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Research paper

Product radicalness and firm performance in B2B marketing: A moderated mediation model☆

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ABSTRACT

There has been ambiguity and controversy in establishing the links between the introduction of radical innovations and firm performance. While radical innovations create customer value and grow product sales, they are also fraught with uncertainty due to customer resistance to innovative products and significant costs associated with commercialization. This research aims to explain the contrarian findings between radical innovations and firm performance in a business-to-business (B2B) context by examining two mediating variables – new product advantage and customer unfamiliarity. Using a multi-informant approach, the authors collected survey data from a sample of 170 Spanish B2B firms engaged in new product development, provided by 357 managers. The authors find that, while new product advantage positively mediates the relationship between product radicalness and firm performance, customer unfamiliarity has a negative mediation effect on this relationship. Furthermore, the authors examine the moderated mediation effect by industry type, manufacturing vs. service, and find that it moderates the mediation of customer unfamiliarity: The negative impact of product radicalness on customer unfamiliarity is greater for manufacturing firms than for service firms. With these findings, the authors discuss implications for development and marketing of radical innovations and how those implications facilitate firm performance in the B2B context.

1. Introduction

There has been ambiguity and controversy in establishing the link between introduction of radical innovations and firm performance. Some empirical studies find a positive relationship between the two variables (Ordanini & Parasuraman, 2011; Salomo, Talke, & Strecker, 2008; Urhahn & Spieth, 2014), but others demonstrate absence of a relationship between them (Lin & Chen, 2007; Stock & Reiferscheid, 2014). A third group of studies have found that the relationship between radical innovation and performance is contingent on factors such as environment, technology, and product related factors (Jansen, Van Den Bosch, & Volberda, 2006; Kyriakopoulos, Hughes, & Hughes, 2016; Pérez-Luño, Gopalakrishnan, & Valle Cabrera, 2014; Schmidt, Walter, & Walter, 2013; Sheng, Zhou, & Lessassy, 2013). This research aims to resolve the radical innovation-performance puzzle by empirically testing two competing relationships that co-exist between product radicalness and firm performance and by adopting a contingency perspective to further examine how contextual factors moderate those relationships.

Researchers have defined radical innovations in a variety of ways (Damanpour & Gopalakrishnan, 1999; Garcia & Calantone, 2002). Some emphasize outcomes (Garcia & Calantone, 2002; Tushman & Anderson, 1986) and others emphasize innovation attributes (Gatignon, Tushman, Smith, & Anderson, 2002; Sood & Tellis, 2005). Here, we use three attributes from the focal or incumbent firm's viewpoint to define radicalness: (a) the newness of technology; (b) its substitutability and disruption of technological trajectories and (c) the relationship between price and performance for the new technology/product. The first factor determines the extent to which the scientific principles contained in a new product are different from those in existing products and organizational competencies (Chandy & Tellis, 2000; Sood & Tellis, 2005). The second factor involves the extent to which a technology that leads to new products is difficult to substitute with an older technology (Gatignon et al., 2002; Sood & Tellis, 2005). The final factor embodies the extent to which radical innovations "can advance the price/performance frontier by more than the existing rate of progress" (Gatignon et al., 2002, p.1107).

Radical innovations create customer value, grow product sales and

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revenues, reconfigure competitive rules, and redefine price-performance frontier (Gatignon et al., 2002; Nijssen, Hillebrand, Vermeulenand, & Kemp, 2006). Yet they are also fraught with risk and uncertainty due to customer resistance to breakthrough technology, cannibalization of existing products in the near term, and significant costs of commercialization (O'Connor & Ayers, 2005). When radical innovations are launched in the form of new products, they sometimes appear to be beneficial to customers because of their functional superiority (new product advantage), and yet at other times, they are difficult to understand and use because of their newness and complexity (customer unfamiliarity). Therefore, we argue that radical innovations can be a double-edged sword from the viewpoint of customer acceptance. On the one hand, radicalness represents technological advantages and therefore this increases customer propensity to purchase new-to-the-market or new-to-the-world products and translates more readily into firm performance. On the other hand, radicalness associated with customer unfamiliarity increases the complexity embodied in a product and increases customer resistance to such an innovation, requiring more investment in educating and communicating with customers; this is less likely to translate into revenues and profitability for the firm introducing this product (Kleijnen, Lee, & Wetzels, 2009). Consequently, we show that product radicalness can be a mixed blessing, depending on how advantages are embodied in a new product and perceived by its customers, and the required adoption effort.

The decision to adopt a radical innovation involves comparing the new customer benefits offered by the firm (product advantage) with the cost of adoption such as the time and the learning effort that the customer needs to invest (customer unfamiliarity) (Calantone, Chan, & Cui, 2006; Cui, Chan, & Calantone, 2014; Gourville, 2006). Therefore, our research focuses on these two variables as mechanisms to explain the product radicalness-firm performance relationship, providing a more manageable approach for managers (as recommended by authors such as Joachim, Spieth, & Heidenreich, 2018). In summary, we examine two customer outcomes of radical innovations: new product advantage (over competitors) and customer unfamiliarity, and explore how they differentially mediate the relationship between product radicalness and firm performance.

We build a competitive mediation framework where these two factors mediate the relationship between product radicalness and firm performance in opposite directions, one being positive and the other being negative. Because the two competitive mediations tend to offset each other in terms of relationship strength (Cui et al., 2014), we take it one step further and examine the context, to understand whether one relationship outweighs the other. We have considered industry type as a contextual factor to study whether the manufacturing vs. service firms play a moderating role in the two competing mediation effects.

We tested our conceptual framework in a Business-to-Business (B2B) context. B2B, as compared to Business-to-Consumer (B2C), is characterized by a more complex purchase decision process (Lilien, 2016) and therefore has higher risk associated with the purchase. Thus, B2B firms are facing critical challenges to commercialize radical innovations to create firm value (Aarikka-Stenroos & Lehtimäki, 2014). In addition, B2B marketing features long-term customer relationships. However, radical innovation is likely to generate strong resistance from customers due to their unfamiliarity with the innovation, which in turn damages such relationships and firm performance. Take modular facility technology as an example: This B2B innovation in the pharmaceutical industry allowed firms to save 6–18 months to build a facility; despite such a relative advantage, pharmaceutical firms were still reluctant to purchase this technology due to uncertainty about its impact on firm performance (Gao, Leichter, & Wei, 2012; Leichter & Turstam, 2004). As a result, it is of particular interest to examine the dynamics between radical innovation and firm performance in the B2B context.

