable in the model of the y variable from the m variable controlling for the x variable (and covariates) respectively. In this case, a_1 is the coefficient for *Innovative Attributes* (coded as “1” for “core innovation” and “0” for “non-core innovation”) in the model of the mediator *Perceived Risks* (controlling for the *Peripheral Innovation*); b_1 is the coefficient for the mediator *Perceived Risks* in the

model of *Product Evaluation* score from *Perceived Risks* controlling for *Innovative Attributes* (and *Peripheral Innovation*).

As for the moderated mediation test, I used the PROCESS model 7 (Hayes, 2012; Preacher, Rucker & Hayes, 2007). The conditional indirect effect of X on Y through M (the mediator) depending on the value of W (moderator) is denoted by the formula

$$M_j = (a_{1j} + a_{4j}W)b_{1j} \quad (2)$$

where a_4 denotes the coefficients for the interaction between the x variable and the w variable (the moderator) in the model of the m variable (including covariates). In the current case, a_4 is the coefficient for the interaction between *Innovative Attributes* (coded as “1” for “core innovation” and “0” for “non-core innovation”) and *Peers’ Adoption Intention* in the model of *Perceived Risks* (controlling for *Peripheral Innovation*).

Time of Adoption as Dependent Variable To analyze the dependent variable of time of adoption, I ran a survival analysis, which typically focuses on time to event data (see Islam and Meade 2011; Meade and Islam 2010). In the most general sense, it consists of techniques for positive valued random variable. It should be noted, however, that this type of “time-to-event” data may introduce a censoring problem. Typically, some subjects have censored times, which means that their event times are not observed or do not take place before the termination of the study. Failure to take censoring into account could produce serious bias in estimates of the timing of the event. In this case, participants were asked to indicate how many years from now they would like to adopt the studied product, by ticking one time period listed in the answer (Islam & Meade 2013), with six months apart from each time option (anchored as $I = 6 \text{ months from now}$, $II = \text{beyond 5 years from now}$). Therefore, it is possible that participants who chose the

time of adoption as “11” would like to delay their adoption till 10 years later, or never adopt at all. However, it was unknown that how many of those who chose “11” would not adopt at any point. Although this results in some loss of information, the data can still be analyzed using a hazard model in order to overcome this censoring problem.

The event time T is always non-negative ($T \geq 0$). T can either be discrete (taking a finite set of values, e.g., (a_1, a_2, \dots, a_n)) or continuous (defined on $(0, \infty)$). In the current case, only the random variable $X_i = \min(T_i, U_i)$ is observed (T : event time; U : censoring time). It is called right-censoring because the true unobserved event is to the right of our censoring time. In addition to observing X_i , I also checked the failure indicator:

$$\delta = \begin{cases} 1, & \text{if } T_i \leq U_i \\ 0, & \text{if } T_i > U_i \end{cases} \quad (3)$$

Suppose we have a sample size n from the target population. For subject i , $i = 1 \dots n$, we have observed values of covariates x_{i1}, \dots, x_{ip} and possible censored survival times T_i . The model is specified by the equations

$$\log(T_i) = \beta_0 + \beta_1 x_{i1} + \dots + \beta_p x_{ip} + \sigma \epsilon_i \quad (4)$$

where β_0, \dots, β_p are the regression coefficients of interest, σ is a scale parameter and ϵ_i are the random disturbance terms, usually assumed to be independent and identically distributed with some density function $f(\epsilon)$.

Therefore, the survival time for the populations can be expressed as follows:

$$T_i = e^{\beta_0 + \beta_1 x_{i1} + \dots + \beta_p x_{ip}} e^{\sigma \epsilon_i} \quad (5)$$

In this study, the mediation and moderated mediation indirect effects of innovative attributes on time of adoption through perceived risks were calculated by running a Monte-Carlo simulation for the combination of the coefficient estimate of regressing

Perceived Risks on Innovative Attributes (controlling for *peripheral innovation*) from simple regression, and the coefficient estimate of regressing the *Time of Adoption* on *Perceived Risks* (including *Innovative Attributes* and controlling for *peripheral innovation*) from the hazard model regression.

The anticipated censored survival time model were provided as follows:

$$\begin{aligned} \log(T_i) = & \beta_0 + \beta_1 \text{Innovative Attribute} + \beta_2 \text{Perceived Risks} \\ & + \beta_3 \text{Peripheral Innovation} + \sigma \epsilon_i \end{aligned} \tag{6}$$

$$T_i = e^{\beta_0 + \beta_1 \text{Innovative Attributes} + \beta_2 \text{Perceived Risks} + \beta_3 \text{Peripheral Innovation}} e^{\sigma \epsilon_i} \tag{7}$$

Critical terms are defined below:

- T_i denotes the time of adoption for the bike of subject i
- *Innovative Attributes* is the type of the innovative bike features. It was coded as “1” for “core innovation” (“no-pedals bike with energy-transferring battery”) and “0” for “non-core innovation” (“bike with peripheral new features of GPS-Navigation” or “regular bike without new feature”)
- *Perceived Risks* is the mean score ratings on the 3-item scale testing for the overall perceived risks associated with the bike product
- *Peripheral Innovation* is the controlled covariate for the innovative bike feature, coded as “1” for “bike with peripheral new features of GPS-Navigation” and “0” for “bike with core innovation” or “regular bike without new feature”
- σ is a scale parameter and ϵ_i represents the random disturbance terms.

