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Understanding the implementation of retail self-service check-out technologies using necessary condition analysis

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Abstract

Purpose – Self-service check-out technologies (SSTs) are becoming a trend across different retail settings, allowing companies to gain efficiency and reduce costs. Nevertheless, the success of SSTs implementation is still subject to challenges and uncertainties. This study aims to provide insights for theory and managers on the necessary conditions for the successful implementation of retail SSTs.

Design/methodology/approach – Based on an online survey, data from 251 participants were collected to understand the factors predicting SSTs adoption and realise what conditions are mandatory for the adoption. partial Least Squares Structural Equation Modelling (PLS-SEM) and necessary condition analysis (NCA) were used to analyse the data.

Findings – According to the NCA analysis results, 12 latent variables were relevant for predicting SSTs adoption, but only seven were necessary conditions for user adoption.

Originality/value – The complementarity of perspectives for understanding the adoption of SSTs based on the two data analysis techniques provides novel insights into theory and support for retailers' decision-making on self-service technologies (STTs) implementation.

Keywords Self-service technology, Adoption, Retail, NCA, Omnichannel strategy

Paper type Research paper

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1. Introduction

The retail landscape is constantly changing, and shopping has moved from the purchase of products to enjoying new shopping experiences tuned to a modern lifestyle. As a result, retailers increasingly face the challenge of designing efficient digital interactive platforms (DIPs) for value creation (Thomas-Francois and Somogyi, 2022). This movement spans the retail landscape from omnichannel store environments and smart-connected retailing to entire retail ecosystems where interactive self-service technologies (STTs) can provide an exciting contribution (Wei *et al.*, 2017).

SSTs are a combination of technology and self-service that can be defined as technological interfaces that allow customers to produce a service without being dependent on direct service employee involvement (Lee and Lyu, 2016; Meuter *et al.*, 2000). Amongst the various types of SSTs, the introduction of retail self-checkouts has grown at a fast pace (Holman and Buzek, 2007; Rinta-Kahila *et al.*, 2021; Statistica, 2021). Retail self-checkouts allow shoppers to scan, bag and pay for items either independently or with minimal assistance (Alpert, 2008; Lee *et al.*, 2010). Using self-service kiosks brings significant benefits to both consumers and retailers (Cebeci *et al.*, 2020; Lee, 2015). A survey conducted by NCR company shows that almost half of the shoppers under 45 prefer to use self-services in supermarkets (Orel and Kara, 2014) and Liang *et al.* (2022) indicate that 43% of US Internet users would prefer to use scan-and-go solutions. On their side, retailers can be more efficient and flexible in using staff. One cashier can serve several consumers simultaneously, allowing the redeployment of employees to areas where particular customer service is needed (Holman and Buzek, 2007).

The SSTs market size was valued at US$ 16,06 billion in 2015 and is forecasted to exceed US$ 42 billion by 2023, at 13.2% compound annual growth rate (CAGR) from 2016 to 2024 (Amone, 2016; Johnson *et al.*, 2020) with an estimated number of 10,000 stores offering fully autonomous check out in 2024 (Statistica, 2021). A market research report published post-Covid19 estimates that the SSTs market will grow by 10.2% during the 2021–2026 period. The pandemic has contributed to fostering the acceptance and usage of self-checkout due to reduced risk of contagions by decreasing human contacts and queues (Mordor Intelligence, 2020, 2021).

Traditionally deployed in big-box supermarkets, SSTs will continue to evolve, with similar concepts popping up in different retail sectors (Lesonsky, 2017). The implementation of SSTs is currently visible in sporting goods stores (e.g. Decathlon), apparel (e.g. Zara, Urban Outfitters and Rebecca Minkoff) and even in beauty and cosmetics (e.g. Sephora) (IHL, 2019; Binns, 2017; Marino-Nachison, 2018; Gilliland, 2016). In addition, restaurants like McDonald's have in-store kiosks in about 45% of their European restaurants, through which customers can place orders without interacting with a human cashier (Sozzi, 2016). Retailers display interest in SSTs due to cost reductions, efficiency, flexibility, productivity and improved corporate performance that these technologies allow. However, there are also growing concerns regarding self-checkout use, namely the increase in the number of thefts in stores. A study of 1 million transactions in the UK found that the losses incurred through SSTs systems totalled 3.97% of the stock, compared to just 1.47% in traditional checkouts (Harding, 2012).

Also, considering the consumer side, the acceptance of SSTs is not always successful (Larson, 2019). For example, Puget Consumers Co-op removed its self-checkout machines in 2018, a move praised by some shoppers who said they found them frustrating and tedious. The same occurred with American Retailer Target. According to Demoulin and Djelassi (2016), in European countries such as France, most customers view self-checkout installation in all stores unfavourably, and half still prefer traditional checkouts. In general, the figures show that self-checkouts only attract 10–15% of French hypermarkets' customers (Demoulin and Djelassi, 2016). To understand the opportunities to improve the self-checkout experience Statista Research Department surveyed 2,803 consumers, and only 17% replied that there were no conceivable upgrades to be done (Statistica, 2014). This finding suggests that consumers consider the current SSTs satisfactory, which is intriguing given the usage rates.

Therefore, it is imperative to examine the customers' shopping experiences, motivations and profiles to enhance SSTs' proper use and increase retailer service performance, customer satisfaction and loyalty (Lee *et al.*, 2013; Meuter *et al.*, 2005; Sharma *et al.*, 2021).

While the predominant literature reflects the great interest amongst practitioners and scholars in consumers' attitudes and motivations to use SSTs (e.g. Thomas-Francois and Somogyi, 2022), there is a lack of studies focussing on which attributes are actually necessary and should be prioritised for the adoption process to be successful. By combining the results from equation analysis and necessary condition analysis (NCA), the current study offers novel insights into the relationship between consumer motivations and self-checkout use by revealing which factors are, in reality, indispensable for SSTs adoption. The findings show that only some factors from the utilitarian benefits (UB) construct are truly necessary for SSTs adoption. Despite having a significant contribution to predicting the adoption of SSTs, other factors are not actually essential, and they offer a marginal contribution to SSTs adoption solely. Thus, this study's significant contribution clarifies the division between contributing and necessary factors. By doing so, the findings expand the theoretical knowledge and offer insights to managers about the necessary, priority and marginal conditions for the successful implementation of SSTs in retail.

2. Theoretical background

Customers' preference for simpler and faster check-out systems depends on multiple factors. Long lines and lengthy waiting times at checkouts have been reported as significant reasons motivating customers to turn to online shopping (Demoulin and Djelassi, 2016); Lesonsky (2017). Self-checkout aims to improve check-out operations whilst decreasing customers' waiting experiences (Morimura and Nishioka, 2016). However, in a study conducted by GPShopper, some consumers were considered significantly more interested in some SSTs than others. For example, 50% would use them when shopping grocery, 27% shopping for fashion items, 25% for beauty and cosmetic goods and only 21% would accept using scan and go in sports and outdoors goods. However, these findings are contingent. Not surprisingly, 77% of shoppers aged 18 to 34 years like the general idea of SSTs, but only 42% over 55 years accept using them (Alpert, 2008).

2.1 Factors affecting consumer motivation to use SSTs

According to the attribute-based model (Dabholkar, 1996), consumers evaluate service quality using five SST-related attributes: speed of delivery, ease of use (EU), reliability (RE), control (CO) and enjoyment (EN). Relying also on the attributes related to the SSTs, Bitner (2001) suggested that RE (defined as dependability and user-friendliness) and advantage (the ability of SSTs to deliver benefits to customers) are significant attributes affecting the success of SSTs. More recently, and based on previous research, Walker and Johnson (2006) suggested that personal capacity, perceived risk, relative advantage and preference for a personal contact are the major factors influencing the adoption and use of SSTs. The integrated model of self-service technology usage in a retail context proposed by Demoulin and Djelassi (2016) proposes that situational factors influence customers' decisions to use SSTs. That perceived behavioural CO is a determinant for predicting behavioural intention (Boudkouss and Djelassi, 2021), followed by perceived usefulness, need for interaction (NI) and perceived EU and EN. Therefore, based on the previous evidence, perceived advantage emerged as a crucial factor for SSTs adoption.

From a different theoretical perspective, Cetto *et al.* (2015) analyse and organise the motivations for using SSTs according to their utilitarian or hedonic nature. Following this line of thought, the essential UB of using SSTs include time savings (TSs) (Boudkouss and

Djelassi, 2021; Dabholkar, 1996), CO (Bateson, 1985), RE (Davis *et al.*, 1989), EU (Lee *et al.*, 2012; Liang *et al.*, 2022) and avoidance of service employees (Meuter *et al.*, 2000). Ideally, SSTs allow the actual transaction to be performed more quickly, allowing the customer to save time (Collier *et al.*, 2015; Dabholkar *et al.*, 2003; Demoulin and Djelassi, 2016). Using SSTs also gives the user the feeling of being in CO of the service delivery process (Bateson, 1985; Boudkouss and Djelassi, 2021; Dabholkar, 1996; Sarel and Marmorstein, 2003). Moreover, as a customer is more likely to use SSTs if they work correctly, RE is a determinant attribute too. Due to technical accuracy and trust (De Cicco *et al.*, 2020), SSTs are currently perceived as a more reliable option to prevent mistakes that service employees might make (Dabholkar *et al.*, 2003). If SSTs are designed to reduce the effort and complexity of the purchase process, their willingness to adopt these systems will increase (Davis, 1989; Dabholkar and Bagozzi, 2002; Lee *et al.*, 2012; Meuter *et al.*, 2000). Finally, avoiding interactions with the service employee is also seen as a benefit for many customers (Bridges and Florsheim, 2008; Dabholkar and Bagozzi, 2002; Lee *et al.*, 2012; Meuter *et al.*, 2000). However, there is also evidence that satisfaction with the employee at checkout has a stronger positive effect on store satisfaction and loyalty than satisfaction with self-checkout itself (Sharma *et al.*, 2021). Supported by previous findings on UB, the following hypothesis is proposed:

H1. Perceived UB positively affect the intention to use self-checkout.

