Determinants of continuance intention to use mobile self-scanning applications in retail

Abstract

Purpose: Retailers are increasingly using self-service technologies to improve customer experience and reduce costs. The purpose of this study is to identify factors that could explain the level of continuance intention of mobile self-scanning applications in retail. Based on previous theoretical streams, the present study integrates technology readiness (TR) and service quality into the technology acceptance model (TAM).

Design/methodology/approach: Using data collected through an online survey of 217 users of a mobile self-scanning application of a large supermarket chain operating in Portugal, the study uses partial least squares structural equation modeling to test the proposed hypotheses.

Findings: The results indicate that the continuance usage of the self-scanning Apps is directly driven by users' satisfaction, and perceived usefulness. Findings also show that technology readiness has a positive and significant impact on ease of use and perceived usefulness. Ease of use has a positive impact on users' satisfaction and perceived usefulness but has no direct effect on the continuance intention to use the application. Perceived quality has a positive direct effect on satisfaction, and a positive indirect effect on continuance intention. Finally, need for interaction has a negative effect on technological readiness.

Originality: This work contributes to a better understanding of the emerging market for mobile self-scanning applications in retail applications, particularly relevant in a digital transition context.

Keywords: Mobile self-scanning technology; technology acceptance model; perceived quality; satisfaction; continuance intention; technology readiness

Paper Type: Quality Paper

1. INTRODUCTION

Given the increasingly competitive nature of the retail market, innovation should not only be understood as a necessity for commercial success and profitability in the sector, but also decisive for survival and long-term sustainability (Bulmer *et al*., 2018). The impact of these

innovations has been most pronounced in services, where there have been major transformations in business processes and changes in the way services are designed, developed, and delivered (Dabholkar and Bagozzi, 2002; Meuter *et al*., 2005; Roy *et al*., 2018).

Customers are increasingly demanding, have more information to make their own decisions about which products/services to consume and want their needs to be met immediately (Bhattacherjee, 2001a; Grewal *et al*., 2017). Thus, to improve satisfaction and provide unique and innovative service experiences tailored to customer needs, retailers are increasingly adopting a variety of self-service technologies (Curran *et al*., 2003; Grewal *et al.,* 2017; Orel and Kara, 2014; Parasuraman and Colby, 2015; Roy *et al*., 2018*).* Artificial intelligence, *self-scanning* technologies, the use of smartphones and geofencing are examples of the latest retail innovations (Grewal *et al.,* 2017).

Recent years have shown rapid growth in the use of applications in the retail, financial and travel sectors demonstrating an increasing reliance on mobile devices in various areas of daily life, suggesting that we are now in the "App Age″ (Fang, 2019). According to Leon (2018), the use of smartphone applications has changed consumers' lives, and the way they communicate and interact with retailers (Grewal *et al*., 2017; Orel and Kara, 2014). Thus, applications have enormous potential in the business world (Natarajan *et al*., 2017).

The introduction of self-scanning technologies allows customers, in their purchasing process, to register their products with their smartphone and, in the end, pay with the retailer's application, without interacting with a service provider (Grewal *et al*., 2017). Customers gain time, control and faster responses, and retailers enjoy greater efficiency, reduced labor costs, greater interaction, and proximity to customers (Dabholkar *et al*., 2003; Grewal *et al*., 2017; Roy *et al*., 2018; Walker and Johnson, 2006).

Drawing on the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975), this study builds on the Technology Acceptance Model (TAM) that "explains perceived usefulness and usage intentions in terms of social influence and cognitive instrumental processes" (Venkatesh and Davis, 2000, p. 186). A variety of theoretical models have been applied to understand the new information system/information technology (IS/IT) adoption and use. Among these, TAM is the most widely used and has been shown to be highly predictive (Davis *et al*., 1989; Venkatesh & Morris, 2000), particularly regarding the consumers' adoption and use of IS/IT technology (Koufaris, 2002). As originally proposed by Davis (1989), TAM posits that individuals' behavioral intention to use a new IS/IT technology is determined by perceived usefulness and perceived ease of use. focused on the role of usefulness and ease of use in predicting attitudes and intentions to use new IS/IT technology. Although the recognized

importance of TAM, several studies recognize the need to expand it (e.g., Lin *et al*., 2007; Venkatesh and Bala, 2000; Venkatesh and Davis, 2000). In e-service contexts, service cannot be created apart from customers' active participation (Lovelock and Wirtz, 2004). Due to the necessary high involvement of customers to co-produce the service, TAM applied in marketing settings may not sufficiently explain consumers' technology adoption behaviors (Park, Ha and Jeong, 2020). Therefore, a model incorporating some individual difference variables is a necessary first step toward identifying and qualifying the psychological processes of the perceptions of a technology's value. One expansion of TAM is proposed by Lin et al. (2007) by integrating the individual consumer differences in the figure of Technology Readiness (TR), resulting in the Technology Readiness and Acceptance Model (TRAM). Although this expansion, the TRAM model does not include perceived quality which is relatively important in predicting the intention to use or continue using a technology (c.f. Xu, Benbasat, and Cenfetelli, 2013).

Against this framework, the aim of this study is to understand which factors influence continuance intention of mobile self-scanning applications in retail. By adopting the factors considered in the TAM approach, our model includes perceived usefulness and perceived ease of use. The proposed research model also integrates perceived quality which is an important but underexplored predictor of IS/IT usage satisfaction (Zhao, et al., 2012; Xu, et al., 2013). Furthermore, we also include in the proposed conceptual model the effect of TR on perceived usefulness and perceived ease of use, following the expansion of the TAM towards the TRAM model. To provide a more integrative model to explain continuance intention, we incorporated the need for interaction in the model following the suggestion of Lee et al. (2010) regarding the use of consumer traits in the research regarding intention to use retail self-checkouts.

This study fills a gap in the literature to the extent that, although there are several studies that address the determinants of adoption of mobile applications (Jin, 2019; Leon, 2018), the factors affecting satisfaction (e.g., Iyer *et al*., 2018; Wang *et al*., 2019a) and the intention to continue using applications (e.g., Cho, 2016; Fang, 2019; Kim *et al*., 2016; Weng *et al*., 2017), there are, to the best of the authors' knowledge, no study that examines the effects of the above mentioned factors on the intention to continue using mobile self-scanning applications. In addition, few studies analyze the effect of the need for interaction on TR in the context of self-service. This work thus contributes to a better understanding of the emerging market of retail applications.

