

**The effect of multimodality on customers' decision-making and experiencing: A comparative study****Abdullah Alsokkar<sup>a</sup>, Effie L-C. Law<sup>b</sup>, Dmaithan Almajali<sup>a\*</sup> and Mohammad Alshinwan<sup>a</sup>**<sup>a</sup>*Applied Science Private University, Jordan*<sup>b</sup>*Durham University, United Kingdom***CHRONICLE****ABSTRACT***Article history:*

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The primary objective of this article is to present the findings of an experimental study on the use of a human-like “naturalistic” avatar (of both genders) for information presentations. The primary goal is to investigate how users' frame of mind, purchasing behavior, and satisfaction are affected by being presented with information by a naturalistic avatar that lacks expressive capabilities. Two different types of information presentations were developed and empirically tested on 48 participants, namely: (i) two dimensional static graphical and textual information presentation and (ii) non-expressive naturalistic avatar. For this comparative research study, a simplified version of the user experience model that was used in our earlier research (the EUX-DM) was selected to serve as the measurement model. Participants' perceived values of the measured qualities were found to be independent of both their own and the naturalistic avatar's gender, and the non-expressive avatar had a positive effect and a stronger encouragement on participants' intention to purchase, usage attitude, and satisfaction than other types of information presentations.

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**1. Introduction**

For the past two decades, multimodal interfaces have sparked a considerable amount of interest and effort in the fields of Human-Computer Interaction (HCI), Digital Marketing, and Psychology, because these non-traditional interfaces have been shown to be capable of providing more usable and visually appealing interfaces to their users. Specifically, such interfaces can alleviate information overload (Liew, Tan, & Ismail, 2017; Karpov & Yusupov, 2018; Turk, 2005; Tractinsky, 2018) by improving information transmission bandwidth (Baylor & Kim, 2009; Pustejovsky & Krishnaswamy, 2021; Sarter, 2006). When discussing human-computer interaction (HCI), “modality” refers to how a user's senses, including as sight, sound, smell, taste, and touch, are engaged while interacting with a technological system, as well as how this engagement impacts the user on both a cognitive and an emotional level (Obrenovic & Starcevic, 2004; Al Sokkar & Law, 2013; Orehovački, Al Sokkar, Derboven, & Khan, 2013; Al Sokkar A. A., 2014). Also, in the context of multimedia systems, the term “multimodal information presentation” refers to an interface that makes use of a wide variety of different media to convey data to the user (Sarter, 2006). The capacity to deliver information across many channels, or modalities, is what gives rise to the term “multimodal” or “multi-channel”. This allows for more naturalistic interaction between humans and computers (Sarter, 2006; Lee & Charles, 2008; Hammouri et al., 2022). Furthermore, several studies have shown evidence that multimodal information presentation and interaction with a realistic environment can improve the usefulness of user interfaces (e.g., Argyropoulos et al., 2008) which also can guarantee a better overall user satisfaction than traditional user interfaces with text and static images.

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According to Argyropoulos et al. (2008), the efficiency of communicating during the interaction that is provided to users by having an expressive content with a desired state can reason this higher degree of satisfaction, since user-desired expressive content or status, as well as effective communication through-out the interaction, which is of course be at the root of this increased level of both satisfaction and usability in interfaces. Likewise, a visual avatar is considered as a channel of interaction that that has also sub-channels (e.g., facial expressions and body gestures) that may help to facilitate communication during user interactions, also to be as natural and intuitive communication (Karpov & Yusupov, 2018; Hammouri et al., 2022; Kunc & Jan, 2007; Mao, Zheng, & Haiyan, 2008; Huei-Shan, Pi-Chuan, Tzong-Shyuan, & Ying-Jie, 2015). Precisely, in multimedia research, three main types of visual avatar were classified and discussed, this classification was based on the avatar appearance and the media types that are embodied to it (Lui & Hui, 2010; Diederich, Brendel, Morana, & Kolbe, 2022), which are as follows, (i) Abstract or symbolic avatars: These avatars are designed to resemble non-human beings (such as cartoon characters) and can be employed during interactions when anonymity is required; (ii) Humanoid avatars, which are accurate representations of people and may be utilized to enable lifelike interactions; finally (iii) Naturalistic avatars: these are avatars with a human-like look. This form of avatar is recognized to be capable of communicating the conversational functions using nonverbal signals, and body motions (Lui & Hui, 2010).

Several research studies have been conducted in the area of e-Commerce user interfaces and marketing research to investigate the consequences of multimodal human-computer interaction (MHCI) to user interaction experience (Mao et al., 2008; Huei-Shan et al., 2015; Diederich et al., 2022; Scarle, et al., 2012; Jin & Bolebruch, 2009). Customers' trust is an essential component in determining whether or not customers would engage in an online purchase is the level of confidence they have in the company offering the service (Mao et al., 2008; Kim et al., 2009; Ratnasingham, 1998). However, within the digital era we are living, e-Commerce has been criticized due to its nature of transactions, which has different types of limitations or constraints that works against customers from building up trust in e-Commerce websites and associated online retailers. Among others, the limited use of auditory channels (Porat & Tractinsky, 2012). The key limitations with which this study is attempting to deal are the faceless communication of the client and seller. One of the important recommendations made by Porat and Tractinsky (2012) was for B2C e-Commerce enterprises to increase their efforts in web-site visual design in order to meet the aforementioned restrictions.

As evidenced by the prior review, it led us to conduct the comparative study presented in this work. An emotionless human-like avatar was used to provide facts to examine the results for a specific B2C online shopping environment on user usage attitude as an important component that may influence consumer purchase intention and overall satisfaction. The following outlines the structure of this paper: Section 2 provides a literature review on avatar information display and e-Commerce interfaces. Section 3 describes the measurement model and dependent variables investigated in this study. Sections 4 and 5 go through avatar design and development, as well as the design of empirical study. Section 6 presents and evaluates the findings of this research investigation. Finally, Section 7 discusses the conclusion, implications, and future work.

