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Adoption of Technological Products and Services for Different Consumer Profiles: An analysis using the Technology Adoption Propensity Scale

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Abstract

Purpose – To evaluate how different consumer profiles react to the adoption of new technologies through the replication and validation of the TAP scale in Brazil.

Design/methodology/approach – We designed a descriptive study of a quantitative nature applied through a survey. Exploratory and confirmatory factorial analysis procedures were performed in order to validate the scale. We used *t* tests to check for statistical differences between consumer profiles.

Findings – The TAP scale proved to be a valid and reliable instrument to measure technology adoption propensity among Brazilian consumers. In this group, those in a higher domain of computational innovation showed greater proficiency in the technology adoption process. In a comparison of the data from our study with those of the original one in the USA, Brazilians presented a higher propensity for technology adoption.

Originality/value – The study provided advancements in three ways: 1) validating the TAP scale for Brazilian usage; 2) bringing insights to research on innovation in specific domains; 3) contributing to the studies about potential differences between developed and emergent countries related to new technology adoption and late acceptance of innovation.

Keywords – Technology Adoption Propensity; Cultural Differences; Scale Validation; Consumer Profiles.

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1 Introduction

The increasing influence of technology in the current societal context has not only affected the way individuals interact with each other, but also the interactions occurring between companies and their consumers (Parasuraman & Colby, 2002). According to Mick and Fournier (2014), the effect of this massification of technology may be better understood by analyzing not only the increasing number of technological innovations, but also the increasing exposure to technology experienced by individuals, whether intentionally or unintentionally. This invasion of technology in our daily routine has aroused the interest of an increasing number of researchers from several fields, including the applied social sciences field. Such researchers seek to understand how these interactions occur among individuals, companies, and technology (Lippert & Volkmar, 2007), minimizing the effects of competitors and adding value to the consumer.

In this regard, several research studies that sought to understand the behavior of individuals with regard to new technologies and the relationship between the two were carried out as long ago as the 1980s, in the psychology field, giving rise to the so-called *Theory of Reasoned Action* (TRA), developed by Ajzen and Fishbein (1980). Several studies have been developed based on this theory, producing three models that aim to understand the relationship between individuals (consumers) and technology, namely the TAM (*Technology Acceptance Model*), the TRI (*Technology Readiness Index*) scales, and finally, the TAP (*Technology Adoption Propensity)* scale, proposed by Ratchford and Barnhart (2012), which analyzes factors that encourage (optimism and proficiency) and factors that inhibit (dependence and vulnerability) the adoption of new technologies, and is the central object of this study.

Although the TAP scale has shown strength in its constructs, to date, there are no previous studies identified – outside the North American context – which have used this scale to measure the propensity of consumers to adopt new technologies. In Brazil, the theoretical approach used in the TAP scale was used in an exploratory study of elderly people (Farias, Vitor, Lins, & Pedroza, 2015). The results showed that factors that inhibit and those that influence the propensity for the adoption of information and communication technologies are recurrently mentioned and that the elderly see themselves as digitally included. The authors even emphasize the need for future quantitative research seeking to improve the TAP scale knowledge in Brazil (Farias et al., 2015).

This vulnerability meant that no comparisons have been made as yet, which could lead to a better understanding of how consumers with different cultural profiles, or experiences with regard to the specific domain of adoption, behave toward the factors that encourage and inhibit the adoption of new technology, as proposed by Ratchford and Barnhart (2012). The studies carried out by Burgess and Steenkamp (2006) highlight and reinforce the need and importance of the replication of studies carried out in developed countries in the context of emerging countries. The authors also suggest that the differences in the institutional context between developed and emerging countries can directly affect the results of marketing research, and so this process is essential for advancing the field of marketing, since these replications would be key to the generalization of the theoretical constructs (Hunter, 2001).

The lack of studies that include discussions about the adoption of new technologies in emerging economies has led several authors to call for new research to better understand the norms and forces that act in these economies (Ferreira, Rocha, & Silva, 2014; Peres, Muller, & Mahajan, 2010). Thus, the main objective of this study is to evaluate how consumers with different profiles react to the adoption of technological products and services through the replication and validation of the *Technology Adoption Propensity* scale in Brazil. By comparing its results to those from the original

US study, it is possible to draw a parallel between the countries of origin. The comparison between Brazilian consumers with different profiles in terms of the specific domain for new technologies allows an experiential or existential parallel to be drawn. Based on this opportunity, this research was carried out by testing and validating the scale using samples with distinctive consumer profiles, in the Brazilian context, and comparing its adoption indicators with those found in the original study with US consumers.

The remainder of this study presents the theoretical pillars of the consumer relationship with technology, the methodological procedures applied, the results found, and the implications of these findings.