The paper proceeds as follows. The next section presents a review of the extant literature and the framework and hypotheses of the study. The methodology and data source for empirically

testing the hypotheses are addressed in section three. We then present the analysis and discussion of the results. The last section presents the conclusions, limitations and directions for future research.

2. LITERATURE REVIEW

2.1. Technology acceptance model

In recent years, several studies have been conducted to understand the factors that lead consumers to adopt new technologies (Dabholkar *et al*., 2003; Ferreira *et al*., 2014; Jin, 2013; Jin, 2019; Liljander et *al.,* 2006; Mukerjee *et al*., 2019; Natarajan *et al*., *2017;* Wang *et al*., 2003). Among several models that have been proposed, the *Technology Acceptance Model* (TAM) has been the most cited and empirically replicated (Lin, Shih & Sher, 2007).

The Technology Acceptance Model (TAM) emerged as a model that predicted and explained the adoption of information technologies in the workplace (Davis, 1989; Davis *et al*., 1989). TAM proposes that the user's acceptance of a new technology is determined by its intention to use it, which in turn is influenced by perceived usefulness and ease of use (Agrebi and Jallais, 2015; Davis, 1989; Lin *et al.,* 2007). Perceived usefulness is defined as the "degree to which a person believes that the use of a particular system would improve his or her performance at work" (Davis, 1989; p. 985). Ease of use affects the behavior of users of technology, directly and indirectly, through perceived usefulness (Lin *et al*., 2007), and is defined by Davis (1989; p. 985) as the "degree to which a person believes that the use of a specific system would be effortless".

2.2 Technology Readiness Index and Technology Readiness and Acceptance Model

According to Parasuraman (2000; p. 308), Technology Readiness (*TR*) refers to "propensity to adopt and use new technologies to achieve goals in home life and at work". As conceived by the author, the TR represents a mental state resulting from a set of motivators and inhibitors, and the balance between them determines a person's predisposition to accept or reject new technologies. It is thus an individual characteristic, which regardless of the technology does not change in the short term (Parasuraman and Colby, 2015; Roy *et al.,* 2018). Parasuraman (2000) suggests four dimensions to measure TR: optimism, innovation, discomfort and insecurity.

Optimism relates to a positive view of technology and the belief that technology offers greater control, flexibility and efficiency, while innovation refers to the tendency to be a pioneer in the adoption of technology and a leader in technological thinking. Discomfort consists of a lack of control over technology and a feeling of being dominated by it. Insecurity measures distrust of technology and skepticism about its ability to function properly.

Optimism and innovation are considered determinants in increasing an individual's propensity to adopt a new technology, while insecurity and discomfort act as inhibitors resisting the acceptance of new technologies (Parasuraman. 2000; Roy *et al.,* 2018). That is, an individual with a higher degree of optimism and innovation, and a lower degree of discomfort and insecurity is more likely to use a new technology. Although the TR reflects a person's predisposition to use a particular technology, it does not indicate his or her competence to use it (Mukerjee *et al*., 2019).

Lin *et al*. (2007) noted that TAM model in marketing environments, where adoption is not mandatory, was not sufficient to explain consumer technology adoption behavior. Thus, the authors added to the model the Technology Readiness (TR), to integrate individual consumer differences, giving rise to the Technology Readiness and Acceptance Model (TRAM).

TRAM has been used to explain the adoption of new technologies, such as online stock trading systems (Lin *et al*., 2007); self-service technologies (Elliott *et al*., 2012; Lin and Chang, 2011); social networking websites (Jin, 2013); use of e-books (Ferreira *et al*., 2014)*;* airline applications (Jin, 2019); self-checkout services with a supermarket application (Mukerjee *et al*., 2019).

2.3 Conceptual model and hypotheses

According to the study by Mukerjee *et al.* (2019), individuals with a higher level of optimism and innovation more easily adopt self-checkout services through mobile applications and therefore find it easier to use them (Leon, 2018; Weijters *et al.*, 2007). Also, if the individual understands how much easier it is to use a self-service technology, he or she will better understand its usefulness (Lin and Chang, 2011). Lin *et al.* (2007) found a positive and significant relationship between TR and ease of use, and TR and perceived usefulness in the context of online stock trading systems. Similar results were found in other studies conducted in different contexts, such self-service technologies (Elliott et *al.,* 2012), and use of e-books (Ferreira *et al*., 2014). Other studies conducted in the context of new technologies in retail fund a positive relationship between TR and ease of use (e.g., Mukerjee *et al.,* 2019; Roy *et al*.,

2018). In accordance with the above, the following hypotheses are proposed:

H1a: Consumers' technology readiness has a positive effect on perceived of ease of use
H1b: Consumers' technology readiness has a positive effect on perceived usefulness

Prior studies divide the concept of satisfaction into two perspectives, the cumulative perspective and the transaction-specific perspective (e.g., Boulding *et al*., 1993; Wang *et al.*, 2019a). The cumulative perspective indicates that customer satisfaction is developed based on the assessment of all their interactions with a specific service provider. The transaction-specific perspective refers to the level of satisfaction with a specific transaction. According to Kotler and Armstrong (1996), quoted by Orel and Kara (2014), satisfaction is the result of a level defined by the customer, which results from a comparison of the performance of a product/service with its expectations. This means that satisfaction is achieved only after the use of the product/service and to measure the impact of using a service on satisfaction, it is essential to measure the entire customer experience cycle (Baabdullah *et al.*, 2019). In other words, satisfaction is defined as a process of assessing consumers, where they analyze previous services and decide whether to continue using the service (Bhattacherjee, 2001a). Amoroso and Lim (2017) reinforces that satisfaction is a state in which consumers feel satisfied, neutral or dissatisfied when they compare their initial expectations with actual experience.

Regarding the impact of ease of use on satisfaction, studies such as Cho (2016) show that there is a positive relationship between these two variables. Agrebi and Jallais (2015) state that easy-to-use and enjoyable websites and applications increase user satisfaction. This is in line with the results obtained by Singh and Kaur (2013) which show that ease of use was the variable with the most significant positive impact on user satisfaction of the technology. In the context of using mobile internet services, Thong *et al.* (2006) also found a positive and significant relationship between ease of use and satisfaction. In the light of the above, the following hypothesis is formulated:

H2a: Perceived ease of use has a positive effect on satisfaction.