Using a multi-informant approach for data collection from a sample 170 Spanish firms engaged in new B2B product/service development (provided by 357 respondents), we found that new product advantage positively mediated the relationship between product radicalness and firm performance, and that customer unfamiliarity had a negative mediation effect. Moreover, we found a difference between manufacturing and service firms – that is, the negative mediated effect between product radicalness and firm performance through customer unfamiliarity was stronger for manufacturing firms than for service firms. This suggests that the customer resistance is greater for tangible products than for intangible services in the B2B market. Our research contributes to the literature in three areas by: (a) understanding further the relationship between radical innovations and firm performance in a B2B context; (b) determining differences between B2B innovations in the manufacturing vs. service sector; and (c) analyzing the relationships between product radicalness and organizational outcomes at the firm level across multiple products.

Next, we will present theoretical background and hypothesis development. We will describe sample, data collection procedure and measures in the Research Method section, and then show our findings in the Results section. Finally, we will discuss implications and limitations of this research.

2. Theoretical Background

2.1. Product radicalness and firm performance

Radicalness is determined by the extent of changes contained in the technology; it can also be viewed in terms of departure from the prevailing norms and the supersession of existing technologies from the focal firm or incumbent's viewpoint (Gatignon et al., 2002; Story, Daniels, Zolkiewski, & Dainty, 2014). There are significant benefits associated with radical innovations. First, radical innovations create new products that substantially advance the price/performance frontier by much more than the existing rate of progress (Chandy & Tellis, 2000; Gatignon et al., 2002). This suggests that radical innovations improve the amount of performance or functionality derived for a specific price. Second, firms that launch radical innovations may earn monopoly profits in new markets because they face little direct competition and those innovations cannot be easily substituted (Sood & Tellis, 2005). Third, radical innovations also allow firms to differentiate themselves from competition and therefore strengthen their positioning relative to competition (Kleinschmidt & Cooper, 1991).

Despite the obvious benefits radical innovations provide to the incumbents, they also have substantial costs. The costs are due to the risks and uncertainties that a launching firm assumes for a variety of reasons – it takes much longer for customers to buy-in to a new product because they need education and training (Sorescu, Chandy, & Prabhu, 2003); the firm may not have access to complementary assets and relational resources that a radically new product may require to make it successful and widely accepted (Kyriakopoulos et al., 2016).

Past research has demonstrated inconsistencies in the relationship between radical innovation and performance (Pérez-Luño et al., 2014; Urhahn & Spieth, 2014). While many researchers reach a consensus on the positive effect of radical innovations (e.g., Ordanini & Parasuraman, 2011; Salomo et al., 2008), some others do not find such an effect (e.g., Lin & Chen, 2007; Stock & Reiferscheid, 2014). We suspect that there are two possible reasons for the inconsistent findings. First, we suggest that there are two competing effects between product radicalness and performance, and we therefore examine two competitive mediations in our conceptual model. Second, many innovation studies are based on a variety of industries. We maintain that high diversity can mask differential effects of radicalness on performance. Thus, in this research we introduce industry type (manufacturing vs. service) as a moderator.

In summary, radical innovations appear to bring both benefits and costs to firms. Following this logic, we expect a dual effect in the relationship between product radicalness and firm performance, one being positive and another negative. In the next section, we explain the two customer-focused factors that have competing effects in relation to

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firm performance, new product advantage and customer unfamiliarity.

2.2. New product advantage and customer unfamiliarity

New product advantage indicates that customers obtain greater benefit from unique utilities when using the innovation, as compared to when using competing products. New product advantage has been deemed as product uniqueness/superiority or new customer benefits in the literature (e.g. Kleinschmidt & Cooper, 1991; Kock, 2007; Montoya-Weiss & Calantone, 1994). New product advantage involves "the degree to which an innovation is perceived by the customer as being better than the idea it supersedes" (Rogers, 1995, p.229).

Customer unfamiliarity (also labelled "newness to customers") represents "the degree to which the new product varies from current customer consumption requirements and experience; thus, there is a high degree of learning and adoption effort required by customers" (Atuahene-Gima, 1996, p.38). Highly innovative products could imply more time and difficulty to understand the new product concept and its full advantages, and they are more complex and difficult to use (Avlonitis & Salavou, 2007). Some customers may not be willing to make the effort to learn about the innovative products (e.g. how they work), which impedes product sales (Szymanski, Kroff, & Troy, 2007).

In this research we examine how new product advantage and customer unfamiliarity respectively mediate the relationship between product radicalness and firm performance. Fig. 1 displays the proposed model.

3. Hypothesis development

3.1. Competitive mediation

One of the reasons why organizations innovate is to gain first or early mover advantage (Damanpour, Walker, & Avellaneda, 2009), and it is well-known that innovation is a source of competitive advantage (Damanpour & Wischnevsky, 2006). Radical innovations are more likely to provide a relative advantage to customers than existing products, given that such new products incorporate a substantially different technology that offers great advance in the price/performance rate in comparison to existing products using the old technology (Gatignon et al., 2002), thereby offering more opportunities for differentiation (from competitors' products).

Meanwhile, product advantage is related to product superiority, unique customer benefits, (excellent) product quality and (good) value for money (Cooper & de Brentani, 1991). As noted by Cooper (2019), superior products meet customer needs or solve problems, offer unique features or useful attributes. Such products have a much higher success rate, capture market share and are profitable. There is empirical evidence showing that new product advantage *is associated with* innovation success (McNally, Cavusgil, & Calantone, 2010; Storey, Cankurtaran, Papastathopoulou, & Hultink, 2016*), which in turn influences* firm/organizational performance (Zaefarian, Forkmann, Mitręga, & Henneberg, 2017). Rogers (1995) demonstrates that the adoption of a new product is positively influenced by a product's relative advantage over competing products. These previous findings have also been found in more recent research (Ordanini, Parasuraman, & Rubera, 2014). Early adoption of the products can further strengthen the firm's organizational outcomes. In addition, in the B2B market new product advantage positively affects customer perceived value of the brand and brand loyalty (Wang, Capon, Wang, & Guo, 2018), which can in turn boost firm performance. To sum up, creating an advantage that the customer is able to readily perceive and experience is a major determinant of the customer's desire to purchase the product, which in turn increases sales and delivers financial performance. *Therefore, we predict*:

H1. New product advantage positively mediates the relationship between product radicalness and firm performance.