Previous research suggests that the willingness to use SSTs is also influenced by hedonic motives (Bagozzi, 2007; Cetto *et al.*, 2015; Venkatesh, 2000). According to Cetto *et al.* (2015) and Baethge *et al.* (2016), the main hedonic motives to be considered are EN, inherent novelty seeking and challenges. Morimura and Nishioka (2016) analysed the role of attractiveness in SSTs and concluded that it positively affects SSTs usage and SSTs usage experience, turning it more fun and enjoyable. Thus, customers are more likely to use SSTs if it looks fun and enjoyable. EN has also been shown to impact service quality and perceived risk perception (Lee and Lyu, 2019).

Playing with machines is attractive for many consumers. Therefore, the perception of playfulness as a hedonic value is important for the willingness to adopt technological systems (Agarwal and Karahanna, 2000; Collier and Barnes, 2015; Demoulin and Djelassi, 2016; Venkatesh *et al.*, 2003). In playfulness, aesthetics has an essential role in human attraction and attitudes towards technologies (Schenkman and Jönsson, 2000; Shin, 2012; Tractinsky, 2004). For example, Shin (2012) concluded that aesthetics is a significant determinant of smartphone use intention, while Castillo and Bigne (2021) found that aesthetics and navigation are significant predictors of perceived usefulness and perceived EU when consumers evaluate SSTs acceptance.

Additionally, the opportunity for playing with machines is stimulated by customers' novelty-seeking desires, an epistemic consumption value proposed by Sheth *et al.* (1991). Customers with a higher predisposition toward novelty seeking are, therefore, more willing to use SSTs and enjoy the stimulation of trying new ways to approach old problems (Dabholkar and Bagozzi, 2002; Holbrook and Hirschman, 1982; Parasuraman, 2000). Related to novel seeking is the hedonic motive linked to the feeling of being challenged (Ghani *et al.*, 1991; Koufaris, 2002; Novak *et al.*, 2000).

Finally, the challenges provided by an activity are relevant predictors of flow (Novak *et al.*, 2000). The idea of flow was introduced by Csikszentmihalyi in 1975 to "understand enjoyment [. . .] as an ongoing process which provides rewarding experiences in the present" and is referred to as a cognitive state derived from activities that are enjoyable by themselves (Csikszentmihalyi, 2000). The feeling of the satisfaction arises when the person can perform the activity successfully, approximately to a game. This experience positively affects both customer responses and the intention to repeat the experience in the future (Koufaris, 2002). Supported by this evidence on hedonic benefits (HB), the second hypothesis is proposed.

H2. Perceived HB positively affect the IU self-checkout.

2.2 Personal traits

Despite the growing implementation of new technologies in the retail environment, not all consumers choose or are interested in adopting them. Some psychological traits play a notable role in the adoption of SSTs (Johnson *et al.*, 2021). One major predictor of SSTs' interest is technology anxiety (Cebeci *et al.*, 2020; Dabholkar, 1996; Johnson *et al.*, 2021; Larson, 2019; Lee *et al.*, 2010; Meuter *et al.*, 2000). Technological anxiety takes a broader scope by explicitly focussing on the user's state of mind regarding their ability and willingness to use technology-related tools, also referred to as technology self-efficacy (Cebeci *et al.*, 2020; Meuter *et al.*, 2000). In the Meuter *et al.* (2003) study, technology anxiety was a better predictor of SSTs usage than demographic factors. Therefore, it is proposed that

H3. The level of technology anxiety negatively affects the willingness to use self-checkout.

Technology anxiety is commonly linked with the preference for human interaction. For many customers, human interaction is essential, especially to evaluate a service (Bitner, 2001; Dabholkar, 1996; Surprenant and Solomon, 1987). Some believe that using machines dehumanises the shopping experience (Parasuraman *et al.*, 1985). However, studies show that people have different perceptions of automated technologies based on how important human contact is to them (Dabholkar, 1996; Forman and Sriram, 1991; Meuter *et al.*, 2003; Venkatesh, 2000; Wang *et al.*, 2017). Personal contact seems to be vital to consumers with a high NI (Lee *et al.*, 2010), and since SSTs diminish interpersonal interaction, it may be less considered a feasible option by consumers that enjoy human interaction (Dabholkar, 1996; Lee *et al.*, 2010; Meuter *et al.*, 2000; Sharma *et al.*, 2021). Therefore, the following hypothesis is formulated.

H4. The level of NI negatively affects the willingness to use self-checkout.

Likewise, the opposite feeling of social anxiety (SA) is also considered a relevant trait to explain usage intention (Dabholkar and Bagozzi, 2002). SA is defined as the "discomfort in the presence of others" (Fenigstein *et al.*, 1975, p. 523). Accordingly, customers who experience SA may become anxious when others are watching them, thus reducing their intention to use SSTs if they believe they are not easy to use (Dabholkar and Bagozzi, 2002; Kinard *et al.*, 2009). Consequently, SA may discourage customers from using SSTs (Dabholkar and Bagozzi, 2002). Accordingly, the following hypothesis is proposed:

H5. The level of SA negatively affects the willingness to use self-checkouts.

Table 1 summarises the factors affecting the use of SSTs, which compose the proposed conceptual model (Figure 1), considering the utilitarian and hedonic nature of the benefits proposed by Cetto *et al.* (2015). The hypotheses will be tested using a combination of multivariate data analysis techniques described in the methodology section.

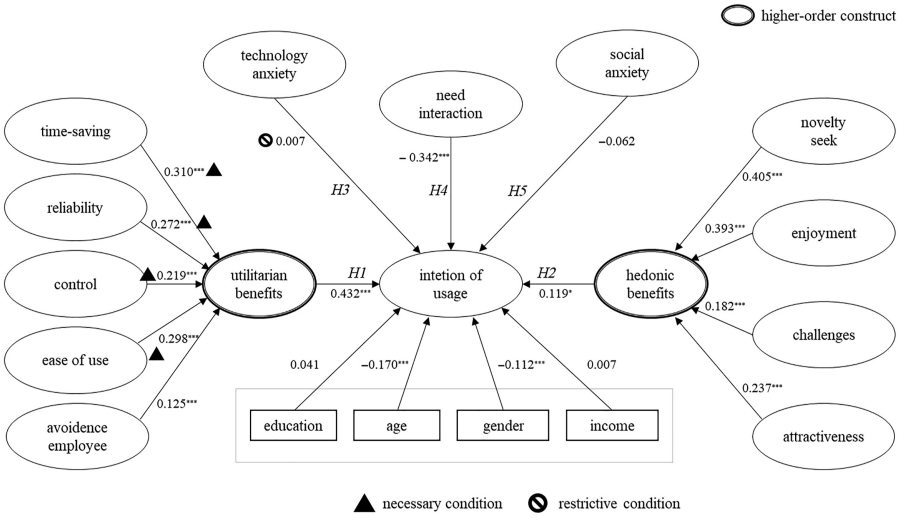
3. Methodology

3.1 Measures and sample

An online survey was developed based on questions and scales derived from previously validated scales to ensure the RE and validity of measures. To address technological anxiety (Meuter *et al.*, 2003) and the NI (Dabholkar, 1996), the items were scored using a seven-point Likert scale where one represents strongly disagree, and seven represents strongly agree. The scale ranged from one to four for SA (Fenigstein *et al.*, 1975). To measure the intention of use (IU), two questions from Elliott *et al.* (2008) were used. The last part of the survey evaluated hedonic (HB) and UB. A five-point Likert scale was used, ranging from strongly disagree (1) to strongly agree (5) to match the previous studies using the scale (Belk, 1974; Cetto *et al.*, 2015; Dabholkar, 1996; Morimura and Nishioka, 2016).

Nature of the factors	Factors	Authors	Hypo-theses
Utilitarian	Time-Saving (TS)	Boudkouss and Djelassi (2021), Dabholkar (1996), Dabholkar *et al.* (2003), Lee *et al.* (2012) and Meuter *et al.* (2000)	H1
	Reliability (RE)	Dabholkar (1996), Dabholkar *et al.* (2003) and Davis *et al.* (1989)	
	Control (CO)	Bateson (1985), Boudkouss and Djelassi (2021), Dabholkar (1996), Dabholkar *et al.* (2003) and Sarel and Marmorstein (2003)	
	Ease of Use (EU)	Castillo and Bigne (2021), Dabholkar and Bagozzi (2002), Dabholkar *et al.* (2003), Lee *et al.* (2012), Liang *et al.* (2022) and Meuter *et al.* (2000)	
	Avoidance Employee (AS)	Bateson (1985), Dabholkar (1996), Dabholkar and Bagozzi (2002), Lee *et al.* (2012), Meuter *et al.* (2000), Sharma *et al.* (2021) and Wang *et al.* (2017)	
Hedonic	Inherent Novelty Seek (INS)	Agarwal and Karahanna (2000), Dabholkar and Bagozzi (2002), Holbrook and Hirschman (1982) and Parasuraman (2000)	H2
	Enjoyment (EN)	Agarwal and Karahanna (2000), Collier and Barnes (2015), Dabholkar (1996), Demoulin and Djelassi (2016), Venkatesh *et al.* (2003) and Lee and Lyu (2019)	
	Challenges (CH)	Ghani *et al.* (1991), Koufaris (2002) and Novak *et al.* (2000)	
	Attractiveness (AT)	Morimura and Nishioka (2016)	
Technological anxiety		Dabholkar (1996), Larson (2019) and Lee *et al.* (2010)	H3
		Meuter *et al.* (2000) and Cebeci *et al.* (2020)	
Social Interaction		Bitner (2001), Dabholkar (1996) and Forman and Sriram (1991)	H4
		Meuter *et al.* (2003) and Venkatesh (2000)	
Social Anxiety		Dabholkar and Bagozzi (2002) and Fenigstein *et al.* (1975) Kinard *et al.* (2009)	H5