2 Individuals' Relationship with Technology

The ambivalence of feelings and emotions, both positive and negative, involved in the adoption of technology has intrigued and aroused the interest of some researchers. According to Mick and Fournier (1998), whilst technology can create a feeling of freedom, control, and efficiency, it can also arouse a feeling of unfitness, lack of control, and enslavement.

For Bagozzi and Lee (1999), this conflict of feelings caused by the coexistence of both positive and negative emotions towards technology contributes to consumers adopting different actions and responses when faced with certain incentives. Similarly, Winner (1994) also treats technology as a paradox and states that the same technology that creates radiant feelings of intelligence and effectiveness can also create feelings of foolishness, silliness, and passivity. This duality of feelings involved in technology use is inherent to the technological paradoxes, since such paradoxes have the ability to create both positive and negative consequences. In other words, there are encouraging and inhibiting factors related to the adoption of new technologies.

The advances and discoveries already demonstrated by several research studies seeking to understand the relationship between individuals and new technologies (Ajzen & Fishbein, 1975; Davis, Bagozzi & Warshaw, 1989; Parasuraman & Colby, 2001) are unquestionable. The developments that have occurred in aspects related to the behavior of consumers, their cultural and educational differences, and how they react to these technological innovations, can directly affect organizational outcomes.

The groundwork for studies seeking to understand this consumer-technology relationship began in the psychology field with the development of the so-called *Theory of Reasoned Action* (TRA), developed by Ajzen and Fishbein (1980), which, by using two dimensions (attitudes towards behavior and subjective norms), has been used to foresee a wide range of behaviors (Sheppard, Hartwich, & Warshaw, 1988). Among the studies influenced by TRA and that aim to understand the relationship between individuals (consumers) and technology, the three most significant are: the *Technology Acceptance Model* (TAM), developed by Davis (1989); the *Technology Readiness Index* (TRI), presented by Parasuraman and Colby (1998); and, finally, the studies of Ratchford and Barnhart (2012), which resulted in the creation of the *Technology Adoption Propensity* (TAP).

The first of these models, the TAM scale, aims at improving the understanding of the process related to consumer acceptance of technologies, and at developing a theoretical basis for users' acceptance of technology (Davis, 1989). The second one, the TRI scale, is based on the concept of readiness for technology (Parasuraman & Colby, 2001), which is related to the attitudes of individuals towards adopting new technologies. This model can be better understood by analyzing the mental factors that might act in order to contribute to or inhibit this readiness. By evaluating both types of factors, it is possible to determine a particular person's readiness to adopt new technologies. Parasuraman and Colby (2001) have classified these dimensions of the TRI scale as optimism, innovativeness, discomfort, and insecurity, with the first two dimensions being

related to the encouraging factors and the last two related to the inhibiting factors.

The development of the TAP scale by Ratchford and Barnhart (2012) stemmed from the reflections made since the definition of the TAM scale, regarding encouraging and inhibiting factors, besides aiming to overcome the limitation imposed by the TRI, which measures specific technologies – computers, cell phones, and tablets – somewhat limiting its application due to the fast obsolescence of new technologies. When developing the TAP scale, Ratchford and Barnhart (2012, p.1211) carried out an extensive literature review, seeking to find an appropriate definition for all the constructs, thus using as a concept of technology "the application of science, especially for industrial or commercial purposes". According to the authors, this definition enables the likes of service provision methods to be incorporated into technological products, being broad enough to include a wide range of technologies previously studied in the literature, as well as future technological innovations.

Based on these concepts, the TAP scale has been developed with two factors that encourage (optimism and proficiency) the adoption of technology and two factors that inhibit (dependence and vulnerability) it. This coexistence of encouraging and inhibiting factors for the adoption of technologies is also directly related to the technological paradoxes (positive and negative feelings) presented by Mick and Fournier (1998).

2.1 Technology Adoption Propensity Scale

In order to be sure that the scale would measure the individual consumer's propensity regarding technologies and not only their understanding of technology's significance for society, Ratchford and Barnhart (2012) took reasonable care to draw up the scale items using the first person singular, such as in, for example, "technology enables me to have more control over my daily life" instead of "technology enables people to have more control over their daily lives", so that the consumers could reflect on the effect of adopting technology in their daily routine. The TAP scale is a measuring instrument, which effectively predicts the consumer's probability of adopting a wide range of new technological products and services. The scale's four dimensions are presented below with the purpose to detailing each construct definition.

2.1.1 *Optimism*

Optimism is defined as "the belief that technology provides greater control and flexibility in life" (Ratchford & Barnhart, 2012, p. 1212). This can be considered as a factor that incorporates aspects of the perceived utility of technology in making life easier and allowing us to do the things we want to.

