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Differences between early adopters of disruptive and sustaining innovations ☆

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ABSTRACT

The success of innovations strongly depends on knowledge about early adopters. Prior research helps to describe the characteristics of this important customer type. However, not distinguishing between different types of innovation and different types of early adopters bears substantial risk. This study investigates systematic differences and similarities between early adopters of disruptive innovations and early adopters of sustaining innovations. The results from a heterogeneous sample of consumers (n = 849) suggest that significant differences between these groups exist. Early adopters of disruptive innovations are more knowledgeable of the product domain. In contrast, consumers who purchase sustaining innovations relatively early are more involved in the product domain. Therefore, managers must address early adopters differently and differentiate their product development and marketing strategy in accordance with the type of innovation.

1. Introduction

Customer value, customer satisfaction, customization and many other central management concepts have one joint premise — acquiring knowledge about customers. The process of understanding why consumers become customers of a firm becomes particularly important when firms develop new products and services. Adoption and diffusion theory as well as research on consumer innovativeness has aided managers in identifying and addressing an important group of customers, early adopters of new products (Bartels & Reinders, 2011; Goldsmith & Hofacker, 1991; Rogers, 2003). However, previous research assumes that the characteristics of early adopters are identical regardless of the specific types of innovation (Arts, Frambach, & Bijmolt, 2011). This study challenges the assumption that adopter psychographics are the same for different types of new products.

The theory of disruptive innovation addresses the relevance of differences among innovative customers (Christensen, 1997). This theory posits that when established firms listen to the opinions of their current customers regarding new products, managers allocate resources to insufficient or unsuitable technologies. Technologies that current customers of such firms reject will later displace these technologies. Research indicates that incumbent firms that view current customers the same as potential customers face an increasing risk of failure (Christensen & Bower, 1996). For example, BlackBerry customers were satisfied with an integrated keyboard and initially rejected the idea of touchscreens, because they were heavy users writing many emails per day. Consequently, BlackBerry did not invest in touchscreens and smartphones. However, a majority of consumers later switched to this new technology and Apple and other competitors displaced BlackBerry.

The starting point to address this problem is the assumption that early adopters of disruptive innovations and those of sustaining innovations have different needs and characteristics. For example, in the case of disk drives, the former early adopters of 8-inch disk drives (i.e., mainframe users) were laggards regarding the purchase of 5.25-inch disk drives compared with the initial buyers (Schmidt & Druehl, 2008). Therefore, this study aims to analyze the extent to which early adopter characteristics are different or similar in whether they adopt disruptive or sustaining innovations. A deeper understanding of early adopters could assist managers in developing new products that meet the needs of customers who are the initial buyers of their products.

The article has the following structure. The next section examines disruptive innovation theory and clarifies relevant terms. The article then analyzes the second stream of research – consumer innovativeness – and develops hypotheses by integrating both theories of disruptive innovation and consumer innovativeness. Sections three and four report the research method and the results. Subsequently, the paper discusses the results and derives implications from the investigation of links among innovation types, time of adoption and the psychological characteristics of consumers. Finally, the last section presents the limitations of this study and highlights further research opportunities.

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2. Disruptive innovation theory

The theory of disruptive innovation (Christensen, 1997; Christensen & Bower, 1996; Christensen & Raynor, 2003) has become an influential theory in both academia and practice. This theory challenges the assumption that established firms fail when they encounter competence-destroying technological change (Christensen & Bower, 1996). A disruption is more likely when mainstream customers in an established market reject innovations that initially underperform in the most important performance dimension.

Researchers understand disruptive innovation as a process and describe this process as follows. A new and potentially disruptive product underperforms on the performance dimension that mainstream customers have historically valued. However, the product performs better on a secondary performance dimension or is less expensive than existing products. Incumbents initially dismiss these disruptive innovations because their current customers demand improvements with regard to the primary performance dimension and do not value increased performance with regard to the secondary performance dimension or a lower price. Meanwhile, entrants develop potentially disruptive innovations and sell them in a niche or emerging market.

Over time, both the potentially disruptive innovation and existing products and technologies improve with regard to the primary performance dimension; however, the disruptive innovation continues to underperform compared with existing products. However, the level of performance has now become sufficient for mainstream customers to adopt the new product. At this point, customers begin to switch from the old to the new technology; meanwhile, the likelihood that entrants will displace incumbents increases sharply (Christensen & Bower, 1996). Incumbents reject future key technologies because they underestimate their potential value for new customers and new markets. Christensen (1997) derives his conclusion from numerous contexts, such as the disk-drive, steel and excavator industries.

Despite the considerable amount of research effort and publications devoted to disruptive innovations, a consensus on the definition of disruptive innovations has not been reached (Danneels, 2004; Markides, 2006). One issue connected to disruptive innovation is the term itself. "Disruptive" describes the potential outcome of a specific type of innovation rather than the actual outcome. Hence, disruptive innovations, as Christensen defines them, may not be disruptive, and innovations that do not meet the characteristics of a disruptive innovation could still disrupt businesses and markets (Danneels, 2004; Schmidt & Druehl, 2008; Sood & Tellis, 2011).