Table 1.
Factors affecting the use of SSTs



Note(s): *p-value < 0.05, **p-value < 0.01, ***p-value < 0.001

Figure 1.
Conceptual model and results

The questionnaire was shared via social media networks such as LinkedIn, Facebook and Instagram using the convenience sampling technique. This sampling technique enabled an easy and diversified collection of responses at a low cost and time but has the risk of being biased. The questionnaire was online for 11 days in early 2021 and achieved 253 responses. A total of 251 valid responses were recorded after data screening. The sample consisted of 162 females (64.8%) and 89 males (35.2%), ranging from 15 to 61 years old; most of the participants were aged between 19 and 30 years (46.6%). Only 28.7% of the participants have less than a bachelor's degree, and 79.3% stated they consider themselves SSTs users. Table 1 summarises the sample's descriptive statistics.

3.2 Procedures

An approach based on PLS path modelling (PLS-PM) was chosen to identify the factors predicting the intention to use SSTs. The choice of PLS-PM follows Alber's (2010) recommendation on the use of this statistical technique as preferred for success factor studies in marketing. In fact, countless PLS path models are reported in the leading marketing journals, which validates the value of PLS in assessing marketing phenomena (Hair *et al.*, 2012; Henseler, 2017). Another important reason relates to PLS-PM ability to handle both reflective and formative factors. In the current study, the constructs HB and UB are formative while the remaining are reflective, which supports the use of PLS. Despite the long-lasting controversy on the criteria to decide on the nature of the constructs, the decision on the nature of the constructs is supported by Jarvis *et al.*'s (2003) discussion on the choice of indicators in marketing research.

The asymmetry of the number of observable indicators in the dimensions of the HB and UB constructs is required using the two-step approach for second-order formative constructs (Sarstedt *et al.*, 2019). Finally, CO variables were included in the conceptual model to rule out alternative explanations to test the influence of age, gender, education and income on the intention to use the SSTs.

An NCA was conducted to validate the results of the PLS approach and advance the literature by identifying the necessary conditions for adopting SSTs. An NCA was conducted. The "necessity logic" differs from the "sufficiency logic" present in regression studies or structural equations, which assumes an additive idea, where each equation factor is computed for its contribution to the final result. Under these conditions, when one of these factors is insufficient, the other factors compensate for these deviations. In contrast, the logic of necessity implies that a result – or a particular level of result – can only be met if the necessary factor is in place or is at a certain level (Dul, 2016). Thus, by linking these two data analysis techniques (PLS-SEM and NCA), the current study provides a broader and more accurate understanding of the phenomenon.

4. Study I: The partial least squares approach – identifying the factors predicting SSTs' usage

Study 1 aims to test the conceptual model's hypotheses by understanding the impact of behavioural motivators and personal traits on SSTs' usage intention, using a structural modelling approach through PLS-PM.

4.1 Results

4.1.1 Measurement model. In PLS-path analysis, evaluating the RE and validity of the measures in the outer model is processed differently depending on the construct's formative or reflective nature (Sarstedt *et al.*, 2019). Reflective items depend on the value of a latent variable, with the latent variable determining the item scores while the formative perspective

treats items as determinants of the latent variable. Therefore, formative constructs are defined by their items (Cadogan and Lee, 2013).

The indicators for the constructs TA, NI, SA, IU, individual indicator RE, convergent validity and discriminant validity were assessed. Regarding the nature of HB and UB constructs, we have decided to select the formative form since we consider that changes in the indicators (low-order constructs) would cause changes in the high-order construct since they are not interchangeable in our view in accordance with the guidelines from the study by Duarte and Amaro (2018).

An initial assessment of the first-order measurement model was conducted. The analysis suggested minor adjustments, and four indicators (INS3, EN3, SA1 and SA4) were excluded due to low loadings. Although four other indicators showed loadings below the reference value ($\lambda \geq 0.707$), they were not excluded because their corresponding construct had high-RE scores (average variance extracted (AVE) > 0.5 and composite reliability (CR) > 0.7) (see Appendix 1). The acceptance of these less optimal indicators aimed to keep the original scale as unchanged as possible to avoid potential biases and preserve comparability (de Souza Bido and Da Silva, 2019). Finally, the scores of the latent variables in the adjusted model were calculated and used to assess the RE and validity of the second-order formative construct and the final analysis of the structural path model.

The Fornell and Larcker criterion (1981) was used to evaluate discriminant validity. The results in Table 2 confirm the discriminant validity.

Next, the nomological validity of the second-order formative constructs (HB and UB) was evaluated using the significance of the adjusted coefficients of the path model (Sarstedt *et al.*, 2019). All relationships between the first-order dimensions and the higher-order constructs revealed statistically significant p-values, suggesting that this latent variable portrays its desired meaning. Finally, the validity of the measurement model must be assessed by evaluating the collinearity between the dimensions of the second-order constructs. All variance inflation factors (VIFs) were inferior to three, thus confirming the absence of collinearity (Hair *et al.*, 2019).

4.1.2 Structural model. After assessing the quality of the measurement model, the next step consisted of evaluating the structural model. The SEM model was tested using SmartPLS path modelling software Version 3.3.3 to test its statistical significance. The statistical significance of the path coefficients was assessed using 5,000 bootstrap runs. The results in Table 3 show that H1 is supported and its positive impact of UB on the intention to use ($\beta = 0.432$ and p-value $= 0$). The effect size shows that this is a significant effect. The relationship between HB and intention to use (H2) is also supported. However, its predictive impact ($\beta = 0.119$ and p-value $= 0.022$) and its contribution to the model ($f^2 = 0.022$) are lower when compared to the UB. As expected, the NI (H4) displays a significant and negative impact ($\beta = -0.342$ and p-value $= 0$) on the intention to use SSTs and a stronger contribution to the model ($f^2 = 0.281$). Hypotheses H3 (addressing the impact of TA on the IU) and H5 (addressing the effect of SA on the IU) were not supported in this study, and the implications of these results will be analysed in the discussion section.

Finally, the adjusted R^2 value further suggests that the model has a significant capacity to predict the intention to use SSTs since 63.2% of the variance is explained by the proposed predictors. Furthermore, the Stone-Geisser Q^2 is greater than zero (0.612), suggesting that the model has predictive relevance. Therefore, the model presents the predictive power regardless of the data used in the current analysis.

As UB and HB revealed significant predictive ability of the intention to use SSTs, it is important to understand the relevance of the dimensions of the UB and HB. In the case of UB, which reported a higher prediction capability, all factors show statistical significance at a 0.05 level. Amongst them, TS ($\beta = 0.310$ and p-value $= 0.000$) was the most important, followed by EU ($\beta = 0.298$ and p-value $= 0$), RE ($\beta = 0.272$ and p-value $= 0$), CO ($\beta = 0.219$ and p-value $= 0$)

	Total	
	N	%
Gender		
Female	162	64.5
Male	89	35.5
Not informed	0	0.0
Age		
15–18 years	35	13.9
19–30 years	117	46.6
31–40 years	29	11.6
41–50 years	39	15.5
51–60 years	18	7.2
above 60 years	13	5.2
Education		
High school	72	28.7
Bachelor's degree	94	37.5
Master's degree	82	32.7
PhD or higher	3	1.2
Income (monthly)		
Under 700€	80	31.9
701€ - 1,300€	87	34.7
1,301€ - 2,000€	60	23.9
Over 2,000€	24	9.6
SSTs users		
No	52	20.7
Yes	199	79.3
SSTs usage frequency		
Almost never	43	21.5
Often	72	36.2
Very often	60	30.2
Always	24	12.1
SSTs – types of retailers used (multiple-choice)		
Groceries	173	86.9
Restaurants	95	47.8
Department store	71	35.7
Sport store	53	26.6
Beauty	34	17.1

Table 2.
Sample characteristics

and finally employee avoidance (β = 0.125 and p-value = 0.000). In relation to HB two dimensions stand out, namely inherent novelty seeking (β = 0.405 and p-value = 0) and EN (β = 0.393 and p-value = 0). Attractiveness (β = 0.237 and p-value = 0) and challenges (β = 0.182 and p-value = 0) display also statistically significant predictive capacity at a 0.05 level but to a lesser degree when compared to the other two dimensions.

Regarding the CO variables, not surprisingly, age appears as the most important factor (β = −0.170 and p-value = 0). The negative sign associated with age suggests that the older the individual, the lower the intention to use SSTs. Gender (β = −0.122 and p-value = 0) was also statistically significant, suggesting that women have a lower intention to use SSTs than men. Figure 1 summarises the model results.