This optimism dimension is tied to the tendency to believe that a desire will usually result in a positive experience (Scheier & Carver, 1992). Thus, optimism leads to more positive attitudes, with this being a factor that can contribute to individuals with optimistic characteristics being more willing to use new technologies. Walczuch, Lemmink, and Streukens (2007) add that the optimism dimension is inversely related to feelings of anguish, concern, and a perception of risk, with these feelings also possibly being tied to technology use. This inversion means optimists have a lower probability of focusing on negative events, which ends up allowing them to view technology in a more open way.

In this regard, although both the TRI and TAP scales present the optimism dimension in their construct, the construction of the optimism dimension in the TAP scale differs to the extent that, according to Ratchford and Barnhart (2012), this factor is specific to beliefs about control and flexibility and does not include beliefs about increased efficiency, as happens in the optimism dimension of the TRI scale.

2.1.2 *Proficiency*

Ratchford and Barnhart (2012, p. 1212) describe "proficiency as being the confidence in

one's own ability to easily learn and quickly use new technologies, as well as the feeling of being technologically competent". This dimension is tied to the encouraging factors and to the individual's skills in using technology. Being able to deal with and overcome frustrations are key factors while seeking to achieve proficiency, mainly when it comes to items involving technology (Strebel, O'Donnell, & Myers, 2004).

Proficiency represents an important advance in the process of understanding the individual's relationship with technology, as the consumer's confidence in their capacity to learn and effectively use new technologies has become a more critical factor in their propensity to adopt than feelings of being a pioneer in using technology (Ratchford & Barnhart, 2012).

In this regard, the proficiency dimension represents an important redefinition of the innovativeness factor presented by the TRI scale, mainly if considering the increasing speed of technological changes that have happened in the last decade, the sophistication presented by new technologies, and consumers' ever more complex expectations (Wood & Moreau, 2006).

2.1.3 *Dependence*

Dependence can be defined as "a feeling of being excessively dependent . . . it is a feeling of being enslaved by technology" (Ratchford & Barnhart, 2012, p. 1212). The dependence dimension is directly tied to user engagement and to the inhibiting factors. This engagement is a psychologically subjective state, which reflects the importance and relevance given by the individual to a certain object or event (Amoako-Gyampah, 2007). This dimension was incorporated into the TAP scale by virtue of the findings presented by Mick and Fournier (1998). These findings brought up a number of technological paradoxes, which guide the consumer's relationship with technology.

As there has been a significant increase in individuals' exposure to technology, this factor has become highly relevant, as there are an increasing number of consumers who confess to being "addicted" to using laptops, cell phones, and wireless devices (Ratchford & Barnhart, 2012; Tanaka & Terry-Cobo, 2008).

2.1.4 *Vulnerability*

Vulnerability refers to "the belief that technology increases the chances of being deceived or used by criminals and companies" (Ratchford & Barnhart, 2012, p. 1212). This dimension refers to the possibility for some technological system to fail due to outside impacts. Each new technology seems to involve some vulnerability for its users and this vulnerability may occur in several ways, such as: accidents, diseases, environmental degradation, and social disruption (Kearton & Martin, 1989).

In this context, the vulnerability dimension presents an important change if compared to the insecurity dimension identified in the TRI. According to Ratchford and Barnhart (2012), the vulnerability factor in the TAP index reflects the concern that technology will work very well for anybody seeking to use it for illegal purposes. Thus, according to the same authors, vulnerability measures the extent to which individuals believe that their chances of being victimized increase with the use of new technologies, since technologies facilitate abusive practices.

2.2 Adoption of New Technologies and User Profile

The process of adopting a new technology, product, or service is closely related to the concept of consumer innovativeness (Rogers, 2003). The tendency to adopt new technologies does not only depend on the individual's perception, but also on the context around them (Gatignon & Robertson, 1991). Robertson (1971) states that the consumer's capacity for innovation is constantly found within product categories and, occasionally, among classes of related products.

The adoption of innovation in a specific domain was coined by Goldsmith and Hofacker

(1991) as *Domain-Specific Innovativeness*. This innovation takes into account the aspects of human behavior within an area of specific interest for a person (Bartels & Reinders, 2011), i.e. it seeks to capture an individual's predisposition to the adoption of a specific class of products (Araujo, Ladeira, Santini, & Sampaio, 2016). In addition, it reflects the tendency to learn and adopt new products in this area of interest (Goldsmith & Hofacker, 1991; Roehrich, 2004). For Bartels and Reinders (2011), this is a predisposition of the consumer to adopt new and different products and brands instead of maintaining previous choices and consumption patterns. This tendency is, perhaps, a consequence of the interaction between the innovation as a whole and the strong interest for the category of a given product (Roehrich, 2004).

Huotilainen, Pirttilä-Backman, and Tuorila (2006) showed that the capacity for innovation in a specific area has a greater influence on adoption within a specific category of products than the overall innovation, considering that consumers can be more innovative in one area and more backward in another (Gatignon & Robertson, 1991); this occurs due to the proficiency and domain of a given category (Ratchford & Barnhart, 2012).