## 2. Related Work

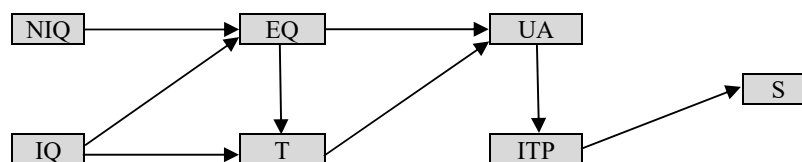
During the last two decades, the development and use of avatars in different kind of application has received much research attention, most commonly it has been integrated into the user interface of a technological system for supporting naturalistic interaction and communication (e.g., (Baldassarri & Cerezo, 2012)). Other similar research projects have stated their goals in developing realistic avatars and integrating them into user interfaces to simulate human-to-human dialogue, which may, of course, synergize other sorts of multimodal metaphors. (e.g., Lui & Hui, 2010; Baldassarri & Cerezo, 2012). Some other new studies were extended the avatar abilities to convey different emotions through different types of multimodal metaphors during user interaction or information presentation (Karpov & Yusupov, 2018; Baylor & Kim, 2009; Pustejovsky & Krishnaswamy, 2021; Lee et al., 2015), stressing the fact that any naturalistic avatar may portray human emotions through appearance, verbal and nonverbal signals (Baylor & Kim, 2009), where nonverbal signals relate to body gestures and facial expressions. For instance, Kuligowska and Lasek (2011) conducted an experimental study that combined e-business website virtual help with conversational ability to enhance customer interactions and company operations. The findings of this study point to the benefits of adopting an avatar: it saves consumers' time by allowing for faster information interchange, it gives a website a more genuine feel, and it can improve customer loyalty, as clients appear to visit the website quite frequently (Kuligowska & Lasek, 2011). As previously stated, various research projects have addressed the limitations of user interfaces without natural communication signals such as auditory and visual cues. To address this limitation, In B2C e-Commerce interfaces, human-like avatars have been deployed. This was the case for various research investigations that were carried out as a comparative research study to investigate users' confidence towards smiling and neutral avatars, as well as how the avatar positively improves user trust (Lee et al., 2015; Lui & Hui, 2010; Chae et al., 2016). In 2016, Chea et al. (2016) took a further step in investigating perceived participation intention through avatar trust which for sure is influenced by social presence. The research study of Lui and Hui (2010) was extended to evaluate the impact of avatar gender on the attitudes of female and male users on utilizing these avatars as recommendation agents. The study's findings found that, when compared to the neutral avatar, the avatar with a happy facial expression garnered higher trust from users. This was reinforced by the fact that female and male users had significant discrepancies. In greater detail, female users assessed the degree of trustworthiness for the female avatar to be much lower than for the male avatar, whilst male users observed no significant variations in their perceived

trust towards the avatar of various genders. This research study was significant in that it gave insight into the research, design, and development of realistic avatars, as well as their incorporation into user interfaces, which may be based on social psychology and emotion psychology. As a means toward an end of comprehending users' perspectives and the associated perceived values of various non-instrumental and emotional state aspects and traits for user experience (UX) development, while also taking into consideration the avatar's gender (Lui & Hui, 2010). Consequently, using naturalistic avatars that can convey human facial expressions and body cues in B2C e-Commerce interfaces helps in overcoming the constraint of faceless communication and enhancing consumer confidence, hence increasing the user's desire to purchase, usage attitude, and contentment, these are the main themes and factors investigated in this research study. In general, according to the literature on multimodality in B2C e-Commerce interfaces, an avatar with non-verbal cues can lead to more natural user participation. Despite this advancement, designing a multimodal avatar is still difficult; these agents may be capable of a high level of expression which may not be suitable for the needs of or be accessible to a wide range of users (Baylor, 2011; Nowak & Rauh, 2005). In the same vein, literature points to a lack of a conceptual framework that emphasizes the recent move from usability to user experience (UX) in HCI and explains how customers' perceptions of a website's significant design aspects impact their emotions and attitudes about a specific e-retail business (Porat & Tractinsky, 2012; Al Sokkar & Law, 2013; Wen et al., 2011).

Therefore, this article describes a comparative study that sets out to investigate the effects of presenting product information through a non-emotional avatar in a business-to-consumer (B2C) online retail setting on consumers' attitudes, intentions, and experiences which will be explained through the simplified EUX-DM as a conceptual framework. Our findings will also serve as a benchmark for future studies that compare avatars equipped with facial emotions and body movements. Accordingly, the most common types of measurements are outlined below in Section 3.

### 3. Measurement

The study's goal is to assess the impact of a humanistic avatar's content presentation in a targeted B2C setting on the key determinant of users' decisions: purchase intent, usage attitude and experience, and overall satisfaction. To measure the success of the digital shopping process, we applied our Episodic User Experience Model on Decision-Making (EUX-DM) (Al Sokkar & Law, 2013; Al Sokkar A. A., 2014). The CUE model, or Components of User Experience, (Thüring & Mahlke, 2007) and the Technology Acceptance Model (TAM) (Kim et al., 2009; Al Sokkar & Law, 2013; McKinney et al., 2002; Thüring & Mahlke, 2007; Dewi et al., 2022) are two of the foundational models upon which the EUX-DM was built. The verified 'EUX-DM' was used to assess four major facets of User Experience (UX) (Fig. 1). There are three types of user experience characteristics: (a) instrumental characteristics, which are described as characteristics of interaction that contribute to the successful completion of a task and the attainment of behavioral goals (i.e. usability); (b) non-instrumental characteristics, which can be defined as elements that fulfill user demands that go beyond completing an assigned task (i.e. aesthetics); and (c) experiential characteristics, which represent the emotional impact of a user's interaction. And (d) the system appraises related qualities that the user could pick up on because of their interaction (i.e., usage attitude and satisfaction). As mentioned above, EUX-DM had been validated in this research study which provided insights (Al Sokkar, 2014; Al Sokkar & Law, 2013). To be more specific, to capture a single person's emotional state in a physical context, the model needs to have three key characteristics: arousal, pleasure, and dominance (Lavie & Tractinsky, 2004; Tractinsky & Klimov, 2022). It also needs to have two aesthetic qualities: classical aesthetics and expressive aesthetics. This is because a recent study showed that aesthetics has a big impact on how customers feel about e-commerce websites (Porat & Tractinsky, 2012; Al Sokkar & Law, 2013; Tractinsky & Klimov, 2022). This model was evaluated under two conditions: (a) a two-dimensional static graphical and textual information display, and (b) a naturalistic avatar information presentation without facial expressions. Here are some explanations of the different parts and structures (see Table 1 for the corresponding items).