Initial acceptance of the technology is an important factor in its success, but its long-term viability is determined by the decision to continue using it after the first use (Bhattacherjee, 2001b). Thus, continuance intention is an important variable because the acquisition of a new customer has a higher unit cost than the unit cost of retaining an existing one (Bhattacherjee,

2001b; Wang *et al*., 2019a).

For Amoroso and Lim (2017) continuance intention is a rational attitude, as users of the technology make the decision to continue using it based on perceived usefulness, ease of use and expectations of experience. But continuance intention is also influenced by the affective part, including satisfaction, emotion and cognitive absorption (Amoroso and Lim, 2017; Bhattacherjee, 2001b; Hsiao et *al.,* 2016; Natarajan et *al.,* 2017). Continuance intention emerges as loyalty and is defined as a standard behavior of clients when they repeatedly use technology and do not switch to another identical service over time (Baabdullah *et al*., 2019). Lee *et al*., (2001) reported that continuance intention refers to the intention to repurchase and greater resistance to switching to another product/service from a competitor, as well as the willingness to recommend the product/service to others.

According to Wiese and Humbani (2019), after the first experience of using an application, ease of use will determine users' attitudes towards the application. The authors also conclude that because they are user-friendly applications, users want to continue using them. According to the study developed by Choi *et al.* (2019) in the context of travel applications, ease of use was one of the main determinants for users to continue using the application. The relationship between these two variables was further corroborated in several studies developed in different contexts: use of mobile internet with a mobile phone (Thong *et al*., 2006); health-related applications (Cho, 2016); travel applications (Kumar *et al*., 2018); internet banking (Rahi *et al*., 2020). Thus, the following hypothesis is proposed:

H2b: Perceived ease of use has a positive effect on continuance intention.

According to Davis (1989), when individuals adopt a new product or service, ease of use increases and they are more likely to perceive its usefulness (Lin and Chang, 2011). According to Leon (2018), ease of use positively influences perceived usefulness. A study developed in the context of ride sharing applications supports the evidence that if the software is easy to understand and use, it will influence the perceived usefulness (Weng *et al.,* 2017). Similar results were found in studies related to the use of mobile internet with a mobile phone (Thong *et al.,* 2006); online stock trading systems (Lin *et al*, 2007); self-service technologies (Lin and Chang, 2011); use of mobile phone website*s* for shopping (Agrebi and Jallais, 2015); mobile retail shopping applications (Natarajan *et al*., 2017); new technologies in the retail context (Roy *et al*., 2018); self-checkout services with a supermarket application (Mukerjee *et al*., 2019); mobile payment services (Lee *et al*., 2019); internet banking (Rahi *et al*., 2020). Thus, the

following hypothesis is suggested:

H2c: Perceived ease of use has a positive effect on perceived usefulness.

Perceived usefulness is an important antecedent of satisfaction (Choi *et al.*, 2019). In the context of internet banking, Rahi *et al*. (2020) found a strong relationship between perceived usefulness and satisfaction. Several studies developed in different contexts reinforce this positive relationship: on shopping applications for mobile devices (Natarajan *et al.,* 2017), online banking (Bhattacherjee, 2001b), use of mobile internet with a mobile phone (Thong *et al*., 2006), use of mobile websites for shopping (Agrebi and Jallais, 2015), and mobile based payments in COVID-19 context (Sreelakshmi and Prathap, 2020). Contradicting this studies, Cho (2016) found a not significant relationship between perceived usefulness and satisfaction. Formally, we proposed the following hypothesis:

H3a: Perceived usefulness has a positive effect on satisfaction.

According to Kim *et al*. (2015) and Lee (2018), applications only impact the relationship with customers when they are willing to continuously use the mobile application. Wang *et al.* (2019a) consider that the continuance intention is an important variable as it influences the success of applications. The authors also state that if the quality of the application is high, users are less likely to seek other alternatives. On the other hand, as the storage space for smartphones is limited, users consider whether the use of the application meets their needs and is worth continuing to use it. But satisfaction is not the only variable that positively affects the continuance intention to use a product/service (Hsiao *et al*., 2016; Kumar *et al*., 2018; Lee, 2018).

Wiese and Humbani (2019) concluded that users find mobile payment applications useful and therefore intend to continue using them. In the context of social applications, Hsiao *et al.* (2016) found a no significant relationship between perceived usefulness and continuance intention. However, several studies conducted in different contexts have shown a positive and significant relationship between the perceived usefulness of a technology and the intention to continue using it, for example in the context of online banking (Bhattacherjee, 2001b); health applications (Cho, 2016); taxi applications (Weng *et al*., 2017); travel applications (Choi *et al.,* 2019; Kumar *et al*., 2018); internet banking (Rahi *et al*., 2020). Therefore, the following hypothesis is suggested in this study:

H3b: Perceived usefulness has a positive effect on continuance intention

With the increased use of smartphones and high-speed internet, companies are increasingly focusing on marketing strategies and sales through mobile devices (Natarajan *et al*., 2017). But by making large investments in e-commerce, they need to be constantly evaluating the success of the systems (DeLone and McLean, 2004).

To evaluate the performance of Information Systems (IS), DeLone and McLean (1992) created a multidimensional model with interdependencies between six dimensions with measures of IS success: quality of the system, quality of information, use, user satisfaction, individual impacts and organizational impacts. The six dimensions proved to be sufficient, but due to the growth of e-commerce it was necessary to update the model (Wang, 2008). Thus, DeLone and McLean (2004) proposed an updated model with two new dimensions: quality of service, to reflect the importance of service in IS; and net benefits, where they grouped individual impact and organizational impact measures into a single dimension.

In this study we measure perceived quality using three dimensions, namely, information quality, system quality, and service quality, as these are widely used in the context of Apps and Websites (Wang *et al*., 2019a).

With regard to satisfaction, in their study on social applications, Hsiao *et al.* (2016) define customer satisfaction as the perception of total consumption when using social applications. Agrebi and Jallais (2015) define satisfaction as the emotional and/or cognitive response after the use of the application. When users, in the context of applications, perceive that the quality of service is high, they are willing to develop a higher level of satisfaction (Wang *et al*., 2019a). According to Iyer *et al*. (2018), the hedonic value associated with the use of an application influences customer satisfaction. The same authors also state that if, after using the application, the customer has a negative perception about the functional value of the application, this may not only reduce his satisfaction with the application, but also reduce the satisfaction with the retailer himself.