H1a. Product radicalness is positively related to new product advantage.

H1b. New product advantage is positively related to firm performance.

Radical innovation represents breakthrough technology embedded in the new product. The breakthrough component is new-to-market or new-to-the-world, and thus customers are unfamiliar with this type of innovation. While a new product opens new consumption possibilities or fulfills a new function unavailable to existing products, it often requires additional product information that facilitates user learning. However, radical innovations, as compared to existing products, often lack available product information, and therefore it takes time for customers to understand the product concepts and features. In this sense, product radicalness is positively associated with customer unfamiliarity.

Meanwhile, research has demonstrated that customer unfamiliarity is also associated with increased risk and uncertainty for the customer, which delays adoption of new products (Robinson & Min, 2002), notably in a B2B context (Cortez & Johnston, 2017; Jackson, Neidell, &

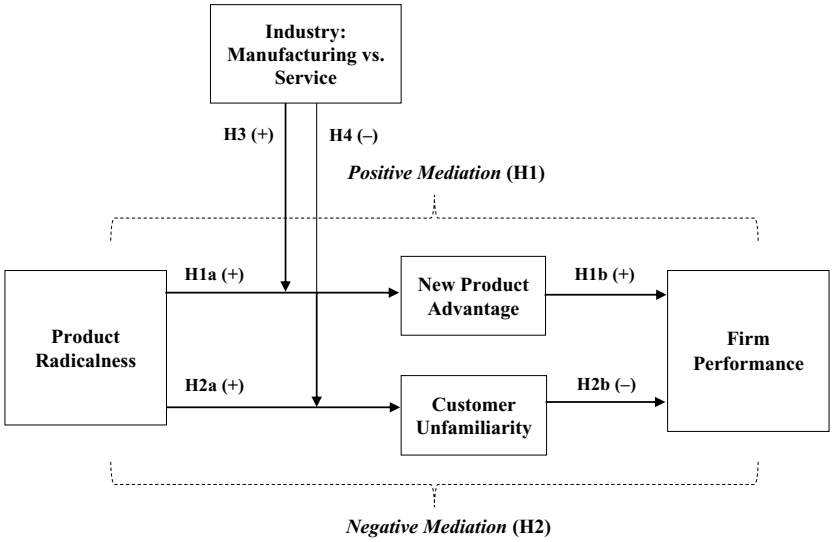

Fig. 1. Theoretical model.

Lunsford, 1995). In the B2B markets, the cost involved in purchases is substantially greater than that in the B2C markets. Thus, business customers tend to be more risk averse, which in turn decreases the likelihood of their purchasing radically innovative offerings (Szymanski et al., 2007). This adversely impacts the seller's firm performance. Second, customer unfamiliarity also implies that firms launching radically new products need to invest resources in customer education and training to change perceived values (Sorescu et al., 2003). Therefore, it is likely to take longer for radical innovations to yield returns when compared to incremental innovations. Moreover, when a product is high on the unfamiliarity scale, it often requires additional product support through market and technology investments to add to the infrastructure that will build up the use of the innovation that is new and unfamiliar to its customers. The additional investment will decrease profitability, which in turn damages firm performance. In summary, the customer resistance to radical innovations, and the additional expenses that the firms need to expend for customer or client training and infrastructure development increase costs and therefore inhibit firm performance. Consequently, we propose:

H2. Customer unfamiliarity negatively mediates the relationship between product radicalness and firm performance.

H2a. Product radicalness is positively related to customer unfamiliarity.

H2b. Customer unfamiliarity is negatively related to firm performance.

3.2. Moderated mediation: manufacturing vs. service

There are many fundamental differences between manufacturing and service industries. The offering of the services industry, as compared to the manufacturing industry, has a number of distinct characteristics including intangibility, heterogeneity, inseparability, and perishability (Wilson, Zeithaml, Bitner, & Gremler, 2012), which make a service innovation process different (Atuahene-Gima, 1996; Ettlie & Rosenthal, 2011; Nijssen et al., 2006). In the case of B2B services two more characteristics need to be considered: specialization (requiring more customization) and technology, which add complexity to commercialization (Jackson & Cooper, 1988).

The perceived risk of being imitated by competitors in the service sector is lower than in manufacturing (Drejer, 2004). Generally, radical innovations in manufacturing firms are costly (Green, Gavin, & Aiman-Smith, 1995) and require high R&D investment, so firms might use patents to protect their profits. By contrast, service firms usually invest less in formal R&D (Hipp & Grupp, 2005; Lin, 2013), and being quickly imitated is somehow an expectation in service industries, since innovations are normally not patentable (Atuahene-Gima, 1996), and competition in services is usually based on continuous innovations (Prajogo, 2006). In other words, given that imitation is relatively common, firms respond fast to other service innovations in order to stay competitive and be profitable. Service innovations are more easily developed and more rapidly implemented than product innovations (Djellal & Gallouj, 2001), with a shorter time-to-market. Biemans and Griffin (2018) also observe a shorter B2B development cycle time for service-dominant firms than product-dominant ones, especially for more innovative and radical projects. Therefore, services firms achieve a better and faster product/market fit as a result of a higher number of user interactions due to continuous innovations. In addition, agile methodologies or spiral developments – based on a series of build-test-feedback-revise interactions with customers (Cooper, 2019) – are expected to be more rapidly applied to services than to manufacturing. This makes it more probable to translate the new offering into relative advantage and subsequent firm success. As Ettlie and Rosenthal (2011, p.295) conclude: “services are more likely to convert novelty into success.” As a result, the effect of product radicalness on new product advantage seems to be stronger for services firms than manufacturing firms. Accordingly, we state:

H3. The industry type moderates the mediated effect of new product advantage on the relationship between product radicalness and firm performance – specifically, the positive effect between product radicalness and new product advantage is stronger for service firms than manufacturing firms.