Therefore, β_2 as the coefficient for the mediator *Perceived Risks* in the model of *Time of Adoption* from *Perceived Risks* controlling for *Innovative Attributes* (and *Peripheral Innovation*) was used to combine with a_1 , the coefficient for *Innovative Attributes* in the model of the mediator *Perceived Risks* (controlling for the *Peripheral Innovation*), in order to test the indirect effect of *Time of Adoption* on *Innovative Attributes* through mediation of *Perceived Risk*. To test the conditional indirect effect of *Time of Adoption* on *Innovative Attributes* through mediation of *Perceived Risk* depending on the moderator of *Peers' Adoption Intention*, I used β_2 and a_4 , the coefficient for the interaction between *Innovative Attributes* and *Peers' Adoption Intention* in the model of *Perceived Risks* (controlling for *Peripheral Innovation*).

4.3 Results

This chapter presents the findings from the pilot study and current main study, and includes detailed analysis of sample descriptive characteristics, manipulation check, exploratory findings from models, and the results of hypothesis testing.

4.3.1 Pilot Result

A pre-test was conducted ($n = 77$) among undergraduate students to determine the attributes used in the main study to represent the product categories (bicycle). Participants were asked to compare groups of attributes (collected from the internet) and determine which attributes in each set are the most important features to the product category that is mostly agreed upon by all consumers, that missing such important features can cause confusions in understanding the product for them. For bicycle, I tested five different attributes, including pedals, GPS navigation device, saddles, handlebars and

spoke. Among all the 77 participants, 53 participants chose pedals as one of the most important attributes defining the bike category, followed by 52 choosing handlebars, 43 selecting saddles, 19 preferring spoke, and lastly 3 selecting GPS device. The combined results afforded insight into the relative importance of each attribute. The top rated attribute pedal was chosen to represent the core feature of the bike product, whereas the last rated attribute GPS device was chosen to represent the peripheral feature of the bike category.

In the pre-test, the participants were also asked three questions to test whether or not changing the defining features can violate the core beliefs about the product category. The three nine-point scale items were used as discussed in previous section of methodology (Campbell & Goodstein, 2001; Noseworthy, et al., 2012). The current study predicted that those participants assigned to the core innovation groups should rate the bike less typical than those assigned to the control group. As predicted, a one-way ANOVA on the Typicality test revealed a significant effect of core violation ($F(1, 75) = 38.71, p < .05$; $F(1, 75) = 16.918, p < .05$; $F(1, 75) = 10.444, p < .05$). Participants assigned to the core innovation group rated the bike product less typical ($M = 3.434$), more novel ($M = 3.68$), and less likely ($M = 4.43$) relative to those assigned to the control group ($M = 5.84$; $M = 5.51$; $M = 5.97$).

4.3.2 Sample Descriptive Characteristics

The study attracted 159 students to participate, but only 155 participants provided valid responses. The remaining 4 survey results were deleted on the basis of the incorrect answer in response to the screening question. As shown in Table 1, the 155 participants

were randomly assigned to the three conditions: as 51 (32.9%) in the core condition and 52 (33.5%) in each of the peripheral and control conditions.

Table 1: Sample Descriptive Characteristics

Condition	Frequency	Percent
Core innovation	51	32.9
Peripheral innovation	52	33.5
Control	52	33.5
Total	155	100.0

4.3.3 Results of Typicality and Functionality as Manipulation Check

This section presents the results from a manipulation check for core violations due to innovative core attributes – that is, whether or not changing the core features can violate people’s fundamental beliefs regarding the bike’s intended function. To test manipulation, participants were asked four questions, including three items for typicality (How typical/novel/likely do you think the bike is to other bike?) and one item for functionality (How likely do you think the bike will well function?). The higher the rating of typicality and functionality, the more likely people think the bike is typical with respect to the existing bike category and the more likely it will function as a typical bike.

The results of the manipulation check are shown in Tables 2 and 3. For TYP1, the rating for the control condition (M= 6.92) was higher than for the peripheral condition (M=4.25) and the core condition (M=3.41), and the differences between conditions were significant (F=48.764, p<0.05). For TYP2, the rating for the control condition (M= 6.08) was higher than for the peripheral condition (M=5.12) and the core condition (M=4.16), and the differences between conditions were significant (F=14.914, p<0.05). For TYP3, the rating for the control condition (M= 7.00) was higher than the peripheral condition (M=5.52) and the core condition (M=3.45), and the differences between conditions were

significant ($F=47.821$, $p<0.05$). For FUNC, the rating for the control condition ($M= 5.75$) was higher than the peripheral condition ($M=5.52$) and the core condition ($M=3.49$), and the differences between conditions were significant ($F=40.285$, $p<0.05$).

Table 2: Descriptive of Manipulation Check Results

Variables	Condition	N	Mean
How typical do you think the product is to other Bicycles?	Core innovation	51	3.41
	Peripheral innovation	52	4.25
	Control	52	6.92
How novel do you think the product is?	Core innovation	51	4.16
	Peripheral innovation	52	5.12
	Control	52	6.08
How likely would you say the product's design was?	Core innovation	51	3.45
	Peripheral innovation	52	5.52
	Control	52	7.00
How well do you think the product will function as a bicycle?	Core innovation	51	3.49
	Peripheral innovation	52	5.52
	Control	52	5.75

Table 3:ANOVA

Variables	F	Sig.
How typical do you think the product is to other Bicycles?	48.76	0.000
How novel do you think the product is?	14.91	0.000
How likely would you say the product's design was?	47.82	0.000
How well do you think the product will function as a bicycle?	40.29	0.000

4.3.4 Results of Hypothesis Testing for Product Evaluations

This section includes results directly related to all hypotheses related to product evaluations, which were tested using PROCESS (Preacher, Rucker & Hayes, 2007) with

the SPSS PROCESS function. Critical tables are presented together with detailed explanations.