Wang (2008) and Wang *et al.* (2019b) state that the perceived quality of an e-commerce system include three dimensions, namely, information quality, system quality and service quality. The DeLone and McLean model, used by several authors, proposes that information quality, system quality and service quality positively influence satisfaction (Delone and Mclean, 2004; Wang, 2008; Wang *et al.,* 2019b). In the context of a mobile catering app, Wang *et al.* (2019b) found a positive significant effect of system quality and service quality on satisfaction, while the effect of information quality was not significant. Other empirical studies

have shown a positive and significant effect of information quality (e.g., Delone and Mclean, 1992; Filieri *et al.,* 2017; Wang, 2008), system quality (Delone and Mclean, 1992; Filieri *et al*., *2017;* Kim *et al*., 2015*;* Lin *et al*. 2015; Lin *et al.,* 2014; Wang, 2008), and service quality (Lin and Hsieh, 2006; Orel and Kara, 2014; Wang, 2008) on satisfaction. Thus, we present the following hypothesis:

H4a: Perceived quality has a positive effect on satisfaction.

In the context self-checkout services in a supermarket, Orel and Kara (2014) found a non-significant relationship between service quality and loyalty. On the other hand, a study developed by Hu *et al.* (2009) in the context of an electronic government (eGovernment) service (eTax) showed that service quality has a positive and significant effect on continuance intention. This positive relationship was also found by Kallweit *et al.* (2014) on self-service information technologies in retail. Accordingly, the following hypothesis is suggested:

H4b: Perceived quality has a positive effect on continuance intention.

The interaction between customer and service provider during the service delivery process plays an important role in determining the level of customer satisfaction (Wang *et al*., 2019a). According to DeLone and McLean (2003), satisfaction is an important means of measuring customers' views on the services provided. And, increasing satisfaction with a product/service can lead to inertia, regardless of the presence of better alternatives, which results in the intention to continue using the product/service as a cognitive behavioural response (Amoroso and Lim, 2017; Bhattacherjee, 2001a; DeLone and McLean, 2003; Hsiao *et al.*, 2016; Orel and Kara, 2014; Wang *et al.*, 2019a). Thus, satisfaction is an important variable in that it is the key to promoting and maintaining a loyal relationship with clients over the long term (Bhattacherjee, 2001b; Hsiao *et al*., 2016).

According to Wang *et al.* (2019a), satisfaction is one of the main factors influencing the intended continuity of users of mobile communication applications. A recent study conducted by Wang *et al.* (2019b) found that user's satisfaction positively influences user's intention to continue using catering apps to order meals. Similar results were found in studies conducted in the context of online banking (Bhattacherjee, 2001b); health applications (Cho, 2016); social networking websites, Facebook (Lin *et al.*, 2014); self-checkout services in a supermarket (Orel and Kara, 2014); smartphone users (Kim *et al.,* 2015); augmented reality applications for

smartphones (Kim *et al.,* 2016); social applications (Hsiao et *al.*, 2016); mobile-based applications (Amoroso and Lim, 2017); taxi applications (Weng *et al.,* 2017); bank applications (Baabdullah *et al.,* 2019). Thus, the following hypothesis is proposed:

H5: Satisfaction has a positive effect on continuance intention

According to Walker and Johnson (2006), the need for interaction is defined as a need or desire for personal interaction, which can influence behavior regardless of what is believed. The authors also point out that the user may recognize the advantages of using the technology, but still decide not to use it because they prefer to have personal contact with the employee providing the service. A greater need for interaction with the employee may lead to a reduction in motivation to try out self-service technologies and less interest in learning how they work (Dabholkar, 1996).

Consumers may consider self-scanning to be reliable, but still prefer to use the traditional box to interact with an employee (Dabholkar *et al*., 2003). In the Parasuraman and Colby (2015) study, respondents noted that technology has a dehumanizing effect, which diminishes the quality of personal relationships. As such, the use of self-service technologies can be uninteresting for some consumers (Curran and Meuter, 2005), so the greater the need for personal contact to obtain a service, the less use of self-service technologies (Walker and Johnson, 2006). On the other hand, Meuter *et al.* (2000) report that some consumers choose to use self-service technologies to avoid contact with employees. Thus, the following hypothesis is presented:

H6: Need for interaction has a negative effect on consumers' technology readiness

3. METHODOLOGY

3.1 Data collection

The target population of this study are users of the App Auchan (*formerly* App Jumbo), a mobile self-scanning application of a supermarket retail chain in Portugal. The application is used in the registration of products throughout the shopping process and, at the end, payment for purchases is made, without removing the products from the cart, at a specific cashier and without queues for the users of the application. Due confidentiality issues it was not possible to obtain a sampling frame for the target population. Thus, following prior studies (e.g., Chen, Chen, and Chen, 2009; Lin and Hsieh, 2006; Mukerjee et al., 2019) a non-probability

convenience sampling was used in this study. Furthermore, data was collected through a web-based the link of the online survey was available on social networks and on the website of the supermarket retail chain and App Auchan' users. The use of this sampling procedure was deemed appropriate for this study for the following reasons. First, this study requires that the sample have had prior usage experience with the mobile self-scanning application (i.e., App Auchan). A filter questions was included in the questionnaire requiring that participants had used the App Auchan at a retail store in the past three months. Given that a web-based sample is likely to be familiar with technology-driven services (e.g., internet, SST, mobile applications) (Lee et al., 2010), participants tend to have adequate experience to mobile self-scanning applications. Thus, a web-based sample makes it possible to include more participants who meet the inclusion criteria defined in this study. Second, the web-based survey also allows a wider geographical reach (Ilieva et al., 2002) which prevents the sample being composed of consumers of the same supermarket store or supermarket stores from the same region (Lee et al., 2010; Meuter, Ostrom, Bitner, & Roundtree, 2003).The link of the online survey was available between May and July 2019 on social networks and on the website of the supermarket retail chain. The online survey obtains a sample of 217 users of the App Auchan.

The survey was initially developed using existing measures. Then, before putting the survey online for data collection, a two-step approach for reviewing and revising the survey was followed. First, two academic experts in Marketing and two in Quality Management were consulted to access content validity of the scales. After that, the survey was pre-tested with users of App Jumbo. Based on the feedback and comments from both users of App jumbo and academic experts the survey was revised.

