The influence of mobile app design on emotions leads to purchase intention for risk avoidance cultures

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Abstract: In the current competitive environment, retailers should focus more on customers' experiences and perceptions while designing interactive interfaces to evoke positive emotions. Improving user experiences by refining design strategies is considered a successful business strategy. This is because customers' perceptions and related experiences influence the utilisation behaviour and purchase intention. Therefore, this study intends to explore the effect of design characteristics on emotions leading to purchase intention. An experimental prototype of an online ticket booking is developed to collect the data for validation of the intended objective. The collected data is analysed using partial-least-squares, a structural equation modelling technique. The results provide partial support for the proposed hypotheses. Accordingly, animation, colour, and transition are observed to be associated with positive emotions, while font and aesthetic graphics are determined as strong indicators of negative emotions. However, hierarchy and control were more crucial for positive (and negative) emotions. Lastly, positive and negative emotions contribute to changing the purchase intention.

Keywords: e-commerce; emotions; navigation design; usability; visual design; purchase intention.

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1 Introduction

The main objective of this study is to assess whether certain aspects of design of e-commerce mobile apps have an effect on positive and negative emotions and, in turn, in purchase intention, for the specific case of a risk avoidance culture (Cyr, 2013; Alexander et al., 2017; Faisal et al., 2017; Lu et al., 2018). Organisations and online service providers spend massive resources to design responsive, user-friendly, and easy-to-use applications, especially for online shopping (Faisal et al., 2017). The importance of a good interface design has been evidenced in many previous research works. Improving

customer experiences and perceptions through design quality are important factors to entice new customers and keep existing ones, especially in uncertainty or risk avoidance cultures, whose individuals feel embarrassed, uneasy, and uncomfortable with uncertain situations (Faisal et al., 2017). Besides unknown situations/ ambiguity, individuals also try to avoid technological risks (Chen et al., 2013; Yoon, 2009). A well-designed interface requires fewer mental resources to search the products and facilitate customers' buying decisions through instantaneous information (Faisal et al., 2020). On the other hand, inappropriate design and poor service quality irritate individuals while shopping online, and they are more prone to leave the website without completing the buying process (Faisal et al., 2018; Hasan, 2016).

In a different dimension, the importance of emotions with regard the purchase intention has also been evidenced (Deng and Gu, 2021). Previous works (Koo and Ju, 2010; Kuo and Wu, 2012; Loureiro and Roschk, 2014; Chen et al., 2016b; Deng and Gu, 2021) assume that both motivation and emotions are precursors of purchase intention or utilisation behaviour. Emotions (e.g., happiness, joy, anticipation, fear, irritation, sadness, anger, and acceptance) refer to strong feelings resulting in psychological and physical reactions that stimulate final behaviour (Éthier et al., 2008; Kuo and Wu, 2012). The link between interface design and emotions has been suggested by many authors (Kuo and Wu, 2012; Loureiro and Roschk, 2014). However, prior research generally focused on cognitive and behavioural aspects, neglecting the role of emotions.

This study makes three vital contributions: first, the identification of usability-related design aspects and the strength of association between these design characteristics and emotions (i.e., positive and negative) leading to purchase intention. Second, exploring the emotions that modify purchase intention is crucial to this study. Third, in continuation of prior work (Éthier et al., 2008; Faisal et al., 2017, 2018, 2020; Nabeela et al., 2019; Younas et al., 2021), this study also proposes the emotional criteria based on customer perception to evaluate the mobile application design, which enables the designers' community to recognise essential design features while developing online selling applications fit for risk avoidance cultures.

The rest of the article is arranged as follows: Section 2 reviews literature linked to design, emotions, purchase intention, intended model along with hypotheses. Section 3 details the methodology, experimentation, data collection and statistical data analysis. Finally, Section 4 presents the discussion, followed by the conclusion, limitations, and future scope.