Table 3. Discriminant validity

	AS	AT	CH	CO	EN	EU	INS	IU	NI	RE	SA	TA	TS
AS	*0.806*												
AT	0.402^{***}	*0.858*											
CH	0.242^{***}	0.397^{***}	*0.950*										
CO	0.418^{***}	0.276^{***}	0.385^{***}	*0.851*									
EN	0.517^{***}	0.537^{***}	0.593^{***}	0.513^{***}	*0.928*								
EU	0.431^{***}	0.259^{***}	0.173^{***}	0.481^{***}	0.502^{***}	*0.933*							
INS	0.427^{***}	0.416^{***}	0.475^{***}	0.474^{***}	0.701^{***}	0.536^{***}	*0.848*						
IU	0.647^{***}	0.386^{***}	0.206^{***}	0.499^{***}	0.544^{***}	0.555^{***}	0.497^{***}	*0.925*					
NI	-0.613^{***}	-0.249^{***}	0.063^{ns}	-0.122^{ns}	-0.142^{*}	-0.189^{***}	-0.098^{ns}	-0.503^{***}	*0.875*				
RE	0.441^{***}	0.233^{**}	0.171^{*}	0.610^{***}	0.523	0.686^{***}	0.510^{***}	0.544^{***}	-0.184^{**}	*0.766*			
SA	0.038^{ns}	-0.076^{ns}	-0.064^{ns}	-0.135^{ns}	-0.027^{ns}	-0.146^{ns}	-0.243^{*}	-0.121^{ns}	-0.126^{ns}	-0.264^{**}	*0.814*		
TA	-0.420^{***}	-0.226^{**}	-0.066^{ns}	-0.363^{***}	-0.397^{***}	-0.595^{***}	-0.602^{***}	-0.481^{***}	0.194^{**}	-0.538^{***}	0.120^{ns}	*0.754*	
TS	0.488^{***}	0.340^{***}	0.237^{**}	0.527^{***}	0.588^{***}	0.660^{***}	0.611^{***}	0.597^{***}	-0.152^{*}	0.672^{***}	-0.197^{ns}	-0.591^{***}	*0.811*

Note(s): Significance level: * p-value < 0.05, ** p-value < 0.01, *** p-value < 0.001 and ns – not significance
AS – avoidance of service employee; AT – attractiveness; CH – challenges; CO – control; EN – enjoyment; EU – ease of use; INS – inherent novelty seek; IU – intention of usage; NI – need of interaction; RE – reliability; SA – social anxiety; TA – technology anxiety; and TS – time saving
Diagonal values are the square root of the AVE

4.1.3 Discussion. An exciting finding from the current study is that 79.3% of the participants had already tried SSTs (Table 1). Moreover, amongst those who have tried SST, a large number (76.4%) reported being loyal since they state using them often, very often and even permanently. Examining how the experience with SSTs affected the perception and importance of the hedonic vs utilitarian perceived benefits, the findings challenge the existing literature on SSTs adoption as not all the proposed hypotheses were significant. However, some results may be connected to the particular moment the research was conducted. The non-significant relationship between TA and SA with the intention to use SSTs may have been influenced by the epidemic scenario of Covid19 that significantly altered consumer behaviour (Mehta *et al.*, 2020). However, it is possible to confirm this potential impact of the context on the results. The findings are close to that of Cetto *et al.* (2015), pondering the utilitarian and HB results. In the current study, all the constructs proposed by Cetto *et al.* (2015) as UB (e.g. TS, RE, CO, EU and avoidance of service employees) were significant.

Similarly, TS was also the most substantial factor. The relevance of TS does not come as a surprise in today's fast-paced world, where customers may fear that traditional counters are time consuming due to service inefficiencies or unavoidable interactions (Boudkouss and Djelassi, 2021; Cetto *et al.*, 2015; De Cicco *et al.*, 2020). Accordingly, in our study, the EU displays the second highest loading (0.298) on UB after TS, stressing the value of offering effortless, easy to use and fast SSTs.

The findings indicate that users with low experience with SSTs value more hedonic values than utilitarian ones. One possible explanation is that they do not entirely realise the UB because they focus on the fun factor. Consequently, for them, hedonic reasons prevail. Conversely, for more experienced users, the UB were more important. These findings suggest that a two-phase approach to the use of SSTs may be useful. In the first phase, SSTs promotion should stress the excitement and EN of the system, and in the second phase, enhance the functionalities associated with the system's efficiency (De Cicco *et al.*, 2020).

The analysis of psychological traits revealed that only the NI was a significant factor. This finding is consistent with former studies pointing out that people have different perceptions of automated technologies based on how vital human contact in retail is to them (Dabholkar, 1996; Forman and Sriram, 1991; Meuter *et al.*, 2003; Venkatesh, 2000). Despite technology anxiety being commonly regarded as a factor conditioning the use of automation systems (Meuter *et al.*, 2000), the current findings do not support that idea. This finding agrees with previous results by Cebeci *et al.* (2020), indicating the absence of relationship between technology anxiety, perceived EU and perceived usefulness of SSTs. The explanation for these results may be associated with two factors. The first is the ubiquity of technology in modern life, and the second is linked with the user-friendliness of the current tactile systems. In summary, the results suggest that the single valid reason for the customers to decide not to use SSTs is related to the need to interact with the employees.

Although some studies have focussed on demographic characteristics as determinants of SSTs usage (Lee *et al.*, 2010), we could not establish a massive relationship. Our results indicate that only two CO variables tested (age and gender) are statistically significant influencers. Age was found to have a negative relationship, as predicted from existing evidence (e.g. Seifert and Charness, 2022). In the case of gender, a relationship was found between gender and the intention to use SST, with men being more prone to adopt them. Education and income levels showed no significant influence on the adoption of SSTs.

5. Study II: The necessary condition analysis (NCA) approach – identifying the necessary conditions for the adoption of SSTs

Although the results of Study I allowed us to identify a set of predictors for the intention to use SST, these results still do not allow us to know which factors are mandatory conditions

for adoption. Thus, Study II aims to identify which predictors identified in the conceptual model analysed through PLS are necessary conditions for the intention to use SSTs.

The scores of the latent variables from the PLS analysis were considered the raw data for the NCA. R software and the NCA package (Dul, 2021) were used to run the analysis. NCA is bivariate as it involves analysing the need for a particular condition, "X", for a particular output "Y" to happen. Thus, a conceptual model with different constructs may require performing different NCAs for each endogenous construct. Furthermore, additional analyses focussing on their dimensions are recommended if one or more exogenous constructs is a formative construct (Dul, 2016). Adopting the suggestion from Dul (2016) on the application of the technique, two analyses were performed: NCA to determine which of the hypotheses in this study are the necessary conditions for SSTs adoption; NCA to determine which of the factors in the UB constructs are determinants of SSTs adoption, and likewise, for the HB construct.

5.1 Results

When evaluating the NCA results, it is essential to analyse the necessary effect size (d) and its respective statistical significance to define whether a variable is a necessary condition for the phenomenon. Also, it is essential to analyse the model's bottleneck limits (see Appendix 2), identifying the minimum patamars and restrictions to the relationship being studied (Dul, 2016). Table 4 presents the NCA results of all factors present in the model. The findings show that UB and HB present relevant effects size ($d \geq 0.10$) and are statistically significant (p-value < 0.05), thus becoming necessary conditions. TA presents an effect size of 0.244 and a p-value of 0, thus becoming a significant restrictive condition for adopting SSTs. For a complete analysis, assessing the UB and HB constructs' dimensions is recommended. The results of these analyses indicate that four dimensions of UB (TS; RE; CO; and EU) are necessary conditions for adopting SSTs. The EU presents the most prominent effect size in this set of factors. In the case of the factors associated with HB, the findings show that none of the studied dimensions seems to be a necessary condition for the intention to use SSTs (Tables 4 and 5).

5.2 Discussion

The results of Study I pointed out UB as the strongest predictor of the intention to use SSTs. In addition, technology anxiety (TA) did not reveal predictive significance, these results are in line with previous findings such as Cetto *et al.* (2015) and Meuter *et al.* (2000). However, this result does not mean that these factors are either mandatory or restrictive conditions for SSTs use. The results from study II provide additional and novel information which confirm that UB is indeed a necessary condition for SSTs use since its scores are more than one standard deviation (SD) below the mean of UB, which were restricted to values lower than the mean intention to adopt SSTs. Similarly, HB is also confirmed as a necessary condition with a smaller effect size. These results provide support to previous findings by Cetto *et al.* (2015). Thus, to obtain higher than average IU values of SSTs, it is necessary to ensure positive evaluations of UB and HB above the reported thresholds since UB and HB are necessary conditions for the intention to use SSTs.

Hypothesis	β	f^2	SD	p-value	Q^2	R^2 adjusted	Decision
H1: UB → IU	0.432	0.213	0.079	0.000	0.612	0.632	Supported
H2: HB → IU	0.119	0.022	0.052	0.022			Supported
H3: TA → IU	0.007	0.000	0.070	0.923			Rejected
H4: NI → IU	−0.342	0.281	0.042	0.000			Supported
H5: SA → IU	−0.062	0.009	0.044	0.163			Rejected

Table 4. Structural model results

Construct	Effect size[d]	CE-FDH of intention of usage SSTs *p*-value	*c*-accuracy (%)	*p*-value
UB – Utilitarian Benefits	0.211	0.000	100	0.000
HB – Hedonic Benefits	0.154	0.006	100	0.001
TA – Technology Anxiety	0.244	0.000	100	0.000
NI – Need for Interaction	0.000	1.000	100	0.000
SA – Social Anxiety	0.000	1.000	100	0.000
TS – Time Saving	0.145	0.000	100	0.000
RE – Reliability	0.171	0.000	100	0.000
CO – Control	0.174	0.003	100	0.001
EU – Ease of use	0.213	0.001	100	0.000
AS – Avoidance Employee	0.041	0.001	100	0.000
INS – Inherent Novelty Seek	0.050	0.000	100	0.000
EN – Enjoyment	0.000	1.000	100	0.000
CH – Challenges	0.000	1.000	100	0.000
AT – Attractiveness	0.000	1.000	100	0.000

Table 5.
NCA effect sizes and accuracy

Note(s): $0 < d < 0.1$ = small effect size; $0.1 \leq d < 0.3$ = medium effect size; $0.3 \leq d < 0.5$ = large effect size; $d \geq 0.5$ = very large effect size

Surprisingly, technology anxiety (TA) that did not reveal itself as a significant predictor in study I, contradicting the findings by Meuter *et al.* (2000), appears in study II as a necessary condition with a statistically significant medium effect ($d = 0.244$) (Dul, 2016). Considering the negative effect of TA on the adoption of SSTs, the current results indicate that this condition becomes restrictive when the declared TA is 1.4 SD greater than its average, even though in the PLS analysis, TA did not present a significant effect.