Main Effect of Innovative Attributes

In the present study, the effects of innovative attributes (core vs. non-core) on bike evaluations were examined statistically by analyzing the main effect of changes in product attributes. The first hypothesis, H1b, addressed this, stating that there will be a main effect of types of product attributes (core- vs. non-core) upon product evaluations, such that products will be less favored for innovations with changes in core attributes; whereas products will be more favored in the non-core (incl. control and peripheral) conditions.

A one-way ANOVA test was used to test the above hypothesis. Since core innovative bikes violate the functional assumptions of the existing bike category and cause confusion for consumers when making inferences regarding the bike’s intended function, we thus expect to see the product evaluation lowest for core innovation, with peripheral innovation in the middle and highest for the control condition. Detailed statistics for the bike product is summarized in Tables 4 and 5.

Table 4: Descriptive of Bike Product Evaluations

Variables	Condition	N	Mean
Product Evaluations	Core innovation	51	3.53
	Peripheral innovation	52	4.20
	Control	52	4.62
	Total	155	4.12

Table 5: Multiple-Comparison Between Conditions for Bike Product Evaluations

Variable	(I) Condition	(J) Condition	Mean Difference (I-J)	Std. Error	Sig.
Product					
Evaluations	Core innovation	Peripheral	-.68*	0.22	0.01
		Control	-1.09*	0.22	0.00
	Peripheral innovation	Core	.68*	0.22	0.01
		Control	-0.42	0.22	0.15

As shown above in Table 4, the core innovative bike was the least preferred (M=3.5278) and the regular bike was the most preferred (M=4.6186). The results of a one-way ANOVA test indicated that the differences between conditions were significant (F=12.085, p<0.05). Therefore, hypothesis H1b was supported.

The contrasts between core & control/peripheral were also tested –whether there is a main effect of the difference between core & control/peripheral conditions. As indicated by Table 5, the differences in product evaluations between core and peripheral conditions (M=-0.67575, p<0.05) and control conditions (M=-1.09081, p<0.05) were both significant, whereas the difference in product evaluations between peripheral and control conditions (M=-0.41506, p=0.153) was insignificant.

Mediation Effect of Perceived Risk

H2b focused on the role of perceived risks in mediating the effect of innovative attributes on product evaluations. Specifically, I hypothesized that there is a significant indirect effect of type of product attributes (core- vs. non-core) on product evaluations fully (partially) mediated through the perceived risks (high vs. low), such that products with innovative core attributes trigger higher level of perceived risks, which ultimately

lead to lower product evaluations, whereas products in non-core condition cause lower level of perceived risks, leading to higher product evaluations. This indirect effect of core innovation was manifested as follows:

Table 6: Indirect effect of Core Innovation on Evaluation

Variables	Effect	Boot SE	BootLLCI	BootULCI
Risk	-0.50	0.13	-0.81	-0.28

The indirect effect of core innovation on evaluation through perceived risks (effect=-0.4995) were tested through estimating the lower limit and upper limit of confidence interval (-0.8147, -0.2843). Since “0” did not lie between the confidence interval, this indirect effect was significant. I also tested the coefficient estimate of core innovation in the model of perceived risks from innovative attributes, and the coefficient estimate of perceived risks in the model of product evaluations from perceived risks and innovative attributes. And the model outcome were summarized as follows:

Table 7: Model Outcome of Risk

	Coefficient	Std. Error	t	Sig.
Constant	3.46	0.20	17.69	0
Core innovation	1.24	0.28	4.48	0
Peripheral innovation	0.26	0.28	0.93	0.36

Table 8: Model Outcome of Product Evaluation

	Coefficient	Std. Error	t	Sig.
Constant	6.01	0.24	25.07	0
Risk	-0.40	0.06	-7.07	0
Core innovation	-0.59	0.21	-2.86	0.00
Peripheral innovation	-0.31	0.19	-1.61	0.11

As indicated in Table 7, the coefficient estimate of core innovation explaining perceived risks was 1.2443 ($p < 0.05$), meaning that the perceived risks from core

innovation were higher than the risks from non-core innovation. As shown in Table 8, the coefficient estimate of perceived risks explaining product evaluation was -0.4014 ($p < 0.05$), indicating that the increased perceived risks from core innovation will ultimately decrease product evaluation. Based on all these findings, it can be concluded that H2b was supported.

Moderated Mediation Effect of Social Network

The moderating influence of social network was proposed in the final hypothesis, H3b, which stated there is a conditional indirect effect of type of product attributes (core- vs. non-core) on evaluations at values of social influence (peers' adoption intentions) through the mediation of perceived risks of innovations (high vs. low). It is expected that consumers perceive significant higher risks in core innovations which ultimately lead to lower product evaluations than in products from non-core condition when alters' adoption intentions are relatively low; however, the differences in in risks perceived from products won't be significantly different between core and non-core conditions when peers' adoption intentions are relatively high, since the higher peers' adoption intentions can serve as a replacement of the unobtainable product information to mitigate the perceived risks from core innovation.