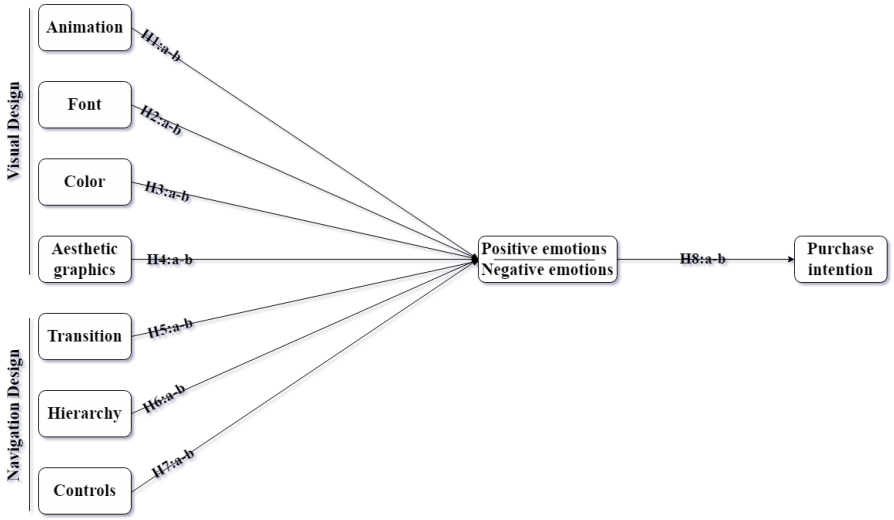
2 Theoretical background and hypothesis

2.1 Design and emotions

Electronic commerce's emergence also depends on individuals' acceptance of useable and well-designed technologies. Both usability and interface design are important for accepting technologies (Saadé and Kira, 2009; Younas et al., 2021). In addition, the design (i.e., font, layout, colour, graphics) and usability aspects also affect the usefulness of a system (Hoehle et al., 2016; Younas et al., 2021). Equally, the role of animation was also considered important in developing a positive perception and information processing (Lowe, 2003; Yoo and Kim, 2005; Shaouf et al., 2016). Therefore, the prime role of the designers is to improve the user's experiences by adopting appropriate design strategies.

This is because, due to increasing competition, online retailers attempt to distinguish themselves from their rivals by relying on web atmospherics (design) to create an environment that evokes a positive emotion and looks trustworthy, especially for uncertainty avoidance cultures. Uncertainty or risk avoidance is related to trust that influence online transactions (Cyr, 2013; Money and Crotts, 2003). It is related to confidence, level of anxiety, and fear that individuals in a culture feel when faced to ambiguous and uncertain situations and try to avoid them (Alexander et al., 2021; Cyr, 2013). Negative emotions such as anxiety emerge when ambiguous situations are encountered (Alexander et al., 2017). Accordingly, the users prefer controlled and useable interaction to minimise ambiguity and handle situations (Alexander et al., 2017; Ganguly and Nag, 2021).

Figure 1 Proposed model



Customers can experience a broad range of emotions in electronic shopping while navigating the user interface (Éthier et al., 2008). The intended purpose of the present study is also built on the assumption that the design of a specific environment creates certain effects on consumers' behaviour and produces emotional reactions that may change the purchase intention. Emotions refer to complex stimulation patterns, feelings, perceptions, and cognitive aspects. The interpretation varies from person to person. Psychologists consider cognitive motives such as memories, interpretation, and perception as important ingredients of emotions (Young and Murray, 1965). They are a "mental state of readiness that arises from cognitive appraisals of events or thoughts" (Bagozzi et al., 1999). They can also be distinct as a state of willingness or readiness that assists individuals and organisms to communicate and interact with the surrounding environment (Lottridge et al., 2011). The emotions can be either positive or negative. Positive emotions tend to be related with positive outcomes (response), and negative emotions are associated with negative ones. Positive emotions refer to pleasurable or satisfactory experiences (Loureiro and Roschk, 2014; White and Yu, 2005). They also refer to a pleasant response to environmental stimuli. White and Yu (2005) regarded

positive emotions as satisfaction or a gauge for system success were discussed. They highlight customer perception and are the most commonly adopted measure in HCI and marketing-related research (Bagozzi et al., 1999; White and Yu, 2005). A customer may feel satisfied if a product executes its functions per expectations. White and Yu (2005) included the aspects of positive emotions (i.e., pleasurable, happy, hopeful, and positively surprised) to constitute the satisfaction scale. Further, the authors observed satisfaction emotions as a strong predictor of behavioural intentions (White and Yu, 2005). Additionally, negative emotions refer to unpleasant/bad experiences, which ultimately have an unhappy and negative emotion-evoking effect. In prior studies (Bagozzi et al., 1999; Éthier et al., 2008; Kuo and Wu, 2012; Faisal et al., 2018), negative emotions refer to infuriation, momentary impatience, feelings of discomfort, and displeasure due to frustrating or annoying stimuli. Accordingly, annoying and negative incidents take the user experience from extremely comfortable to extremely frustrating (Faisal et al., 2018). Thus, in the current study, we classify negative emotions as the limit to which an online shopping application appears irritating and messy (Faisal et al., 2018). The intent is to seek the association between design elements and emotions (positive and negative), leading to purchase intention (see Figure 1). Moreover, the design characteristics used to constitute usability are adopted from a recent study (Hoehle et al., 2016) and majorly categorised into visual (i.e., animation, font, colour, and aesthetic graphics) and navigation design (i.e., transition, hierarchy, and control). We assume that the structural organisation, layout, precise arrangement, and appropriate visual appearance are important environmental stimuli for evoking emotions. The well-known 'stimulus-organism-response' (SOR) framework is used to explain the leading role of design aspects (Albert and Russell, 1974). According to the SOR framework, the stimulus (design elements) acts as environmental characteristics or triggers that cause change to internal states or organisms (such as emotions and feelings) of individuals, resulting in their approach or avoidance response (purchase intention) (Albert and Russell, 1974). Several design-related studies adopted this framework to explain user perception, experiences, and utilisation behaviour (see Table 1).

2.2 Visual design

Visual design is key to express a website's emotions and organisation (Kuo et al., 2022). It incorporates interface design elements such as balance, aesthetics, consistency, and space, increasing the site's appearance quality. It mainly includes font type, colours, graphics, and layout to manage the visual appearance or aesthetic quality (Faisal et al., 2017; Faisal et al., 2020). Faisal et al. (2017) discussed visual design as an important factor in determining user satisfaction, which is also related to sensation and emotional experience (Loureiro and Roschk, 2014). Thus, an aesthetically attractive, balanced, well organised, and aligned design positively affects consumers' intention; if these characteristics do not meet the criteria, the behavioural intention will be adversely affected (Nabeela et al., 2019). Literature reveals visual appearance as a crucial aspect of system success (Faisal et al., 2020; Éthier et al., 2008; Faisal et al., 2017; Loureiro and Roschk, 2014). The present study narrows the visual design assessment criteria into animation, font, colour, and aesthetic graphics.