When combined, the results obtained through PLS-Path analysis with the NCA analysis provide complementary novel insights on SSTs adoption. Although HB dimensions displayed a significant impact in study I, none proved to be a necessary condition for adopting SSTs. These results suggest that although customers appreciate the hedonic aspect of the experience when using SSTs, as proposed by several authors (e.g. Bagozzi, 2007; Cetto *et al.*, 2015; Venkatesh, 2000), these are not necessary for adoption. What seems to be determinant is the functional benefits that customers get from the use. Nevertheless, since novelty-seeking and EN reported highly significant impacts in study I, these dimensions must not be ignored and should be thoroughly considered and analysed in future investigations. Amongst the UB dimensions, prioritisation should be given to EU, CO and RE, as the results confirm that customers value the practical or utilitarian aspects of SSTs.

6. Conclusions and contributions

The landscape of retail is evolving and changing at an extremely fast rate. The same can be said about technology and the different possible implementation and role in retail. SSTs have been used for several years across different businesses but with different outcomes. Self-service checkouts allow companies to increase efficiency and reduce costs when well accepted and implemented. However, even though the self-service check-out acceptance and use by consumers are increasing, it is crucial to consider that its implementation represents high investments, employee's job function reallocation, risk of robbery and ultimately, potential lack of customer acceptance. The present study helps understand the weight and impact of different benefits on consumers' intention to use a self-service check-out, contributing to the growth of theoretical knowledge and assertively driving priorities in the managerial context.

6.1 Theoretical contributions

This study expands the theory of SSTs adoption from at least two perspectives. First, by adopting a robust methodological perspective, this study goes beyond identifying and understanding factors for SSTs adoption. Challenging previous studies based solely on cause-and-effect analysis, such as those based on structural equation models, which seek to understand the impact of each factor on the adoption of SSTs, this study extends the understanding of the conditions truly necessary for their successful adoption. The complementarity of approaches to understanding SSTs adoption using two data analysis techniques is a central contribution of this study. The current approach advances the results found in previous research by providing new and robust results to add to the existing literature. These results allow not only to identify the determinants of adoption in the cause–effect rationale but also to identify the minimum thresholds necessary for SSTs adoption to be effective from a necessary condition perspective. The findings underscore that despite confirming the construct of HB and its predictive ability in the cause–effect context, none of the factors that comprise this construct presented themselves as a necessary condition for SST adoption. Thus, from a theoretical perspective, it is proposed that HB should be understood as a secondary factor since their contribution to explaining the phenomenon should be seen as supplementary to the UB construct.

Furthermore, although technology anxiety did not significantly impact the cause-and-effect model, which may lead one to think that these devices no longer cause discomfort due to their extensive use; it proved to be a necessary condition for adopting SSTs. The current results complement previous knowledge by proposing that certain levels of TA generate real constraints and block the adoption of SSTs. This finding postulates that the relationship is detrimental and can compromise the adoption and use of SSTs.

Beyond the priority and predictive ability of hedonic and utilitarian benefits on SSTs adoption, this study brings a second contribution by examining how prior experience with SSTs affects the perception and importance of hedonic versus utilitarian benefits amongst recurrent users or little experience users. Again, the results support the conclusion that a one-size-fits-all approach will fail. In contrast, the research findings suggest a two-stage approach, initially emphasising the hedonic aspects most strongly valued by inexperienced users and highlighting the utilitarian features and benefits experienced users value.

6.2 Managerial contributions

NCA applied in this research brought an additional and significant contribution to marketing managers by highlighting the drivers which should be prioritised for an efficient SSTs adoption strategy. Utility benefits demonstrated to have the most significant impact on SSTs adoption. Unsurprisingly, TS and EU display relevant importance, being the two most prioritised and necessary utility benefits, and therefore should be targeted first by marketing managers. In a fast-paced world, gaining time is clearly an advantage (Demoulin and Djelassi, 2016). Thus, retailers must ensure that these desired benefits are successfully implemented. Initially, the proposed actions should emphasise the association of SSTs with agility and EU. Then, these should focus on providing indisputable proof that using SSTs actually saves users' time. This feature can, in the future, be considered along with a gamification process where consumers could be given badges/rewards and be informed about the time they saved by using SSTs. These savings/gifts could be virtual currencies for promotions related to services and products with a strong quality of life appeal. In our study, inherent novelty seek (INS) and EN proved to be the most significant predictors and can be addressed within possible service gamification as already elucidated.

EU has proven to be an essential requirement. Retailers should initially guarantee this condition, seeking to create friendly and stable interfaces on the timeline and welcoming physical space. Convenience should also be stimulated (Duarte *et al.*, 2018; Thomas-Francois

and Somogyi, 2022), reducing the initial learning curve that consumers need to go through (Tongxiao *et al.*, 2011) and avoiding the pain of losing intimacy with the equipment with each new version that might be frequently launched. These requirements should be guaranteed so that retailers could also take advantage of advertising and promotional strategies, ensuring clear and persuasive communication regarding the ease of using self-service checkouts and their gains in TSs, reinforcing the indication by Demoulin and Djelassi (2016). Simultaneously, in-store actions to promote the use of the checkouts could count on promotional discounts on certain products when paid exclusively at the SSTs. At the same time, employees could initially be available to assist in the process, providing support and incentives for the service experimentation. Results show that when consumers already have experience with SSTs, they tend to value utility benefits more and enhance the efficiency of shopping activity (Tongxiao *et al.*, 2011), reinforcing the need for an initial nudge. The NI was an essential predictor of rejecting SSTs. Age also plays a role in the need for interaction which may justify targeting the group with special offers and assistance.

Thus, when companies analyse strategies and the cost–benefit of implementing an SST, they should first focus on understanding their target consumer, considering a dual method approach. One of the conclusions drawn from this study is that target consumers' age and behavioural traits display different levels of NI and TA. In markets targeting older consumers with a higher NI and some discomfort with using new technological devices, the cost of strategies to encourage and monitor new users may be too high and jeopardise the benefits of the implementation. However, in a sector having a diversified range of consumers, it may be helpful to prioritise some stores to implement SSTs based on size, product portfolio or location.

Since only a tiny percentage of customers enthusiastically use SST, retailers must understand if the implementation of SSTs matches their customer needs and, ultimately, how to maximise the investment when adapting their strategy to the future retail landscape.

6.3 Limitations and future research

The Covid19 outbreak was revealed to be an exogenous aspect of this research that may have influenced the impact of behavioural traits, technology anxiety (TA) and SA. The pandemic brought challenges, impacts and behavioural changes that affected the propensity and desire to use SSTs. Future studies can retest current hypotheses to confirm behavioural traits' influence on adopting SSTs. Moreover, adopting SSTs within a scenario of omnichannel strategy should also be considered to examine if having different SSTs alternatives affects consumers' behaviour. A longitudinal study was also beneficial since it is expected that, as time goes by, some learning effects occur, and the fear and discomfort associated with SSTs will diminish. The current study is an online survey-based investigation based on customer self-report perceptions, which may have affected the results. Furthermore, as confirmatory tetrad analysis (CTA) was not performed due to an insufficient number of indicators in some constructs, there is the risk of inaccurate inner model parameter estimates of indicators. Future research should go beyond perceptions and self-assessed measures by examining customers' actual STTs' usage behaviour.

References

Agarwal, R. and Karahanna, E. (2000), "Time flies when you're having fun: cognitive absorption and beliefs about information technology usage", *MIS Quarterly: Management Information Systems*, Vol. 24 No. 4, pp. 665-694.

Albers, S. (2010), "PLS and success factor studies in marketing", in Esposito Vinzi, V., Chin, W.W., Henseler, J. and Wang, H. (Eds), *Handbook of Partial Least Squares*, Springer, Berlin, pp. 409-425.

Alpert, H.K. (2008), "The self-service 'buy-and-pay' market: kiosk, vending and foodservice trends in the US", available at: http://academic.marketresearch.com/ (accessed 12 October 2008).

Amone, W. (2016), "Global market trends", in *International Business*, IGI Global, Hershey, Pennsylvania, pp. 16-36.

Baethge, C., Klier, J. and Klier, M. (2016), "Social commerce—state-of-the-art and future research directions", *Electronic Markets*, Vol. 26 No. 3, pp. 269-290.

Bagozzi, R.P. (2007), "The legacy of the technology acceptance model and a proposal for a paradigm shift", *Journal of the Association for Information Systems*, Vol. 8 No. 4, pp. 244-254.

Bateson, J.E. (1985), "Self-service consumer: an exploratory study", *Journal of Retailing*, Vol. 61 No. 3, pp. 49-76.

Belk, R.W. (1974), "An exploratory assessment of situational effects in buyer behavior", *Journal of Marketing Research*, Vol. 11 No. 2, p. 156.