A study proposed by Margaryan, Littlejohn, and Vojt (2011) investigated the extent and nature of digital technology adoption by undergraduate students for them to learn and socialize. Their findings suggest that the use of technology by students might be mediated by the more extensive use of technology in Engineering degrees than in Social Sciences degrees. In addition, age difference was also observed as being an important characteristic for the extent of technology use, and university promotion of the use of digital technology has affected student learning. Therefore, it can be observed that people who have more experience and specific knowledge in a given area tend to have more capacity to innovate in that specific domain.

2.3 Adoption of New Technologies and Country of Origin

Comparative studies on the adoption of technological innovation scales in different countries began to appear in the first decade of the 2000s. However, the large number of findings in developed nations does not necessarily apply to developing ones (Baker, Al-Gahtani, & Hubona, 2010), where the dimensions of the technological adoption scales tend to involve different behaviors.

These restrictions to the application of the technological adoption scales in Latin American countries have existed since TAM scale replications were first carried out. The study of McCoy et al. (2005), by exception, sought to validate the TAM scale in Uruguay and the United States. The reliability of the scale dimensions always showed higher values for the Uruguayan sample. The study of Alshare, Mesak, Grandon, and Badri (2011) complements the study of McCoy et al. (2005) by investigating the moderating role of national culture in the extended TAM model. The authors also used data from countries with different cultural foundations – the United States, Chile, and the United Arab Emirates – and found wide support for the moderating role of national culture.

A study carried out by Ferreira et al. (2014) used Brazil as its research context and showed that cognitive and affective assessments of new technologies are significantly influenced by technological readiness. Moreover, the readiness effects over the affective measures were bigger than those related to cognitive assessments for high technology innovations. The research emphasizes that Brazilians, as well as other Latin American cultures, favor the expression of emotions over rational decisions.

With this in mind, Putsis, Balasubramanian, Kaplan, and Sen (1997) stress that understanding the effects among countries is extremely important to understanding technology diffusion in a globalized world. The authors found that innovations for many products were first diffused by using casual discussions among consumers.

Peres et al. (2010) argue that, even though personal communication is of great importance in the adoption of new products, consumer heterogeneity provides a new guide. This approach claims that social systems are heterogeneous in terms of innovation capacity, sensitivity to prices, and needs, leading to heterogeneity in the propensity to adopt innovations.

According to Peres et al. (2010), based upon several preliminary studies, countries introducing a given innovation will, later on, have a faster dissemination process and will take less time for this innovation to be accepted. According to the authors, even if there is no communication or imitation among individuals, the level of acceptance in a country acts as a sign to consumers in other countries, reducing their perception of risk and increasing the legitimacy of using the new product. The authors even state that, besides time to market, the marketing mix, demographic, cultural, and economic variables all have diverse impacts on the process of adopting new technologies.

3 Method

In order to carry out this research, the use of a study of a descriptive and quantitative nature was chosen, which was carried out through a survey applied to a considerable sample with the purpose of collecting structured data (Hair, Black, Babin, Anderson, & Tatham, 2009). It is important to stress that this study takes a positivist approach, and is characterized by the use of a scientific method in the problem-solving process (Bonoma, 1985). The data collection was performed by means of structured and auto-populated questionnaires.

For this purpose, the data collection instrument was divided in three blocks: 1) data about technological product ownership; in this stage, a filter question was added, which the respondents should answer if they had understood the concept of technology (the applicability of science, especially for industrial or commercial purposes), as according to Ratchford and Barnhart (2012); 2) 14 questions related to the 4 dimensions of the TAP scale; and 3) characterization of the sample. These items were measured with a five-point Likert-type scale.

In order to adapt the TAP scale to the Brazilian context, a process called reverse translation was carried out into Portuguese. Before applying the questionnaire, it was submitted to a pretest performed by ten undergraduate students, the same type of participants as the final and the original study.

The final application of the questionnaire resulted in a sample of 500 respondents. The focus population used to carry out this study was defined as university students associated with the Computer Science degree and Business degree of a large university in the south of Brazil, aiming at achieving the goal of checking differences between the adoption of new technologies by users from distinct areas of specific interest towards technology. The students at the Computer Science School were considered to be users with a high domain of specific interest, since they chose to deal with technological innovation in their daily routine. On the other hand, the students at the Business School were chosen for having a more neutral profile with regard to the specific domain of technological innovation, since they were involved in an applied social sciences field, where there is no strong encouragement to embrace innovation when using new technologies, but neither is there a restriction on using them. The data analysis procedures are detailed below, in the results section.

4 Results Analysis

In order to assure the qualification of the data collected and of the studied scale dimensions in the Brazilian context before addressing the comparative data, the results will be presented in two comprehensive steps: 1) Preliminary procedures for data qualification and scale validation; and 2) Study of consumer profiles: analysis of propensity for technology adoption as per cultural profile by comparing the original

study and the Brazilian one, and by comparing groups with different levels of experience and interaction with technology. At this stage, the SPSS®23.0 statistical software along with the AMOS®23.0 software were used.