NIQ: Non-Instrumental Qualities T: Trust UA: Usage Attitude IQ: Instrumental Qualities ITP: Intention to Purchase EQ: Experimental Qualities S: Satisfaction

**Fig. 1.** A simplified EUX-DM

The non-instrumental qualities: Various research articles were evaluated as a reference, since it was established that aesthetics, as a related component to studying user interface, plays a significant part in shaping consumers' attitudes about the usability of e-commerce websites, which in turn influences users' usage attitudes (Porat & Tractinsky, 2012; Lavie & Tractinsky, 2004; Tractinsky & Klimov, 2022). In light of this, the two fundamental components of aesthetics are utilized to investigate participants' perceptions of aesthetics as non-instrumental characteristics, namely, Classic and Expressive Aesthetics;

*Classic Aesthetics:* describes how balanced and clutter-free the website's layout and visual design are.

*Expressive Aesthetics:* how much thought and effort were put into making the site look unique and interesting.

*Instrumental quality:* After the two primary dimensions of aesthetics, usability was a factor that may influence a user's attitude of e-commerce websites (Thüring & Mahlke, 2007; Lavie & Tractinsky, 2004; Tractinsky & Klimov, 2022; Tractinsky, 2018; Almajali & AL-Sous, 2021). Another substantial investigation into the domain was conducted by Porat and Tractinsky (2012), who examined the B2C e-commerce industry via the lens of usability as measured across four different items. Therefore, in this study we use identical items for both genders to assess how participants of both genders perceive the usability of information presented by naturalistic avatars.

*Experiential Qualities:* Throughout the last two decades, researchers have paid close attention to experience qualities (e.g., (Porat & Tractinsky, 2012; Lavie & Tractinsky, 2004; Yik et al., 1999; Al-Gasawneh et al., 2022), since how design aspects affect users' emotional states and behaviors is mostly unexplored. Mehrabian and Russell's environmental psychology model (M-R model) (Russell & Mehrabian, 1977), on the other hand, addressed an individual's emotional state in physical surroundings through three main dimensions pleasure, arousal, and dominance (PAD). The most notable finding from a review of recent UX research studies (Bargas-Avila & Hornbæk, 2011) is that qualitative methods have been used to analyze users' emotional states; however, objectively quantifying users' emotional states or re-actions remains a challenging process and area for future development in the field (Law & Van Schaik, 2010). However, other studies (e.g., Porat & Tractinsky, 2012; Lavie & Tractinsky, 2004; Yik et al., 1999; Nusairat et al., 2021) employed the M-R model since it was theoretically intriguing to examine how design elements affect users' emotional states, wherein one's level of satisfaction or happiness in a certain area is measured in terms of pleasure, and one's level of arousal is measured in terms of how stimulated one becomes in that location. Dominance is a person's sense of control over their environment (Kim et al., 2009; Palvia, 2009; Almajali et al., 2022). Porat and Tractinsky (2012) define a user's emotional state in three ways (i.e., PAD). Consequently, we incorporated pleasure, arousal, and dominance items (each dimension comprises five questions, as shown in Table 1) in our study to assess participants' emotional states in reaction to various kinds of information presentation in our study.

**Table 1**  
Dependent variables and its related items

| Component                | Construct             | Items   |
|--------------------------|-----------------------|---|
| Non-instrumental Quality | Classic aesthetics    | The website is Clean  |
|                          |                       | The website is Pleasant   |
|                          |                       | The website is Symmetrical  |
|                          |                       | Aesthetic   |
|                          |                       | The website is Original   |
|                          | Expressive aesthetics | The website is Sophisticated  |
|                          |                       | The website is Spectacular  |
|                          |                       | The website is Creative   |
|                          |                       | This website's navigation was simple.   |
|                          |                       | This website's purchasing procedure is straightforward.                               |
| Instrumental Quality     | Usability             | Using this website is simple.   |
|                          |                       | This website makes it simple to discover information.                                 |
|                          |                       | Using this website made feel Happy  |
|                          |                       | Using this website made feel Hopeful  |
| Experiential Qualities   | Pleasure              | Using this website made feel Satisfied  |
|                          |                       | Using this website made feel Relaxed  |
|                          |                       | Using this website made feel Content  |
|                          |                       | Using this website made feel Energetic  |
|                          |                       | Using this website made feel Excited  |
|                          | Arousal               | Using this website made feel Wide-awake   |
|                          |                       | Using this website made feel Restless   |
|                          |                       | Using this website made feel Aroused  |
|                          |                       | Using this website made feel In-control   |
|                          |                       | Using this website made feel Respected  |
|                          | Dominance             | Using this website made feel Dominant   |
|                          |                       | Using this website made feel Autonomous   |
|                          |                       | Using this website made feel Active   |
|                          |                       | I may put your trust in this site.  |
|                          |                       | There is confidence in this website provider since it appears to meet its obligations |
| System Appraisal         | Trust                 | This website vendor has my best interests in mind, in my opinion.                     |
|                          |                       | I enjoyed using the website.  |
|                          |                       | I found the website's design and layout are appealing to me.                          |
|                          |                       | I value the website.  |
|                          |                       | I'm interested in exploring the website again.  |
| Decision Making          | Intention to purchase | I felt compelled to make a purchase after browsing the website.                       |
|                          |                       | I'm interested in making a web-based purchase of the item.                            |
|                          |                       | I will be recommending this site to my friends  |
|                          |                       | If I end up needing the items I want to buy, I will shop here again.                  |
| Overall Satisfaction     | Satisfaction          | Using this website made feel Pleased  |
|                          |                       | Using this website made feel Delighted  |
|                          |                       | Using this website made feel Content  |
|                          |                       | Using this website made feel Satisfied  |

Considerations in System Appraisal, Decision Making, and TAM: Items relevant to the constructs/qualities listed in Table 1 are employed in our comparative research study to assess the effects of interaction experiences with various forms of information presentations. These items were adapted from several research studies based on TAM, ISSM, and other theoretical models (Kim et al., 2009; Porat & Tractinsky, 2012; Kuligowska & Lasek, 2011; Palvia, 2009; AL-Sous et al., 2022; Almajali et al., 2021; Abuaddous et al., 2018; Al-Sous et al., 2023). System appraisals: two constructs Trust (listed with 3 items), and Usage attitude (listed with 5 items). Decision-making: mainly the Intention to purchase (listed with 3 items). Satisfaction (listed with 4 items).