Table I presents information about sample characteristics. In the final sample, 70.0% of respondents are female, and 44.7% are between the ages of 35 and 44, and 39.6% have a higher education degree. Regarding the frequency of grocery shopping, 48.8% of the respondents shop 2 or 3 times a week**.** In what concerns earnings, 82% of individuals have a net monthly income up to €2000. The main reasons for using App Jumbo identified by the respondents are not having to wait in line to pay and be able to shop faster.

Insert Table I about here

3.2 Measures

In the present study, the scales used to measure each construct were adopted from the literature. To increase reliability and reduce measurement error (Churchill 1979; Hulland, 1999) we used multi-item scales. All constructs were measured using five-point Likert scales anchored by one (strongly disagree) and five (strongly agree). Technology Readiness was measured using 16 items, namely: optimism (4 items), innovation (4 items), discomfort (4 items) and insecurity (4 items). All items were adopted from Parasuraman and Colby (2015) after obtaining permission from Professor Parasuraman and Rockbridge Associates. As suggested by the authors of the scale TR was calculated as the average of the four dimensions, above mentioned. For the average calculation, the discomfort and insecurity dimensions were re-coded by subtracting the value indicated in each item by the respondent from 6.

The five items used to measure perceived ease of use were adapted from Thong *et al.* (2006) and Weijters *et al*. (2007). Perceived usefulness was measured using five items adapted from Hsiao *et al.* (2016) and Weijters *et al.* (2007).

Satisfaction and continuance intention were measured using six items and four items, respectively, adapted from Wang *et al*. (2019a) and Hsiao *et al.* (2016).

Perceived quality was operationalized as a second-order factor that consisted of three first-order factors: information quality, measured by four items; system quality, measured by four items; and service quality, measured by three items. All items were adapted from Baabdullah *et al.* (2019). Four items adapted from Dabholkar (1996) and Walker and Johnson (2006) were used to measure need for interaction. To ensure the robustness of findings, this study included three control variables More specifically, we used the demographic variables age, gender, and income as control variables as in recent studies (e.g., Kumar et al., 2021; Kumar and Shah, 2021). The use of these control variables reduced the extraneous effects which might affect the direction and intensity of the structural coefficients.

3.3. Common method bias

This study followed some of the procedural remedies suggested by Podasakoff et al. (2003) to safeguard against common method bias, namely: we protected respondents' anonymity to reduce evaluation apprehension; we created simple, specific and concise items; respondents were not aware of our conceptual model; the dependent variables were placed after the independent variables in the survey. To assess the impact of common method bias we performed the Harman's (1967) single-factor test. The results showed that no single factor emerged from

a factor analysis of all survey items. The non-rotated solution EFA analysis produced five factors with eigenvalues greater than 1.0 that accounted for 76% of the total variance. The first factor only account for 36.7% of the variance.

4. RESULTS AND DISCUSSION

In line with previous studies (e.g., Rahi *et al*., 2020), the conceptual model was tested using a variable-based structural equation modelling technique, more specifically, Partial Least Squares (PLS). The analysis was conducted using Smart PLS 3.0 software (Ringle *et al*., 2015). This technique is considered a good methodological alternative to co-variance based structural equation modelling when the model is complex, and data do not follow a Normal distribution (Hair *et al*., 2017). Moreover, it provides similar parameter accuracy when used with sample sizes below 250 (Reinartz *et al*., 2009), as in the case of this study.

The empirical model was analyzed and interpreted following the suggested two-stage analytical approach (Hulland, 1999). First, we analyze the measurement model, which assesses the reliability and validity of the scales, and then we analyze the structural model which includes testing the hypothesized relationship. To evaluate the significance of the path coefficient and loadings, a boostrapping procedure using 5000 subsamples was employed (Hair *et al*., 2017).

4. 1. Measurement model

To evaluate the measurement model, we analyzed the reliability and validity of the scales (Bagozzi and Yi, 1988; Fornell and Larcker, 1981).

The reliability of individual indicators was assessed by analysing the standardized factor loadings and their *t* statistic. As shown in Table II, all standardized factor loadings are above 0.7 and are all significant at $p < 0.001$, which provides evidence of individual indicator reliability (Hair *et al*., 2017).

We examined convergent validity and internal consistency reliability of the scales by means of average variance extracted (AVE), composite reliabilities (CRs), and Cronbach's alpha (CA). The CR, CA, and AVE values for all constructs are presented in Table II. All CR and CA values surpassed the cutoff of 0.7 (Fornell and Larcker, 1981), and all AVE values exceeded the threshold of 0.5 (Bagozzi and Yi, 1988). These results support construct reliability and convergent validity**.**

Insert Table II about here

The Fornell-Larcker and heterotrait-monotrait ratio (HTMT) criteria were used to assess discriminant validity (Hair *et al*., 2017; Fornell and Larcker, 1981). The first criterion compares the square root of the AVE (shown on the diagonal with bold values in Table III) of each construct with the correlation between the construct and any other construct (Fornell and Larcker, 1981). The results presented in Table III show that this criterion is satisfied for all constructs, indicating discriminant validity. The heterotrait-monotrait ratio (HTMT) criterion was also safisfied since all HTMT ratios (See Table IV) are below 0.9 (Hair *et al*., 2017; Henseler *et al*., 2015). These results provide additional evidence of discriminant validity.

Insert Table III about here

Insert Table IV about here

4.2. Structural model

The structural model assessment includes evaluating the sign, magnitude, and significance of the structural path coefficients, the variance explained (R^2), the predictive relevance (Q^2), and the effect sizes (f^2) (Hair *et al*., 2017). Before evaluating the structural model, we checked for collinearity (Hair *et al*., 2017). The VIF values ranged from 1.00 to 3.3, which was below the indicative critical value of 5 (Hair *et al*., 2017).

Henseler et al. (2014) suggest the use of the standardized root mean square residual (SRMR) for model fit testing in PLS-SEM. The SRMR of our model is 0.071, which is lower than the conservative cut-off value of 0.08 (Hair *et al*., 2017).

Henseler et al. [82] suggest that standardized root mean square residual (SRMR) is a goodness-of-fit measure for PLS-SEM. The index of SRMR assesses the average magnitude of the discrepancies between observed and expected correlations as an absolute measure of the model fit criterion [82]. The fit index of our model is 0.049, which is lower than the cut-off value of 0.08 [83]. Thus, the quality of the structural model is assured, and the path coefficients can be used in further analysis.