4.1 Preliminary Procedures for Data Qualification

The presence verification of univariate and multivariate outliers, performed by applying variable standardization tests through the calculation of Z scores, and by the Mahalanobis (D^2) distance test, identified 10 questionnaires which were eliminated from the database for being outliers, as Hair et al. 2009) suggest. Nineteen respondents who did not answer 10% or more of the questions were also excluded, as well as 43 respondents who did not state that they understood the concept of technology presented in the collection instrument, which was employed as a scale filter question. Finally, 36 respondents were eliminated from the database as they did not fit the sample profile.

Following this process of purifying the initial database (N = 500), a final sample of 392 respondents was reached. This sample is characterized as predominantly male (71.7%), being for the most part (72.3%) aged 18-25, single (85.5%), in paid occupation (82.6%) as an intern or scientific initiation scholarship holder, and with an income ranging from R$ 2,401 to R$ 4,430 (22.8%).

4.1.2 *Exploratory Factor Analysis*

The exploratory factor analysis (EFA) was carried out in order to verify the data set's adequacy to the factorial structure proposed in the original scale. Bearing in mind the purpose of comparing two distinct user profiles which are part of this study, according to their technological proficiency level, all the procedures for the proposed scale validation were checked for the collective sampling and individual sampling, and only the collective results were reported because there were no differences between the factorial structure of the collective sampling and the sampling for each group.

The Bartlett's test of sphericity result (1995.559; $p < .000$) and the KMO measure (0.779) presented values considered as satisfactory (Malhotra, 2012; Hair et al., 2009). The values for communality and factor loading remained within those proposed by the literature and are shown in Table 1. Therefore, with the exception of proficiency item 1 ($h^2 = 0.386$), all the others presented communality above the exclusion criteria of 0.5 proposed by Hair et al (2009). However, according to the authors, when items or constructs present low communalities, a sample higher than three hundred cases assists with the recovery of population parameters, such as is the case of the sample used in this study. For that reason, and also in view of the indicator's importance, the parity of the original study, and the stability of other analysis predictors, the indicator was kept in order to see how it would behave in the confirmatory analysis. The scale explained variance after the Varimax rotation presented a solution with 4 factors, and an explained variance of 64.92% (Hair et al., 2009).

Following the literature's recommendation, the TAP scale reliability was evaluated considering the Cronbach's alpha coefficient values, according to Table 1. All the four scale dimensions presented values higher than those recommended by the literature, and the scale's overall reliability was of a = 0.75, a value that can be considered satisfactory. This result confirms that the scale's inner structure is consistent.

Table
Indexes of TAP scale exploratory factor analysis

Dimensions and Variables	Factor loading	h²
Optimism	α = .80	
1. Technology provides me with more control over my everyday life.	.744	.632
2. Technology helps me make necessary changes in my life.	.739	.592
3. Technology allows me to do the things I want to more easily, when I want to.	.805	.659
4. New technologies make my life easier.	.750	.595
Proficiency	α = .73	
1. I am able to find out how new technological products and services work without anybody else's help.	.579	.386
2. It seems I have fewer problems than other people to make technology work.	.833	.723
3. Other people come to me for advice about new technologies.	.841	.727
4. I like finding out how new technologies work.	.806	.706
Dependence	α = .83	
1. Technology controls my life more than I control technology.	.847	.734
2. I feel I am excessively dependent on technology.	.869	.795
3. The more I use technology, the more I become a slave to it.	.870	.779
Vulnerability	α = .63	
1. I must be careful while using technology, as criminals can make use of it to target me (harm me).	.725	.560
2. New technologies make it much easier for companies and other people to invade my privacy.	.830	.700
3. I believe high technology companies convince us we need things that we actually do not.	.680	.501

Grades: h² = communalities

As observed, the procedure for the TAP factorial structure analysis provides a great contribution to the subsequent analysis, since the factors produced by the TAP scale (optimism, proficiency, dependence, vulnerability) present conceptual coherence when the EFA is carried out after the Varimax rotation. In addition, the results found in this research reinforce those found in the studies of Ratchford and Barnhart (2012), as the same factorial structure was observed with regard to the dimensions found and their respective measurement indicators.

4.1.3 *Confirmatory Factor Analysis*

In order to carry out the confirmatory factor analysis (CFA), the following procedures were executed: i) factor loading; ii) composite reliability; iii) convergent validity, and iv) discriminant validity (Hair et al., 2005; Marôco, 2010). The purpose of this analysis is to confirm the scale validity and reliability adjusted and applied to the Brazilian context.