Table 1 Design studies using the SOR framework

Year	*Stimulus*	*Organism*	*Response*
Loureiro and Roschk (2014)	Information design and graphics	Emotions	Loyalty intention
Ali (2016)	Usability, functionality, privacy, and security	Flow	Purchase intention
Shaouf et al. (2016)	Web advertising/animation	Attitude	Purchase intention
Bhandari et al. (2017)	Aesthetics (visual design)	Emotions	Perceived quality
Carlson et al. (2018)	Interactivity, content, and information/contact quality	Value	Engagement
Rodríguez-Torrico et al. (2019)	Visual/appearance, personalisation, and interactivity	Trust and satisfaction	Purchase intention
Faisal et al. (2020)	Quality (i.e., appearance, navigation, content/information, and interaction)	Affective and cognitive	Continued intention to use
Yin et al. (2021)	Ubiquitous connectivity, active control, and responsiveness	Temporal dissociation and focused immersion	Perceived waiting time
Lee et al. (2021)	Interactivity	Engagement and satisfaction	Loyalty

2.2.1 Animation

Animation is an important mobile application interface design aspect and is considered a useful method to manipulate and convert graphics into moving images (Hoehle et al., 2016). It helps to engage and appeals to the users of web applications by giving them visual feedback (Hoehle et al., 2016). Appropriate animations increase understanding and attractiveness; otherwise, complex and heavy animations may distract users' attention from crucial points (Weiss et al., 2002). Therefore, it is important to keep animations simple to deliver suitable content successfully. Several studies (Weiss et al., 2002; Hamborg et al., 2012; Lee et al., 2015; Shaouf et al., 2016) discussed the impact of animations on emotional and cognitive aspects. Likewise, Yoo and Kim (2005) considered web animation-based features important to explore emotional and cognitive responses. Similarly, Hoehle et al. (2016) recommended that animations are good to avoid distraction. In this study, we used animation design as an essential artefact to seek whether the user perceives animations in the designed prototype as relevant and appropriate. Therefore, based on this assumption, we hypothesise that:

Hypothesis 1a Animation positively influences positive emotions.

Hypothesis 1b Animation negatively influences negative emotions.

2.2.2 Font

Font is a set of characters having a similar shape (Hoehle et al., 2016). It is referred to the appearance, arrangement, layout, and organisation of related characters to improve

information processing and legibility. It is an imperative design element used to measure the usability of desktop/mobile applications. The typographical features normally include style, typeface, spacing, and size to enhance the readability and comprehension of the content (Faisal et al., 2017). Faisal et al. (2020) proposed that font size is the core feature influencing mobile Apps usability because it affects the suitability with which information is displayed, how simple it is to learn the provided information, and how effectively informational contents are presented to the users. The appropriate typographical features were considered essential stimuli that evoke positive emotions (Bayer et al., 2012; Ho, 2013). Hence, font size or style should be suitable for mobile screen sizes; otherwise, inappropriate font size or style may be irritating when the screen size is small. Moreover, readability is a major concern on different screen sizes because poor font choice may invoke negative feelings among users. So, on the basis of the hypothetical ground and association, we hypothesise the followings:

Hypothesis 2a Font positively influences positive emotions.

Hypothesis 2b Font negatively influences negative emotions.

2.2.3 Colour

Colour is a light component consisting of hues (Hoehle et al., 2016; Faisal et al., 2017, 2020). It is strongly associated with attractiveness, beauty, and emotions and helps users to recognise and understand the function of buttons, boxes, and icons (Faisal et al., 2017). In addition, it is useful to distinguish and remember the contents and to draw the user's attention to specific content by changing the hue and contrast level (Faisal et al., 2017). The components of colour include saturation, hue, and brightness (Faisal et al., 2017). Hue distinguishes between colours, saturation is the richness of hue, and brightness discriminates light colours from dark ones. Faisal et al. (2017) findings suggest that colour is associated with emotions; further, the authors observed the impact of colour elements on memorisation and loyalty. In another study, Faisal et al. (2018) considered the precise composition of the colour scheme important to avoid irritation in an e-commerce context. Thus, a suitable colour scheme to frame the mobile interaction could help to avoid negative feelings. Upon the above theoretical base and association, we build hypotheses as follows:

Hypothesis 3a Colour positively influences positive emotions.

Hypothesis 3b Colour negatively influences negative emotions.