Table 9: Model Outcome of Perceived Risks

	Coefficient	Std. Error	t	Sig
Constant	3.95	0.32	12.23	0
Core innovation	2.66	0.52	5.10	0
Peers adoption intention	-0.15	0.09	-1.82	0.07
Interaction between Core innovation and Peer adoption intention	-0.62	0.17	-3.60	0.00
Peripheral innovation	0.20	0.26	0.76	0.45

The interaction estimate denotes the moderating influence of social network on perceived risks associated with core innovation. As shown in Table 9, the coefficient estimate of social network (operationalized as “peers adoption intentions”) was -0.1545 ($p < 0.05$), indicating that increasing social network influence can reduce the perceived risks associated with core innovation. Furthermore, the coefficient estimate of the interaction between core innovation and social network was -0.6183 ($p < 0.05$), implying that the influence of social network on innovative attributes significantly varied between conditions; in this case, the interaction indicates that social network can largely reduce perceived risks when interacting with core innovation, but not when interacting with non-core innovation.

Table 10: Conditional Indirect effect of Core Innovation on Evaluation

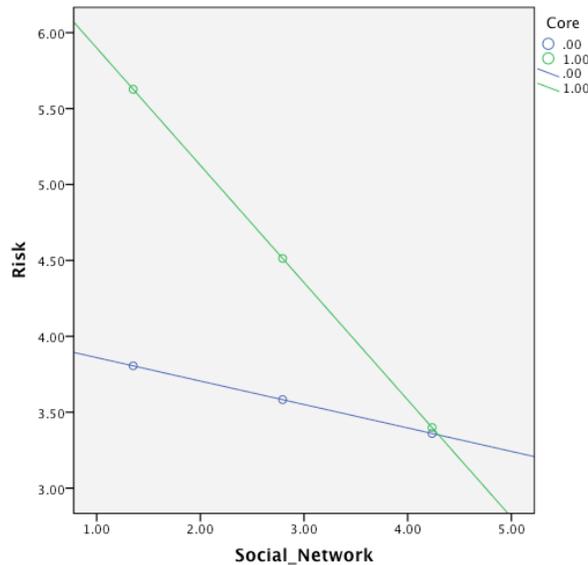
	Social Network	Effect	Boot SE	BootLLCI	BootULCI
Overall Risks_					
1SD below					
Mean	1.35	-0.73	0.16	-1.06	-0.44
Overall					
Risks_Mean	2.79	-0.37	0.12	-0.64	-0.18
Overall					
Risks_1SD					
above Mean	4.24	-0.02	0.17	-0.34	0.32

As shown in Table 10, the conditional indirect effect of core innovation on evaluation through perceived risks depending on the value of social network was tested through estimating the lower limit and upper limit of confidence interval. This analysis revealed that influences of social network were categorized into three levels, with 1.352 as the least influential level (-1.0592, -0.4433), 2.7935 as the moderate level (-0.6389, -

0.1788), and 4.2351 as the most influential level (-0.3409, 0.318). Therefore, the moderating effects of social network were significant at the least and moderate influential level, but not significant when social influences were high.

Fig. 1, showing the interaction between social network and innovative attributes, indicates that perceived risks significantly decreased along with increasing social network influence for the core innovation; in contrast, risks didn't reduce with increasing social influence for the non-core innovation. Based on all these findings, it can be concluded that H3b was supported.

Figure 1: Interaction Effect of Social Network and Innovative Attributes



1= core innovation; 0= non-core innovation

4.3.5 Results of Hypothesis Testing for Time of Adoption

In this section, I will present findings resulted from analysis of the hazard model used for testing indirect and conditional indirect effects of innovative attributes on time of adoption.

Main Effect of Innovative Attributes

In the present study, the effects of innovative attributes (core vs. non-core) on time of adoption were examined with respect to changes in product attributes. The first hypothesis (H1a) addressed this question, stating that there would be a main effect of type of product attributes (core- vs. non-core) on innovation adoptions. It was expected that time of adoption will be relatively later for innovations with changes in core attributes; whereas time of adoption will be relative earlier for products innovations with changes in non-core attributes.

Two flexible parametric hazard models were used to test the above hypothesis: the Weibull and the Log-Logistic models (Meade & Islam 2010). In case of Weibull model, the assumption that ϵ has a standard extreme distribution was retained as shown in the equation (5), but the assumption that $\sigma = 1$ is relaxed. If ϵ has an extreme-value distribution, then T itself has a weibull distribution. Detailed statistics for the bike product are summarized in Table 11.

Table 11: Parameter Estimates for the Main Effect Model with Weibull Distribution

Parameter	DF	Estimate	Std. Error	LLCI	ULCI	Chi-Square	Pr > ChiSq
Intercept	1	2.38	0.17	2.05	2.72	198.17	<.0001
Core							
Innovation	1	0.31	0.25	-0.18	0.80	1.54	0.22
Peripheral							
Innovation	1	0.01	0.24	-0.45	0.47	0	0.97
Scale	1	0.93	0.09	0.78	1.12		
Weibull	1	1.07	0.10	0.89	1.29		

As shown in the above table, the coefficient for core innovative attribute was 0.3089 ($p>0.05$), indicating that this estimate was not significantly different from 0. To further test the H1a hypothesis, I also used more flexible Log-Logistic model, which is similar to the log-normal model, but allows for an inverted U-shaped hazard and a more general estimate. The results of this analysis are shown in Table 12.