Binns, J. (2017), "Rebecca Minkoff deploys self-checkout technology", *Retail Info Systems*, available at: https://risnews.com/rebecca-minkoff-deploys-self-checkout-technology (accessed 4 May 2022).

Bitner, M.J. (2001), "Self-service technologies: what do customers expect?", *Marketing Management*, Vol. 10 No. 1, p. 10.

Boudkouss, H. and Djelassi, S. (2021), "Understanding in-store interactive technology use: a uses and gratifications theory (UGT) perspective", *International Journal of Retail and Distribution Management*, Vol. 49 No. 12, pp. 1621-1639.

Bridges, E. and Florsheim, R. (2008), "Hedonic and utilitarian shopping goals: the online experience", *Journal of Business Research*, Vol. 61 No. 4, pp. 309-314.

Cadogan, J.W. and Lee, N. (2013), "Improper use of endogenous formative variables", *Journal of Business Research*, Vol. 66 No. 2, pp. 233-241.

Castillo, S., M.J. and Bigne, E. (2021), "A model of adoption of AR-based self-service technologies: a two country comparison", *International Journal of Retail and Distribution Management*, Vol. 49 No. 7, pp. 875-898.

Cebeci, U., Ertug, A. and Turkcan, H. (2020), "Exploring the determinants of intention to use self-checkout systems in super market chain and its application", *Management Science Letters*, Vol. 10 No. 5, pp. 1027-1036.

Cetto, A., Klier, J. and Klier, M. (2015), "Why should I do it myself? Hedonic and utilitarian motivations of customers' intention to use self-service technologies", *23rd European Conference on Information Systems, ECIS 2015, Vol. 2015-May, 23rd European Conference on Information Systems, ECIS 2015, 2015-May*, pp. 1-16.

Collier, J.E. and Barnes, D.C. (2015), "Self-service delight: exploring the hedonic aspects of self-service", *Journal of Business Research*, Vol. 68 No. 5, pp. 986-993.

Collier, J.E., Moore, R.S., Horky, A. and Moore, M.L. (2015), "Why the little things matter: exploring situational influences on customers' self-service technology decisions", *Journal of Business Research*, Vol. 68 No. 3, pp. 703-710.

Csikszentmihalyi, M. (2000), *Beyond Boredom and Anxiety*, Jossey-Bass, San Francisco.

Dabholkar, P.A. (1996), "Consumer evaluations of new technology-based self-service options: an investigation of alternative models of service quality", *International Journal of Research in Marketing*, Vol. 13 No. 1, pp. 29-51.

Dabholkar, P.A. and Bagozzi, R.P. (2002), "An attitudinal model of technology-based self-service: moderating effects of consumer traits and situational factors", *Journal of the Academy of Marketing Science*, Vol. 30 No. 3, pp. 184-201.

Dabholkar, P.A., Bobbitt, L.M. and Lee, E.J. (2003), "Understanding consumer motivation and behavior related to self-scanning in retailing implications for strategy and research on technology-based self-service", *International Journal of Service Industry Management*, Vol. 14 No. 1, pp. 59-95.

Davis, F.D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technology", *MIS Quarterly*, pp. 319-340.

Davis, F.D., Bagozzi, R.P. and Warshaw, P.R. (1989), "User acceptance of computer technology: a comparison of two theoretical models", *Management Science*, Vol. 35 No. 8, pp. 982-1003.

De Cicco, R., Silva, S.C. and Alparone, F.R. (2020), "Millennials' attitude toward chatbots: an experimental study in a social relationship perspective", *International Journal of Retail and Distribution Management*, doi: 10.1108/IJRDM-12-2019-0406.

de Souza Bido, D. and Da Silva, D. (2019), "SmartPLS 3: especificação, estimação, avaliação e relato", *Administração: Ensino e Pesquisa*, Vol. 20 No. 2, pp. 488-536.

Demoulin, N.T. and Djelassi, S. (2016), "An integrated model of self-service technology (SST) usage in a retail context", *International Journal of Retail and Distribution Management*, Vol. 44 No. 5, pp. 540-559.

Duarte, P. and Amaro, S. (2018), "Methods for modelling reflective-formative second order constructs in PLS: an application to online travel shopping", *Journal of Hospitality and Tourism Technology*, Vol. 9 No. 3, pp. 295-313.

Duarte, P., Silva, S. and Ferreira, M.B. (2018), "How convenient is it? Delivering online shopping convenience to enhance customer satisfaction and encourage e-WOM", *Journal of Retailing and Consumer Services*, Vol. 44 September, pp. 161-169.

Dul, J. (2016), "Necessary Condition Analysis (NCA)", *Organizational Research Methods*, Vol. 19 No. 1, pp. 10-52.

Dul, J. (2021), "Necessary Condition Analysis. R package version 3.1.1", R Package Version 3.1.1.

Elliott, K.M., Meng, J.G. and Hall, M.C. (2008), "Technology Readiness and the Likelihood to use self-service technology: Chinese vs American consumers", *Marketing Management Journal*, Vol. 18 No. 2, pp. 20-31.

Fenigstein, A., Scheier, M.F. and Buss, A.H. (1975), "Public and private self-consciousness: assessment and theory", *Journal of Consulting and Clinical Psychology*, Vol. 43 No. 4, pp. 522-527.

Forman, A.M. and Sriram, V. (1991), "The depersonalization of retailing: its impact on the 'lonely' consumer", *Journal of Retailing*, Vol. 67 No. 2, p. 226.

Ghani, J.A., Supnick, R. and Rooney, P. (1991), "The experience of flow in computer-mediated and in face-to-face groups", *ICIS 1991 Proceedings*, Vol. 91, p. Paper 9.

Gilliland, N. (2016), "Zara introduces self-checkout in-store: how will it impact the customer experience?", *Econsultancy*, available at: https://econsultancy.com/zara-introduces-self-checkout-in-store-how-will-it-impact-the-customer-experience/.

Hair, J.F., Sarstedt, M., Ringle, C.M. and Mena, J.A. (2012), "An assessment of the use of partial least squares structural equation modeling in marketing research", *Journal of the Academy of Marketing Science*, No. 403, pp. 414-433.

Hair, J.F., Risher, J.J., Sarstedt, M. and Ringle, C.M. (2019), European Business Review.When to use and how to report the results of PLS-SEM.

Harding, E. (2012), "How cheating at checkouts is turning us into a nation of self-service shoplifters", *Daily Mail*, 25 April, available at: www.dailymail.co.uk/news/article-2135284/How-cheating-checkouts-turning-nation-self-service-shoplifters.html (accessed 6 September 2022).

Henseler, J. (2017), "Partial least squares path modeling", in Leeflang, P.S.H., Wieringa, J.E., Bijmolt, T.H.A. and Pauwels, K.H. (Eds), *Advanced Methods for Modeling Markets*, Springer International Publishing AG, pp. 361-381, doi: 10.1007/978-3-319-53469-5_12.

Holbrook, M.B. and Hirschman, E.C. (1982), "The experiential aspects of consumption: consumer fantasies, feelings, and fun", *Journal of Consumer Research*, Vol. 9 No. 2, p. 132.

Holman, L. and Buzek, G. (2007), "Market study: 2007 North American self-service kiosks", IHL Consulting Group, available at: http://www.ihlservices.com/ihl/public_downloads/pdf5.pdf (accessed 14 September 2008).

IHL (2019), "Decathlon introduces Scan and Go mobile self-checkout", *Essential Retail*, available at: https://www.ihlservices.com/newsletter/june-1-2019/ (accessed 13 December 2018).

Jarvis, C.B., MacKenzie, S.B. and Podsakoff, P.M. (2003), "A critical review of construct indicators and measurement model misspecification in marketing and consumer research", *Journal of Consumer Research*, Vol. 30 No. 2, pp. 199-218.

Johnson, V.L., Woolridge, R.W. and Bell, J.R. (2021), "The impact of consumer confusion on mobile self-checkout adoption", *Journal of Computer Information Systems*, Vol. 61 No. 1, pp. 76-86.

Johnson, V.L., Woolridge, R.W., Wang, W. and Bell, J.R. (2020), "The impact of perceived privacy, accuracy and security on the adoption of mobile self-checkout systems", *Journal of Innovation Economics and Management*, Vol. 31 No. 1, pp. 221-247.

Kinard, B.R., Capella, M.L. and Kinard, J.L. (2009), "The impact of social presence on technology based self-service use: the role of familiarity", *Services Marketing Quarterly*, Vol. 30 No. 3, pp. 303-314.

Koufaris, M. (2002), "Applying the technology acceptance model and flow theory to online consumer behavior", *Information Systems Research*, Vol. 13 No. 2, pp. 205-223.

Larson, R.B. (2019), "Supermarket self-checkout usage in the United States", *Services Marketing Quarterly*, doi: 10.1080/15332969.2019.1592861.

Lee, H.-J. (2015), "Consumer-to-store employee and consumer-to-self-service technology (SST) interactions in a retail setting", *International Journal of Retail and Distribution Management*, Vol. 43 No. 8, pp. 676-692.

Lee, H.-J. and Lyu, J. (2016), "Personal values as determinants of intentions to use self-service technology in retailing", *Computers in Human Behavior*, Vol. 60 July, pp. 322-332.

Lee, H.J. and Lyu, J. (2019), "Exploring factors which motivate older consumers' self-service technologies (SSTs) adoption", *International Review of Retail, Distribution and Consumer Research*, Vol. 29 No. 2, pp. 218-239.

Lee, H.J., Cho, H.J., Xu, W. and Fairhurst, A. (2010), "The influence of consumer traits and demographics on intention to use retail self-service check-outs", *Marketing Intelligence and Planning*, Vol. 28 No. 1, pp. 46-58.