2.2.4 Aesthetic graphics

Aesthetic graphics enhance user experiences and are considered one of the core design artefacts in making design appealing and aligned (Hoehle et al., 2016). In prior studies, aesthetic graphics were measured and conceptualised differently. Li and Yeh (2010) discussed aesthetics-related aspects, i.e., balance, emotional appeal, or interface beauty. Aesthetics can also be considered as the combination of a number of components: colours, animation, structure, shapes, organisation, and layout (e.g., gestalt principles) (Li and Yeh, 2010; Faisal et al., 2020). Ashraf et al. (2019) observed aesthetics as a strong factor of emotions compared to other interface design or usability aspects. These authors further argued that proper use of aesthetics satisfies the customers' needs and

increases their purchase intention. Thus, appropriate aesthetics and precise graphics organisation based on gestalt principles may offer pleasing experiences because of better usability. Considering this theoretical base and association, we theorise the following:

Hypothesis 4a Aesthetic graphics positively influences positive emotions.

Hypothesis 4b Aesthetic graphics negatively influence negative emotions.

2.3 Navigation design

Navigation is the navigational scheme or structure organisation used to assist users in accessing information (Faisal et al., 2017). A navigational structure that is easy to use (i.e., usability) with good clues ensures the accomplishment of the user's task on time and provides efficient means to retrieve vital information immediately (Faisal et al., 2017). According to Webster and Ahuja (2014), "navigation is designed to aid users in creating and interpreting an internal mental model that helps them find and examine data on a site". An easy-to-navigate system arouses pleasure, and satisfaction ultimately increases purchase intention. Numerous studies (Briz-Ponce et al., 2017; Huifeng and Ha, 2022; Nabeela et al., 2019) also found the influence of ease of use or navigation features on positive emotions and behavioural intention. Therefore, it is crucial to integrate the navigation features to improve users' experiences by conveniently searching for the required products. This study includes navigation in terms of transition, hierarchy, and fingertip size as assessment measures. We assume applications that are easy to use with a precise hierarchical structure and allow the user to conveniently access the information arouse pleasure-able feelings as cognitive efforts are reduced.

2.4 Transition

Mobile application transitions direct users to move conveniently from one page to others (Hoehle et al., 2016). When users transit easily from one page to another without any problem, it invokes users for actions. Instant transitioning within an application requires less energy and motivates them to spend more time on it. Lee et al. (2009) discussed that users ought to have the option to viably explore among screens since this would enhance their general impression of system excellence. The authors suggested that navigation-related issues could be recognised by estimating how web users transit among web pages and getting detailed data inside every application page. So, the transition from one window to another is an important factor for an efficient interaction and improved individuals' perception. The smooth moment within the application helps the users to assess their location and easily explore other areas of the application. The appropriate transition effects may increase positive emotions while hindrance and complexity in movement may irritate users. So, we hypothesise the following:

Hypothesis 5a Transition positively influences positive emotions.

Hypothesis 5b Transition negatively influences negative emotions.

2.5 Hierarchy

The menu's hierarchical arrangement supports users in transitioning web applications (Hoehle et al., 2016). It refers to the arrangement of menu items layers to support

convenience. It saves users time locating their current position and the required information (Hoehle et al., 2016; Faisal et al., 2017). Hierarchy has been underlined in conventional web applications as a significant design angle that embeds the web structure and organisation (Agarwal and Venkatesh, 2002). It helps the users to see and experience the structural organisation of web applications. Mobile applications having a precise hierarchical structure illustrate to users the inherent logic of the web (Adipat et al., 2011; Hoehle et al., 2016). In addition, past research also recommends that well-structured navigation with particular hierarchical order brings a sense of pleasure and happiness (Faisal et al., 2020), and the incorporation of reverse or undo-related features allows the users to move back or recover from errors (Faisal et al., 2017). Furthermore, Kim et al. (2005) discuss hierarchy as a significant aspect of mobile apps used for arranging, marking, and sequencing items to help users explore. Otherwise, unstructured design may mislead users and pushes them to quit the application. Then, we can formulate the following hypotheses:

Hypothesis 6a Hierarchy positively influences positive emotions.

Hypothesis 6b Hierarchy negatively influences negative emotions.

2.6 Control

Control is an important element of navigation that allows the users to perform actions precisely and helps them to select appropriate choices through taping and pressing (Hoehle et al., 2016). Accordingly, the elements such as buttons and control should be obvious and fit as per fingertip size for effective interaction by maintaining a reasonable size and space between items; otherwise, the user may experiment problems while selecting an item (Kurniawan, 2008; Hoehle et al., 2016). Therefore, designers should carefully develop mobile applications by considering the mobile screen size or space to display the contents, controls, and keyboards (Brewster, 2002). Fingertip width limitations force the developers to arrange items per screen size. Therefore, designing an interactive style for mobile applications requires careful consideration of the appropriate design strategies to ensure items, buttons, or control fit as per screen size. Kurniawan (2008) studied the relation of the application's ease of use with the control size for the case of elderly users of mobile devices. The main results suggest that obvious and large fingertip-size buttons and controls knob are important to help users to choose the features, functions, and options in mobile applications appropriately (Kurniawan, 2008). Moreover, the prominent location of controls on the screen is also important to improve the accessibility and usability of mobile applications. Then, the hypotheses that can be formulated regarding to control are the following:

Hypothesis 7a Control positively influences positive emotions.

Hypothesis 7b Control negatively influences negative emotions.