Table 12: Parameter Estimates for the Main Effect Model with Log-Logistic Distribution

Parameter	DF	Estimate	Std Error	LLCI	ULCI	Chi-Square	Pr > ChiSq
Intercept	1	1.91	0.19	1.53	2.28	99.53	<.00
Core							
innovation	1	0.41	0.27	-0.12	0.94	2.32	0.13
Peripheral							
innovation	1	0.11	0.26	-0.41	0.62	0.17	0.68
Scale	1	0.74	0.07	0.62	0.88		

Results of this model were similar to those found using the Weibull model. The coefficient for core innovative attributes was 0.4128 ($p>0.05$), implying that this estimate was not significantly different from 0. Therefore, H1a proposing the main effect model of core innovation on time of adoption was not supported. It is worth noting that the $\hat{\sigma}$ (0.7409) being less than 1.0 indicates that the estimated hazard function follows an inverted U-shaped form. The coefficient and the tests statistics were actually closer to the Weibull model.

Mediation Effect of Perceived Risk

Similar to H2b, H2a focused on the role of perceived risks in mediating the effect of innovative attributes on time of innovation adoption. Specifically, it is hypothesized that there would be a significant indirect effect of type of product attributes (core- vs. non-

core) on innovation adoption mediated through the perceived risks. In other words, products with innovative core attributes trigger higher level of perceived risks, and thus lead to later intended adoption, whereas products with non-core innovative attributes cause lower level of perceived risks, and thus induce earlier intended adoption. To test this hypothesis, simple regression and hazard model analysis were used to estimate the coefficient of innovative core attributes in the model of perceived risks and the coefficient of perceived risks in the model of time of adoption from perceived risks and core innovation controlling for the peripheral innovation. As the coefficient of innovative core attributes in the model of perceived risks has already been confirmed in models of product evaluations ($a = 1.2443$, $se = 0.278$, $p < 0.05$), in this chapter I will mainly explore the results of coefficient estimates of perceived risks in analyses using two hazard models: Weibull and Log-logistic. The parameter estimates for the model of time of adoption using the Weibull distribution is shown in Table 13.

Table 13: Parameter Estimates for the Mediation Effect Model with Weibull Distribution

Parameter	DF	Estimate	Std. Error	LLCI	ULCI	Chi-Square	Pr > ChiSq
Intercept	1	2.60	0.18	2.24	2.95	208.72	<.00
Core innovation	1	-0.17	0.26	-0.68	0.35	0.41	0.52
RISK	1	0.29	0.07	0.14	0.43	15.2	<.00
Peripheral innovation	1	-0.13	0.23	-0.57	0.32	0.31	0.58

The coefficient of perceived risks was 0.2856 ($se = 0.0733$, $p < 0.05$), indicating that this estimate was significantly different from 0 in the model of adoption time explained by perceived risks, core and non-core innovation. In this case, risks were positively correlated with adoption time, such that increased risks derived from core innovation can induce late time of adoption. To be more specific, for each one-unit increase in RISK, the

expected time to adopt for innovative adoption increased 100 ($e^{0.2856} - 1$) (33%). I then used this coefficient estimate with the coefficient estimate of innovative core attributes from a simple regression model of perceived risks ($a = 1.2443$, $se = 0.278$, $p < 0.05$) to run a Monte-Carlo simulation (Selig, J. P., & Preacher, K. J., 2008). This produced a confidence interval of (0.1467, 0.6223), indicating that the indirect effect of innovative attributes on adoption time through mediation of perceived risks was significant.

Table 14: Parameter Estimates for the Mediation Effect Model with Log-Logistic Distribution

Parameter	DF	Estimate	Std. Error	LLCI	ULCI	Chi-Square	Pr > ChiSq
Intercept	1	2.07	0.19	1.69	2.45	113.19	<.00
Core							
innovation	1	0.04	0.28	-0.51	0.58	0.02	0.89
RISK	1	0.28	0.08	0.13	0.43	12.99	0.00
Peripheral							
innovation	1	0.07	0.25	-0.43	0.56	0.07	0.80

To further check this mediation effect, I also ran a parameter estimate for the model of time of adoption using log-logistic distribution. As shown in Table 14, the coefficient of perceived risks was 0.2814 ($se = 0.0781$, $p < 0.05$), indicating that this estimate was significantly different from 0 in the model of adoption time explained by perceived risks, core and non-core innovation. In this case, risk was positively correlated with adoption time, such that increased risks derived from core innovation can induce late time of adoption. To be more specific, for each one-unit increase in RISK the expected time to adopt for innovative adoption increased 100 ($e^{0.2814} - 1$) (32%). I then used this coefficient estimate with the coefficient estimate of innovative core attributes from a simple regression model of perceived risks ($a = 1.2443$, $se = 0.278$, $p < 0.05$) to run a

Monte-Carlo simulation. This simulation generated a confidence interval of (0.1279, 0.6305), indicating that the indirect effect of innovative attributes on adoption time through mediation of perceived risks was significant. Together, these findings provided support for hypothesis H2a.

Moderated Mediation Effect of Social Network

The moderating influence of social network on time of adoption was addressed in the final hypothesis, H3a, which stated that there would be a conditional indirect effect of type of product attributes on innovation adoptions at values of social influence through the mediation of perceived risks of innovations. We expect to observe consumers perceive significant higher risks in core innovations inducing later intended adoption than in non-core innovation when alters' adoption intentions are relatively low; however, the differences in risks perceived from products won't be significantly different between core and non-core innovations when influence social are high, since the higher peers' adoption intentions can serve as a replacement of the unobtainable product information to mitigate the perceived risks from core innovation.