The Episodic User Experience Model on Decision-Making (EUX-DM) (Al Sokkar & Law, 2013; Al Sokkar, 2014), as displays in Table 2 below, argues that Usability as an Instrumental Quality and classic and expressive aesthetics as both represent the Non-Instrumental Quality can predict the constructs related to the Experiential Qualities (arousal, pleasure, and dominance). For the perceived system appraisals component, Trust can be predicted by the Usability as an Instrumental Quality, together with constructs related to Experiential Qualities (arousal, pleasure, and dominance). Trust, along with the Experiential Qualities, is also a predictor of Usage Attitude. Both the Usage Attitude and Trust components have been shown to be predictive of purchase intent. Finally, users' Intention to Purchase is the predictor for the User Satisfaction.

**Table 2**  
Dependent Construct in the Simplified EUX-DM

| Component              | Construct             | Predictors            |           |
|------------------------|-----------------------|-----------------------|-----------|
| Experiential Qualities | Pleasure              | Usability             |           |
|                        |                       | Classic aesthetics    |           |
|                        | Arousal               | Expressive aesthetics |           |
|                        |                       | Usability             |           |
|                        | Dominance             | Classic aesthetics    |           |
|                        |                       | Expressive aesthetics |           |
|                        | System Appraisal      | Trust                 | Usability |
|                        |                       |                       | Pleasure  |
| Arousal                |                       |                       |           |
| Usage Attitude         |                       | Dominance             |           |
|                        |                       | Trust                 |           |
|                        |                       | Pleasure              |           |
| Decision Making        | Intention to purchase | Arousal               |           |
|                        |                       | Dominance             |           |
| Overall Satisfaction   | Satisfaction          | Trust                 |           |
|                        |                       | Usage Attitude        |           |
|                        |                       | Intention to purchase |           |

This research compares the effects of two experimental situations that differ in the methods utilized to communicate the information. This experimental study uses the EUX-DM as a model for measuring, therefore it can confirm the following key hypotheses:

**Hypothesis 1:** *Compared to the two-dimensional static graphical and textual information, The use of a non-expressive naturalistic avatar for information presentation will lead to:*

**Hypothesis 1.1:** *Enhancing user assessments across the board, including instrumental, non-instrumental, experiential, and overall system evaluations.*

**Hypothesis 1.2:** *Users' perception in terms of instrumental qualities, non-instrumental qualities, experiential qualities, and system appraisals will have a more significant positive influence on their intention to purchase, with trust acting as a moderator.*

Furthermore, the purpose of this experimental study is to investigate the effect of the avatar and user gender in affecting their assessment of UX attributes, usage attitude, decision-making, and overall satisfaction.

**Hypothesis 2:** The gender of the user and the non-expressive naturalistic avatar have no effect on the user's attitude, decision-making, or satisfaction with the system's qualities. This holds true for the user's perceived value of instrumental qualities, non-instrumental qualities, experiential qualities, and system appraisals.

#### 4. Non-Expressive Avatar Development

In this research study, we argue that the selection of the avatar looks, and related non-verbal modalities is not grounded in user preferences and the multimodal designer's knowledge of how nonverbal cues are used in real life scenarios. Furthermore,

the results of the literature research also showed that the early effort in building avatars for e-Commerce information presentation relied on non-verbal may not be serious for the task in which they are deployed, designing a multimodal avatar remains a challenging task; these agents may be highly expressive, but may not fit users' need or abilities (Baylor & Kim, 2009; Al Sokkar & Law, 2013; Al Sokkar, 2014; Baylor, 2011). As well as on the results of multimodal avatar acceptance tests, which are conducted in a laboratory setting with individuals that are not representative of the population, such as a convenient sample of college students (e.g., Gazepidis & Rigas, 2009). Considering what has been said so far, this study will also be conducted in a laboratory setting with individuals and intends to determine how varying degrees of information presentation in a targeted B2C website affect consumers' tendency to buy, their attitudes toward the site's usability, and their level of satisfaction. Thus, two naturalistic avatars, humanlike avatars of both genders were conceived and generated in 3D for the purpose of presenting information.



**Fig. 2.** The animated non-expressive naturalistic avatars

## 5. Study Design

According to mixed method approaches, researchers can utilize a variety of methods to test and refine their study models and hypotheses. In an empirical study, for instance, a questionnaire may be employed and constructed to obtain more focused data after qualitative techniques like interviews are used to uncover the most critical concerns (Saunders et al., 2009). Considering these advantages, in this study, qualitative and quantitative data were collected using a mixed-method approach to determine what characteristics most affect various types of interactions with a B2C website. To be more specific, these techniques were employed to collect data: semi-structured interviews and surveys based on the items in Table 1 that were designed.

### 5.1 Study Protocol

Participants in this research study were asked to complete the following tasks:

All participants were requested to fill out a demographic questionnaire as a pre-assessment.

*Interaction Experience 1 (IX1):* Participants were given a link to a certain online retailer and instructed to search and browse for a predetermined product using the link provided by the interviewer. IX1 was a situation in which static graphics and textual data were shown in two dimensions. The next step was to have users rate the website according to the criteria in Table 1. Afterwards, participants were interviewed briefly to ask them in-depth questions regarding their experience.

*Break:* Participants were given a short break during which they may get up and stretch their legs or check their email.  
*Interaction Experience 2:* Participants were given similar instructions as in Task 1 and told to search for a certain product on the contrived online store (similar to the product in Task 1 with different type of information presentation). IX2 was the condition in which non-expressive naturalistic avatars (male and female avatars) were utilized for information display. For this reason, we divided our sample into four equal subgroups, one for each possible combination of the avatar's and participants' genders (see Table 3 below) to examine if there were any differences in how the two genders interpreted the avatar's qualities (Table 1). Interaction Experience 2 consisted of a follow-up interview in which participants described their interaction with the online store and their thoughts on the use of the avatar to convey information. Undoubtedly, dependent variable measurements were repeated for both experimental studies, and the order effect was taken into account by reversing the order of these processes in each task by creating two subgroups within each group, as indicated in Table (3) (Krosnick & Alwin, 1987).