4.2.1. Hypothesis testing and discussion

Table V summarizes the result of hypothesis testing. Hypotheses H1a and H1b postulates that technology readiness positively influences perceived ease of use and perceived usefulness. Both hypotheses were supported with $\beta = 0.369$ ($p < 0.001$) and ($\beta = 0.245$; $p < 0.01$). These findings are in consistent with Elliott *et al*. (2012), Ferreira *et al.* (2014), and Lin *et al*. (2007) who also found that consumers have a positive attitude towards using self-service technologies, new technologies, and online stock trading systems when they perceived that they are useful and easier to use.

Hypotheses H2a, H2b; and H2c predict a positive effect of perceived ease of use on satisfaction, continuance intention, and perceived usefulness, respectively. The results show a strong positive effect of perceived ease of use on satisfaction ($\beta = 0.407$; $p < 0.001$), and on perceived usefulness ($\beta = 0.525$; $p < 0.001$), thus supporting H2a and H2c. The ease of use and satisfaction positive link has been validated by prior studies such as Agrebi and Jallais (2016) and Cho (2016). Similarly, the positive effect of perceived ease of use on perceived usefulness corroborates the results of prior studies such as Roy *et al.* (2018), Mukerjee *et al.* (2019) Lee *et al*. (2019), and Rahi *et al*. (2020). Hypothesis H2b was not supported ($\beta = 0.065$; not significant). This result contradicts prior studies that sustains a positive impact of perceived ease of use on continuance intention (e.g., Thong *et al.,* 2006; Cho, 2016; Choi *et al.,* 2019).

Insert Table V about here

The postulated positive effects of perceived usefulness on satisfaction (H3a) and on continuance intention (H3b) were both strongly supported with ($\beta = 0.292$; $p < 0.001$) and ($\beta = 0.238$; $p < 0.001$), respectively. The positive strong relationship between perceived usefulness and satisfaction corroborates recent studies such as Rahi *et al*. (2020), Sreelakshmi and Prathap (2020) in internet banking context and mobile based payments in COVID-19 context, respectively. Choi *et al.* (2019) show that users of travel applications are not only concerned with the affective (emotional, social) nature of the apps but also with the functional part, the perceived usefulness. In contrast, other studies (e.g., Cho, 2016) failed to establish this relationship. However, the meta-analysis study of Ambalov (2018) substantiates our findings. The positive relationship between perceived usefulness and continuance intention found in this study are in line with several previous studies developed in different contexts such as mobile taxi application (Weng et al., 2017), online stock trading systems (Li *et al*., 2007), internet banking (Rahi *et al*., 2020), mobile based payments in COVID-19 context (Sreelakshmi and Prathap, (2020), and mobile internet services (Thong *et al.,* 2006).

Hypothesis H4a which predicts a positive effect of perceived quality on satisfaction, was supported with ($\beta = 0.264$; $p < 0.001$). This result is in line with Wang (2008), which conclude that information quality, service quality, and the system quality have a positive and significant impact on satisfaction. On the other hand, Wang *et al.* (2019b) found that out of these three perceive quality dimensions only system quality has a significant effect on satisfaction.

In contrast, the postulated positive effect of perceived quality on continuance intention (H4b) was not supported ($\beta = - 0.013$; n.s.). This result is in line with the results of the study by Orel and Kara (2014), where the authors found that perceived quality did not have a significant effect on the intention to continue using a self-checkout service in a supermarket. However, other studies developed in different contexts such as electronic government (eGovernment) services (eTax) (Hu *et al.*, 2009) and self-service information technologies in retail (Kallweit *et al*., 2014) found a positive relationship between service quality and continuance intention. These contradicting results can suggest the existence of an indirect effect. Thus, we tested if perceived quality indirectly influences continuance intention through satisfaction. The results show a positive significant indirect effect with ($\beta = 0.178$; $p < 0.01$).

The satisfaction and continuance intention positive relationship postulated in hypothesis H5, was strongly supported with ($\beta=0.584$; $p < 0.001$). This strong effect of satisfaction on continuance intention has been validated in several prior studies such as Wang *et al.* (2019a), Wang *et al.* (2019b), Weng *et al.* (2017), Rahi *et al*. (2020), and Sreelakshmi and Prathap (2020).

Finally, hypothesis H6, which proposes that the need for interaction has a negative effect on technology readiness, was strongly supported with (β = -0.511; $p < 0.001$). This result corroborates the perspective of Walker and Johnson (2006) that customers prefer personal contact rather than using the bank's app. This preference is particularly relevant when costumers have a problem to solve or when they wish to complain because they want the resolution to be immediate and therefore prefer personal contact.

The results also showed that the effects of the control variables gender, age, and income on the continuance usage intention were not significant (See Table IV). These findings are in coherence with previous studies on usage of mobile Apps (e.g., Kumar and Shah, 2021).

4.2.2. Evaluating explained variance (R^2*), predictive relevance (*Q^2*), and effect sizes (*f^2*)*

Table VI shows the explained variance (R^2), predictive relevance (Q^2), and effect sizes (f^2) of the structural model. The explained variance (R^2) of each endogenous variable must be equal to or greater than 10% (Falk and Miller, 1992). In this study, the minimum value obtained was 13.6% for the perceived ease of use and the maximum value obtained was 69.8% for satisfaction. The model explained 66.7% variance in continuance intention to use App Jumbo. This study uses the f^2 statistics to evaluate the relative impact of a predictor variable on endogenous variables (Cohen, 1988). As stated by Rahi (2017 a, b), in addition to statistical significance (*p-value*) it is important to report also the substantive significance (f^2), since the *p-value* shows whether an effect exist but does not evaluate the size of it. Thus, this study also reports the effect sizes (see Table VI). According to Cohen (1988), f^2 values of 0.02, 0.15, and 0.35 are considered small, medium, and substantial effect sizes, respectively. As shown in table VI, the current study found substantial effect sizes for NI-TR (0.354) and PEOU-PU (0.417), and medium effect sizes for SA-CI (0.312), PEOU-SA(0.315), and TR- PEOU (0.158).

A blindfolding procedure with an omission distance of 9 was applied to determine the Q^2 values (Hair *et al*., 2017). As can be shown in Table VI, the Q^2 values obtained for all endogenous constructs (were well above zero, indicating the predictive relevance of the model.

