

# The role of perceived usefulness and annoyance on programmatic advertising: the moderating effect of Internet user privacy and cookies

Perceptions in  
programmatic  
advertising

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## Abstract

**Purpose** – The study of the background to programmatic advertising is of great interest in the context of digital marketing. Therefore, the main aim of this research is to define a structural equation modelling (SEM) model, which allows studying the relationship between the usefulness and privacy of online ads to increase the effectiveness and efficiency of campaigns through the use of computation and big data.

**Design/methodology/approach** – A cross-sectional descriptive study based on the Web Browsers Survey was carried out on a sample of 24,062 Internet users by the Association for Media Research. The partial least squares structural equation modelling method (PLS-SEM) was applied to evaluate the model with the study constructs and test the hypotheses.

**Findings** – The result of this research allows us to know how perceived usefulness (U) and perceived annoyance (A) affect users' privacy concerns (P) and concerns about the storage and use of their data through cookies (C). The authors also seek if there is any relationship between privacy concerns (P) and cookies (C) on users' level of Internet usage (IU).

**Originality/value** – One of the novelties of this study is the consideration not only of Internet user perceptions but also their concerns about privacy and the use of cookies, as key variables in the strategic management of the use of programmatic advertising in digital marketing.

**Keywords** Digital marketing, Programmatic advertising, PLS-SEM model, Perceived usefulness, Perceived annoyance, Cookies, Privacy, Usability, Internet usage

**Paper type** Research paper

## 1. Introduction

Technology has been one of the most disruptive elements of the last century and the marketing discipline has not been immune to this “digital revolution”. Since the emergence of the Internet and as its user base has grown, its influence and relevance in the field of marketing has also become increasingly important. For companies, the ability to accumulate detailed information about their consumers, competitors and the market in general has affected the marketing mix in different ways (Langan *et al.*, 2019).

Continuous technological advances and in particular elements such as the increase in connection speeds, the increase in data processing capacity that makes it possible to manage large amounts of data in a matter of milliseconds, the internationalisation of the digital market or the capacity to store large amounts of data in the cloud make the use of these ad exchange spaces an increasingly attractive alternative for advertisers (Bush, 2014).

The development and use of techniques such as big data, artificial intelligence or data mining, among other technologies, have allowed companies to improve the effectiveness of their programmatic advertising campaigns through the possibility of better targeting the desired audience (Beerli-Palacio and Martín-Santana, 2017; Shehu *et al.*, 2021). However,



this can cause users to feel a sense of continuous surveillance or persecution by the appearance of advertisements and offers for products in which they might be interested while browsing the Internet (Kannan and Li, 2017).

Despite the growing interest in contributions to the digital marketing literature, there is a gap on programmatic advertising (Langan *et al.*, 2019). Previous research has focused on examining consumer response to “personalised” ads (Aguirre *et al.*, 2015). Thus, the present work can make an important contribution to literature and management in the area of digital marketing.

So, the main aim of this research is to propose a SEM model that explains the relationship between perceived usefulness and perceived annoyance of programmatic advertising and privacy concerns and cookie concerns as well as the effect on the level of usage (Rigdon, 2012).

## 2. Conceptual framework and hypotheses

### 2.1 Research framework

The relationships of the model developed and the associated hypotheses are shown in Figure 1. It summarised the research model with the study constructs and the hypothesised links between them.

In this way, the aim of the model is to explain the effects of perceived usefulness (U) and perceived annoyance (A) on users’ privacy concerns (P) and concerns about the storage and use of their data through cookies (C). We also study whether there is any relationship between privacy concerns (P) and cookies (C) on users’ level of Internet usage (IU).

Programmatic advertising is the automated buying of content or advertising space in real time based on opportunities to display advertising on a one-to-one basis (Bush, 2014). It uses an automated big data system that allows organisations (especially retailers) to bid for the privilege of publishing online advertising in the right place, to the right people at the right time (Samuel *et al.*, 2021).

In the communication ecosystem, programmatic advertising is seen as a disruptive element as it has lowered the costs and risks of mass advertising that have often been criticised, presenting a more cost-effective way of advertising and providing a competitive advantage for those organisations that manage to understand their ecosystem (Fernandez-Tapia, 2019).