In accordance with previous research (Govindarajan & Kopalle, 2006; Tellis, 2006), this study defines potentially disruptive innovations as innovations that (1) initially underperform with regard to the dominant performance dimension that mainstream customers have historically valued, (2) add an additional performance dimension, which existing products do not possess, and (3) either address the low end of an established market or are commercialized in emerging or niche markets. The new and additional performance dimension is typically related to a product's size, mobility, convenience, usability or price (Adner, 2002; Anthony, Johnson, Sinfield, & Altman, 2008; Christensen, 1997; Tellis, 2006). The additional performance dimension must fulfill one of these criteria but can violate other criteria. For example, a new product could be smaller and more mobile but more expensive.

In contrast with disruptive innovations, sustaining innovations improve performance along dimensions that mainstream customers have always valued (Christensen, 1997). The needs and preferences of current customers are the basis for these innovations. For example, improvements in television picture quality, from black and white to color, HD and 3D, are sustaining innovations.

The disruptive innovation theory makes no explicit indication whether early customers of disruptive innovations and early customers of sustaining innovations possess different psychological characteristics or whether both types of early customers are of similar nature.

3. Consumer innovativeness theory and hypotheses

Research demonstrates that innovation acceptance depends on both the innovation itself and on the individual who adopts or rejects such an innovation (Arts et al., 2011; Holak, 1988; Rogers, 2003). For instance, compatibility, relative advantage and complexity influence innovation adoption speed (Tornatzky & Klein, 1982). Likewise, innate innovativeness (Im, Bayus, & Mason, 2003), product class knowledge (Hirschman, 1980) and involvement (Foxall, 1995) determine which individuals will adopt innovations earlier than others. Whereas research on disruptive innovation does not explicitly indicate differences in characteristics of early adopters, research on innovative consumers and early adopters rarely makes distinctions between different types of innovations. Consumer innovativeness research assumes that innovative consumers are always both involved and knowledgeable in the product category (Arts et al., 2011; Goldsmith & Newell, 1997).

The foundation of this study's model is the three-level consumer innovativeness theory (see Fig. 1) (Bartels & Reinders, 2011; Hirunyawipada & Paswan, 2006; Hoffmann & Soyez, 2010). Innate innovativeness describes the highest level of abstraction in the three-level model and refers to a trait-like construct. Innate innovativeness influences the next level, domain-specific innovativeness (van Rijnsoever & Donders, 2009), which Goldsmith and Hofacker (1991, p. 211) define as the "tendency to learn about and adopt innovations (new products) within a specific domain of interest". The reasoning behind this proposal is that individual innovativeness differs significantly with regard to product categories. Domain-specific innovativeness influences the least abstract level of innovativeness, the actual adoption of new products, which researchers have also termed actualized innovativeness (Citrin, Sprott, Silverman, & Stem, 2000; Hirunyawipada & Paswan, 2006). This study does not use traditional methods to measure domain-specific innovativeness but the constructs product class knowledge, product class involvement and intention to adopt. In the present context, these constructs together constitute domain-specific innovativeness. Moreover, the model includes behavioral control or facilitating conditions, such as product class knowledge and monetary resources, as the theory of planned behavior (Fishbein & Ajzen, 2010) or advancements of the technology acceptance model (Venkatesh, Morris, Davis, & Davis, 2003) propose.

3.1. Innate innovativeness

The innate innovativeness construct is essential for research on innovative behavior because research considers this type of innovativeness a trait, which remains relatively stable over time (van Rijnsoever & Donders, 2009). Vandecasteele and Geuens (2010) develop a scale for motivated consumer innovativeness (MCI) consisting of social, functional, hedonic and cognitive innovativeness. Vandecasteele and Geuens (2010, p. 311) define socially motivated consumer innovativeness as "consumer innovativeness motivated by the self-assertive social need for differentiation". Hedonic innovativeness centers on positive feelings that accompany new product purchases. Cognitively motivated innovativeness describes consumers who experience satisfaction when they encounter new and complicated information or products. Functional innovativeness focuses on the usefulness of new products and centers on the question of whether new products accomplish tasks better than existing products (Vandecasteele & Geuens, 2010).

The present study uses this multi-dimensional concept at the most abstract level of innovativeness to measure different aspects of innate innovativeness. Studies in various contexts provide evidence of a significant relationship between innate innovativeness and new product adoption intention (Bartels & Reinders, 2011; Jin & Suh, 2005; Okazaki, 2007). Therefore, the study includes innate innovativeness to create a comprehensive model and to control for the influence of different dimensions of innate innovativeness.

Disruptive innovation theory does not predict distinct differences in the effect of innate innovativeness on adoption intention. Assumptions about disruptive innovations lead to mixed predictions regarding the effect of different innate innovativeness dimensions. For instance, disruptive innovations provide less functionality on the primary performance dimension but often perform better on an auxiliary performance dimension (Christensen, 1997). Hence, functional innovativeness depends on the relative importance of a performance dimension but not necessarily on the distinction of disruptive vs. sustaining innovations. Similarly, novel performance attributes enhance and a de-rated primary performance functionality reduces socially motivated innovativeness.

Hedonic and cognitive innovativeness are identical with regard to disruptive and sustaining innovations because the definitions of disruptive innovations vs. sustaining innovations do not depend on the degree of novelty, which could influence the effect of innovativeness on adoption intention (Hirschman, 1980). Therefore, social, hedonic, functional and cognitive innovativeness should have equal effects for both disruptive and sustaining innovations. However, including these influential factors is necessary to control for unexpected effects that theory does not yet predict.