2.7 Purchase intention

Purchase intention is the likelihood of purchasing things under specific restrictions (Ganguly et al., 2010; Jiang et al., 2010; Chen et al., 2016a). In the online shopping environment, it refers to the readiness or willingness of shoppers to make their

transactions or purchases continuously (Chen et al., 2016a). It is particularly assessed by exploring the customers' willingness to purchase and repurchase (Dedeke, 2016; Kuo and Wu, 2012). Furthermore, purchase intention is related to buying behaviour, a cognitive process linked with buying decisions (Faisal et al., 2017). Therefore, a deep understanding and knowledge about purchase intention or buying behaviour facilitates the design community to adopt a relevant design strategy to retain and attract customers. Specifically, it is important to understand purchase intention to determine consumer behaviour in an online environment. In addition, customers' perception of services and design quality is key to understanding their emotional experiences, buying decisions, and affiliation with online stores. Several studies (Kuo and Wu, 2012; Loureiro and Roschk, 2014) adopted emotional aspects to understand purchase intention. Furthermore, Jiang et al. (2010) argue that positive emotions, including happiness and satisfaction, motivate customers to spend more time and lead to positive purchase intention. Otherwise, a poor design strategy irritates the customer, and such negative emotions have numerous negative effects, including less favourable attitudes (Faisal et al., 2018). The design that has poor usability and is difficult to navigate needs a higher level of cognitive processing; resultantly, the customers feel irritated and leave the buying process (Faisal et al., 2018; Kuo and Wu, 2012). Ashraf et al. (2019) also observed the association between emotions and behavioural purchase intention. Finally, it is also remarkable that Kuo and Wu (2012) argue that understanding consumers' emotions is useful for determining customer satisfaction purchase intention. The hypotheses that stem from the above arguments are the following:

Hypothesis 8a Positive emotions positively influence purchase intention.

Hypothesis 8b Negative emotions negatively influence purchase intention.

3 Methodology

An experimental prototype of an online travel booking system was developed resembling the one at Lufthansa.com using responsive technologies. The developed prototype comprises information only relevant to booking activities. However, the irrelevant information was removed from the prototype so the participants could focus only on the employed design elements. Before starting the experimentation, usability experts were invited to perform the cognitive and pluralistic walkthroughs and review the experimental prototype's early mockups (low to high), followed by a heuristic assessment of the final wireframes to improve the overall usability of the application. A series of pilot tests were conducted using local users to ensure the usability and functionalities of the developed prototype. The feedback and comments gathered during the pilot studies were incorporated to improve the usability and interface design of the experimental prototype.

A questionnaire scale was designed and incorporated into the prototype (online ticket booking website) to refute the proposed hypotheses by gathering users' perceptions. The survey scale (questionnaire) consisted of 25 items to gather the participants' experiences of the employed experimental prototype. The survey items utilised to measure the proposed hypotheses were mainly obtained from academic literature (e.g., Éthier et al., 2008; Kuo and Wu, 2012; Hoehle et al., 2016; Faisal et al., 2017) with a little bit of modification. The scale (survey) concentrates on the individual's reply (rating) to visual design (i.e., animation, font, colour, and aesthetic graphics), navigation design (i.e.,

transition, hierarchy, and control), positive emotions, negative emotions, and purchase intention. A higher score (or high ranking) against the assumed items/indicators specifies more positive experiences or perceptions. Further, the expert from academics also reviewed the survey scale to ensure the survey items' relevance, understanding, appropriateness, and meaningfulness. The questionnaire (survey tool) was developed in English, and a five-point Likert scale (1–5) was adopted to gather and measure the employed items.

The data was collected from university students with the help of colleagues working in different Pakistani and Spanish universities. According to Hofstede's culture index table, Pakistan and Spain are considered high uncertainty avoidance cultures, with score values of 70 and 86, respectively (Marcus, 2014). The students were considered the most appropriate samples because they have easy access to internet services/resources and frequently use them to search, sell and order products. Further, the selection of university students as participants is common and reliable, and consistent with recent empirical studies (e.g., Hoehle et al., 2016; Faisal et al., 2017, 2020) because of their confidence, technological awareness, skills, and expertise in performing complicated interactive tasks related to purchasing and researching the online contents. In response to an email invitation, 854 students from different universities (Pakistan and Spain) responded with positive consent. Accordingly, a link to the experimental prototype and a description related to buying scenarios and related activities were shared with students. The experimentation and buying process description was also integrated into the experimental prototype as collapsible content for review before starting the booking process. In the description, the study participants were invited to operate the designed prototype to book the ticket per the scenarios given in the explanation. Lastly, the study participants were asked to login after finishing the booking procedure via an online registration form to gather the device and demographical-related information, followed by a questionnaire survey. 498 surveys were correctly obtained in three months after discarding incomplete, doubtful, or duplicate responses. The descriptive statistics about participants were computed using the SPSS software package (i.e., SPSS 20.0) (see Table 2).