In the services industry, customers perceive innovations as being more incremental than radical (Hipp & Grupp, 2005). In a B2B context, it is also observed that service-dominant firms spend a much higher percentage of their R&D budget on incremental innovations (less on radical innovations) than product-dominant firms (Biemans & Griffin, 2018). Hence, it is expected that customers view new services as variations of existing services mitigating the negative effect of customer unfamiliarity in the service sector. Even if both product and service innovations have the same level of radicalness, inseparability, defined as simultaneous production and consumption of services, which also involves a higher degree of collaboration in a B2B context (Jackson et al., 1995), makes important contributions in several stages of the innovation process that reduce the effect of product radicalness on customer unfamiliarity in service industries.

Firstly, idea generation, idea screening, and concept development, testing and validation, benefit from a close relationship between companies' staff and customers, which represents an opportunity to obtain key customer knowledge for offering new value propositions (e.g. needs, problems, potential solutions, and service attributes). Secondly, during commercialization, high customer contact makes it possible to be flexible by adapting the service to their specific needs, achieving more satisfaction and loyalty. Finally, in the implementation phase, frequent interpersonal interaction facilitates the innovation adoption process by helping to understand a new concept, or to be aware of its advantages, as well as reducing learning efforts.

Thus, although innovation contributes to strengthen customer relationships in a B2B context (Dekoulou & Trivellas, 2017; Kyriakopoulos et al., 2016), the characteristic of inseparability makes them more intense in the case of services, which helps to mitigate customer unfamiliarity. *Therefore, we expect*:

H4. The industry type moderates the mediated effect of customer unfamiliarity on the relationship between product radicalness and firm performance – specifically, the negative effect between product radicalness and customer unfamiliarity is stronger for manufacturing firms than service firms.

4. Research method

4.1. Sample and data collection

In this research, we employed a multi-informant survey to study Spanish B2B companies. They were either manufacturing firms, including mechanical machinery and equipment, and service firms, including software or computer programming services and research and development services. These industries were identified as having a high percentage of innovative companies (INE, 2007). In addition, the service firms studied in this research were considered to be knowledge intensive business services (KIBS) by European Monitoring Centre on Change (EuroFound, 2005). KIBS often leads to more innovation practices, and thus the sampled firms fit well with our research objective.

We extracted the study population of 537 firms from the SABI[1] Bureau Van Djick database, including general and accounting information on Spanish firms. All participating firms were engaged in new product development or improvements of existing products, and

[1] Sistema de Análisis de Balances Ibéricos.

Table 1
Sample of companies.

	Number of companies	Proportion
Number of employees (size)		
Until 49	20	11.8%
50–99	71	41.8%
100–249	55	32.4%
250–499	16	9.4%
500 or more	8	4.7%
Age (years)		
Until 10	37	21.8%
11–20	47	27.6%
21–30	42	24.7%
More than 30	44	25.9%
Industry		
Manufacturing	90	52.9%
Services	80	47.1%
Total	170	100.0%

Note: Data were provided by 357 informants from 170 participating firms.

they had at least fifty employees if they were in manufacturing and software or computer programming services, and at least twenty employees, if they were engaged in research and development services.

The data collection was completed via a telephone survey, using a structured questionnaire. Our unit of analysis in this study is the firm and we used multiple respondents from the same company. We asked two R&D managers and one marketing manager in each firm to respond to the survey, therefore reducing the potential single informant bias and common method bias. In a few cases where the firm size was relatively small, we received the response of one or two managers. This was because one person performed multiple roles (R&D, administration, or both) in smaller firms. After removing cases with missing values, a total of 357 responses were used for data analysis, which represented 170 B2B firms. As there were 537 firms in our sampling frame, the 170 participating firms resulted in a satisfactory response rate of 31.6%. Table 1 provides the information about sample characteristics and distribution. There was not significant difference between the firms in the sample and in the population in terms of industry, firm size and firm age. Thus, non-response bias did not seem to be a concern in this study.

4.2. Measure

All the scale items are listed in Table 2, which also includes standardized factor loadings and reliability indices. Because we adopted a multi-informant approach for data collection, within-firm agreement among respondents was assessed by the inter-rater agreement measure, rwg, developed by James, Demaree, and Wolf (1993). Median rwg for the original measures of each variable, calculated for a subsample of 122 companies (65 with three respondents and 57 with two) are 0.75 for product radicalness, 0.69 for customer unfamiliarity, 0.79 for new product advantage, and 0.78 for firm performance. In general, the values obtained suggest an acceptable degree of agreement or consistency among the respondents (Chen, Chang, & Hung, 2008). Therefore, we averaged the scale items from multiple respondents to form single ratings for each construct and company. In line with past studies (e.g. Biemans & Griffin, 2018; Salunke, Weerawardena, & McColl-Kennedy, 2019), this study focused on innovation practice in the past five years. All independent variables and mediators were measured in Likert scale (1 = totally disagree; 7 = totally agree).

Product radicalness. Respondents were asked about the radicalness of the new or significantly improved products/services launched by their firms in the previous five years. We adapted the *radicalness* scale developed by Gatignon et al. (2002). One item was removed due to low factor loading.

Customer unfamiliarity. We adapted the newness to customer scale used by Avlonitis and Salavou (2007). One item was removed due to low factor loading.

New product advantage. We adapted the new product uniqueness scale used by Avlonitis and Salavou (2007). The items of this measure capture properly the concept of new product advantage, but we did not consider the last item of the adapted scale ("They are superior in technology") in this study due to content overlapping with the measurement of product radicalness. Two more items were also removed due to low factor loading.