3.2. Involvement

Researchers propose the inclusion of traits (e.g., innovativeness) and product class-specific variables, such as product category involvement, in the assessment of early adopters (Manning, Bearden, & Madden, 1995). Consumers can be involved with products, advertisements, product classes or purchase decisions (Zaichkowsky, 1985). Consumer involvement refers to "the feelings of interest and enthusiasm consumers hold toward product categories" (Goldsmith & Emmert, 1991, p. 363). This concept expresses the emotional importance and personal relevance that consumers attach to a product category.

Innate innovativeness influences involvement in specific categories and in turn involvement influences innovative behavior. For example, a high degree of the multi-dimensional innate innovativeness construct (i.e., social, functional, hedonic and/or cognitive innovativeness) leads to a high degree of involvement in consumer electronics, which in turn leads to a high degree of adoption intention.

Empirical studies confirm that innate innovativeness influences involvement (Foxall, 1995). In this study, the product category (consumer electronics) is the same for both disruptive and sustaining innovations. Therefore, the inclusion of the relationships between the innate innovativeness constructs and product category involvement in the model is necessary, but analyzing differences between the two types is not necessary. Similarly, no difference between sustaining and disruptive innovations with regard to the relationship between involvement and knowledge exists. More involved consumers are more curious about the product class and are more likely to attempt to acquire further knowledge (Goldsmith, Clark, & Goldsmith, 2006; Park & Moon, 2003).

Previous studies demonstrate that early adopters are highly involved in a specific product class (Venkatraman, 1991). In contrast, later purchasers are less involved in the product field (Foxall, 1995). Specifically, enduring involvement in a product category significantly influences innovative behavior (Arts et al., 2011; Flynn, Goldsmith, & Eastman, 1996; Goldsmith, d'Hauteville, & Flynn, 1998; Helm & Landschulze, 2009).

Disruptive innovation theory suggests that the effect of involvement on adoption behavior differs based on innovation types. Involvement closely relates to the amount of prior experience within a product class (e.g., television sets) (Foxall & Bhate, 1991). Consumers who are more familiar with a product class more easily and more often form positive innovation adoption intentions (Arts et al., 2011; Gatignon & Robertson, 1985). Because firms introduce sustaining innovations in the same market as the prior product generation and customers of sustaining products are mainstream customers (Govindarajan, Kopalle, & Danneels, 2011), highly involved consumers are more likely to develop positive adoption intentions about sustaining innovations. In contrast, firms commercialize disruptive innovations in a market niche or even in a different market (Linton, 2002). Therefore, early adopters of disruptive innovations are consumers who may not have been previous customers in this product category because existing solutions have not fulfilled their needs. Consumers of disruptive innovations are therefore less likely to be enthusiastic about the product class and involvement in the product category is less likely to affect the development of innovation adoption intentions.

In addition, if consumers are involved and interested in a product category, those consumers will rather be interested in primary performance dimensions than secondary performance dimensions or price. Highly

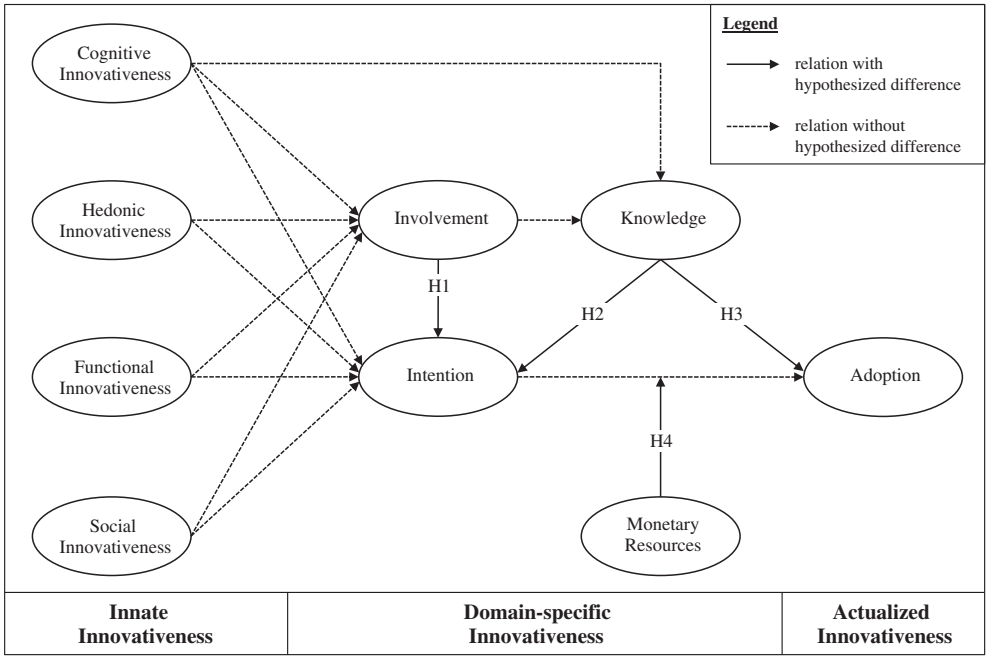

Fig. 1. Theoretical framework and hypotheses.

involved consumers are less likely to accept changes in the accustomed quality (Espejel, Fandos, & Flavián, 2009). Involved customers will more often intend to adopt new products that improve the primary performance dimension rather than adopt new products that have a weaker primary performance. Therefore, highly involved consumers favor sustaining innovations over disruptive innovations.

H1. The influence of involvement on new product adoption intention is weaker for disruptive innovations than for sustaining innovations.