**Table 3**

Research design for participants' interaction scheme

| Interaction Experience with Female Avatar                       | Interaction Experience with Male Avatar                         |
|---|---|
| Participants Group A: 12 Female<br>Participants Group B: 12Male | Participants Group C: 12 Female<br>Participants Group D: 12Male |

## 5.2 Equipment, Settings and Sample

Since this research study argues that the selection of the avatar look and related non-verbal modalities is not grounded in user preferences and the multimodal designer's knowledge of how nonverbal cues are actually used in real life scenarios. And for the reason that this study employed a mixed method approach in a laboratory setting with individuals, it only included 48 participants as a convenient sample. Therefore, the experiments were done independently in one of the library's silent study rooms. Every participant was over the age of 18 and were chosen at random. All participants were required to utilize the exact laptop with the exact settings and complete a consent document form. The participants' ages were ranging from 18-24 (33.3%), 25-34 (50%), 35-44 (12.5%), finally 45+ (4.1%). Where most of participants (77.2%) are undergraduate and postgraduate students, with the remainder participants (36% being university personnel). However, 33 participants (68.8%) said they had never shopped on an e-Commerce website like the one used in this survey before. At the end of the day, participants spent an average of 31 minutes on the study (Standard Deviation SD = 9 minutes).

## 6. Results

### 6.1 Quantitative Data Analysis

#### 6.1.1 Participants and Avatar Gender Differences

Given that the same data collecting procedures, settings, and measures were employed for each group in both interaction experiences (IX1 and IX2), this aimed to compare how different types of information presentation affected participants of different genders. The study also set out to determine whether people's impressions of the characteristics listed in Table 1 varied depending on the gender of the non-expressive naturalistic avatars used to present the information. Mean scores on both Experiences IX1 and IX2 were compared between female and male participants using parametric independent-sample t-tests. There was no statistically significant difference in mean scores between male and female participants across any of the variables examined shown in Table 4. Similarly, independent-sample t-tests were performed to examine participants' impressions of non-expressive naturalistic avatars of both genders in IX2. There was no significant difference in mean scores between the information presented by female and male avatars in any of the categories tested in IX2. Finally, for IX2, a 2X2 factorial design was used as a comparison test for all the groups shown in Table 3, precisely two (Avatar gender: Female vs. Male) X two (Participants gender: Female vs. Male). The genders of the participant and the avatar did not significantly interact on any measures shown in Table 5, according to the results of the between-subject analysis of variance (ANOVA).

**Table 5**  
Between-subjects Analysis of Variance (ANOVA) Factorial Design

| IX2-Constructs        | Participants Gender | Avatar Gender |      |        |      | Participants Gender × Avatar Gender |        |
|-----------------------|---------------------|---------------|------|--------|------|-------------------------------------|--------|
|                       |                     | Male          |      | Female |      | F                                   | p      |
|                       |                     | M             | SD   | M      | SD   |                                     |        |
| Classic Aesthetics    | Male                | 6.09          | 0.58 | 6.22   | 0.97 | 0.204                               | > 0.05 |
|                       | Female              | 6.18          | 0.62 | 6.11   | 0.86 |                                     |        |
| Expressive Aesthetics | Male                | 5.40          | 1.11 | 5.80   | 1.21 | 0.887                               | > 0.05 |
|                       | Female              | 5.39          | 0.91 | 5.63   | 1.35 |                                     |        |
| Usability             | Male                | 6.34          | 0.88 | 6.26   | 1.03 | 2.310                               | > 0.05 |
|                       | Female              | 5.79          | 0.44 | 6.34   | 0.72 |                                     |        |
| Trust                 | Male                | 5.45          | 1.08 | 5.75   | 0.91 | 0.302                               | > 0.05 |
|                       | Female              | 5.23          | 0.86 | 5.71   | 0.98 |                                     |        |
| Arousal               | Male                | 5.60          | 1.08 | 5.48   | 0.73 | 1.665                               | > 0.05 |
|                       | Female              | 5.87          | 0.53 | 5.31   | 0.84 |                                     |        |
| Pleasure              | Male                | 5.60          | 1.08 | 5.69   | 0.74 | 3.855                               | > 0.05 |
|                       | Female              | 6.23          | 0.53 | 5.73   | 0.69 |                                     |        |
| Dominance             | Male                | 5.45          | 1.06 | 5.64   | 0.73 | 2.220                               | > 0.05 |
|                       | Female              | 6.15          | 0.49 | 5.73   | 0.69 |                                     |        |
| Usage Attitude        | Male                | 5.35          | 1.06 | 5.86   | 0.82 | 1.772                               | > 0.05 |
|                       | Female              | 5.89          | 0.51 | 5.86   | 0.87 |                                     |        |
| Intention to purchase | Male                | 5.60          | 1.22 | 5.80   | 0.94 | 2.624                               | > 0.05 |
|                       | Female              | 5.93          | 0.71 | 5.61   | 1.09 |                                     |        |
| Satisfaction          | Male                | 5.63          | 1.21 | 5.80   | 0.85 | 2.030                               | > 0.05 |
|                       | Female              | 6.00          | 0.51 | 5.73   | 0.83 |                                     |        |

The results above corroborate and support the hypothesis (Hypothesis 2) that the perceived values of instrumental qualities, non-instrumental qualities, and experiential qualities, as well as the usage attitude, purchase intention, and satisfaction, were unrelated to either the participants' or the non-expressive naturalistic avatars' genders. Since IX2 of both presentations (Male and Female avatars) employed the same methodologies, settings, and tools throughout the data collection, it was decided to create a single dataset containing data collected for both experiences.

#### 6.1.2 Ratings Summary

The scores on the various components tested in the two stages of this study were also compared using an analysis of variance (ANOVA) within-subjects test. Analysis of variance showed that the two measures' scores differed significantly on all

dimensions (Table 6.13). For instance, when comparing IX1 with IX2, the difference in the means of the concept usability is statistically significant (Mean = 5.45, Standard Deviation = 1.31 vs. Mean = 6.26, Standard Deviation = 0.85) ( $F(1, 48) = 9.38, p(0.05)$ ). It has been reported that employing a non-expressive avatar to provide information to participants resulted in a more positive experience, choice, and overall satisfaction than did the use of 2D static graphics and text.