Programmatic buying is a process in which, from the supply side, web publishers invite organisations (buyers) to participate in a bidding process to buy the online space where to advertise, being this space personalised for the user who accesses the website and sees this ad (Gertz and McGlashan, 2016). This occurs through *Demand-side platforms* (DSPs) that look after the interest of the buyer of the advertising space, *Data-side platforms* (DMPs) that

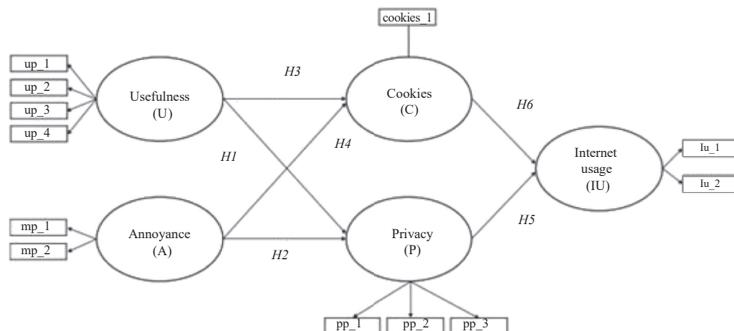


Figure 1. Conceptual model

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look after the interest of the buyer of the advertising space *Data management platforms* (DMPs) that collect the data of the users that enter the websites and *Supply-side platforms* (SSPs) that manage the space available for purchase and display metrics of these (Balseiro and Candogan, 2017). Thus, the DSPs, based on this data, automatically calculate (in a matter of milliseconds) whether the advertising space is appropriate, the value of the space and the type of communication or creative that should be used in it (Bush, 2014; Gertz and McGlashan, 2016; Samuel *et al.*, 2021).

Programmatic advertising is therefore born from the use of technology in the buying and selling of digital advertising, but it is necessary to differentiate it from real time bidding (RTB), which was born as a response to the large amount of supply of spaces on the Internet and demand from advertisers to place their ads in these, resulting in a real-time auction system (Aslam and Karjaluoto, 2017). So, RTB is a model for computational advertising that uses technologies such as big data (Loebbecke *et al.*, 2020). It is based on the analysis of a massive amount of data generated by cookies from Internet users and it has the ability to identify the characteristics and interests in real time of the target audience viewing each ad impression, thus offering ads that best match the user's interests and optimising their prices through a programmatic auction method (Miralles-Pechuán *et al.*, 2021).

This method has meant a change in digital advertising, moving from the traditional method known as media buying or ad-slot buying to target audience buying, focused on the target audience, which is expected to be the standard model for online advertising in the future (Yuan *et al.*, 2014).

Thus, it is important to highlight that programmatic advertising is different from RTB in that non-real-time deals can also occur, with fixed prices that have not been established in an auction or with great weight of the human team in decision-making (Carrillo-Durán and Rodríguez-Silgado, 2018).

Therefore, although all real-time buying is programmatic buying, not all programmatic advertising is bought in real time through RTB, since programmatic is the automation of digital mediabuying, while RTB is a type of programmatic buying (Seitz and Zorn, 2016).

All this constitutes an ecosystem in which data takes on special importance, managing audience profiles instead of advertising spaces (Malthouse *et al.*, 2019). Thus, massive data management systems (big data) will be important, although paying special attention to those that help define the campaign and the quality of these, since the quality of the inventory of websites will be proportional to the response of the audience to which it is advertised (Carrillo-Durán and Rodríguez-Silgado, 2018).

Programmatic advertising emerges as a way to respond to a type of digital marketing focused on a personalised user experience and useful for the consumer, who is offered advertisements and information based on their habits (McGuigan, 2019). But this is the result of a process that includes recording and processing user data and developing consumer profiles (Kamara and Kosta, 2016). This method of obtaining information has generated debate about the potential negative impacts of not protecting privacy and personal data, such as price and service discrimination, information bubbles, surveillance or misuse of personal information (Mills *et al.*, 2019).

The perceived usefulness of programmatic advertising has a direct influence on users' privacy concerns (Palos-Sanchez *et al.*, 2019). This fact, known as the "personalization paradox", is that although consumers perceive the fact that they are shown ads they may be interested in based on their habits as something positive, at the same time, the collection and use of massive data ends up undermining the positive impact of the increased effectiveness of advertising (Aguirre *et al.*, 2015). Despite the perceived usefulness of programmatic advertising for users, there is a sense of insecurity among users, who are becoming increasingly aware of the potential privacy and personal data issues online (Roca *et al.*, 2009; Yang and Nair, 2014). Therefore, the following hypotheses can be defined:

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- H1.* User perceived usefulness of programmatic advertising negatively influences privacy concerns.
- H2.* User perceived annoyance with programmatic advertising positively influences privacy concern.