3.3. Behavioral control

In addition to innate innovativeness and involvement, several factors inhibit or foster the adoption intention and actual adoption. These factors constitute the construct "behavioral control." Ajzen and Madden (1986) define a behavior as being under a person's control if the person can perform the behavior at will. For example, consumers confront barriers when purchasing innovative consumer electronics; therefore, purchase behavior is not completely under a person's control.

3.3.1. Product class knowledge

Knowledge can be an intervening variable affecting the early purchase of new products (Midgley & Dowling, 1978). Researchers typically use a self-report scale to measure product class knowledge; thus, the items measure subjective product class knowledge and emphasize self-perceptions of consumer expertise. Studies demonstrate that subjective knowledge has more influence on motivated behavior than objective knowledge (Selnes & Grønhaug, 1986). Product class knowledge has two effects on innovative behavior. First, a high level of knowledge increases the probability that consumers will be aware of new products in a specific domain. Second, they will be more likely to possess knowledge about all of the functions and the manner in which these functions could fulfill unmet needs (Hirschman, 1980). Third, knowledge increases the level of independent judgment making. Consumers who judge independently are more likely to adopt new products (Manning et al., 1995).

During the early development stage, disruptive innovations serve niche or emerging market segments (Adner, 2002; Govindarajan et al., 2011). Customers of disruptive innovations must have extensive product category knowledge to become aware of these new products. For example, mainstream customers did not use the disruptive innovation Skype because they were not aware of the new technology (Rao, Angelov, & Nov, 2006). In contrast, sustaining innovations follow the traditional path of performance improvements. Becoming aware of sustaining innovations requires a lower level of product class knowledge because such innovations have predecessors that have demonstrated improvements in the same performance dimension.

Another dimension of product class knowledge that is relevant for adopters of disruptive and sustaining innovations concerns the assessment of primary and secondary performance dimensions. Novice consumers are more likely to evaluate a product based on the holistic assessment of the category, while expert consumers apply attribute-based assessments (Sujan, 1985). According to the disruptive innovation theory, consumers that adopt disruptive innovations are overshot with current offers and switch to new products with lower primary performance that sufficiently meet their needs (Anthony et al., 2008; Christensen, 1997). Recognizing the threshold of performance requires product class knowledge and attribute-based assessments. In addition, recognizing and valuing the secondary performance dimension of disruptive innovations require similar evaluation processes that in turn require product category knowledge.

H2. The influence of knowledge on the intention to adopt new products is stronger for disruptive innovations than for sustaining innovations.

H3. The influence of knowledge on the actual adoption of new products is stronger for disruptive innovations than for sustaining innovations.

3.3.2. Monetary resources

Tellis, Yin, and Bell (2009) note that measures such as price consciousness, monetary resources or budget constraints have attracted little attention in consumer innovativeness research thus far. However, in a free economy, monetary resources play an important role in the purchase process. Consumers purchase new products only if they feel that they possess sufficient monetary resources. Previous studies have identified relationships between monetary resources and the intention to purchase a new product as well as actual purchases (Pavlou & Fygenson, 2006). Furthermore, Im et al. (2003) report that a high level of income increases the probability of new product ownership.

Researchers generally assume that new products are more expensive than existing products (Sriram, Chintagunta, & Agarwal, 2010). In the disruptive/sustaining framework, this assumption is true only for sustaining products. Disruptive innovations can be less expensive than existing solutions but underperform on dimensions that mainstream customers value (Tellis, 2006). Thus, the moderating effect of monetary resources on innovative buying behavior should differ depending on the type of innovation. Disruptive innovations typically appeal to the low end of the market and have a lower unit price (Adner, 2002). Therefore, consumers with wealth-related constraints often adopt disruptive innovations (Anthony et al., 2008). Theory predicts that price sensitive consumers will appreciate the new products even when the new disruptive product diffuses from the niche into the mainstream market (Adner & Zemsky, 2005; Christensen, 1997). In contrast, sustaining innovations improve the primary performance dimension at the expense of a higher price. Therefore, only consumers who possess sufficient monetary resources adopt sustaining innovations.

H4. Monetary resources moderate the relationship of intention to adoption weaker for disruptive innovations than for sustaining innovations.

3.4. Intention

The intention to perform the behavior is typically a predecessor of actual behavior (Fishbein & Ajzen, 2010). This study includes the influence of the general intention or propensity to purchase new products on the early ownership of new products. van Rijnsoever and Donders (2009) propose the use of intention as an antecedent of adoption behavior. With regard to the movie industry, Chintagunta and Lee (2012) show that intentions grow over time, leading up to purchase. Similar to innate innovativeness, disruptive innovation theory does not provide insight into the effect of intention on adoption and therefore this study theorizes that this effect is equal for both innovation types.

4. Data and method

4.1. Measures

The present study uses existing measures of innate innovativeness (Vandecasteele & Geuens, 2010), involvement (Mittal & Lee, 1989) and knowledge (Flynn & Goldsmith, 1999) (see appendix) and applies the single-item construct: "I have the money needed to purchase consumer electronics" (Pavlou & Fygenson, 2006) to measure the construct monetary resources. Single-item measures can be used for a concrete and singular object with a concrete attribute (Bergkvist & Rossiter, 2007; Rossiter, 2002).