Lee, W., Castellanos, C. and Chris Choi, H.S. (2012), "The effect of technology readiness on customers' attitudes toward self-service technology and its adoption; the empirical study of U.S. Airline self-service check-in kiosks", *Journal of Travel and Tourism Marketing*, Vol. 29 No. 8, pp. 731-743.

Lee, H.J., Fairhurst, A. and Cho, H.J. (2013), "Gender differences in consumer evaluations of service quality: self-service kiosks in retail", *Service Industries Journal*, Vol. 33 No. 2, pp. 248-265.

Lesonsky, R. (2017), "Consumers love shopping in stores – it's check-out they hate last", *Retail Trend*, available at: https://smallbiztrends.com/2013/06/consumers-love-shopping-hate-checkout.html.

Liang, Y., Lee, S.-H. and Workman, J.E. (2022), "How do consumers perceive mobile self-checkout in fashion retail stores?", *International Journal of Retail and Distribution Management*, Vol. 50 No. 6, pp. 677-691.

Marino-Nachison, D. (2018), "Urban Outfitters: self checkout is 'exceeding expectations", *Barron's*, available at: https://www.barrons.com/articles/urban-outfitters-self-checkout-is-exceeding-expectations-1534970120 (accessed 4 May 2022).

Mehta, S., Saxena, T. and Purohit, N. (2020), "The new consumer behaviour paradigm amid COVID-19: permanent or transient?", *Journal of Health Management*, Vol. 22 No. 2, pp. 291-301.

Meuter, M.L., Ostrom, A.L., Roundtree, R.I. and Bitner, M.J. (2000), "Self-service technologies: understanding customer satisfaction with technology-based service encounters", *Journal of Marketing*, Vol. 64 No. 3, pp. 50-64.

Meuter, M.L., Ostrom, A.L., Bitner, M.J. and Roundtree, R. (2003), "The influence of technology anxiety on consumer use and experiences with self-service technologies", *Journal of Business Research*, Vol. 56 No. 11, pp. 899-906.

Meuter, M.L., Bitner, M.J., Ostrom, A.L. and Brown, S.W. (2005), "Choosing among alternative service delivery modes: an investigation of customer trial of self-service technologies", *Journal of Marketing*, Vol. 69 No. 2, pp. 61-83.

Mordor Intelligence (2020), "Self-checkout system market | 2021-26 | Industry share, size, growth", available at: https://www.mordorintelligence.com/industry-reports/self-checkout-system-market.

Mordor Intelligence (2021), "Self-checkout system market - growth, trends, covid-19 impact, and forecasts", available at: https://www.mordorintelligence.com/industry-reports/self-checkout-system-market.

Morimura, F. and Nishioka, K. (2016), "Waiting in exit-stage operations: expectation for self-checkout systems and overall satisfaction", *Journal of Marketing Channels*, Vol. 23 No. 4, pp. 241-254.

Novak, T.P., Hoffman, D.L. and Yung, Y.F. (2000), "Measuring the customer experience in online environments: a structural modeling approach", *Marketing Science*, Vol. 19 No. 1, pp. 22-42.

Orel, F.D. and Kara, A. (2014), "Supermarket self-checkout service quality, customer satisfaction, and loyalty: empirical evidence from an emerging", *Journal of Retailing and Consumer services*, Vol. 21 No. 2, pp. 118-129.

Parasuraman, A. (2000), "Technology readiness index (tri)", *Journal of Service Research*, Vol. 2 No. 4, pp. 307-320.

Parasuraman, A., Zeithaml, V.A. and Berry, L.L. (1985), "A conceptual model of service quality and its implications for future research", *Journal of Marketing*, Vol. 49 No. 4, p. 41.

Rinta-Kahila, T., Penttinen, E., Kumar, A. and Janakiraman, R. (2021), "Customer reactions to self-checkout discontinuance", *Journal of Retailing and Consumer Services*, Vol. 61, doi: 10.1016/j.jretconser.2021.102498.

Sarel, D. and Marmorstein, H. (2003), "Marketing online banking services: the voice of the customer", *Journal of Financial Services Marketing*, Vol. 8 No. 2, pp. 106-118.

Sarstedt, M., Hair, J.F., Cheah, J.H., Becker, J.M. and Ringle, C.M. (2019), "How to specify, estimate, and validate higher-order constructs in PLS-SEM", *Australasian Marketing Journal*, Vol. 27 No. 3, pp. 197-211.

Schenkman, B.N. and Jönsson, F.U. (2000), "Aesthetics and preferences of web", *Behaviour and Information Technology*, Vol. 19 No. 5, pp. 367-377.

Seifert, A. and Charness, N. (2022), "Digital transformation of everyday lives of older Swiss adults: use of and attitudes toward current and future digital services", *European Journal of Ageing*, doi: 10.1007/s10433-021-00677-9.

Sharma, P., Ueno, A. and Kingshott, R. (2021), "Self-service technology in supermarkets – do frontline staff still matter?", *Journal of Retailing and Consumer Services*, Vol. 59, 102356, doi: 10.1016/j.jretconser.2020.102356.

Sheth, J.N., Newman, B.I. and Gross, B.L. (1991), "Why we buy what we buy: a theory of consumption values", *Journal of Business Research*, Vol. 22 No. 2, pp. 159-170.

Shin, D.H. (2012), "Cross-analysis of usability and aesthetic in smart devices: what influences users' preferences?", *Cross Cultural Management, An International Journal, Cross Cultural Management*, Vol. 19 No. 4, pp. 563-587.

Sozzi, B. (2016), "McDonald's rolling out self-ordering kiosks in europe; will U.S. Be next?", *The Street*, p. 1.

Statistica (2014), "Improvements to self-checkout for optimising the shopping experience worldwide 2014", *Statistica*, available at: https://www.statista.com/statistics/326341/improvements-to-self-checkout-for-optimizing-the-shopping-experience-worldwide/.

Statistica (2021), "Number of stores which offer autonomous check-outs worldwide from 2018 to 2024", available at: https://www.statista.com/statistics/1033836/number-of-stores-with-autonomous-checkouts-worldwide/ (accessed 4 May 2022).

Surprenant, C.F. and Solomon, M.R. (1987), "Predictability and personalisation in the service encounter", *Journal of Marketing*, Vol. 51 No. 2, p. 86.

Thomas-Francois, K. and Somogyi, S. (2022), "Self-Checkout behaviours at supermarkets: does the technological acceptance model (TAM) predict smart grocery shopping adoption?", *International Review of Retail, Distribution and Consumer Research*, doi: 10.1080/09593969.2022.2051195.

Tongxiao (Catherine), Z., Agarwal, R. and Lucas, H.C. Jr (2011), "The value of IT-enabled retailer learning: personalised product recommendations and customer store loyalty in electronic markets", *Mis Quarterly*, pp. 859-881.

Tractinsky, N. (2004), "Toward the study of aesthetics in information technology", *Proceedings 25th International Conference on Information Systems*, pp. 771-780.

Venkatesh, V. (2000), "Determinants of perceived ease of use: integrating control, intrinsic motivation, and emotion into the technology acceptance model", *Information Systems Research*, Vol. 11 No. 4, pp. 342-365.

Venkatesh, V., Ramesh, V. and Massey, A.P. (2003), "Understanding usability in mobile commerce", *Communications of the ACM*.

Walker, R.H. and Johnson, L.W. (2006), "Why consumers use and do not use technology-enabled services", *Journal of Services Marketing*, Vol. 20 No. 2, pp. 125-135.

Wang, C., Harris, J. and Patterson, P.G. (2017), "Modeling the habit of self-service technology usage", *Australian Journal of Management*, Vol. 42 No. 3, pp. 462-481.

Wei, W., Torres, E.N. and Hua, N. (2017), "The power of self-service technologies in creating transcendent service experiences: the paradox of extrinsic attributes", *International Journal of Contemporary Hospitality Management*, Vol. 29 No. 6, pp. 1599-1618.

(The Appendix follows overleaf)

Appendix 1

Table A1. Convergent validity and internal consistency

Latent variable	Questionnaire item	Loadings	AVE	CR
Time-Saving (TS)	TS1(r): I believe I would need a lot of time for using the Self-Service Checkout	0.747	0.658	0.884
	TS2: I believe the paying process with the Self-Checkout is very quick	0.879		
	TS3: I believe the waiting time for using the SSTs is very quick	0.737		
	TS4: Shopping with the SSTs would allow me to save time	0.870		
Reliability (RE)	RE1: I believe that using the SSTs is accurate (means I will get just what I ordered)	0.765	0.587	0.849
	RE2(r): I believe using the SSTs would result in errors in the order	0.662		
	RE3(r): Using the SSTs is something I don't expect to work very well	0.788		
	RE4: I believe using the SSTs is reliable	0.837		
Control (CO)	CO1: The usage of the SSTs gives me control	0.863	0.724	0.887
	CO2: The usage of the SSTs lets me be in charge of the right result	0.906		
	CO3: The usage of the SSTs lets me be in charge of the right price	0.779		
Ease of use (EU)	EU1(r): I believe the usage of the SSTs is complicated	0.936	0.871	0.953
	EU2(r): I believe the usage of the SSTs takes a lot of effort	0.927		
	EU3(r): I believe the usage of the SSTs is slow and complex	0.936		
Avoidance of service employee (AS)	AS1: Personal attention by the service employee is not important to me	0.599	0.649	0.778
	AS2: It does not bother me to use a machine when I could talk to a person instead	0.969		
Inherent Novelty Seek (INS)	INS1: I am always seeking new ideas and experiences	0.867	0.718	0.911
	INS2: When things get bored I like to find new and unfamiliar experiences	0.872		
	INS3: I prefer a routine way of doing things to experimenting with new things	*(deleted)*		
	INS4: I like to experience novelty and change in my daily routine	0.841		
	INS5: I would like to experience novelty and change in the SSTs	0.809		
Enjoyment (EN)	EN1: I believe it would be enjoyable to use the SST	0.922	0.862	0.949
	EN2: I believe it would be exciting to use the SST	0.925		
	EN3: I believe it would be pleasant to use the SST	*(deleted)*		
	EN4: I believe it would be interesting to use the SST	0.937		
Challenges (CH)	CH1: Using the SSTs challenged me to perform to the best of my ability	0.957	0.903	0.949
	CH2: Using the SSTs provided a good test of my skills	0.944		