**Table 6**  
Paired Sample t test Results of Comparing between IX1 and IX2

| Construct             | IX1  |      | IX2  |      | F     | p      |
|-----------------------|------|------|------|------|-------|--------|
|                       | M    | SD   | M    | SD   |       |        |
| Classic Aesthetics    | 5.46 | 1.12 | 6.09 | 0.81 | 16.87 | < 0.05 |
| Expressive Aesthetics | 3.66 | 1.39 | 5.49 | 1.22 | 41.22 | < 0.05 |
| Usability             | 5.45 | 1.31 | 6.26 | 0.85 | 9.38  | < 0.05 |
| Trust                 | 4.89 | 1.09 | 5.69 | 0.94 | 19.91 | < 0.05 |
| Arousal               | 3.79 | 1.30 | 5.46 | 0.93 | 50.03 | < 0.05 |
| Pleasure              | 4.41 | 1.31 | 5.89 | 0.79 | 30.46 | < 0.05 |
| Dominance             | 4.29 | 1.29 | 5.85 | 0.80 | 39.67 | < 0.05 |
| Usage Attitude        | 4.63 | 1.37 | 5.93 | 0.83 | 45.81 | < 0.05 |
| Intention to purchase | 4.09 | 1.39 | 5.99 | 1.11 | 49.05 | < 0.05 |
| Satisfaction          | 4.43 | 1.19 | 6.18 | 0.85 | 70.01 | < 0.05 |

### 6.1.3 The Revisited Measurement Model

As this study aimed at testing and verifying the measurement model (described previously in Section 3 and published on (Al Sokkar, 2014)) under the two interaction experiences (IX1 and IX2), and in each of these experiences, it also tries to compare the predictors' abilities to explain the dependent constructs. Given these objectives, a multiple regression analysis was performed on each dependent construct tested across the two encounters to determine its variance and unique variance. Therefore, all the chosen variables were input into the regression analysis in one step using the ENTER technique for variable selection. The results of multiple regression analysis (Table 7) Using the aforementioned predictors, we found that the following measurement constructs linked to the interaction experience IX1 and its dependent constructs can be explained as follows: arousal with 30%, pleasure with 27.5%, dominance with 31.1%, trust with 45.4%, usage attitude with 54.4%, intention to purchase with 72.2%, and overall satisfaction with 59.1%. For instance, 30.0% of the variation in arousal can be accounted for by the combination of usability together with classic and expressive aesthetics. Similarly, a multiple regression analysis was performed for the interaction experience IX2 and its associated measurements. The results are shown in Table 8, and they can be explained as follows: arousal (33.5%), pleasure (51.9%), dominance (61.9%), trust (63%), usage attitude (59.8%), intention to purchase (84.1%), and overall satisfaction (63%).

**Table 7**  
Multiple Regression Analysis on each Dependent Construct Measured in IX1

| Construct (IX1)       | Adjusted R <sup>2</sup> | Predictors              | Partial Correlation | Beta   | Contribution to R <sup>2</sup> |
|-----------------------|-------------------------|-------------------------|---------------------|--------|--------------------------------|
| Arousal               | 0.289                   | Usability               | 0.341**             | 0.021  | 0.00                           |
|                       |                         | Classic Aesthetics      | 0.247               | 0.201  | 0.00                           |
|                       |                         | Expressive Aesthetics   | 0.501**             | 0.370  | 0.08                           |
| Pleasure              | 0.329                   | Usability*              | 0.478**             | 0.335  | 0.08                           |
|                       |                         | Classic Aesthetics      | 0.419*              | 0.042  | 0.00                           |
|                       |                         | Expressive Aesthetics * | 0.429**             | 0.351  | 0.09                           |
| Dominance             | 0.309                   | Usability*              | 0.501**             | 0.439  | 0.14                           |
|                       |                         | Classic Aesthetics      | 0.197               | -0.169 | 0.03                           |
|                       |                         | Expressive Aesthetics * | 0.457**             | 0.389  | 0.16                           |
| Trust                 | 0.509                   | Arousal*                | 0.452**             | 0.372  | 0.07                           |
|                       |                         | Pleasure*               | 0.601**             | 0.489  | 0.07                           |
|                       |                         | Dominance*              | 0.114               | -0.400 | 0.07                           |
|                       |                         | Usability               | 0.439**             | 0.216  | 0.03                           |
| Usage Attitude        | 0.487                   | Arousal                 | 0.678**             | -0.189 | 0.00                           |
|                       |                         | Pleasure*               | 0.601**             | 0.483  | 0.07                           |
|                       |                         | Dominance               | 0.711**             | 0.241  | 0.03                           |
|                       |                         | Trust*                  | 0.519**             | 0.309  | 0.06                           |
| Intention to purchase | 0.671                   | Usage Attitude*         | 0.844**             | 0.899  | 0.58                           |
|                       |                         | Trust                   | 0.889**             | -0.058 | 0.00                           |
| Satisfaction          | 0.611                   | Intention to purchase** | 0.661**             | 0.782  | 0.49                           |

\*\* Correlation at the 0.01 level

\* Correlation at the 0.05 level

Both sets of data from the two separate interaction experiences (IX1 and IX2), which are tied to various information presentation modalities, were found to be positive and confirming the validity of the measurement model. All dependent variables were adequately represented by their predictors in both experimental circumstances and the corresponding measurement model (Table 7 and Table 8). Additionally, explanatory power for dependent constructs was found to be lower in IX1 than in IX2, as seen in Table 7., when comparing the results of multiple regression for the two conditions. For instance, it was discovered that Usability, together with Arousal, Pleasure, and Dominance, explained 45.4% and 63%, respectively, of the variation of Trust in IX1 and IX2. This suggests that the avatar presentation "IX2" was found to have stronger correlations between each independent variable's predictors than two-dimensional static graphical and textual information.