Table 2 Descriptive statistics of the participants

Category		*Frequency*	*Percentage*
Gender type	Male	323	64.9
	Female	175	35.1
Age groups	Less than 20	155	31.1
	Between 20 and 30	266	53.4
	Above 30	77	15.5
Qualification	Graduate level	364	73.1
	Postgraduate level	134	26.9
Internet browsing	Beginners	74	14.9
	Intermediate	162	32.5
	Advanced	262	52.6

3.1 Data analysis

PLS-SEM is now a widely adopted approach that enables scholars to assess and estimate research models with numerous factors, constructs, indicators, and structural paths (Chin, 1998; Hair et al., 2017). It is a predictive method that emphasises assessing models, whose formation is designed to give underlying explanations (Hair et al., 2017, 2019). PLS makes this possible by processing measurement (outer) and structural (inner) model relations independently instead of instantaneously (Hair et al., 2017, 2019). It is an effective approach that is used to compute partial-regression relations in the structured and measurement model by applying regressions (Hair et al., 2017, 2019). The first part in assessing the PLS results contains the estimation (measures) of the measurement model. If the measurement model satisfies the essential conditions, which are discussed in the following subsection, scholars proceed to calculate the structural model (Hair et al., 2017, 2019).

Table 3 Reliability, validity, and unidimensionality

Constructs	*Means*	*Loadings*	α	*rho_A*	*CR*	*AVE*	*VIF*	*Initial eigenvalues*		
								Total	*% of variance*	*Cumulative (%)*
Animation			0.844	0.845	0.928	0.865	2.5			
AN1	2.02	0.929						1.73	86.54	86.54
AN2	1.93	0.932						0.26	13.45	100
Font			0.728	0.737	0.880	0.785	1.4			
FNT1	2.42	0.903						1.57	78.60	78.60
FNT2	2.41	0.870						0.42	21.39	100
Colour			0.769	0.788	0.896	0.811	2.1			
CLR1	2.40	0.881						1.62	81.23	81.23
CLR2	2.21	0.920						0.37	18.77	100
Aesthetic graphics			0.851	0.854	0.931	0.870	2.4			
AG1	1.99	0.938						1.74	87.04	87.04
AG2	2.03	0.928						0.25	12.95	100
Transition			0.853	0.862	0.911	0.772	2.7			
TR1	2.09	0.867						2.32	77.31	77.31
TR2	2.20	0.878						0.36	12.08	89.39
TR3	2.08	0.891						0.31	10.60	100
Hierarchy			0.848	0.852	0.908	0.767	2.0			
HRY1	2.36	0.863						2.32	77.31	77.31
HRY2	2.30	0.879						0.36	12.08	89.39
HRY3	2.18	0.884						0.31	10.60	100
Controls			0.853	0.853	0.911	0.773	3.3			
CTR1	2.10	0.873						2.31	77.28	77.28
CTR2	2.09	0.896						0.38	12.93	90.21
CTR3	2.20	0.868						0.29	9.78	100

Table 3 Reliability, validity, and unidimensionality (continued)

Constructs	*Means*	*Loadings*	α	*rho_A*	*CR*	*AVE*	*VIF*	*Initial eigenvalues*		
								Total	*% of variance*	*Cumulative (%)*
Positive emotions			0.819	0.819	0.917	0.846	1.0			
PE1	2.18	0.919						1.69	84.64	84.64
PE2	2.12	0.921						0.30	15.35	100
Negative emotions			0.830	0.851	0.898	0.746	1.0			
NE1	3.67	0.828						2.24	74.66	74.66
NE2	3.72	0.901						0.43	14.41	89.08
NE3	3.68	0.859						0.32	10.92	100
Purchase intention			0.892	0.893	0.933	0.822				
PI1	2.05	0.912						2.46	82.21	82.21
PI2	2.06	0.909						0.28	9.59	91.81
PI3	2.11	0.899						0.24	8.18	100

3.2 Measurement (outer) model

The measurement model reveals the associations between the items, indicators, and constructs (Hair et al., 2017, 2019). The first step in estimating the measurement model normally consists of examining the items' loadings (Hair et al., 2017, 2019). The computed values of items loadings for the employed constructs (survey items) are greater than 0.7 in all cases and observed between from 0.828 to 0.938 (see Tables 2 and 3), with suggested (≤0.05) and t-value (≥1.96) (Hair et al., 2017, 2019). Factor loadings above the advised value, which is 0.708, reveal that the employed study constructs describe above 50% of an indicator's variance, hence giving adequate reliability (Hair et al., 2017, 2019). The second phase reviews internal consistency using composite reliability (*CR*) (Hair et al., 2017, 2019). The composite reliability criterion is considered a consistent and dependable way to calculate reliability and varies between 0 and 1 (Hair et al., 2017, 2019). The suggested value to ensure the composite reliability should be ≥0.70 (Hair et al., 2017, 2019). The values from 0.70 to 0.90 ranking from satisfactory (acceptable) to good, respectively. However, values or figures ≥0.95 are problematic and show the chance of unfavourable response patterns or specifying that all the employed indicators are assessing the same phenomenon (Hair et al., 2017, 2019). In the current work, the extracted values of composite reliability for the employed measures were above the advised value (i.e., ≥ 0.70) and ranged from 0.880 to 0.933 (see Table 3). Moreover, Cronbach's alpha criterion is also useful to satisfy the reliability established on the intercorrelations of the studding variables (Hair et al., 2017, 2019).