Some users report being satisfied with the perceived usefulness of personalised offers and ads through programmatic buying (Liu and Mattila, 2017), although to achieve this personalisation, companies use data analysis techniques of the users themselves through the use of cookies among other techniques (Järvinen and Karjaluoto, 2015; Li and Huang, 2016). So, the responsible use of these tools and the ability to observe the consequences derived from this use are emerging as an important professional and functional challenge (Martínez-Martínez, 2017). Therefore, the following hypotheses can be defined:

- H3.* User perceived usefulness of programmatic advertising has a negative influence on concerns about the use of cookies.
- H4.* User perceived annoyance with programmatic advertising positively influences concerns about the use of cookies.

Whenever dealing with data and especially big data, the first step is to obtain this data, which can be obtained from third parties or directly from users (Li *et al.*, 2018). If these data contain personal information, these data will be subject to the Data Protection Directive (Directive 95/46/EC), which requires, among other requirements, that the owner of the personal data is informed that his or her data are collected and processed and gives his or her explicit permission to process them (Cooper *et al.*, 2022). On the other hand, if the data are obtained directly, the relevant national implementation of the Data Protection Directive will be necessary. In this case, however, even if the data are not of a personal nature, the ePrivacy Directive (Directive 2002/58/EC as amended by Directive 2009/136/EC) requires that consent is obtained from the user before obtaining or storing their information (Beverungen *et al.*, 2019). This often applies to elements such as cookies, client-side javascript, personal identifiers on smartphones or other technologies to collect information from users browsing the Internet (IAB Spain, 2014).

Concerns about the privacy of Internet users have always existed to a greater or lesser extent and have been a matter of dispute especially in recent years (Edelman, 2014). This issue is exacerbated by the difficulty of assessing users' privacy violations due to the identical protected identity of users, coupled with the fact that the international nature of data makes it more complicated to strike a balance between the free flow of information and law enforcement in the physical world (Chen *et al.*, 2019). Therefore, the following hypotheses can be defined:

- H5.* Privacy concerns negatively influence the level of Internet usage.
- H6.* Concerns about the use of cookies have a negative impact on the level of Internet usage.

### 3. Research methodology

This research is based on a cross-sectional descriptive study using the Annual Survey "Web Browsers", conducted by Association for Media Research (AIMC) from October to December 2021. The total number of valid questionnaires collected was 24.062 Internet users.

The composition of the sample was 70.6% male and 29.4% female. By age group, 2.1% are 15–19 years old, 5.8% are 20–24 years old, 15% are 25–34 years old, 26.1% are 35–44 years old, 27.8% are 45–54 years old, 15.9% are 55–64 years old and 7.2% are 65 and more years old.

By education, without education 0.7%, primary education 6.6%, secondary education 43.1% and university studies 49.4% (see [Table 1](#)).

The questionnaire is composed of several sections. So, data are collected about the demographic characteristics, attitudes, opinions and behaviour of Internet users. The scale used for these items has been a five-point Likert-type response format. It also included questions on a series of general classification variables.

In this model, there are five constructs (UP, MP, PP and UN) measured by multiple items, except the cookie concern construct is operationalised by a single indicator (*cookies\_1*), which relates to the following survey question: “How do you feel about the use of the following types of cookies when you browse the Internet? Advertising (to tailor the advertising shown to the user)” (see [Table 2](#)). This indicator is measured on a five-point scale indicating the respondent’s opinion (1 = totally acceptable, 5 = not at all acceptable). A single item has been used for practical considerations and being the only item, the construct and the indicator are equivalent (the relationship between the construct and the measure of a single indicator is always equal to the value one in partial least squares structural equation modelling (PLS-SEM)), so the choice of measurement approach in this construct is not relevant and the relationship between the construct and the indicator is directionless (see [Figure 1](#)).

## 4. Findings

### 4.1 Measurement model: reliability and validity

PLS-SEM is a variance-based exploratory multivariate analysis method that allows the incorporation of unobservable variables that are indirectly measured by means of observable variables ([Chin, 1998](#); [Hair et al., 2011](#)). The results were obtained using SmartPLS 3.3.2 ([Ringle et al., 2015](#)).