(*continued*)

Latent variable	Questionnaire item	Loadings	AVE	CR
Attractiveness (AT)	AT1: If the SSTs is aesthetically appealing, I would be more likely to use it	0.964	0.735	0.889
	AT2: If the SSTs are physically pleasing it would give me satisfaction, thus increasing my likelihood of using it positively	0.965		
	AT3: I would not use SSTs if it was not aesthetically appealing	0.588		
Technology anxiety (TA)	TA1(r): I am confident I can learn technology-related skills	0.798	0.568	0.922
	TA2: I have difficulty understanding most technological matters	0.749		
	TA3: I feel apprehensive about using technology	0.703		
	TA4: When given the opportunity to use technology, I fear I might damage it in some way	0.809		
	TA5(r): I am sure of my ability to interpret the technological output	0.735		
	TA6: Technological terminology sounds like confusing jargon to me	0.626		
	TA7: I have avoided technology because it is unfamiliar to me	0.790		
	TA8(r): I am able to keep up with important technological advances	0.718		
	TA9: I hesitate to use technology for fear of making mistakes I cannot correct	0.831		
Need for interaction (NI)	NI1: Human contact in providing services makes the process enjoyable for the customer	0.860	0.765	0.907
	NI2: I like interacting with the person who provides the service	0.925		
	NI3(r): Personal attention by the service employee is not very important to me	0.837		
Social anxiety (SA)	*SA1: It takes me time to overcome my shyness in new situations*	*(deleted)*	0.662	0.887
	SA2: I have trouble working when someone is watching me	0.769		
	SA3: I get embarrassed very easily	0.805		
	SA4: I don't find it hard to talk to strangers	*(deleted)*		
	SA5: I feel anxious when I speak in front of a group	0.774		
	SA6: Large groups make me nervous	0.901		
Intention of use (IU)	IU1: In the future, how likely is it that you would use self-scanning technology if it were available at the store in which you are shopping?	0.909	0.856	0.922
	IU2: If SSTs are available at the store, they are your first choice?	0.941		

Note(s): (r) reverse coded items; AVE – average variance extracted; CR – composite reliability
TS, RE, CO, EU, AS, EN and NI were adapted from Dabholkar (1996)
INS and CH were adapted from Cetto *et al.* (2015)
AT was adapted from Morimura and Nishioka (2016)
TA was adapted from Meuter *et al.* (2003)
SA was adapted from Fenigstein *et al.* (1975)
IU was adapted Elliott *et al.* (2008)

Table A1.

Appendix 2

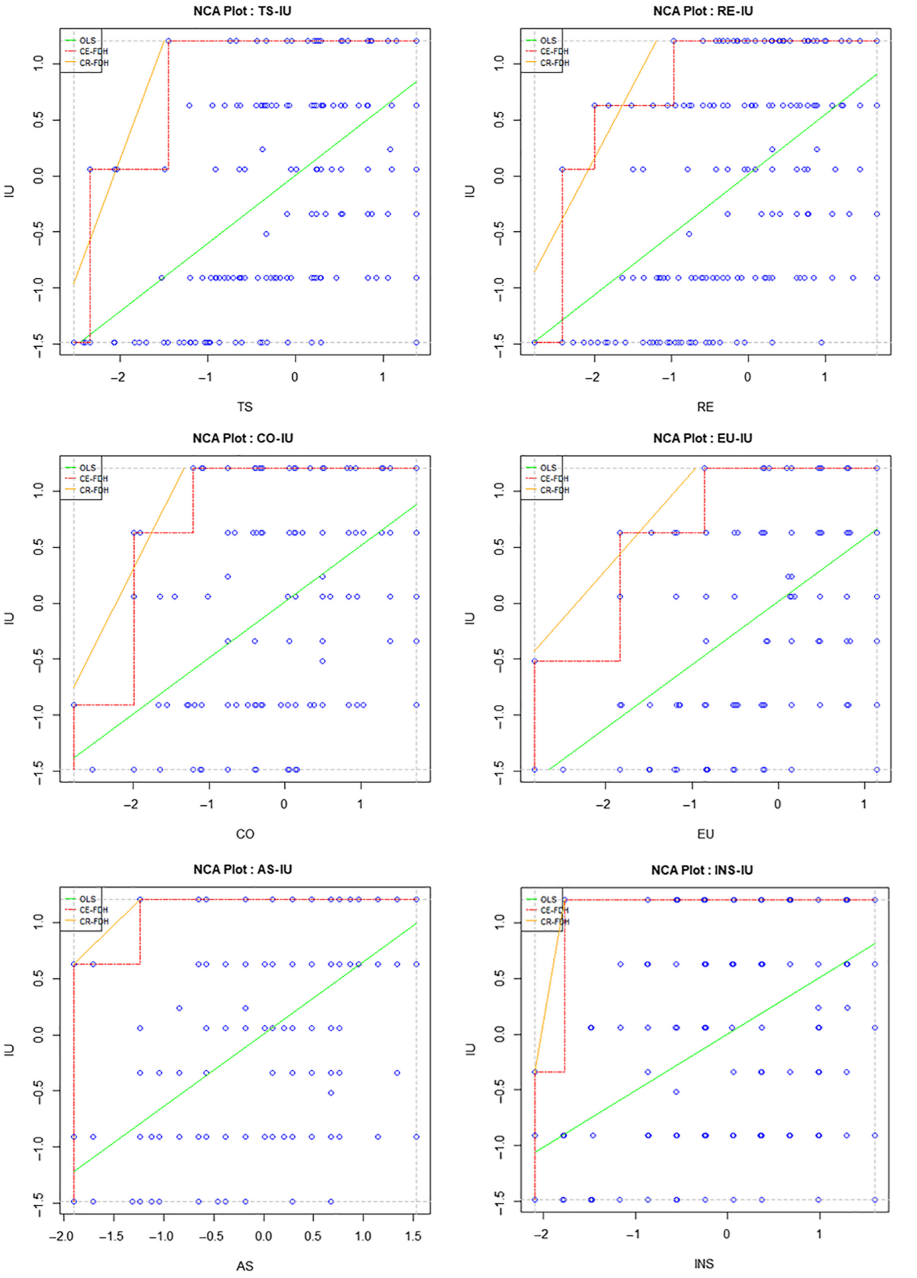


Figure A1.
NCA results – ceiling graphic analysis

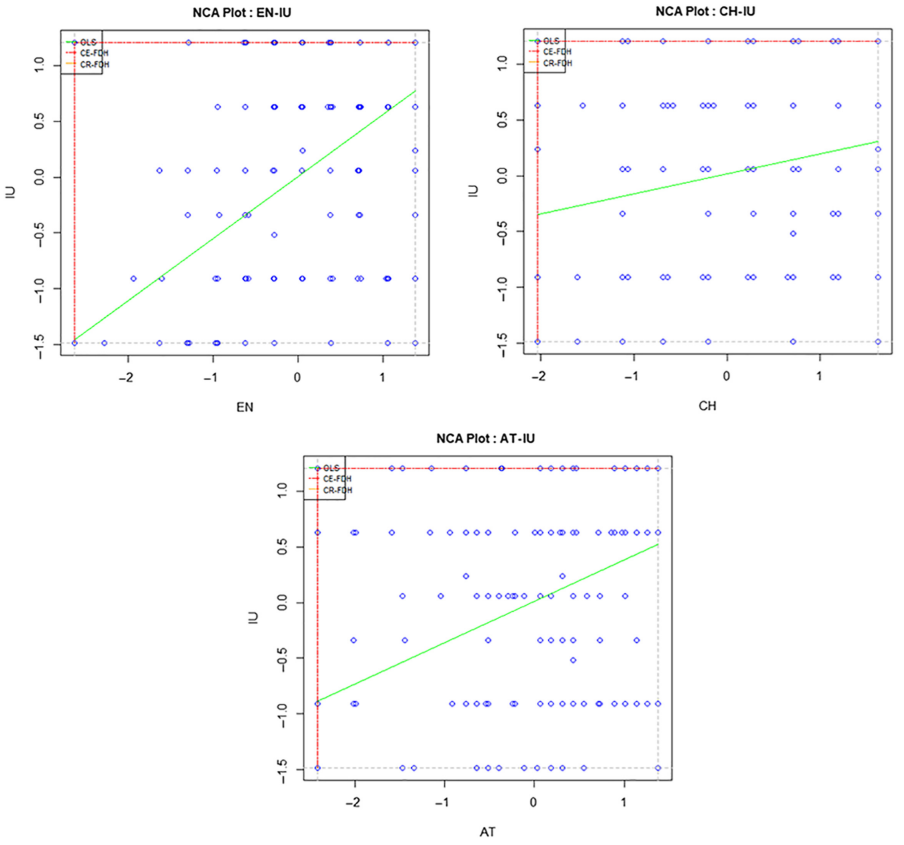


Figure A1.

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