5. CONCLUSIONS

5.1. Theoretical contributions

This study aims to enrich the current understanding of the continued use of mobile self-scanning applications in retail. To achieve this, a research model that integrates TAM model, TR,

perceived quality of mobile services, and need for interaction was developed. Empirical testing of the research model found the model to be strongly supported, with most of the paths (nine out of eleven) significant. Moreover, the results show that the proposed model explained 66.1% of the variance in continuance intention.

This study contributes to the IS/IT usage intention literature in several aspects. First, by highlighting the importance of both individual-specific constructs such as technology readiness and need for interaction as well as system-specific constructs such as ease of use and usefulness on the continued use of mobile self-scanning. Second, the findings showed that consumers' technology readiness propensities strongly influence their perceptions of ease of use and usefulness about a mobile self-scanning application, while their need for interaction negatively influence their technology readiness propensity, thus expanding the TAM and TRAM approaches. Third, the theoretical is also related to studying these models in mobile self-scanning applications in retail. To our best knowledge, these models have never been applied in this context and aligns with previous research providing empirical testing in other technological solutions (e.g., Etemad-Sajadi, 2014 in virtual agents or Rahi, Khan, and Alghizzawi, 2021 in Internet banking).

Consumers' perceptions of ease of use about a mobile self-scanning application have a strong direct positive influence on their perceptions of usefulness and satisfaction about it, but do not directly influence their continuance intentions to use it. On the other hand, consumers' perceptions of usefulness about a mobile self-scanning application directly and positively influence their satisfaction and the continuance intention to use it.

The results support the perceived quality-satisfaction path but do not support the perceived quality-continuance intention path. That means, consumers' perceptions of a mobile self-scanning application quality positively influence their satisfaction about it but do not directly influence the continuance intention to use it. The effect of perceived quality on continuance intention is mediated by satisfaction. Finally, the findings show that consumers' satisfaction with a mobile self-scanning application strongly influence the continuance intention to use it. These findings also contribute to the ongoing discussion on the expansion of the TAM and TRAM model in IS/IT usage intention by integrating the need for interaction dimension.

5.2. Managerial implications

The results of this study contribute to management as they help retailers understand which factors most affect the satisfaction and continued use of a mobile app for self-scanning. Retailers should seek to create Apps that are perceived as useful by users. In addition, they

should take care to ensure perceived quality of the App, as with higher levels of satisfaction, customers feel more willing to continuously use the application. Perceived quality involves the quality of information that is provided through the App, the quality of the system and the quality of service. Therefore, retailers should strive to provide accurate and up-to-date information on their Apps; create Apps that are easy to load, visually appealing, and where it is easy to navigate and provide a level of service with quick responses on their Apps. To encourage customers with a high need for interaction to use Apps, retailers should emphasize the availability of employees, if needed, to help them when they face problems or they need to complain. Thus, customers using the Apps cause retailers to reduce both systems and labour costs (Grewal *et al*., 2017; Roy *et al*., 2018).

5.3. Limitations and future research

This study attempts to enrich the current understanding of consumers' continuance intention to use a mobile self-scanning application. However, as with any other study, our study contains some limitations, which could be addressed in future research.

First, this study uses data collected through a web-based convenience sampling procedure. This sampling procedure is prone to self-selection bias and can lead to samples including users with lower levels of internet phobia compared to the entire population of users. Future research may collect data using other methods such as mall intercept surveys. Second, our study is cross sectional. Future research may use a longitudinal study to establish causality more fully, and to get a better understanding of users' continuance intention to use mobile self-scanning applications. Finally, our study is based on a sample of users of a self-scanning App from a single retailer. Therefore, the generalizability of our study findings should be further tested using other mobile self-scanning applications. For future studies it would also be interesting to analyze other antecedents of the intention to continue using mobile self-scanning applications, such as perceived pleasure, social influence, habits, security, and perceived privacy, which have been shown in other studies and other contexts to be significant (Amoroso and Lim, 2017; Hsiao *et al*., 2016; Kumar *et al*., 2018; Lee, 2018; Natarajan *et al*., 2017).

Covid-19 pandemic change consumers behaviors regarding the use of mobile services (Kumar and Shah 2021; Sreelakshmi and Prathap, 2020) by several reasons such as social distancing policies, and the fact that the probability to getting infected with Covid-19 by touching objects or surfaces infected by the virus is high. While earlier mobile services were a medium of convenience now, they appear to be a necessity due to the COVID-19 pandemic (Sreelakshmi and Prathap, 2020). This is not different in the context of mobile self-scanning application in

retail. As the current study did not capture the effect of perceived threat of Covid-19 on the continuance intention to use the mobile self-scanning applications in retail, a direction for future research is to incorporate the health belief model (HBM) into the current proposed conceptual model.

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Table I.

Sample characteristics

Characteristics	Frequency	Percentage
Gender		
Male	65	30
Female	152	70
Age		
Less than 24	20	9.2
25-34	46	21.2
35-44	97	44.7
45-54	45	20.7
Over 54	9	4.1
Education		
Elementary school	3	1.4
High school	117	53.9
College	11	5.1
Grad School	86	39.6
Frequency of grocery shopping		
Daily	9	4.1
4 or 5 times per week	34	15.7
2 or 3 times per week	106	48.8
Once a week	49	22.6
Less than once a week	19	8.8
Net monthly income		
Less than €2.001	178	82
€2.001-€4.000	18	8.3
More than €4000	4	1.8
Do not answer	17	7.8

Table II.