Firm performance. The six-item subjective index by Zahra (1996) was adapted to gauge firm performance. Each item measured the respondent's satisfaction with the firm's achievement of a goal (1 = dissatisfied; 7 = very satisfied), which was weighted by its perceived importance (1 = unimportant; 7 = very important). There were six goals covering return on investment, return on equity, return on asset, net profit margin, sales growth and market share. Since both satisfaction and importance used a seven-point scale, the overall index ranges from 1 to 49. Subjective measures of firm performance have been widely used (Cheng & Krumwiede, 2012; Rhee, Park, & Lee, 2010), and demonstrated to be valid, as they are positively correlated with objective counterparts (Murphy & Callaway, 2004; Wall et al., 2004).

Industry type. The moderating variable, industry type, was measured in dummy coding: 0 = manufacturing, 1 = service. This is an objective data directly obtained from the SABI database.

Control variables. Two control variables were used. Firm size can affect radical innovation (Camisón-Zornoza, Lapiedra-Alcamí, Segarra-Ciprés, & Boronat-Navarro, 2004). Therefore, firm size was included as a control variable. In order to prevent skewness, it was measured by the (natural) logarithm of the number of employees. We also controlled for firm age (the number of years since the firm was founded), following previous research (Pérez-Luño et al., 2014). Both firm size and firm age were directly obtained from the SABI database.

4.3. Measurement analysis

Given that the measurement scales used were based upon an exhaustive review of the relevant literature concerning the constructs under study, we can initially affirm their content validity. Table 2 shows Cronbach's alpha, composite reliability (CR) and average variance extracted (AVE) for the studied variables. Cronbach's alpha and CR were above 0.7, and AVE was over 50%. Confirmatory factor analysis shows satisfactory model fit: $\chi^2 = 272.29$, d.f. = 98, comparative fit index (CFI) = 0.91; incremental fit index (IFI) = 0.91; standardized root mean square residual (SRMR) = 0.06. All standardized factor loadings exceeded also 0.70. Thus, we can state that scale measurement have satisfactory reliability and convergent validity.

Furthermore, we examined common method bias. An exploratory factor analysis was performed using the principal component method. Results showed that the items of each construct loaded on just one factor with eigenvalue greater than 1 (see Table 3). In addition, the first factor accounted for 28.32% variance, which was less than half of the total variance (77.41%) by the four factors. To warrant this conclusion, we used also a more sophisticated version of Harman's single-factor test using confirmatory factor analysis. Specifically, all scale items were loaded in one latent variable. Results showed much worse model fit: $\chi^2 = 1154.43$, d.f. = 103, CFI = 0.45; IFI = 0.46; SRMR = 0.22. This suggests that common method bias was not a concern in this study.

Table 4 reports means, standard deviations, and Pearson's correlations for all the constructs under study. In addition, as the table shows, the square root of the AVE is higher than the corresponding correlation between for all pairs of construct. Therefore, discriminant validity is verified.

5. Results

Because hypothesis testing includes both competitive mediation and moderated mediation, we adopted PROCESS analysis for hypotheses

Table 2
Scale item, factor loading, and convergent validity.

Construct	Scale Item	SFL	α	CR	AVE
Product Radicalness (1 = Totally disagree, 7 = Totally agree)	Regarding the new or significantly improved products/services launched by the company in the previous five years, it can be say that:		0.89	0.90	0.68
	FP_1: They were based on a revolutionary change in technology	0.84			
	FP_2: They were a breakthrough innovation	0.75			
	FP_3: They led to products that were difficult to replace with substitutes using older technology	0.84			
	FP_4: They represented a major technological advance in the subsystems.	0.87			
	FP_5: They represented a minor improvement over the previous technology (reversed)*	n/a			
New Product Advantage (1 = Totally disagree, 7 = Totally agree)	NPA_1: They offer more possibilities to customers	0.86	0.83	0.85	0.65
	NPA_2: They cover more customer needs	0.83			
	NPA_3: They have more uses	0.72			
	NPA_4: They offer unique, innovative features to customers*	n/a			
	NPA_5: They are of higher quality*	n/a			
Customer Unfamiliarity (1 = Totally disagree, 7 = Totally agree)	CU_1: They required a major learning effort by customers	0.79	0.88	0.88	0.70
	CU_2: It took a long time before customers could understand their full advantages	0.92			
	CU_3: The product/service concept was difficult for customers to understand	0.80			
	CU_4: They were not known and tried in the market*	n/a			
Firm Performance (Satisfaction: 1 = Dissatisfied, 7 = Very satisfied Importance: 1 = Unimportant, 7 = Very important)	FP_1: Return on investment	0.86	0.93	0.96	0.70
	FP_2: Return on equity	0.90			
	FP_3: Sales growth	0.83			
	FP_4: Net profit margin	0.76			
	FP_5: Market share	0.78			
	FP_6: Return on assets	0.89			
Industry	0 = manufacturing 1 = service	n/a			
Firm Size	Number of employees	n/a			
Firm Age	Number of years since the firm was founded	n/a			

SFL = Factor Loading, α = Cronbach's Alpha, CR = Composite Reliability, AVE = average variance extracted.
Note: All factor loadings are significant at the 0.01 level.
* Items were removed due to low factor loadings.

Table 3
Exploratory factor analysis.

	Factor 1	Factor 2	Factor 3	Factor 4
FP_1	0.84			
FP_2	0.88			
FP_3	0.86			
FP_4	0.84			
FP_5	0.83			
FP_6	0.90			
PR_1		0.89		
PR_2		0.83		
PR_3		0.79		
PR_4		0.80		
CU_1			0.85	
CU_2			0.91	
CU_3			0.89	
NPA_1				0.83
NPA_2				0.83
NPA_3				0.81
Eigenvalues	5.67	3.54	1.95	1.23
% of variance	28.32	19.05	15.41	14.62
Cumulative % of variance		47.37	62.78	77.41

PR = product radicalness, CU = customer unfamiliarity, NPA = new product advantage, FP = firm performance.

testing (Hayes, 2013). It is agreed that PROCESS analysis is preferred over the conventional causal steps approach when two competitive effects coexist between the independent and dependent variables (Zhao, Lynch Jr., & Chen, 2010). In this study, product radicalness impacts firm performance both positively (via new product advantage) and negatively (via customer unfamiliarity). Consequently, PROCESS analysis is an ideal technique to test the two opposite routes.