To test this hypothesis, again simple regression was used to estimate the coefficient of interactions between innovative attributes and social network influence in the model of perceived risks, adopting a hazard model to estimate the coefficient of perceived risks in the model of adoption time from perceived risks and core innovation while controlling for the peripheral innovation. The coefficient of interactions between innovative attributes and social influences has already been confirmed in models of product evaluations ($a = -0.6183$, $se_a = 0.172$, $p < 0.05$). Similarly, the coefficient of perceived risks in the model of time of adoption from perceived risks and innovative attributes were

also calculated by estimating the two hazard models using Weibull ($b=0.2856$, $se_b=0.0733$, $p<0.05$) and Log-logistic distributions ($b=0.2814$, $se_b=0.0781$, $p<0.05$). These parameters were then used to run a Monte Carlo simulation to test the proposed conditional indirect effect.

The range of the confidence interval for the Weibull hazard model was estimated as (-0.3248, -0.06473), while that of the Log-logistic hazard model was calculated as (-0.326, -0.058). Together, these findings provided support for hypothesis H3a.

5.0 Discussion and Conclusion

This section offers a detailed discussion and explanation of the research findings reported in the previous chapter, in addition to concluding remarks.

5.1 Main Effect of Innovative Attributes

As expected, study findings indicated that customers' product evaluations were less favorable for innovative core attributes than for innovative non-core attributes (including both peripheral innovative and regular products). The main reason for these lower evaluations was that products with innovative core features (exemplified by the bike without pedals) were deemed as less typical and less functional, fundamentally challenging the intended functions of the product category. Generally speaking, the current study confirmed that people's responses to product innovations vary in their nature and characteristics. In particular, people tend to appreciate innovations when they concern non-core features but not when they concern core ones.

In contrast, and contrary to our hypothesis, there were no significant differences between adoption times for core and non-core innovations. In both the Weibull and Log-

logistic models, the coefficient of innovative core attributes (0.3089 and 0.4128) failed to reach significance, indicating that there was no significant difference between adoption times for core and non-core innovations.

This particular finding may have resulted from a financial constraint attached to the student sample that I failed to take into account. Going into the current study, it is assumed that people who favored product innovations (as with peripheral innovative products) would report an earlier time of adoption. It should be noted, however, that higher product evaluations do not necessarily lead directly to early adoption, especially in consideration of the possible cost-related concerns associated with innovation. That is why the discrepancy between product evaluations and adoption decisions has been manifested in previous studies (Alexander, Lynch, & Wang, 2008; Arts, Frambach, & Bijmolt, 2011; Castaño, et al. 2008). In running meta-analysis of previous 77 studies, Arts, et al. found that factors driving adoption intentions (eg. product evaluations) and actual purchase decisions are quite different. In other words, when considering about innovation adoptions, product evaluation is not everything and won't translate into a confirmed purchasing decision automatically. It is possible that people believe that most innovative products are quite expensive, and they may simply endorse the innovation without considering making such a purchase given by the price and their financial conditions.

This may have been an especially relevant in this study, which drew participants from a group (university students, mostly 17-22 years old) that has particularly limited budgets and buying power. Thus, the participants in this study would be particularly likely to estimate longer adoption times for both core and non-core innovations. Such a

disconnection between evaluations and perceived adoption time would explain the lack of significant differences in adoption times between core and non-core innovations.

In summary, the current main hypothesis regarding innovative product evaluations was supported, whereas hypothesis regarding time of innovative product adoption was not. This apparent discrepancy is likely a consequence of the skewing of the participant pool towards financially constrained young people.

5.2 Mediating Role of Perceived Risks

Previous literature has provided evidence that product innovations can cause uncertainty about perceived risks, preventing consumers from appreciating the innovativeness and/or delaying their time of adoption. In the current study, this mediating role of perceived risks was statistically significant, confirming its ability to explain lower product evaluations and late time of adoption. Differences in perceptions of risk were detected between two types of product innovations. In particular, the overall risks perceived from innovative core attributes were stronger and induced lower product evaluations and later times of adoption, whereas innovative non-core attributes were associated with relatively low perceived risk, and were more likely to be favored and quickly adopted.

It should be noted, however, that the proposed indirect effect of innovative attributes on adoption time through mediation of risks was supported, despite the absence of a significant direct effect of product innovations on adoption time. This result seems counter-intuitive in the sense that, without a significant direct effect to be mediated, an effect mediated by risks would be examined, let alone detected. Nonetheless, this research provided support for the argument that there need not be a significant “zero-

order” effect of X (innovative attributes) on Y (time of adoption), r_{xy} , to establish mediation (Zhao, Lynch & Chen, 2010). This concept is illustrated in Figure 2, wherein we define path a as “indirect path” from innovative attributes to risks, path b as “indirect path” from risk to time, and path c as “direct path” from attributes to time (when controlling for risks). We also define c' as the “total effect” of attributes on time (when not controlling for risks) as shown in Figure 3.