First, the reliability of the indicators has been analysed by looking at their convergent validity and internal consistency (see [Tables 2 and 3](#)). All loadings exceed 0.72 for these items. Using the rule of thumb of accepting items with loadings of 0.707, it shows that each variable explains a substantial part of the variance of each indicator ([Hair et al., 2014](#)). These results provide strong support for the reliability of reflective measures. In this model, the latent constructs were constructed with reflective measures. The reason is that this option can be

Gender	%	N
Male	70.6	16,992
Female	29.4	7,070
<i>Age</i>		
14–19	2.1	517
20–24	5.8	1,393
24–34	15	3,608
35–44	26.1	6,292
45–54	27.8	6,698
55–64	19.9	3,828
65 and more	7.2	1,726
<i>Education</i>		
No education	0.7	174
Primary education	6.6	1,595
Secondary education	43.1	10,365
University studies	49.4	11,893
More than 4	2.6	65

**Table 1.**  
Sample information

Construct	Code	Item	Factor loading
Usefulness (U)	up_1	I find advertising on the Internet more interesting than in other media	0.798
	up_2	I see Internet advertising as more useful than other media	0.743
	up_3	I usually look at advertising on the Internet	0.762
	up_4	Assessment of the presence of advertising on the Internet	0.728
Annoyance (A)	mp_1	I stop visiting a website if it has excessive advertising	0.811
	mp_2	I feel persecuted by advertisements on the Internet	0.874
Privacy (P)	pp_1	I am concerned about the use that may be made of the personal data I provide on the Internet	0.895
	pp_2	I am concerned about privacy on social networks	0.878
	pp_3	I am concerned about companies monitoring what I do on the Internet	0.843
Cookies (C)	cookies_1	How do you feel about the use of the following types of cookies when you browse the Internet?	1
Internet usage (IU)	Iu_1	How often do you actively access the Internet?	0.83
	Iu_2	How much time would you say you use the Internet on a daily basis?	0.863

**Table 2.**  
Constructs, codes and items, factor loading

**Source(s):** Elaboración propia a partir del cuestionario de la AIMC (2021)

**Table 3.**  
Cronbach's alpha, composite reliability (CR) and average variance extracted (AVE)

Constructs	Average variance extracted (AVE)	Composite reliability (CR)	Cronbach's alpha
U	0.575	0.844	0.757
A	0.711	0.831	0.596
IU	0.717	0.835	0.605
P	0.761	0.905	0.843

supported in that the effects when items are removed do not affect content validity and the items are correlated (Cuesta-Valiño *et al.*, 2022).

To assess internal consistency, Cronbach's alpha, composite reliability (CR) and average variance extracted (AVE) are used as shown in Table 3. All indicators show a satisfactory composite reliability value (Nunnally and Bernstein, 1994). Cronbach's alpha exceeds the recommended minimum of 0.60 for all indicators, although it should be noted that this measure is sensitive to the number of items in the scale and usually tends to underestimate internal consistency reliability, thus being a rather conservative measure of reliability (Hair *et al.*, 2019). For this internal consistency is also used the AVE and a value at least equal to 0.5 is recommended (Hair *et al.*, 2014). So, all the coefficients of each set of reflective measures in the study AVE exceed 0.5.

Discriminant validity informs us of the degree to which a construct is distinct from other constructs by empirical standards, showing that they are unique and capture phenomena not represented by other constructs in the model (Sarstedt *et al.*, 2017). So, AVE is also used for assessing discriminant validity when it is compared the square root of AVE with the correlations among constructs. The square root of AVE is greater than the correlation between the constructs (Fornell and Larcker, 1981). The result is shown in the main diagonal and the correlations of the different constructs outside the diagonal (see Table 4), showing how the square roots of the AVE values of the reflective constructs UP (0.758), A (0.843), IU (0.847), P (0.872) and are all higher than the correlations of these constructs with any other latent variable present in the model and thus indicating that all constructs are valid measures of single concepts.

It is common like a second option, the use of Heterotrait-Monotrait ratio of correlations (HTMT) in assessing the discriminant validity in PLS-SEM model. It is necessary to run the bootstrapping routine (5,000 bootstrap samples in our results) and if the value is below 0.90, discriminant validity has been established between two reflective constructs. In our model, all HTMT values are clearly below the 0.9 threshold (see [Tables 5 and 6](#)).