We first tested the two competitive mediation effects in H1 and H2, which state that new product advantage and customer unfamiliarity mediate the relationship between product radicalness and firm performance. Table 5 shows that product radicalness was positively related to new product advantage (b = 0.45, $p < .01$), which was positively related to firm performance (b = 1.75, $p < .05$). H1a and H1b are supported. The bootstrapping results showed that this indirect effect was 0.79 and significant (95% confidence interval [CI] = 0.17, 1.64), confirming H1. In addition, Table 5 shows that product radicalness was positively related to customer unfamiliarity (b = 0.28, $p < .01$), which was negatively related to firm performance (b = −1.12, $p < .01$). Thus, H2a and H2b are supported. Furthermore, the bootstrapping results showed that this indirect effect was −0.03 and significant (95% CI = −0.98, −0.05), confirming H2.

Next, we used PROCESS to test the moderated mediation effects, and used the mean-centered function in PROCESS because of interaction terms. H3 and H4 state that the industry type moderates the indirect effects of product radicalness on firm performance via the two mediators. For new product advantage, Table 6 shows that interaction term was not significant (b = 0.07, $p = .58$). The indirect effects were respectively 0.68 (95% CI = 0.09, 1.47) for manufacturing firms and 0.78 (95% CI = 0.10, 1.89) for service firms. The difference between them was 0.10 but not significant (95% CI = −0.24, 0.90). H3 is not supported. Table 6 shows that the interaction term of product radicalness and industry on customer unfamiliarity was significant (b = −0.45, $p < .01$). Thus, H4 is supported. The indirect effect of customer unfamiliarity was found to be −0.56 and significant (95% CI = −1.34, −0.09) for manufacturing firms, but not for service firms (95% CI = −0.47, 0.30). The difference between the two was 0.51 and significant (95% CI = 0.03, 1.49). This further confirmed the moderated mediation effect hypothesized in H4. Similar to the conditional direct effect, we conducted simple slope analysis for H4. When it was manufacturing, product radicalness had a positive effect on customer unfamiliarity (b = 0.50, $t = 2.68$, $p < .01$), but its effect was not significant when it was service (b = 0.05, $t = 0.61$, $p = .54$). The graph of moderation is displayed in Fig. 2.

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Table 4
Correlation Matrix, Descriptive Statistics, and Discriminant Validity.

	Mean	SD	1	2	3	4	5	6	7
1. Product Radicalness	4.73	0.98	(0.83)						
2. New Product Advantage	5.33	0.88	0.52**	(0.81)					
3. Customer Unfamiliarity	3.47	1.12	0.25**	0.13	(0.84)				
4. Firm Performance	26.27	7.81	0.26**	0.26**	−0.10	(0.84)			
5. Industry	0.47	0.50	0.08	0.22**	0.09	−0.07	n/a		
6. Firm Size (log)	4.66	0.97	−0.01	−0.08	−0.05	0.11	−0.22**	n/a	
7. Firm Age	23.12	15.33	−0.10	−0.18*	−0.08	0.02	−0.51**	0.33**	n/a

Notes: Diagonal values in parentheses are values of square root of AVEs.
*$p < .05$, **$p < .01$ (two-tailed); SD = Standard Deviation, n/a = Not Applicable.

Table 5
Regression on customer unfamiliarity, new product advantage and firm performance, and bootstrap analysis for indirect effects.

	Model 1		Model 2		Model 3	
	New product advantage		Customer unfamiliarity		Firm performance	
Regression results						
New Product Advantage					**H1b**	1.75*
Customer Unfamiliarity					**H2b**	−1.12**
Product Radicalness	**H1a**	0.45**	**H2a**	0.28**		1.63*
Industry		0.27*		0.14		−1.59
Firm Size		−0.03		−0.03		0.84
Firm Age		−0.00		−0.00		−0.01
R^2		0.31		0.07		0.14
F value		18.50**		3.05*		4.32**

Indirect Effect (bootstrapping analysis)

	Indirect Effect	Boot SE	95% CI
Product Radicalness → New Product Advantage → Firm Performance (**H1**)	0.79	0.37	[0.17, 1.64]
Product Radicalness → Customer Unfamiliarity → Firm Performance (**H2**)	−0.31	0.20	[−0.98, −0.05]

SE = standard error; CI = confidence interval.
* $p < .05$.
** $p < .01$ (two-tailed).

6. Discussion

6.1. Theoretical implications

The effect of relative advantage on innovation success has been studied mainly from the consumer's perspective (Ordanini et al., 2014; Rogers, 1995) or at the product level (Calantone et al., 2006; McNally et al., 2010). Yet, Wiersema (2013, p.474) suggests that: "marketing should focus less on tracking the effectiveness of individual programs and activities and more on corporate-level metrics." Our research attempts to fill this gap. We suggest that while analyzing these relationships at the product level makes sense, many organizational aspects tend to be neglected. Consequently, the impact of firm's investments and fixed costs on the development and commercialization of a new offering is not easy to assign when the company has a wide range of products and/or services. Secondly, interrelations and trade-offs in terms of cost, risk, returns, and use of common organizational resources, capabilities, and skills tend to be overlooked. In this research, a model with customer-focused mechanisms (new product advantage and customer unfamiliarity), which mediate between product radicalness and firm performance, is empirically tested at the firm level. Thus, this research contributes to a gap in the existing literature by examining product radicalness at the firm level to ensure that the innovation-performance relationship covers a broader range of products and services.

The findings in this paper also contribute to the marketing literature in several ways. Firstly, we show that the positive effect of radicalness through new product advantage and the negative effect through customer unfamiliarity on innovation success observed in previous research can be extended to the relationship between product radicalness and organizational performance at the firm level. Secondly, according to Table 5, the total effect of radicalness on firm performance was positive and significant (b = 1.63, $p < .05$). Thus, we can conclude that the positive indirect effect through new product advantage was greater than its negative indirect effect through customer unfamiliarity. This suggests that customer benefits generated by new products possibly outweigh customer resistance to those products.