Various ways to measure actualized innovativeness exist: time of adoption, the cross-sectional method or a form of self-report (Goldsmith & Hofacker, 1991). The time of adoption measures the relative time at which an individual adopts a new product relative to other consumers. The cross-sectional method measures the number of new products that an individual owns in a certain product category. Behind

this method lies the assumption that innovative consumers own more products in a particular product category than less innovative consumers. The cross-sectional method is less sensitive to the recall of respondents (Midgley & Dowling, 1978) and is strongly recommended when examining personality–consumer behavior relationships because of its aggregated nature (Lastovicka & Joachimsthaler, 1988). However, common method bias is an issue when using the cross-sectional method (Bartels & Reinders, 2011). To reduce this problem, this study applies a combination of the cross-sectional method and the time of adoption. For the adoption construct, this study relies on a scale that is comparable to the approach of van Rijnsoever and Castaldi (2011). The respondents had to state whether they owned a certain product and how long they had owned the product. Respondents had to choose from three equal timeframes, which stretched from market start of the product to the time of the survey.

Subsequently, the answers were used to calculate an index. Depending on the time of adoption, one to three points were awarded on the actualized innovativeness index for each new product that a consumer owned. Three points were awarded if a respondent purchased a new product during the earliest time span. Accordingly, one point was awarded if a respondent purchased a product recently. To summarize the innovativeness index, when a respondent owned a higher number of different products and had initially purchased these products at an early time, they scored higher on the index.

This approach approximates the adoption graph of Rogers (2003) to measure actualized innovativeness and therefore rewards earlier adoption with more points than later adoption. The index uses equidistant measures, which are a reasonable approximation because different products follow very different diffusion curves with unique time spans (Mahajan, Muller, & Srivastava, 1990). The study uses a similar approach to measure the intention to purchase new products in a particular product domain. The index relates to the finding that intentions grow over time and eventually lead to a purchase (Chintagunta & Lee, 2012).

For the intention index, the respondents had to state whether they owned a given product; whether they intended to purchase the product in the near future, the distant future, or possibly at some time; or whether they did not intend to purchase the product. For each product, the algorithm awarded zero to four points, depending on the strength of the respondent's intention (1 = 'possibly at some time', 2 = 'distant future', 3 = 'near future'). The level of intention is highest shortly before the purchase of the product; thus, the algorithm awarded four points for each product that the respondent owned. Overall, the approach measures the average level of purchase intention in a particular product domain.

4.2. New product selection

Representative products in the field of consumer electronics must be selected to operationalize intention and the adoption of new consumer electronics. Moreover, innovations must be assessed as disruptive or sustaining. Only a systematic approach to select innovations and assess their disruptiveness avoids sampling biases. Therefore, the research team generated a list of 54 new products in the field of consumer electronics during an explanatory research phase. The search focused on fair reports, websites of national brands, consumer electronic shops and expert interviews.

Three innovation management experts from the business and economics faculty at a large Western European university assessed the list of new products. All of the experts were familiar with disruptive innovation theory and they have published articles in the domain of disruptive and radical innovation. The experts rated whether the products are disruptive or sustaining using a binary scale. Before the rating, each expert received the definitions of disruptive and sustaining innovation. During the second round, the experts obtained the opinions of the other experts and categorized the products again. After the second round, 76% of the classifications were consistent among all judges. The study excluded all products that the experts could not categorize unambiguously. The research team then randomly drew eight disruptive innovations and eight sustaining innovations from the remaining 41 products. The disruptive innovations included mobile phone navigation, internet television, tablet PCs, cloud storage, e-book readers, pocket camcorders, solar chargers and video glasses. The sustaining innovations included 3D television, in-ear headphones, Wi-Fi memory cards, blue-ray players, cooling pads, USB record players, iPod sound systems and 3D cameras.

4.3. Questionnaire construction and data collection

In the first step, the experts translated all items into German. Subsequently, other researchers independently back-translated the items into English for verification. For all items that demanded a rating, this study makes use of a seven-point Likert scale anchored with "strongly disagree" and "strongly agree". In addition, the questionnaire provided pictorial representations and a detailed description of each new product, as Tellis et al. (2009) suggest.

To recruit participants for the survey, this study relied on two data sources. The first source was the SoSci Panel, which is a nonprofit panel for scientific research (Leiner, 2012). The second source entailed the sending of e-mails and messages on social networking sites. The e-mail contained a link to the survey and a request to forward the e-mail. The research team also invited members of a social network to a group that contained an invitation to the survey and a request to invite more people to join the group.

5. Results

5.1. Sampling results

The number of responses was 1011. Of the 1011 questionnaires, 849 were complete and used in the study. The respondents were 15–81 years old, and the mean age was 31.9 years (SD = 12.4). The participants included 382 men and 467 women. Of the 849 participants who completed the entire questionnaire, e-mails and messages recruited 575 participants, and the SoSci Panel recruited 274 participants.

5.2. Confirmatory factor analysis

Confirmatory factor analysis (CFA) applying maximum likelihood estimation tested the measurement model with AMOS 19.0 (Arbuckle, 2010). The data violates the assumption of normal data. However, values for skewness were lower than |2|, and kurtosis was lower than |3|. Hence, the violation of the normal distribution is not severe (Curran, West, & Finch, 1996; West, Finch, & Curran, 1995). In addition, the ratio of sample size to the number of free parameters is greater than 8.8:1 (N = 849, f.p. = 96) and, therefore, higher than the recommended ratio of 5:1 (Bentler & Chou, 1987).

The results for the confirmatory measurement model show significant loadings for all factors ($p < .001$). The indicator reliability of all but one item is greater than .40. Although an elimination is possible, this study retains the item in the model because the responses address an important aspect of the construct (smaller size as a reason for functional innovativeness). Moreover, Cronbach's alpha decreases when this item is eliminated.