With respect to the factor loadings, their values should be observed (higher than 50), and each latent variable item has a significant loading at $p < 0.01$ (Hair et al., 2009). After measuring the validity of the dimensions, efforts were made to confirm the factorial structures. Thus, initially, the CFA was carried out using the AMOS® 19.0 software, with the items that compose the measurement model. The analysis of adjustment measures (absolute and comparative), which determine the extent to which the model predicts the observed covariance matrix, presented consistent results (SRMR = 0.042; RMSEA = 0.052; CFI = 0.958; TLI = 0.946; $\chi^2_{(71)} = 151.803$; $p < 0.000$; $\chi^2/_{df} = 2.138$) with the literature (0.90), showing an appropriate adjustment of the model (Hair et al., 2009), as according to Table 2. Additional evidence regarding this adjustment can be verified by considering its similarity to the adjustment of the original scale validity of the final sample (SRMR = 0.056; RMSEA = 0.052; CFI = 0.94; TLI = 0.92; $\chi^2_{(71)} = 168.65$, $p < 0.000$; $\chi^2/_{df} = 2.38$).

Table 2
Factor Validity of Confirmatory Factor Analysis

Observed Variable		Latent Variable	Non-Std. Est.	Std. Estimate	S.E.	*t*-value	*p*
1. Optimism	←	Optimism	1.000	.749	-	-	-
2. Optimism	←	Optimism	1.040	.693	.084	12,330	***
3. Optimism	←	Optimism	.832	.675	.069	12,065	***
4. Optimism	←	Optimism	.837	.669	.070	11,976	***
1. Proficiency	←	Proficiency	1.000	.798	-	-	-
2. Proficiency	←	Proficiency	1.172	.794	.074	15,783	***
3. Proficiency	←	Proficiency	1.050	.775	.068	15,501	***
4. Proficiency	←	Proficiency	.547	.479	.058	9,359	***
1. Dependence	←	Dependence	1.000	.806	-	-	-
2. Dependence	←	Dependence	1.071	.864	.065	16,538	***
3. Dependence	←	Dependence	.892	.735	.059	15,212	***
1. Vulnerability	←	Vulnerability	1.000	.561	-	-	-
2. Vulnerability	←	Vulnerability	1.394	.802	.215	6,472	***
3. Vulnerability	←	Vulnerability	.797	.467	.115	6,950	***

Grades: (***) $p < 0.000$; ← path regression.

With respect to the composite reliability of the constructs, this is an analysis that represents the total amount of the true score variance compared with the total score variance (Malhotra, 2012), where values higher than 0.70 are the acceptable index for confirmatory studies (Hair et al., 2005).

With regard to the convergent validity, this represents how much the scale correlates positively with other measures of the construct (Steenkamp & Trijp, 1991), which must be equal to or higher than 0.50. On the other hand, for the discriminant validity calculation, the square root of the average variance extracted for each construct must be lower than the correlation between the constructs (Fornell & Larcker, 1981). In this case, for each of the dimensions, the obtained variance is higher than the shared variance, and the discriminant validity is confirmed. The literature recommends a value equal to or higher than 0.50 (Fornell & Larcker, 1981). These indicators can be observed in Table 3.

It can also be observed that the results of the square root of the AVE present higher indexes than the shared variances of the constructs (correlations). Such results confirm the discriminant and convergent validity of all model measurements (Hair et al., 2009).

Table 3
Convergent and Discriminant Validity

Dimension	CR	AVE	1	2	3	4
1. Optimism	.865	.616	**.785***	-	-	-
2. Proficiency	.875	.645	.499	**.803***	-	-
3. Dependence	.907	.765	.246	.197	**.874***	-
4. Vulnerability	.741	.501	.042	.125	.264	**.707***

Grades: CR = Composite Reliability; AVE = Average Variance Extracted Analysis; (*) AVE Square Root; bottom diagonal refers to correlation between dimensions.

4.2 Consumer Profiles Analysis

Once the scale validity in the Brazilian context could be measured, the analysis of consumer profiles with regard to technology adoption began to be carried out.

4.2.1 *Propensity for Technology Adoption by Brazilian vs US consumers*

With the purpose of measuring the propensity for technology adoption by consumers in this study, the T-test (one sample) was performed by comparing the averages of each TAP scale variable in this study with data provided by the study of Ratchford and Barnhart (2012). Table 4 presents the results found in this comparison.