Measurement model results

Construct	Item	Standardized loading	t-value	CR	CA	AVE
Perceived usefulness	PU1	0.842	31.674	0.932	0.909	0.733
	PU2	0.850	34.803			
	PU3	0.895	49.308			
	PU4	0.816	34.380			
	PU5	0.877	50.555			
Perceived ease of use	PEOU1	0.849	34.164	0.932	0.909	0.733
	PEOU2	0.876	37.886			
	PEOU3	0.898	49.050			
	PEOU4	0.798	25.497			
	PEOU5	0.856	38.513			
Satisfaction	SAT1	0.890	48.899	0.950;	0.937	0.762
	SAT2	0.908	62.689			
	SAT3	0.889	49.305			
	SAT4	0.839	29.819			
	SAT5	0.832	38.044			
	SAT6	0.846	28.786			
Continuance intention	CI1	0.888	55.680	0.918	0.881	0.737
	CI2	0.898	52.853			
	CI3	0.876	41.446			
	CI4	0.767	20.185			
Need for interaction	NI1	0.746	6.440	0.826	0.720	0.545
	NI2	0.774	6.270			
	NI3	0.626	5.438			
	NI4	0.795	6.485			
Perceived Quality (second-order factor)				0.919	0.930	0.792
Information Quality		**0.904**	**55.386**			
	IQ1	0.853	29.223	0.941	0.916	0.799
	IQ2	0.905	41.897			
	IQ3	0.922	57.173			
	IQ4	0.895	37.159			
System Quality		**0.911**	**57.312**			
	SQ1	0.624	9.468	0.883	0.820	0.658
	SQ2	0.879	38.044			
	SQ3	0.872	41.015			
	SQ4	0.842	32.736			
Service Quality		**0.854**	**34.633**			
	SEQ1	0.891	50.369	0.919	0.867	0.792
	SEQ2	0.934	74.112			
	SEQ3	0.842	29.999			

Note: CR- Composite reliability; CA- Cronbach's Alpha; AVE – Average variance extracted

Table III.

Correlations and discriminant validity checks.

Variables	CI	NI	PEOU	PU	PQ	SAT	IQ	SQ	SEQ	TR	Age	Gender	Income
Continuance Intention (CI)	**0.859**												
Need for Interaction (NI)	-0.257	**0.738**											
Perceived ease of use (PEOU)	0.635	-0.328	**0.856**										
Perceived Usefulness (PU)	0.691	-0.278	0.615	**0.856**									
Perceived Quality (PQ)	0.597	-0.281	0.582	0.688	**0.890**								
Satisfaction (SAT)	0.794	-0.329	0.740	0.724	0.701	**0.873**							
Information Quality (IQ)	0.499	-0.254	0.506	0.624	0.904[a]	0.615	**0.894**						
System Quality (SQ)	0.569	0.270	0.541	0.640	0.911[a]	0.656	0.730	**0.811**					
Service Quality (SEQ)	0.536	-0.223	0.509	0.569	0.854[a]	0.604	0.635	0.707	**0.890**				
Technology Readiness (TR)	0.429	-0.511	0.369	0.438	0.492	0.472	0.398	0.477	0.449	NA			
Age	-0.011	0.092	-0.172	-0.049	-0.037	-0.108	-0.068	0.004	-0.029	-0.043	NA		
Gender	0.079	-0.044	-0.007	0.116	0.067	0.071	0.036	0.112	0.031	0.13	0.144	NA	
Income	0.076	-0.098	0.028	0.065	0.0300	0.036	0.059	-0.014	0.031	0.092	0.161	0.178	NA

Note: Bolded numbers are the square roots of AVE. Below the diagonal elements are the correlations between the constructs. [a] Lower order components of the higher order component of perceived quality.

Table IV.

HTMT ratios

Variables	CI	NI	PEOU	PU	SAT	IQ	SQ	SEQ	TR	Age	Gender	Income
Continuance Intention (CI)												
Need for Interaction (NI)	0.314											

Perceived ease of use (PEOU)	0.695	0.404									
Perceived Usefulness (PU)	0.764	0.345	0.674								
Satisfaction (SAT)	0.863	0.401	0.800	0.780							
Information Quality (IQ)	0.553	0.306	0.555	0,683	0.666						
System Quality (SQ)	0.665	0.344	0.615	0.733	0.741	0.841					
Service Quality (SEQ)	0.610	0.277	0.574	0.637	0.67	0.712	0.835				
Technology Readiness (TR)	0.575	0.732	0.496	0.570	0.618	0.507	0.633	0.610			
Age	0.087	0.170	0.178	0.057	0.112	0.070	0.026	0.031	0.085		
Gender	0.082	0.076	0.034	0.122	0.074	0.054	0.118	0.057	0.200	0.144	
Income	0.083	0.133	0.052	0.065	0.045	0.062	0.098	0.033	0.105	0.161	0.178

Table V. Results of the hypothesis testing

Hypothesis	Path coefficient	*t* statistics	Decision
H1a) Technology readiness → Perceived ease of use	0.369	3.320***	Supported
H1b) Technology readiness → Perceived usefulness	0.245	2.824**	Supported
H2a) Perceived ease of use → Satisfaction	0.407	6.578***	Supported
H2b) Perceived ease of use → Continuance Intention	0.065	0.906$^{n.s.}$	Not Supported
H2c) Perceived ease of use → Perceived usefulness	0.525	9.290***	Supported
H3a) Perceived usefulness → Satisfaction	0.292	4.712***	Supported
H3b) Perceived usefulness → Continuance Intention	0.238	3.372***	Supported
H4a) Perceived Quality → Satisfaction	0.264	4.478***	Supported
H4b) Perceived Quality → Continuance Intention	-0.013	0.215 $^{n.s.}$	Not Supported
H5) Satisfaction → Continuance Intention	0.584	7.327***	Supported
H6) Need for Interaction -> Technological Readiness	-0.511	4.725***	Supported
Control Variables			
Age → Continuance Intention	0.073	1.695^{ns}	NA
Gender → Continuance Intention	-0.003	0.077^{ns}	NA
Income → Continuance Intention	0.027	0.673^{ns}	NA

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; ns- not significant; NA- not applicable

Table VI. Effect sizes (f^2), predictive relevance (Q^2), and variance explained (R^2).

Construct	R^2	Q^2	f^2	*Decision*
Continuance Intention (CI)	0.667	0.476		
Perceived ease of use (PEOU)			0.010	Small
Perceived usefulness (PU)			0.060	Small
Perceived Quality (PQ)			0.001	Small
Satisfaction (SA)			0.312	Medium
Satisfaction (SA)	0.698	0.524		
Perceived ease of use (PEOU)			0.315	Medium
Perceived usefulness (PU)			0.129	Small
Perceived Quality (PQ)			0.112	Small
Perceived usefulness (PU)	0.430	0.309		
Technology readiness (TR)			0.091	Small
Perceived ease of use (PEOU)			0.417	Substancial
Perceived ease of use (PEOU)	0.136	0.100		
Technology readiness (TR)			0.158	Medium

Technological Readiness (TR)	0.262	0.113	
Need for Interaction (NI)			0.354 Substancial

Note: f^2: 0.02, small; 0.15, medium; 0.35, substancial.

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