In [Table 6](#), we observe the original HTMT values in the “Original sample (O)” column for each pair of constructs present in the model and the mean HTMT values calculated from these 5,000 subsamples (column “Sample mean (M)”). The columns labelled 2.5 and 97.5% show the lower and upper limits for a 95% confidence interval and as can be seen, none of the confidence intervals include a value of 1, which speaks in favour of the discriminant validity of the constructs.

#### 4.2 Structural model: goodness of fit statistics

Absolute fit indices measure the extent to which a model fits the sample data ([McDonald and Ho, 2002](#)). [Henseler et al. \(2014\)](#) explain the standardised root mean square residual (SRMR) as a goodness of fit measure for PLS-SEM. Standardised SRMR is defined as the difference between the observed correlation and the model implied correlation matrix. A value less than 0.10 is considered to indicate a good fit to data ([Hu and Bentler, 1999](#)). For this model, SRMR is 0.079, indicating a good fit.

#### 4.3 Results of SEM

The conceptual model results (see [Table 7](#)) show that, although low, the relationships of perceived usefulness (U) with respect to cookie concern and privacy concern are significant

	U	A	IU	C	P
U	0.758				
A	-0.284	0.843			
IU	0.11	0.049	0.847		
C	-0.142	0.148	0.028	1	
P	-0.182	0.265	0.014	0.18	0.872

**Table 4.**  
Discriminant validity

	U	A	IU	C	P
U					
A	0.405				
IU	0.171	0.083			
C	0.158	0.19	0.036		
P	0.221	0.371	0.02	0.195	

**Table 5.**  
Heterotrait-Monotrait

	Original sample (O)	Sample mean (M)	Bias	2.50%	97.50%
U → C	-0.109	-0.109	0	-0.122	-0.096
U → P	-0.116	-0.116	0	-0.13	-0.102
A → C	0.117	0.117	0	0.103	0.13
A → P	0.232	0.232	0	0.218	0.246
C → IU	0.026	0.027	0	0.012	0.04
P → IU	0.009	0.01	0	-0.006	0.023

**Table 6.**  
Confidence intervals for HTMT

but negative, and it is also significant for the total effects perceived usefulness (U) and level of use (Table 8). The perceived annoyance (A) variable also shows a low but significant and positive relationship with respect to concern about cookies and concern about privacy and is also significant for the total effects perceived annoyance (A) and level of use (Table 8).

By analysing the path coefficients in the modelling window, we have arrived at the results of the relative importance of the exogenous constructs explaining privacy concern (P); we see that perceived annoyance (A) is stronger, presenting a stronger relationship than perceived usefulness (U). However, it can be observed that for the level of concern about cookies (C), perceived usefulness (U) presents a stronger relationship than perceived annoyance (A).

As for the level of use (IU) construct, it is observed that privacy concern (P) has no significant relationship and that cookie concern (C) has a positive but weak relationship with it (values close to zero) and therefore, the total effects explained by the perceived annoyance (A) and perceived usefulness (U) constructs are not strong either.

Although the relationship between concern about cookies and level of usage is positive and significant, however, it cannot be said that there is a relationship between privacy concerns and level of Internet use as it is not significant. So, the hypotheses H1, H2, H3, H4 and H6 are not rejected. However, the hypothesis H5 is rejected (Table 9).

### 5. Discussion and conclusions

Programmatic buying is a part of advertising that is gaining more and more followers and popularity among advertisers, proving to have great potential and capacity to generate Internet advertising campaigns that are increasingly better directed to the target audience of the company that uses it and therefore to report increasingly greater benefits as the technology that influences its operation improves (Cluley, 2020). However, one of the main drawbacks is the concern on the part of users about privacy and the processing of their data through the so-called cookies.

Thus, the proposed model aims to analyse the relationship between users' perceptions of online ads and their concerns about privacy and the collection of their data through cookies,

**Table 7.**  
Resultados del proceso de bootstraping

	Original sample (O)	Sample mean (M)	Desviación Estándar (STDEV)	Estadísticos <i>t</i> ((O/STDEV))	<i>P</i> Valores
U → C	-0.109	-0.109	0.007	15.812	0.000
U → P	-0.116	-0.116	0.007	16.197	0.000
A → C	0.017	0.117	0.007	16.827	0.000
A → P	0.232	0.232	0.007	31.696	0.000
C → IU	0.026	0.027	0.007	3.678	0.000
P → IU	0.009	0.01	0.007	1.261	0.207