Furthermore, this research was conducted in a B2B marketing context, using a sample of both manufacturing and service industries, in which, to the best of our knowledge, these distinctive relationships have not been previously tested. Findings about the moderation effects also add novel insights into the contrast between goods and services in B2B marketing. Following a demarcation approach (Drejer, 2004), extant literature has compared product with service innovations (Ettlie & Rosenthal, 2011; Prajogo, 2006), but this has led to contradictory findings. For instance, Nijssen et al. (2006) and Ettlie and Rosenthal (2011) reveal a higher effect of radicalness on product success or firm general performance for new services than for new products. In contrast, Prajogo (2006) finds a stronger correlation between innovation and firm performance in manufacturing firms than in service firms. These inconsistent findings also lead to inconclusive radicalness-performance relationships between services and goods in past meta-analyses (Calantone, Harmancioglu, & Droge, 2010; Henard & Szymanski, 2001; Szymanski, Kroff, & Troy, 2007). One explanation may be the

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Table 6
Regression on new product advantage and customer unfamiliarity, moderating effect of industry, and bootstrap analysis for conditional indirect effects.

	Model 4		Model 5	
	New Product Advantage		Customer Unfamiliarity	
Regression results				
Product Radicalness		0.45**		0.28*
Industry		0.27*		0.13
Product Radicalness × Industry	**H3**	0.07	**H4**	−0.45**
Firm Size		−0.03		−0.03
Firm Age		−0.00		−0.00
R^2		0.31		0.11
F value		14.80**		3.93**

Conditional indirect effect (bootstrapping analysis)

	Moderator (Industry)	Indirect Effect	Boot SE	95% CI
Product Radicalness → New Product Advantage → Firm Performance	Manufacturing	0.68	0.36	[0.09,1.47]
	Service	0.78	0.44	[0.10,1.89]
	test of equality	0.10	0.27	[−0.24,0.90]
Product Radicalness → Customer Unfamiliarity → Firm Performance	Manufacturing	−0.56	0.30	[−1.34,-0.09]
	Service	−0.05	0.19	[−0.47,0.30]
	test of equality	0.51	0.35	[0.03,1.49]

SE = standard error; CI = confidence interval.
* $p < .05$.
** $p < .01$ (two-tailed).

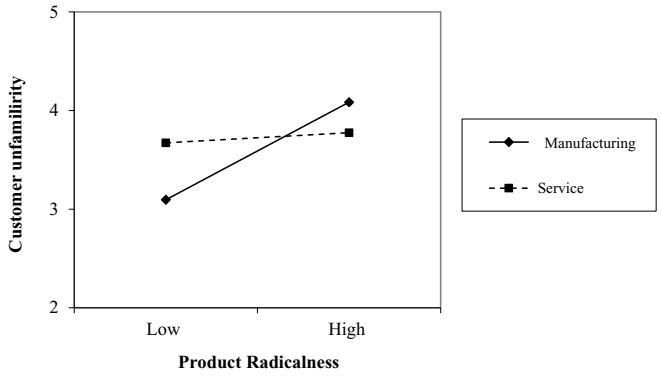

Fig. 2. Plot for the interaction between Product Radicalness and Industry on Customer unfamiliarity.

high heterogeneity across the service sector (Hughes & Wood, 2000), which can be greater than the heterogeneity across the manufacturing sector (Rubalcaba, Gago, & Gallego, 2010). In line with past studies (e.g., Rubalcaba et al., 2010; Teixeira & Bezerra, 2016), this research focuses on one of the most innovative segments of the service sector, KIBS (knowledge intensive business services). As such, the comparison between service and product innovation in the B2B context allows us to effectively control for some of the confounding effects generated by industry characteristics.

We found that the negative effect of radicalness on customer unfamiliarity was higher for manufacturing firms than for services firms. Interestingly, this finding contradicts the idea that offering tangible clues or physical evidence is associated with the awareness, understanding, and evaluation of highly innovative service concepts (de Brentani, 2001). However, services – especially KIBS – are characterized by more direct, intensive relationships with customers or clients given the inseparability of production and consumption. This offers an opportunity to reduce innovation adoption efforts, by providing education, training and ongoing support to adopters (Bettencourt, Ostrom, Brown, & Roundtree, 2002). In the case of B2B services, the high client contact also allows firms to be more flexible and adaptable, adjusting the new service to individual client needs (Atuahene-Gima, 1996; de Brentani, 2001). The close relationship facilitates opportunities for clients' in providing feedback, an important source of new ideas for service development.

We also need to recognize that radical innovations evolve over time and when the new products/services of a firm are successful, their competitors tend to introduce “me-too” product/service innovations with similar or better benefits, reducing the initial advantage of the firm. Therefore, it is expected that the positive effect of product advantage on firm performance would diminish over time, unless the firm continues to launch new attractive value propositions. By contrast, given that customers have had time to learn about the advantages and usage of the new product/services, they would be more familiar to customers. Hence, it is expected that the negative effect of customer unfamiliarity on firm performance would also decrease over time.

6.2. Managerial implications

Based on our results, it is evident that managers should develop both radical product and service innovations in B2B companies, taking into account their favorable impact on firm performance, but ensuring that the positive effect of their relative advantage is greater than the negative effect caused by customer unfamiliarity. Managers need to ensure that new customer benefits emanating from product or service innovations are more than adequate to cover the shortcomings that arise from the time and learning effort required for adopting them. Further, managers need to design sales and communication strategies to make the customers perceive the product benefits.

On the one hand, when radical innovations are launched, companies could focus their marketing efforts on announcing the relative advantages of their new products or services so that customers' uncertainties are reduced (Damanpour & Gopalakrishnan, 1999). Toward this objective, benefit comparison between the firm's and competitor's products/services (Heidenreich & Spieth, 2013; Talke & Heidenreich, 2014) highlighting the new or superior product/service benefits, and at the same time, minimizing the differences, could help to increase the customer's perceived relative advantage of the firm's offering. In this sense, functional advertisements as part of marketing strategy would seem to work better than emotional ads with new products that have clear advantages or superior customer benefits (Lee & O'Connor, 2003).