Figure 2: A Three Variable Causal Model

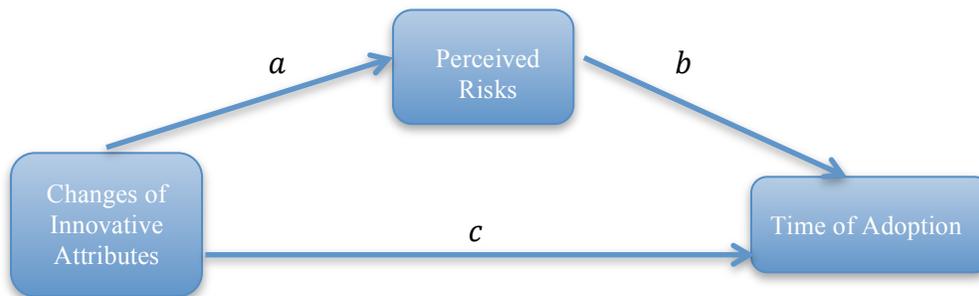
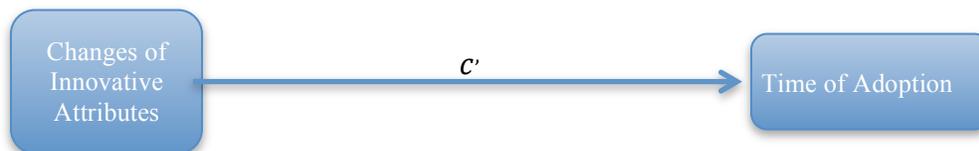


Figure 3: A Two Variable Causal Model



From the above figure, we can derive the following equation:

$$c' = (a \times b) + c$$

That is, the “total effect” – or in this case the main effect of innovative attributes on time – equals the sum of the “indirect path” (path $a \times$ path b) and the “direct path” (path c).

The detailed mathematical validation for this can be found in Baron and Kenny's (1986) paper. I will mainly focus on explaining why this is applicable to this study.

As summarized by Zhao, Lynch and Chen (2010), c' now represents only the total effect, and a non-significant c' doesn't necessarily indicate lack of mediation. In the current study, $a=1.2443$ (se=0.278, $p<0.05$), $b = 0.2814$ (se=0.0781, $p<0.05$), and $c = 0.0369$ (se= -0.5069, $p=0.8942$) and $c' = 0.4128$ (se=0.2713, $p=0.128$) as results from log-logistic model. Since the Monte-Carlo simulation results indicated that the indirect path $a \times b$ is significant, this study actually maintained that the X-Y test (as exemplified by c') is neither relevant nor necessary to establish mediation, that it may well be possible to establish an indirect effect despite no total effect. Specifically, Zhao et al.,(2010) defined that we have a *indirect-only mediation*, where indirect path $a \times b$ is significant, and the direct effect c is insignificant (as exemplified in this study), indicating that the mediator (perceived risks) we identified was consistent with the hypothesized theoretical framework and unlikely omitted mediator in the direct path.

On the whole, the mediating role of perceived risks between innovative features and product evaluations and time of adoption was confirmed in the present study. In addition, we were able to observe statistically different patterns in their perceptions of risks derived from core and non-core innovations.

5.3 Moderating Role of Social Network Influence

Previous literature suggests that social influence may play a role in the process of innovation diffusion. The current study showed that social influence can replace product-related information to mitigate perceived risks when information is unobtainable or too

vague to allow for informative decisions, ultimately improving product evaluations and accelerating the procedure of innovation adoption.

Specifically, differences in social network influence were detected between core and non-core innovative attributes. Specifically, perceived risks associated with core innovation were not significantly different from risks derived from non-core innovation when influence of social network was high; when social influence was medium or low, however, perceived risks associated with core innovations were significantly higher than the risks from non-core innovation. Therefore, the overall interaction between social network influence and innovative attributes was confirmed, as the conditional indirect effect of innovative attributes on product evaluations through mediation of perceived risks depending on the value of social influence was significant.

Similarly, this significant moderating effect was also verified when predicting adoption time with innovative attributes. Results from running Monte Carlo simulation indicated that social network (exemplified as peers' adoption intentions) significantly reduced the perceived risks for core innovation and accelerated time of adoption. This relationship was not present for non-core innovations.

6.0 Contribution, Limitations & Future Research

The present studies examined the effect of different types of innovation upon product evaluations and adoption time. The mediating role of perceived risks and the moderating role of social influence were also investigated. This chapter summarizes the theoretical and managerial contributions made by the current study, in addition to its limitations and directions for future research.

6.1 Theoretical Contributions

The theoretical contributions of the current study exist in two domains. First and foremost, the current study theorizes risks as the underlying reason explaining the effects of schema incongruity. Most of previous studies in schema congruity theory advocate a cognitive interpretation and suggest that limited cognitive resources and capabilities might explain aversion of extreme incongruity. Schema congruity theory argues that people don't like extreme incongruity because they can't make sense of it; it is too taxing for them to accommodate. It is summarized that the dynamic relationship between arousal level and cognitive tensions, which accompanies increases in incongruity between an object and a schema, accounts for reasons underlying such schema incongruity effect (Mandler, 1982). In this study, core innovations were deemed as extremely incongruent and induce high perceived risks, because they represent challenges to the fundamental intended functions of a given product category. The current study thus offers an alternative way to explain the schema incongruity effect by demonstrating a significant mediating role of perceived risks underlying the indirect effect of core innovation on innovation adoption. Specifically, the prominent mediating role of perceived risks suggests that people are less likely to favor and adopt extremely incongruent products because they perceive higher risks associated with these unfamiliar products that they are reluctant to take. In other words, the extreme incongruity of core innovation doesn't necessarily induce lower product evaluations or late time of adoption. It is only those who associate high risks with novel products are more likely to evaluate products as less favorable and delay innovation adoption. More importantly, I further proposed an approach to mitigate the aversive attitudes towards extreme incongruity, by

replacing unobtainable product information with social influence to reduce perceived risks.