**Table 8.**  
Resultados de los efectos totales

	Muestra original (O)	Media de la muestra (M)	Desviación Estándar (STDEV)	Estadísticos <i>t</i> ((O/STDEV))	<i>P</i> Valores
U → IU	-0.004	-0.004	0.001	3.886	0.000
U → C	-0.109	-0.109	0.007	15.812	0.000
U → P	-0.116	-0.116	0.007	16.197	0.000
A → IU	0.005	0.005	0.002	3.01	0.003
A → C	0.017	0.117	0.007	16.827	0.000
A → P	0.232	0.232	0.007	31.696	0.000
C → IU	0.026	0.027	0.007	3.678	0.000
P → IU	0.009	0.01	0.007	1.261	0.207

Hypo-thesis	Content	Verification
H1	User perceived usefulness of programmatic advertising negatively influences privacy concerns	Supported
H2	User perceived annoyance with programmatic advertising positively influences privacy concern	Supported
H3	User perceived usefulness of programmatic advertising has a negative influence on concerns about the use of cookies	Supported
H4	User perceived annoyance with programmatic advertising positively influences concerns about the use of cookies	Supported
H5	Privacy concerns negatively influence the level of Internet usage	Rejected
H6	Concerns about the use of cookies have a negative impact on the level of Internet usage	Supported

**Table 9.**  
Summary of hypothesis verification

as well as the level of usage. Therefore, a scenario is presented in which all players in the programmatic buying ecosystem will have to adapt and change the way they do things (White and Samuel, 2019).

Therefore, considering that programmatic advertising continues to grow, companies must prepare themselves to face this type of change (Akoka *et al.*, 2017), adapting to the new ecosystem or reducing the negative perception of users regarding the use of their data by demonstrating the positive aspects of Internet advertising (personalised ads, better offers based on users' interests, non-invasive nature of the same, transparency in relation to data processing and treatment, etc.), assuming that this will have repercussions not only on consumer opinion, but also on legislation and the decisions taken by large entities with weight in the programmatic ecosystem such as web browsers and social networks.

Among the main implications of this work is the possibility of contributing more knowledge to the literature with the model on programmatic advertising, seeking to improve the system on which it is based and the understanding of it, which would make it more efficient, gaining in usefulness as shown by the model and reducing the inconvenience to the user who is concerned about their privacy and the use of cookies. Considering that this is a sector in constant change, it is especially interesting to involve management in the evolution of digital marketing strategies and their efficiency, in which the key factor is to design more useful and less intrusive or annoying advertising campaigns that avoid violating the privacy of the Internet user (Cuesta-Valiño *et al.*, 2020). Digital advances are appearing more and more rapidly and this means that companies, in search of comparative advantages, can make decisions, which shows the need to make corporate experience compatible with academic rigour and knowledge in order to shed light on such a rapidly changing discipline (Kannan and Li, 2017; Pérez-Curiel *et al.*, 2021).

Likewise, the proposed model contributes to the literature and management in the design of programmatic advertising campaigns that are less intrusive with cookies and less intrusive with privacy, as well as more personalised to the particular needs and desires of consumers (Pérez-Curiel *et al.*, 2021), making the campaigns more attractive, the target shows more trust and therefore more interest, which allows gaining engagement and affinity towards the brand of an entity which allows them to gain in quality of life (Silva Robles *et al.*, 2012).

Another managerial implication of this work is that it allows a more effective and efficient management of online communication strategies, as messages are more selective and less intrusive, reaching the target through a more efficient investment of resources (Castillo-Abdul *et al.*, 2022). In this way, organisations can learn more about the needs of consumers, including their purchasing habits, and develop more efficient online management channels that benefit both parties (Alonso-García *et al.*, 2021; Tiet and Karjaluoto, 2021). On the one hand, the supplying company would have a more efficient use of resources and on the other

hand, the demanding consumer would be facilitated in the purchase decision process with more online channels to choose from, with time flexibility (Alonso-Garcia *et al.*, 2022), a more personalised communication and a product offer more adapted to their preferences (Qin and Jiang, 2019). Despite the large sample size, one of the limitations of this study is that the geographical scope of the study population was Spain, so that future lines of research can be extended to a more international scope. It is also a cross-sectional study carried out in the year 2021. Therefore, in future lines of research, a longitudinal study can be carried out with annual panel data to see how new changes influence the study.

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