Table 4
Difference of TAP Scale Between Studies

TAP Variables	Current Study Average (SD)	Original Study Average (SD)	T-test (Sig. 2-tailed)
1. Optimism	4.29(0.82)	4.03(0.93)	6.573(000)
2. Optimism	3.94(0.93)	3.67(0.98)	5.946(000)
3. Optimism	4.47(0.76)	4.17(0.84)	8.217(000)
4. Optimism	4.41(0.77)	3.92(0.94)	13.076(000)
1. Proficiency	4.27(0.83)	3.47(1.14)	19.737(000)
2. Proficiency	3.99(0.99)	3.64(1.07)	7.231(000)
3. Proficiency	4.03(1.08)	3.04(1.30)	19.064(000)
4. Proficiency	4.30(0.92)	3.67(1.15)	14.246(000)
1. Dependence	2.75(1.16)	2.43(1.08)	5.435(000)
2. Dependence	3.03(1.18)	2.77(1.15)	4.549(000)
3. Dependence	2.90(1.18)	2.89(1.14)	0.116(.907)^{ns}
1. Vulnerability	3.78(1.15)	3.30(1.14)	8.622(000)
2. Vulnerability	3.68(1.12)	3.34(1.11)	4.373(000)
3. Vulnerability	3.60(1.10)	3.48(1.16)	2.169(031)

Note: (^{NS}) nonsignificant

As observed in Table 4, with the exception of dependence item 3 (the more I use technology, the more I become a slave to it), all the other indicators of this study presented significantly higher averages than those found in the study of Ratchford and Barnhart (2012). This result shows

that this research sample has a bigger propensity for technology adoption than the one used in the study of Ratchford and Barnhart (2012), thus supporting the studies of Peres et al. (2010) regarding late adoption of innovation.

4.2.2 *Relationship Between Different Domain-specific groups and Technology Adoption*

In order to verify possible differences between the samples composed of groups with potentially distinct domain-specific interests, represented by Computer Science and Business School students, an analysis of the T-test was undertaken using independent samples. This test helped to better understand, identify, and measure the differences presented by the respondents belonging to different courses/colleges with regard to technology adoption propensity. This sample consists of 50.51% (198) of respondents associated to the Computer Science School and 49.49% (194) to the Business School, according to Table 5.

Table 5
Difference of TAP Scale between profiles

TAP Variables	Comp. Science Average (SD)	Business Average (SD)	T-test (Sig. 2-tailed)
1. Optimism	4.364(.786)	4.216(.872)	1.755(0.080)
2. Optimism	4.066(.902)	3.783(.963)	3.004(0.003)*
3. Optimism	4.455(.784)	4.471(.769)	-.213 (0.831)
4. Optimism	4.308(.794)	4.479(.777)	-2.159(0.031)*
1. Proficiency	4.391(.777)	4.170(.862)	2.669(0.008)*
2. Proficiency	4.308(.850)	3.665(1.026)	6.770(0.000)*
3. Proficiency	4.520(.725)	3.577(1.150)	9.731(0.000)*
4. Proficiency	4.592(.675)	3.970(1.038)	7.047(0.000)*
1. Dependence	2.846(1.139)	2.675(1.191)	1.451(0.148)
2. Dependence	3.061(1.160)	2.959(1.195)	856(0.393)
3. Dependence	2.797(1.205)	2.932(1.187)	-1.117(0.256)
1. Vulnerability	3.818(1.152)	3.778(1.105)	349(0.727)
2. Vulnerability	3.677(1.138)	3.696(1.108)	-.168 (0.866)
3. Vulnerability	3.626(1.136)	3.619(1.077)	069(0.945)

Grades: (*) significant difference

As observed, only one of the dimensions (proficiency) that form the TAP scale presented a significantly different result ($t_{(390)}$ = 8.566; p < 0.000). It is important to stress that, through the T-test performed for each variable of the proficiency construct, all of them presented higher averages for Computer Science students than for Business students. This result reinforces the idea that the Computer Science School respondents present more proficiency (confidence in their own capacity to easily learn and quickly use new technologies, as well as the feeling of being technologically competent) in technology adoption than the Business School respondents. Confirmations regarding other dimensions cannot be made by means of this study.

It is also important to highlight that, for each of the groups (Business and Computer Science), the Exploratory Factor Analysis and Confirmatory Factor Analysis procedures were carried out individually and did not presented differences in the range of the scale dimensions, thus supporting the data validation.

5 Final Considerations

This study sought to assess the propensity for technological product and service adoption by different consumer profiles by using the *Technology Propensity Adoption* (TAP) scale validation in the Brazilian context. It was possible to observe that the TAP scale differs from the other technology scales developed to date, because it is parsimonious, as well as presenting a flexible and broad concept of technology. This concept contributes to increasing the scale's applicability, by not restricting it to a given type of product or service, thus being able to keep track of fast evolving technology.

The exploratory and confirmatory factor analysis allowed the underlying structure of the propensity for technology adoption construct in the study to be observed with relation to Brazilian consumers. In this regard, the TAP scale, through its 14 grouped items in four constructs, was shown to be a reliable and valid measurement tool to measure Brazilian consumers' propensity for technology adoption, considering the investigated sample's limitations. It is also important to stress that the adjustment indexes of the herein validated scale were quite similar, though slightly higher than those observed in the final sample of the original scale validation.