**Table 8**  
Multiple Regression Analysis of each Dependent Construct Measured in IX2

| Construct (IX2)       | Adjusted R <sup>2</sup> | Predictors              | Partial Correlation | Beta   | Contribution to R <sup>2</sup> |
|-----------------------|-------------------------|-------------------------|---------------------|--------|--------------------------------|
| Arousal               | 0.389                   | Usability*              | 0.481**             | 0.284  | 0.04                           |
|                       |                         | Classic Aesthetics      | 0.601**             | 0.267  | 0.03                           |
|                       |                         | Expressive Aesthetics * | 0.679**             | 0.389  | 0.03                           |
| Pleasure              | 0.489                   | Usability               | 0.455**             | 0.139  | 0.01                           |
|                       |                         | Classic Aesthetics      | 0.721**             | 0.410  | 0.05                           |
|                       |                         | Expressive Aesthetics   | 0.628**             | 0.189  | 0.03                           |
| Dominance             | 0.590                   | Usability               | 0.539**             | 0.351  | 0.04                           |
|                       |                         | Classic Aesthetics      | 0.721**             | 0.211  | 0.01                           |
|                       |                         | Expressive Aesthetics * | 0.635**             | 0.281  | 0.06                           |
| Trust                 | 0.629                   | Arousal*                | 0.557**             | 0.373  | 0.04                           |
|                       |                         | Pleasure                | 0.609**             | -0.143 | 0.01                           |
|                       |                         | Dominance               | 0.745**             | 0.159  | 0.01                           |
|                       |                         | Usability**             | 0.821**             | 0.411  | 0.08                           |
| Usage Attitude        | 0.611                   | Arousal                 | 0.481**             | 0.309  | 0.04                           |
|                       |                         | Pleasure                | 0.711**             | -0.069 | 0.00                           |
|                       |                         | Dominance*              | 0.633**             | 0.463  | 0.07                           |
|                       |                         | Trust*                  | 0.598**             | 0.261  | 0.07                           |
| Intention to purchase | 0.798                   | Usage Attitude**        | 0.889**             | 0.189  | 0.60                           |
|                       |                         | Trust**                 | 0.911**             | 0.809  | 0.05                           |
| Satisfaction          | 0.629                   | Intention to purchase** | 0.829**             | 0.773  | 0.30                           |

\*\* Correlation at the 0.01 level

\* Correlation at the 0.05 level

## 6.2 Qualitative Data Analysis

As mentioned in the method, a post-interaction interview assessed participants' experience and detailed their experience with both conditions. Since qualitative data was acquired using semi-structured interviews, it was collected and analyzed top-down and bottom-up for each task (Humble, 2009). The questionnaire components were utilized to create the first coding categories, which may logically cohere to form the measurement model (EUX-DM model). More specifically, it was discovered that the directed content analysis was beneficial for the top-up phase (Al Sokkar & Law, 2013). Following the top-down phase's conclusion, the bottom-up phase began utilizing the summative content technique to identify keywords and phrases. Net Positive Values (NPV) were used to count the information that was deemed to be part of the final report (Hart, Sutcliffe, & De Angeli, 2013). Three coding categories—Design Features, User Engagement, and Interaction Returns—were created as a consequence of the final study. (Table 9). There is an identification named P1, P2,... P48 for each interview; these identifiers are shown in brackets (e.g. [P1]).

Concerning the design features, 768 user comments were classified into one of five themes based on how they referenced the two different types of interactions they had, and Net Positive Values (NPV) were determined independently for each theme (Table 9). Comparatively, IX2 had more total comments (64%), a larger percentage of favorable comments (94%), and a higher NPV value (+418) than IX1; the percentage for frequency of total comments (36%), and the percentage of the positive comments is 51% of the total number of comments. These results show that all of the themes in IX2 tended to be more positive than those in IX1. This might be because IX2 employed a non-expressive naturalistic avatar to deliver the information, and IX2's overall assessment of the design aspects was found to be more favorable. For instance, [P7] "It is a highly engaging and novel idea for online purchasing; it reminds me of being in a shopping mall and having salesmen approach you to assist you; this is precisely what occurs in there." [P13] "It is a highly tempting way for discussing the thing I actually desire in detail rather than just reading the text. And I understand the product's measurements and proportions."

User engagement, NPV values were independently calculated for each of the five key themes that were identified from a total of 924 comments: participation, focused attention, excitement, active, and comfort (Table 9). All of the themes in IX2 (percentage of the comments 70% with 91% positive comment, NPV +485) tended to be more positive than those in IX1 (percentage of the comments 30% with 26% positive comment, NPV -129). This can be linked to the non-expressive naturalistic avatar, which increases participant interest and be more engaged. For instance, [P 18] " In my opinion, this presentation represents the wave of the future for e-commerce platforms. Additionally, I feel more engaged in and interested by the product itself, and I enjoyed the presentation I received."

The last coding category, Interaction Returns, consisted of 678 comments that were divided into four key themes: benefit, trustworthiness, achievement, and willingness to transact. All of the themes in IX2 (comment percentage of 68%, positive comment percentage of 93%, net present value of +377) tended to be more positive than those in IX1 (comment percentage of 32%, positive comment percentage of 27%, net present value of -30). It can also be linked to the employment of non-expressive naturalistic avatars, demonstrating improved interaction consequences/returns in IX2. Participants, for example, perceived IX2 to be more trustworthy than IX1, with greater advantages and desire to purchase. [P29] "It's the same as talking to someone who will explain and sell it to you, which will increase my confidence in that person and influence my choice to buy it. Reading the product specs is not the same as having the information explained to you; reading it there is not the same as having it explained to you."

**Table 9**  
NPV Results for Generated Coding Categories

| Coding Categories          | Themes                               | IX1        |            |             | IX2        |           |             |
|----------------------------|--------------------------------------|------------|------------|-------------|------------|-----------|-------------|
|                            |                                      | <i>P</i>   | <i>N</i>   | <i>NPV</i>  | <i>P</i>   | <i>N</i>  | <i>NPV</i>  |
| <b>Design Features</b>     | <i>Interconnectivity</i>             | 14         | 30         | -16         | 59         | 8         | +51         |
|                            | <i>The website is easy to use</i>    | 59         | 21         | +38         | 107        | 4         | +103        |
|                            | <i>Usefulness of the website</i>     | 18         | 22         | -4          | 58         | 2         | +56         |
|                            | <i>Navigating between pages</i>      | 19         | 4          | +15         | 51         | 6         | +45         |
|                            | <i>Attractiveness of the website</i> | 30         | 59         | -29         | 176        | 19        | +157        |
|                            | <b>Total NPV</b>                     | <b>140</b> | <b>136</b> | <b>+4</b>   | <b>455</b> | <b>37</b> | <b>+418</b> |
| <b>Total Comments</b>      |                                      | <b>276</b> |            |             | <b>492</b> |           |             |
| <b>768</b>                 |                                      |            |            |             |            |           |             |
| <b>User Engagement</b>     | <i>I was present</i>                 | 7          | 40         | -33         | 101        | 12        | +89         |
|                            | <i>Concentrated attentiveness</i>    | 11         | 44         | -33         | 181        | 19        | +172        |
|                            | <i>I felt excited</i>                | 9          | 26         | -15         | 90         | 11        | +79         |
|                            | <i>I felt energetic</i>              | 7          | 31         | -24         | 50         | 15        | +45         |
|                            | <i>It was convenient</i>             | 40         | 66         | -26         | 141        | 21        | +119        |
|                            | <b>Total NPV</b>                     | <b>74</b>  | <b>207</b> | <b>-133</b> | <b>563</b> | <b>78</b> | <b>+485</b> |
| <b>Total Comments</b>      |                                      | <b>283</b> |            |             | <b>641</b> |           |             |
| <b>924</b>                 |                                      |            |            |             |            |           |             |
| <b>Interaction Returns</b> | <i>Benefit</i>                       | 11         | 19         | -8          | 69         | 13        | +56         |
|                            | <i>Reliability</i>                   | 30         | 17         | +13         | 81         | 6         | +75         |
|                            | <i>Accomplishment</i>                | 31         | 47         | -16         | 202        | 18        | +184        |
|                            | <i>Willing to transact</i>           | 30         | 38         | -8          | 59         | 7         | +52         |
|                            | <b>Total NPV</b>                     | <b>102</b> | <b>121</b> | <b>-19</b>  | <b>411</b> | <b>44</b> | <b>+377</b> |
| <b>Total Comments</b>      |                                      | <b>223</b> |            |             | <b>455</b> |           |             |