Table 4 Validity: outer loadings

Constructs	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Animation	*0.929*	0.395	0.538	0.584	0.624	0.512	0.650	0.638	–0.156	0.657
	0.932	0.364	0.551	0.607	0.688	0.503	0.664	0.653	–0.153	0.666
Font	0.373	*0.903*	0.453	0.436	0.419	0.351	0.426	0.432	–0.063	0.425
	0.348	*0.870*	0.470	0.397	0.351	0.406	0.380	0.376	–0.061	0.394
Colour	0.481	0.478	*0.881*	0.454	0.52	0.504	0.500	0.511	–0.03	0.514
	0.567	0.462	*0.920*	0.649	0.524	0.563	0.557	0.606	–0.115	0.608
Aesthetic graphics	0.608	0.417	0.583	*0.938*	0.567	0.576	0.629	0.611	–0.188	0.666
	0.586	0.464	0.576	*0.928*	0.608	0.546	0.678	0.575	–0.152	0.639
Transition	0.632	0.325	0.485	0.558	*0.867*	0.458	0.636	0.593	–0.136	0.559
	0.544	0.385	0.485	0.512	*0.878*	0.470	0.618	0.576	–0.106	0.573
	0.674	0.432	0.549	0.584	*0.891*	0.528	0.698	0.690	–0.158	0.655
Hierarchy	0.476	0.396	0.508	0.482	0.467	*0.863*	0.541	0.503	–0.015	0.523
	0.463	0.363	0.558	0.519	0.495	*0.879*	0.562	0.526	–0.027	0.533
	0.493	0.359	0.497	0.573	0.494	*0.884*	0.644	0.578	–0.026	0.541
Control	0.637	0.399	0.535	0.646	0.652	0.629	*0.873*	0.628	–0.158	0.610
	0.634	0.38	0.532	0.589	0.674	0.567	*0.896*	0.619	–0.170	0.608
	0.591	0.424	0.485	0.609	0.634	0.565	*0.868*	0.642	–0.100	0.634
Positive emotions	0.645	0.413	0.579	0.556	0.657	0.552	0.680	*0.919*	–0.092	0.671
	0.632	0.429	0.570	0.614	0.648	0.576	0.639	*0.921*	–0.116	0.699
Negative emotions	–0.097	–0.070	–0.036	–0.156	–0.137	–0.004	–0.098	–0.074	*0.828*	–0.115
	–0.208	–0.020	–0.115	–0.192	–0.169	–0.046	–0.196	–0.157	*0.901*	–0.213
	–0.108	–0.104	–0.059	–0.119	–0.083	–0.012	–0.112	–0.047	*0.859*	–0.125
Purchase intention	0.655	0.422	0.583	0.663	0.647	0.567	0.683	0.694	–0.200	*0.912*
	0.660	0.402	0.569	0.635	0.618	0.526	0.612	0.650	–0.155	*0.909*
	0.619	0.435	0.551	0.604	0.587	0.560	0.614	0.680	–0.134	*0.899*

However, it was considered a weak criterion because the indicators or items are unweighted (Hair et al., 2017, 2019). For α value, there is no specified criterion or cut-off value. But, the lowest value of the α criterion is typically admitted at approximately 0.70 (Hair et al., 2017, 2019). The acceptable minimum value should be equal to 0.80 for the research which is not exploratory; however, a rule-of-thumb or a guideline for α threshold rating is "$\alpha \geq 0.9$ = excellent, $\alpha \geq 0.8$ = good, $\alpha \geq 0.7$ = acceptable, $\alpha \geq 0.6$ = questionable, $\alpha \geq 0.5$ = poor, and $\alpha \leq 0.4$ = unacceptable" correspondingly (George and Mallery, 2003; Hair et al., 2019). In this study, the assessed values of α ranged between 0.728 and 0.892 (see Table 3). The average α value = 0.828; thus, the employed assessment tool may be good. The rho_A is also an important criterion for assessing reliability (Dijkstra and Henseler, 2015; Hair et al., 2019). The computed values of rho_A were observed to be upper than the suggested value (i.e., ≥0.70) and lie between from 0.737 to 0.893 (see Table 3). Finally, the indicators or measures reliability was further ensured by assessing the items loadings of the employed constructs to which the items are theoretically or hypothetically related (see Tables 3 and 4).

The third phase measures the convergent validity and strength of employed constructs. Convergent validity is "the degree to which the construct converges to explain the variance of its items" (Hair et al., 2017, 2019). It is the unit to which an employed measure completely relates to alternate measures of the same construct (Hair et al., 2017, 2019). Besides outer loadings to assess the indicators' reliability, the 'average variance extracted' (AVE) criterion is useful to calculate the convergent validity (Hair et al., 2017, 2019). However, the lowest recommended value for the AVEs criterion must be greater than or at least equivalent to 0.50, indicating that the employed constructs explain at least 50 % of the variation of the items that make the construct (Hair et al., 2017, 2019). The computed values of AVE in the current study were observed to be more than the suggested cut-off value of 0.50 (see Table 3) (Hair et al., 2017, 2019).