Construct reliability for all constructs is greater than .84, which is well above the recommended value of .6 (Bagozzi & Yi, 1988). The measurement model shows adequate convergent validity for all constructs. The average variance extracted was greater than .5 for all constructs, confirming construct validity (Fornell & Larcker, 1981). Furthermore, all squared factor correlations were lower than the average variance extracted, indicating sufficient discriminant validity (Fornell & Larcker, 1981). In testing the validity, the analysis revealed that two errors (d4 and d5 as

well as d27 and d28) highly correlated. Ignoring the correlation would overestimate the measurement parameters, but including the correlation will not affect the estimates of the structural parameters (Reddy, 1992). Therefore, the CFA and the structural model included the correlations.

Although the chi-square goodness-of-fit index is statistically significant, this result is common for large samples (Bagozzi & Yi, 1988). The chi-square/degrees of freedom ratio equals 3.17 and is slightly greater than the 3.0 cutoff value for large samples (Homburg & Giering, 1996). However, a large sample and non-normal data will lead to the rejection of valid models if chi-square statistics are used (Bagozzi & Yi, 1988; Curran et al., 1996; West et al., 1995). Hence, other goodness-of-fit indices must be used for large samples (Schermelleh-Engel, Moosbrugger, & Müller, 2003).

All baseline comparisons were greater than .90 (NFI = .94, RFI = .93, IFI = .96, TLI = .95, CFI = .96) and thus exceed the requirements for acceptable model fit (Bagozzi & Yi, 1988). The goodness-of-fit index (GFI) equals .91, which is acceptable for large samples with medium and high factor loadings (Shevlin & Miles, 1998). The Root Mean Square Error of Approximation (RMSEA = .051) and the Standardized Root Mean Square Residual (SRMR = .047) values also suggest a good model fit (Hu & Bentler, 1999). Table 1 provides descriptive statistics and correlations.

5.3. Structural equation model

First, the model was calculated separately for disruptive and sustaining innovations. All measures indicate an adequate fit with the empirical data. All baseline comparisons were considerably greater than .90 (NFI = .94, RFI = .93, IFI = .96, TLI = .95, CFI = .96). The RMSEA (.035) and the SRMR (.051) meet the rigorous requirements of Hu and Bentler (1999).

In addition to assessing model fit, evaluating the predictive validity of the proposed model is of great importance to test for overfitting and to assess the soundness of the model (Byrne, 2001; Woodside, 2013). For both the disruptive innovation model and the sustaining innovation model, the data was randomly split into two groups. Each sample was used as a holdout sample to test the predictive validity of the other sample. Cross-validation in covariance structure modeling requires that each structural path in the model is constrained for both subsamples (Byrne, 2001). Therefore, AMOS 19.0 (Arbuckle, 2010) constrains the estimated values of the calibration subsample's structural paths for the validation subsample (Byrne, 2001). Subsequently, the cross-validation method compares the chi-squared values of the original model without constraints and the complete sample with the chi-squared values of the model including the constraints of the two holdout samples. The chi-squared difference was significant for neither the disruptive innovation nor the sustaining innovation model ($p > .10$). The results indicate that the causal structure is equivalent across the calibration and the validation sample. Therefore, the cross-validation procedure provides strong support for the predictive validity of both models (Byrne, 2001).

To analyze the type of moderator for monetary resources, this study followed the procedure of Sharma, Durand, and Gur-Arie (1981) to conclude that 'monetary resources' are a pure moderator of the relationship of intention to adoption. Consequently, this study uses the moderated regression analysis to incorporate monetary resources into the model (Sharma et al., 1981).

The third step contained analyzing differences in the model with regard to sustaining and disruptive innovations using a multi-group analysis. For every relationship that theory predicted to be different or equal, a separate model was calculated. Each path under investigation was restricted to be equal for the sustaining and the disruptive innovation group (Byrne, 2001). The present study applies the chi-squared statistic to assess whether the observed differences in effects are significant.

Of the controls regarding innate innovativeness and the intention–adoption relationship, the results only show a marginally significant difference in the influence of hedonic innovativeness ($p < .10$). Table 2 provides the results of the structural models concerning the differences for disruptive and sustaining innovations.

Of the four hypotheses, the results support three and reject one hypothesis. Based on disruptive innovation theory, H1 predicted that involvement has a weaker influence on the intention to adopt disruptive innovations than on the intention to adopt sustaining innovations. In accordance with extant theory, the results lead to the acceptance of H1 ($p < .001$). In addition, H2 states that knowledge influences the intention to adopt disruptive innovations more strongly than the intention to adopt sustaining innovations and the results support this hypothesis ($p < .001$). H3 predicts that product class knowledge also influences the actual adoption of disruptive innovations more strongly than the adoption of sustaining innovations. This difference is moderately significant ($p < .10$). In contrast to extant theory, the moderating influence of monetary resources on the relationship of intention to adoption is stronger, not weaker, for disruptive innovations; leading to the rejection of H4.

6. Discussion

Prior research suggests various characteristics of consumers who are early adopters compared with other consumers. However, no previous study investigated whether these characteristics vary or remain the same when analyzing different types of innovations. Researchers have raised the question of whether disruptive innovation theory is able to provide additional information to be used for product development

Table 1
Descriptive statistics and correlations.