In summary, there is a significant difference for all categories and in the overall experience between IX1 and IX2. For IX2, 1544 comments were received which is 794 more comments than what has been received for IX1 (921 comments). Additionally, 95% of the comments linked to IX2 were positive, compared to 51% recorded for IX1. Participants in this research study preferred to compare both presentations as an overall evaluation, and it was clear that they felt more satisfied, enthusiastic, and obtained general judgments about it as being innovative and original than in IX1. These perceptions directly influenced their attitudes regarding the online buying website: [P29] “Having a human or salesman explain the product to you is a clever idea.”. [P20] “It’s a novel concept; you won’t find anything like it on other websites, and the personal touch makes it more likely that you’ll buy the item being promoted.”. [P28] “It’s something new and distinctive. This presentation was engaging; it gave me the impression that I was there and that I could see the object in three dimensions.”.

## 7. Summary and Conclusion

The aim of this study was to examine how presenting product information in a (B2C) e-commerce environment with non-expressive naturalistic avatars of both genders affected consumers' final purchase decisions and satisfaction. The EUX-DM (Figure 1) was to be visited and used as a measurement model (Al Sokkar & Law, 2013) and (Al Sokkar, 2014) in two settings: (i) a two-dimensional static graphical and textual information presentation (IX1), and (ii) a non-expressive naturalistic avatar information presentation (IX2). This research goes further by examining how the user's gender and avatar influence their responses to the system's trust, usage attitude, purchase intent, and satisfaction levels. Participants evaluated both interaction experiences, and the within-subjects' differences (Paired Sample t test) was undertaken (Table 4) and it reveals higher ratings on all measured constructs for IX2 than those in IX1. These results corroborated and agreed with the literature discussed in section 2, particularly Porat and Tractinsky's findings (Porat & Tractinsky, 2012), participants' evaluations of Non-instrumental Qualities (e.g., Classic Aesthetics), Instrumental Qualities (e.g., Usability), Experiential Qualities (e.g., Pleasure), and System Appraisals were all changed directly by the design elements and usage of realistic avatar in IX2 (e.g., Usage Attitude). Surprisingly, the biggest variations were seen in the examined constructs Usage Attitude and Satisfaction. According to the simplified measurement model (EUX-DM, adapted from (Al Sokkar & Law, 2013)), participants' intention to purchase (Sections 6.1.2) and overall rating for both interactions were positively affected and influenced using a non-expressive naturalistic avatar information presentation (Section 6.1.3). Finally, the results showed that neither the participants' nor the avatars' gender had any impact on their perceived values of the variables.

It may be inferred that the aforementioned findings, along with the findings on participant comments (Section 6.2), validate the research hypotheses. These findings can be seen as follows: (a) The use of a non-expressive naturalistic avatar for information presentation will lead to improved user perception across the board, from the perspective of instrumental qualities to non-instrumental qualities to experiential qualities to system appraisals, as compared to the use of two-dimensional static graphical and textual information in the contrived B2C website. (Hypothesis 1.1); (b) Compared to the two-dimensional static graphical and textual information, users' perception in terms of instrumental qualities, non-instrumental qualities, experiential qualities, and system appraisals will have a more significant positive influence on their intention to purchase when presented with a non-expressive naturalistic avatar, with trust acting as a moderator. (Hypothesis 1.2); And finally, (c) The gender of the user and the non-expressive naturalistic avatar have no effect on the user's attitude, decision-making, or satisfaction with

the system's qualities. This holds true for the user's perceived value of instrumental qualities, non-instrumental qualities, experiential qualities, and system appraisals. (Hypothesis 2).

This research study provided a significant contribution to moving beyond studying instrumental and non-instrumental issues on any typical B2C e-Commerce website. It investigated the employment of a naturalistic avatar for information presentation in relation to design aspects, with the goal of elucidating the ways in which this choice may affect users' decision-making and satisfaction with the website. In addition, business-to-consumer (B2C) e-Commerce companies (especially e-retailer websites) place a premium on usability and associated factors when seeking design guidance for their websites or developing and refining their online retailer storefronts. Similarly, this study suggests that these e-retailers may benefit from taking into account conspicuous design characteristics such as aesthetics and experience qualities, as this may lead to more complete design suggestions as well as an improvement in their marketing tactics. This study also suggests that online stores take into consideration integrating realistic avatars into their website's user interface, since the results showed that doing so would improve consumers' usage attitudes, trust, and intention to buy as well as their general contentment or overall satisfaction. This research study's data and findings will serve as a foundation for our future work, in which we'll examine the effects of utilizing expressive avatar in the same B2C online retail context. Customers' trust, usage attitude, and decision-making will be measured and compared among presentation modalities using these data and outcomes. The use of avatars of various sorts (expressive or non-expressive avatars) may add new dimensions to human-computer interaction (Liew et al., 2017) and (Pustejovsky & Krishnaswamy, 2021), as well as encourage an emotional attachment to the website, in contrast to the two-dimensional static graphical and textual information interfaces on e-commerce websites (Diederich et al., 2022). More specifically, naturalistic avatars of both genders with positive facial expressions (e.g., smile and joy) and body gestures (e.g., open palms) will be designed and integrated with all conversational functions (identified in our observational study (Al Sokkar & Law, 2013), with the goal of improving the acceptance of these avatars.

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