On the other hand, communication strategies should also aim at reducing customer unfamiliarity associated with customer's resistance to new products (Veryzer Jr, 1998). Innovation resistance can be passive (general predisposition to resist innovations prior to the evaluation of new products/services) or active (attitudinal outcome following an unfavorable deliberate evaluation of new products/services) (Talke & Heidenreich, 2014). To lower both types of innovation resistance, marketers should reduce both the perceived change generated by the new products/services and customers' satisfaction with the status quo represented by the products/services they possess and uses (Talke & Heidenreich, 2014). Marketing communication using mental simulation or self-visualization of the new usage situation as well as verbal analogies or messages showing the similarity between new and current products/services (Heidenreich & Spieth, 2013; Talke & Heidenreich, 2014) seem to be useful for decreasing customer unfamiliarity.

When new products are difficult to adopt because of the required learning effort and customer behavior change, it is recommended that a preannouncement strategy oriented toward customer education (about the new product and how to use it) as well as using emotional ads for advertising are used (Lee & O'Connor, 2003). Additionally, to cope with the perceived complexity caused by radical innovation, it is recommended that new products/services are bundled with existing ones,

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weakening the negative effect of unfamiliarity; additionally, product demonstrations also allow customers to familiarize themselves with product/service innovations (Heidenreich & Kraemer, 2016).

Our results showed that the negative effect of radicalness on customer unfamiliarity was greater in manufacturing firms than for services firms; therefore, firms need to expend greater adoption effort to gain customers to buy in into innovations in the manufacturing sector. Given the less interactive nature of the relationship with customers for manufacturing firms, more frequent firm-customer meetings, both formal and informal, should be encouraged even prior to the product development stage. This will help anticipate customer problems with the new products quickly and provide a solution. Additionally, manufacturing is generally characterized by a higher investment in R&D and protection of innovations through patents, as well as building expensive production facilities (equipment, robots, etc.), all of which lead to a longer time-to-market, making innovation adoption more difficult. Therefore, customer unfamiliarity seems to have more impact on physical products than on technical services. Hence, it is more important to build long-lasting and deep connections with direct customers in the B2B context in manufacturing, as compared to service firms.

6.3. Limitations and future research

This research also has some limitations. First, participating firms were sampled from one country (Spain). While this reduced confounding effects generated by geography and culture, results in this study may not be generalized to other national contexts. Thus, we recommend that researchers apply the same theoretical framework in a broader geographic setting and possibly compare the examined relationships between different countries or cultures. This allows us to understand whether the findings are robust, and if not, how certain geographic or cultural contexts play a unique role in the examined relationships. In addition, while this study was based on cross-sectional data, future research should consider longitudinal data collection, which allows for analyzing the evolution of relative effects of the mediators (product advantage and customer unfamiliarity) over time. This could provide useful guidelines to managers regarding the timing to introduce new product/service innovations.

Second, although analyzing radicalness at the firm level during a period of time has some advantages as mentioned above, it also has the drawback of aggregating the innovation activity of the firm and providing less accuracy at the product level. However, it is also true that isolating the effect of a single product/service innovation on firm performance from the rest of firm's innovations is almost impossible. In addition, it avoids selection bias toward successful new products/services as well. Therefore, in our opinion, our approach offers a more complete picture of this phenomenon. In the meantime, we recommend that researchers examine multiple (successful and failing) products within a firm for a deeper look at new product portfolio. For example, researchers may want to consider investigating why and when within a firm some radical innovations succeed but some others fail. Concerning the high new product failure rate, we believe that a deeper examination of new product portfolio can provide additional insights into developing radical innovations.

Third, radical innovations require some time to have an effect on firm performance, this can also be applied to customer outcomes: customer unfamiliarity (time required to learn about the innovation) and new product advantage (time required to recognize the greater customer benefits). This issue is addressed by analyzing innovation in a period of five years. Additionally, the decision process of customers for innovation adoption is a complex process involving many stages that happen over time: knowledge, persuasion, decision, implementation and confirmation (Talke & Heindenreich, 2014), and this is expected to take longer time for B2B companies. Hence, using a longitudinal approach may provide greater understanding of the decision process of radical innovation adoption and its impact on performance over time.

Also, the use of subjective measures of performance, rather than objective measures, creates limitations on the applicability of the results. Subjective measures of performance permit comparisons across industries (McNally et al., 2010) and across firms (Song, Di Benedetto, & Song, 2010), and they are found to be valid, as they are positively correlated with objective counterparts (Murphy & Callaway, 2004; Wall et al., 2004). Meanwhile, we suggest that researchers adopt objective measures, such as actual sales volume and profits generated by those new products, to validate findings. In addition, in this study firm performance focuses on financial and market performance. While they capture important business aspects, other dimensions of firm performance should be analyzed in order to have a more complete picture of the effects of radicalness – especially customer-focused performance, such as customer satisfaction. In spite of the relevance of the two mediators used in our study, further research should empirically test the mediating role of other variables such as risk (Wiedmann, Hennigs, Pankalla, Kassubek, & Seegebarth, 2001).

In line with Heidenreich, Kraemer, and Handrich (2016), future research should also explore the moderating role of both adopter-specific factors (e.g. if customers on the firm's market are or not resistant to change) and situation-specific factors (e.g. if they are satisfied or not with the status quo) on the product radicalness-new product advantage relationship, on the one hand, and the product radicalness-customer unfamiliarity relationship, on the other hand. These factors could affect not only passive innovation resistance, but also active innovation resistance (Talke & Heidenreich, 2014).Finally, in this research we identified customer unfamiliarity as a negative factor that hinders radical innovation from enhancing firm performance. As discussed earlier, high unfamiliarity may cause customer resistance to innovation, but we also provide managerial implications regarding how to use communication strategies to reduce such resistance. Especially because the purchase decision process is more complex in a B2B context (Lilien, 2016), we recommend that future studies examine specific barriers and types of innovation resistance together with their corresponding sales and communications strategies for B2B firms.

7. Conclusions

This research contributes to the B2B marketing literature by showing that radical innovation at the firm level in a B2B context impacts firm performance via two competing effects. Those effects are explained by distinct mechanisms: a positive mediating effect of new product advantage and a negative mediating effect of customer unfamiliarity. In addition, in the manufacturing sector the influence of product radicalness on customer unfamiliarity is stronger than in the service sector.

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