		Mean	S.D.	AVE[a]	1	2	3	4	5	6	7	8	9	10
1	Social inn.	2.6	1.43	.72										
2	Functional inn.	3.9	1.21	.52	**.45**									
3	Hedonic inn.	4.2	1.35	.59	**.67**	**.55**								
4	Cognitive inn.	3.3	1.34	.70	**.31**	**.46**	**.33**							
5	Involvement	4.3	1.57	.85	**.42**	**.39**	**.50**	**.24**						
6	Knowledge	3.9	1.42	.71	**.34**	**.30**	**.33**	**.31**	**.60**					
7	Money	4.5	1.81	–	.01	.06	**−.10**	−.02	−.05	**.14**				
8	Intention (DI)[b]	9.1	4.98	–	**.28**	**.31**	**.33**	**.22**	**.31**	**.37**	**.06**			
9	Adoption (DI)[b]	1.8	2.08	–	**.27**	**.26**	**.31**	**.14**	**.27**	**.37**	**.11**	**.74**		
10	Intention (SI)[c]	8.1	4.72	–	**.32**	**.32**	**.30**	**.26**	**.39**	**.29**	**.06**	–	–	
11	Adoption (SI)[c]	2.0	2.18	–	**.28**	**.23**	**.24**	**.15**	**.27**	**.24**	**.11**	–	–	**.70**

All correlations in bold are significant at $p < .01$.
[a] Average variance extracted.
[b] Disruptive innovations.
[c] Sustaining innovations.

Table 2
Differences for disruptive and sustaining innovations.

From	To	DI[a]	SI[b]	Difference	Hypothesis
Involvement	Intention	.02	.26***	Yes ($p < .001$)	H1 accepted
Knowledge	Intention	.26***	.03	Yes ($p < .001$)	H2 accepted
Knowledge	Adoption	.11***	.04	Yes ($p < .10$)	H3 accepted
Monetary resources × intention	Adoption	.09***	.02	Yes ($p < .05$)	H4 rejected

[a] Disruptive innovation.
[b] Sustaining innovation.
*** $p < .001$.

and marketing decisions (Danneels, 2004; Tellis, 2006). The disruptive/sustaining framework would be helpful, if the identification of innovation types provided insights on the characteristics of early adopters. Knowledge of why consumers adopt disruptive or sustaining innovations relatively early could reduce the likelihood of disruption.

According to this study's results, the theory of disruptive innovation can be used to make ex-ante predictions. The disruptive innovation theory predicts significant differences among early adopters, particularly on a domain-specific level. In contrast to previous research, which observed that early adopters are both more knowledgeable and more involved than late adopters (Goldsmith & Newell, 1997), this study's results lead to the conclusion that early adopters of disruptive innovations possess in-depth knowledge of the product category, whereas early adopters of sustaining products do not feel more knowledgeable than late adopters. The first customers of disruptive products like tablet PCs had to know not only about the existence of the product, but also understand its use, functions and advantage. In contrast, early adopters of sustaining innovations are more involved in the product category than early adopters of disruptive innovations. Enthusiasm about prior product generations and the product category in general fosters the adoption of sustaining innovations. Conversely, enthusiasm and involvement are irrelevant for adopters of disruptive innovations, because potential adopters did not have prior product types to get involved with. In addition, consumers are less likely to be enthusiastic about products with de-rated primary performance dimensions. Both findings are consistent with the assumptions of disruptive innovation theory and confirm the theory development in this study.

As assumed, this study does not find significant differences between disruptive and sustaining innovations with regard to the effects of social, cognitive and functional innovativeness. However, some effects are significant in one model but not significant in the other model. In general, the effect size of innate innovativeness is moderate. In addition, the results revealed a marginally significant difference with regard to the effect of hedonic innovativeness on the intention to adopt. The joy of consumption motivated early adopters of disruptive innovations, but did not motivate early adopters of sustaining innovations. The theory of disruptive innovation does not provide a direct explanation. Presumably, this effect occurs because disruptive innovations are typically smaller, less expensive and more convenient (Tellis, 2006) and thus appeal to hedonically motivated consumers. On the contrary, sustaining innovations tend to be more complex (Christensen & Raynor, 2003) and may inhibit enjoyment. In general, innate innovativeness is stable for different types of innovations but only moderately influences adoption. Hence, there is a tradeoff between stable and strong effects.

The finding that monetary resources play a more important role for disruptive innovations than for sustaining innovations is counter to prior theoretical considerations. The results may occur for two reasons. First, not all disruptive innovations have a lower price. Some disruptive innovations are more expansive than existing solutions, but they introduce an additional performance dimension. Second, disruptive innovations imply a higher level of newness to the market, because they introduce a new performance dimension. This increases the adoption risk for consumers, which in turn makes monetary resources more important (Rogers, 2003). For example, an early adopter of video glasses may lose her investment when the product fails to attract a larger market and content providers fail to deliver films for this format. Hence, monetary resources serve as a buffer against the increased risk of adopting disruptive innovations.

7. Managerial implications

An objective of this study was to improve the segmentation of early adopters of new products in accordance with specific types of innovation and thus support managers in distinctively addressing innovative consumers. The results of this study suggest that managers should not ignore the type of innovation. For disruptive innovations, managers should address consumers who feel knowledgeable about their product domain. Firms do not need to address consumers who are intensely involved in the product field when attempting to develop new disruptive innovations. The study's results also have implications for marketing strategy. Advertisements for sustaining innovations should be placed in channels that address mainstream customers. Advertisements for disruptive innovations should be placed in expert journals and niche channels that market mavens consume.