By presenting a more timeless concept of technology, Ratchford and Barnhart (2012) have facilitated the TAP scale replication process over the years, as well as across different institutional contexts such as in developed and emerging countries, such study replications being key to the generalization of the theoretical constructs (Hunter, 2001).

In addition to confirming the TAP's validity and reliability, it was observed that the sample of this study presents a significantly higher propensity for technology adoption than the sample adopted in the study of Ratchford and Barnhart (2012). Although in this study it was not hypothesized if there would be significant differences between groups from different countries and what these differences would be, the results are not only convergent with preliminary studies that suggest potential differences between developed and emerging countries, but also strengthen the call for a better understanding of these differences between technology users (Lippert & Volkmar, 2007). Likewise, as Brazil is a country with usually late technological adoption compared to the United States, the data support the studies of Peres et al. (2010) regarding late adoption and acceptance of innovation, but also indicate a wider perception of dependence and vulnerability.

Both studies were carried out with similar samples of students (considering the final sample of the original study) and in a relatively short period of time, considering that technological barriers might undergo variations over time. Two limitations concerning the comparisons made in this study call for new research. The first one relates to the use of aggregated data information from the US study, given that collective tests could not be carried out between the bases. The second one refers to the absence of intervening cultural variables that could explain the differences perceived in behavior. Future studies, with primary data shared among developed and emerging countries, must fill the gaps to seek a better understanding of the phenomenon herein observed.

Concerning the second comparison between the groups which are the object of this study, significant differences were also observed between the Business and Computer Science course respondents, with regard to the proficiency dimension in technology adoption. These results are consistent with previously developed studies about domain-specific innovation which point out that consumers react in different ways, depending on their previous engagement or intimacy with technology in certain domains (Goldsmith, Freiden, & Eastman, 1995; Mick & Fournier, 1998; Parasuraman & Colby, 2001). Thus, people with more experience and specific knowledge in a given area tend to have a greater

capacity for innovations in that specific domain, which explains why the Computer Science students showed more proficiency in adopting new technologies.

In a context where technology has been increasingly influencing and shaping the way we consume, understanding the variables that contribute to and inhibit new technology adoption becomes a key task for companies. The increased growth of purchases made over the Internet reinforces not only a change in consumption habits, but also the increasing importance of technology in consumers' lives. Therefore, it is vital for companies to be prepared to face new challenges and to better seize the opportunities arising from the advent of new technologies.

It is also important to stress that the development of products and services that incorporate more and more sophisticated technologies requires and demands skills to effectively use them. A number of examples include: automobiles, television sets, smartphones, computers and their operating systems, home banking services, as well as the simplest household appliances, such as programmable coffeemakers. Accordingly, marketing managers need to know how to recognize that the reactions to technologies embedded in these products are susceptible to varying considerably. With this in mind, the use of an instrument capable of measuring propensity for technology adoption by Brazilian consumers may be interesting to organizations, since such a tool might contribute to a better understanding of certain consumers' skills in adopting new technologies.

The results and conclusions obtained through this research should take into account the natural limitations that surrounded this study. Firstly, as it is a cross-sectional study, covering a non-probabilistic sample, it is necessary to highlight and respect the limits to generalizing the results. Sampling limitations should also be considered, since only one sample of digital natives was used, with digital immigrant consumers not being considered for comparison, as occurred in the original study with the use of three distinct samples, including different age profiles and their potential distinctions.

With regard to suggestions for future research, considering the expressive technological diffusion in the lives of modern consumers, significant contributions would be made by further exploring the behavioral consequences of the inhibiting and encouraging factors of this study. Thus, taking into account the limitations herein indicated, some research comparing technology adoption using the TAP scale for groups in different age ranges, such as Internet natives and non-natives in Brazil, would lead us to a better understanding of how public and company policies might be used in order to minimize potential restrictions to technology for older generations. It would therefore be possible to see how to minimize possible vulnerabilities, by enhancing the optimism aspects and future proficiency that these technologies might bring.

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Notes:

[1] The article is derived from the master's dissertation "Adoção de Produtos e Serviços Tecnológicos pelo Consumidor: Uma Avaliação da Aplicabilidade da Technology Adoption Propensity no Contexto", Graduate Program in Business, Business School, PUCRS, Porto Alegre, RS, Brazil.

[2] A preliminary paper, with a distinct emphasis only on scale validation, was presented at the ENANPAD 2016.

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2. Development of hypotheses or research questions (empirical studies)	√	√	√
3. Development of theoretical propositions (theoretical work)			
4. Theoretical foundation/ Literature review	√	√	√
5. Definition of methodological procedures	√	√	
6. Data collection		√	
7. Statistical analysis	√		√
8. Analysis and interpretation of data	√		√
9. Critical revision of the manuscript	√	√	√
10. Manuscript writing	√	√	√