The second contribution is that the current study contributes to understand the underlying process of social influences on innovation adoptions. Consumer choices (behaviors, attitudes, beliefs, etc.) are inevitably affected by the choices of others within the same social networks. As noted by Borgatti and Halgin (2011), innovation contagion through social influences can be conceptualized as a collection of nodes influencing each other to adopt their traits. Previous research suggests that innovation adoptions don't happen to consumers instantly. Rather, it involves different stages for them to get aware of the existence of new products, to search information and update their beliefs accordingly, to communicate and discuss with their peers who have adopted or potentially will adopt, and etc. The question left is that will these different factors affect adoptions of product innovations to the same extent, or the influences vary according the nature of novel attributes? More specifically, will certain type of innovative products and novel attributes be more subjective to social influences comparing to other types? Likewise, the underlying mechanism(s) explaining social influences upon innovation adoption remain unknown. The current study suggests a fruitful direction for future research about the process of innovation adoptions is contingent on the nature of novel product attributes. That is, by testing the moderating role of social influence through mediation of perceived risks, the current study demonstrated that people look into their peers' purchasing behaviors and intentions to adopt as an approach to compensate absence of product information, to reduce uncertainties of making inferences from core innovation.

6.2 Managerial Implications

The model developed in this paper may be of use to marketing managers, as well. It is quite common for marketing managers to employ seeding strategies, wherein they identify influential and central-positioned individuals for the purpose of spreading innovative products (Valente, 2012). Especially for managers who are conducting such marketing campaigns, this program suggests that it is crucial to understand how word-of-mouth influence can vary depending on the nature of innovative product features. Specifically, given possible budgetary limitations, they should target the innovative product features (core vs. non-core innovations) susceptible to social and network influences. In this way, the current research offers creative insights to help marketing managers in refining seeding strategies according to different types of innovative product attributes.

Furthermore, the present research can also help to accelerate the process of innovation adoptions via the use of social networks. One of the main dilemmas for policy makers in both public and private domains is how to accelerate innovation diffusion of promising and environmental-friendly technologies that are uncompetitive. They need accurate estimates of adoption time. However, such innovations generally change bases of competition by changing the performance metrics along which firms compete (Danneels, 2004). More specifically, they introduce a secondary dimension of performance (e.g., innovative attributes) along which products did not compete previously, while underperforming in some primary dimensions valued by mainstream customers (Christensen & Raynor 2003). Therefore, benefits in the products are highly likely to be underestimated by mainstream markets due to different attribute sets

compared to existing products, ultimately leading to slow adoption times (Christensen, Anthony & Roth, 2004). In terms of resource allocation, not understanding this phenomenon is potentially very detrimental. Findings from current study provide a critical indicator (regarding peers' adoption intentions) that can facilitate consumer appreciation of product innovation and thus accelerate the process of innovation adoption.

6.3 Limitations and Future Research

The major limitations of present study are the small sample size, the sample sizes predominantly student composition, the single product category used, and the different dimensions of perceived risks. Following each limitation, corresponding improvements are suggested for future research.

First, the number of subjects who provided valid responses was limited to about 50 people for each condition, barely meeting the requirement for use of the hazard regression model. According to the G-Power calculation, at least 180 respondents needed to be recruited. However, due to time restrictions and inappropriate survey answers, only 155 responses were used for data analysis. In order to guarantee a higher validity, future research needs to secure that the quantity of participants recruited is larger than the calculated sample size requirement.

Second, the student sample was skewed heavily towards young people aged 17-22. In fact, according to the sample's demographic characteristics, there was no significant variation in terms of age, gender, and mostly importantly, their income levels. Consequently, these variables could not be used to further explore influence. Moreover, these participants represent a financially limited group that may be quite biased when

considering future purchases of new innovation. In other words, they may highly favour certain types of innovations but lack the resources to adopt them in the near future. Future work should strive to use a sample pool that is more varied and representative of the population.

Third, I pre-tested the bike products in the pilot study and used the same product stimuli for the current research to investigate preference on innovative attributes. If possible, I would like to test the current hypotheses using other products from different categories in order to determine whether findings from this study remain valid across different product categories.

Finally, it is important to note that perceived risk includes a variety of different dimensions, such as financial, psychological, physical, time, and performance risks. In our current study, only overall perceived risks were tested. In future research, I would like to take specific risk dimensions into account, such that the roles of other specific mediators involved in the process of innovation adoption may be further explored.

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Appendix 1



Core Innovation



Peripheral Innovation

Appendix 2



How likely do you think the person will purchase the printer? (or have already purchased).

	Very Unlikely	Unlikely	Somewhat Unlikely	Undecided	Somewhat Likely	Likely	Very Likely
First Candidate	<input type="radio"/>						
Second Candidate	<input type="radio"/>						
Third Candidate	<input type="radio"/>						
Forth Candidate	<input type="radio"/>						
Fifth Candidate	<input type="radio"/>						

>>



Please place a check in the box if the people listed at the column would talk to the other four listed at the top row, even if you were not present. You can choose "None" if they won't talk to each other.

First Candidate	Second Candidate	Third Candidate	Forth Candidate	Fifth Candidate	None
	<input type="checkbox"/>				
Second Candidate	First Candidate	Third Candidate	Forth Candidate	Fifth Candidate	None
	<input type="checkbox"/>				
Third Candidate	First Candidate	Second Candidate	Forth Candidate	Fifth Candidate	None
	<input type="checkbox"/>				
Forth Candidate	First Candidate	Second Candidate	Third Candidate	Fifth Candidate	None
	<input type="checkbox"/>				
Fifth Candidate	First Candidate	Second Candidate	Third Candidate	Forth Candidate	None
	<input type="checkbox"/>				

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