The finding that knowledge significantly influences both the adoption intention and actual adoption of disruptive innovations implies an additional direction for managers. As the ancillary performance dimension is superior to existing solutions or even creates a new performance dimension, firms need to explain this dimension to consumers. For example, a new TV model requires less explanation than the first tablet PC. This difference implies that the sales force of consumer electronics dealers should focus on disruptive rather than sustaining innovations to increase consumer knowledge.

Researchers have argued that innovative consumer analysis and market research methods must be employed to detect and develop disruptive innovation opportunities (Christensen & Raynor, 2003; Reinhardt & Gurtner, 2011). Although these previous studies explained how different consumers can be analyzed, this study demonstrates which consumers must be addressed during early phases of development. For instance, if managers use the probe and learn method to investigate market needs during the development phase, then they should use consumers who correspond to the characteristics that this study finds. If they approach customers who are not representative of the early adopters of disruptive innovations, then the risk of product failure may be higher.

8. Limitations and further research

The findings of this study have to be qualified in several ways. Although this study's sample is broad and heterogeneous and covers a wide range of demographics, the sample is not representative, is biased toward younger and more educated individuals and contains more females than males. Furthermore, the sampling method could provoke criticism because the calculation of a response rate is not possible. The

number of consumer characteristics included in the survey also limits this research. Further research could investigate whether other important characteristics such as opinion leadership or risk aversiveness affect the decision to adopt disruptive innovations or sustaining innovations. In addition, this study relies on self-reported indices of intention and adoption. Further research can make use of consumers' past purchasing data available from online or offline retailers to better predict purchasing behavior and to move beyond cross-sectional survey research (Woodside, 2011).

This study specifically investigates differences between early adopters of disruptive and sustaining innovations in a consumer setting. No attempt has been made to assess group differences in a business-to-business setting. Further studies could investigate whether systematic differences also appear in this segment. Analyzing customers of customers could also facilitate the development of a better understanding of disruptive innovation in this context (Bohlmann, Spanjol, Qualls, & Rosa, 2013). In addition, the relationship between the business-to-consumer and business-to-business markets appears to be worthy of investigation. For example, disruptive innovations can be commercialized in consumer markets and subsequently diffuse to the business market. For instance, consumers initially used Google Docs, which is likely to diffuse into the business market (Keller & Hüsig, 2009). Focusing on consumer electronics further limits the validity of this study. Although this product area is a common research object (Im et al., 2003; van Rijnsoever & Donders, 2009), the results may vary across industries and markets.

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Appendix A. Scale items

Item	Measure	Factor loading
Social innovativeness — Vandecasteele and Geuens (2010), α = .93		
x_1	I love to use innovations that impress others.	.86
x_2	I like to own a new product that distinguishes me from others who do not own this new product.	.90
x_3	I prefer to try new products with which I can present myself to my friends and neighbors.	.92
x_4	I like to outdo others, and I prefer to do this by buying new products which my friends do not have.	.79
x_5	I deliberately buy novelties that are visible to others and which command respect from others.	.76
Functional innovativeness — Vandecasteele and Geuens (2010), α = .84		
x_6	If a new time-saving product is launched, I will buy it right away.	.79
x_7	If a new product gives me more comfort than my current product, I would not hesitate to buy it.	.79
x_8	If an innovation is more functional, then I usually buy it.	.72
x_9	If I discover a new product in a more convenient size, I am very inclined to buy this.	.60
x_{10}	If a new product makes my work easier, then this new product is a "must" for me.	.71
Hedonic innovativeness — Vandecasteele and Geuens (2010), α = .88		
x_{11}	Using novelties gives me a sense of personal enjoyment.	.78
x_{12}	It gives me a good feeling to acquire new products.	.79
x_{13}	Innovations make my life exciting and stimulating.	.75
x_{14}	Acquiring an innovation makes me happier.	.80
x_{15}	The discovery of novelties makes me playful and cheerful.	.74
Cognitive innovativeness — Vandecasteele and Geuens (2010), α = .92		
x_{16}	I mostly buy those innovations that satisfy my analytical mind.	.69
x_{17}	I find innovations that need a lot of thinking intellectually challenging and therefore I buy them instantly.	.80
x_{18}	I often buy new products that make me think logically.	.90
x_{19}	I often buy innovative products that challenge the strengths and weaknesses of my intellectual skills.	.91
x_{20}	I am an intellectual thinker who buys new products because they set my brain to work.	.88
Product Involvement — Mittal and Lee (1989), α = .94		
x_{21}	In general I have a strong interest in consumer electronics.	.86
x_{22}	Consumer electronics are very important to me.	.97
x_{23}	Consumer electronics matters a lot to me.	.94
Subjective knowledge — based on Flynn and Goldsmith (1999), α = .93		
x_{24}	I know pretty much about consumer electronics.	.95
x_{25}	I feel very knowledgeable about consumer electronics.*	.96
x_{26}	Among my circle of friends, I'm one of the "experts" on consumer electronics.	.81
x_{27}	Compared to most other people, I know less about consumer electronics.$^{(R)}$	.70
x_{28}	When it comes to consumer electronics, I really don't know a lot.$^{(R)}$	.78

$^{(R)}$Reverse scored.

*Item not reversed, as Flynn and Goldsmith (1999) propose, because of comprehensibility problems.

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