Table 5 Validity: Fornell-Larcker

Constructs	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Animation	0.930									
Font	0.408	0.886								
Colour	0.585	0.520	0.901							
Aesthetic graphics	0.640	0.471	0.621	0.933						
Transition	0.706	0.436	0.579	0.629	0.879					
Hierarchy	0.545	0.425	0.594	0.601	0.555	0.876				
Control	0.706	0.456	0.589	0.699	0.743	0.668	0.879			
Positive emotions	0.693	0.458	0.624	0.636	0.709	0.614	0.717	0.920		
Negative emotions	-0.166	-0.070	-0.085	-0.183	-0.153	-0.015	-0.162	-0.113	-0.863	
Purchase intention	0.711	0.463	0.626	0.700	0.681	0.608	0.703	0.745	0.181	0.907

Table 6 Discriminant validity: Heterotrait-monotrait Ratio

Constructs	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Animation	-									
Font	0.519									
Colour	0.721	0.698								
Aesthetic graphics	0.754	0.599	0.756							
Transition	0.826	0.547	0.712	0.736						
Hierarchy	0.644	0.545	0.734	0.705	0.648					
Control	0.832	0.577	0.724	0.822	0.867	0.782				
Positive emotions	0.834	0.590	0.781	0.761	0.843	0.734	0.858			
Negative emotions	0.190	0.098	0.111	0.214	0.177	0.047	0.186	0.130		
Purchase intention	0.819	0.573	0.751	0.802	0.776	0.698	0.805	0.871	0.203	-

The fourth phase of the measurement (outer) model is to calculate the discriminant validity suggested by Hair et al., (2017, 2019). Discriminant validity refers to "the degree to which a construct is empirically distinct from other constructs in the structural model" (Hair et al., 2017, 2019). Thus, ensuring the discriminant validity suggests that a concept is distinctive and holds facts not expressed by related constructs (Hair et al., 2017, 2019). Accordingly, the discriminant validity assessment mainly depends on two important

criteria (Hair et al., 2017, 2019). The first criterion to assess the discriminant validity is associated to the AVE proposed by Fornell and Larcker (1981). It specified that the square-root of the AVE (√AVE) values for every factor should be more than its maximum correlation with any other construct, or AVE should be larger than the squared correlation (coefficients) with other constructs (Fornell and Larcker, 1981; Hair et al., 2019). Table 5 exhibits the criterion related to the (√AVE). As a complement to the Fornell-Larcker method, Henseler et al. (2015) suggested the 'heterotrait-monotrait ratio' (HTMT) as an important measure to ensure discriminant validity. Further, the HTMT is described as "the mean value of the item correlations across constructs relative to the mean of the average correlations for the items measuring the same construct" (Henseler et al., 2015; Hair et al., 2019). The discriminant validity issues exist if HTMT values are higher than 0.90 (Hair et al., 2017, 2019). In the current study, no value was observed to be greater than the suggested threshold for HTMT (see Table 6). The second criterion to ensure the discriminant validity (indicators validity) specifies that for each of the items, their outer loading on the linked measure should be more than any of their loadings on employed constructs (Chin, 1998; Hair et al., 2019). As "the correlation of the latent variable scores on the measurement items needs to show an appropriate pattern of loadings, one on which the measurement items load highly on their assigned factor and not high on other factors" (Gefen and Straub, 2005). In the current study, all the items loading meet the suggested criteria. It was also important to examine the unidimensionality of the used study tool via principal component analysis (PCA), which is an exploratory data analysis normally used for dimensionality reduction (Kaiser, 1960). The basic criterion to assess unidimensionality is to check if the eigenvalue of the 'principal component' is higher than one (Kaiser, 1960). If so, it is ensured that the constructs used in this study fulfil Kaiser's criterion (Kaiser, 1960); further, the 'principal component' extracted delivers a variance value considerably greater than the second one. So, the outcomes attained fulfil the recommended criteria (see Table 3).

Table 7 Additional quality measures

Indices	*Observed*	*Standard criteria*	*Ideal cut-off (value)*	*95%*	*99%*
SPR	0.833	≥0.7	1		
RCR	0.963	≥0.9	1		
SSR	0.967	≥0.7			
NBCDR	0.765	≥0.7			
SRMSR	0.070	≤0.08		0.037	0.040
d_ULS	1.609			0.454	0.531
d_G	0.661			0.511	0.525
Chi-square	2,218.9				
NFI	0.763				
RMS theta	0.118				
AVIF	2.04	≤5	≤3.3		

Notes: SPR – Sympson's paradox ratio, RCR – R-squared contribution ratio, SSR – statistical suppression ratio, NBCDR – nonlinear bivariate causality direction ratio', SRMSR – standardised root means square residual.

We used the complete 'variance inflation factor' (VIF) statistic to confirm multicollinearity between the used items (Hair et al., 2017, 2019). This approach is conducted to identify the possibility of similarity existence (Hair et al., 2019; Kock, 2014). It specifies that if the two latent variables have a greater VIFs index, they appear to measure similar aspects. It is important to remove the variable from the involved constructs in the proposed model (Hair et al., 2019; Kock, 2014). Hence, greater VIFs might be a serious problem if the calculated values exceed the specified criterion. In the literature (Hair et al., 2019; Kock, 2014), the edge value of VIF for parameters is normally suggested as smaller than 5. Although, the more permissive condition proposed in the previous study maintains the edge at 10 (Hair et al., 1987; Bagozzi and Yi, 1988; Joseph, 2009; Kock, 2014). The calculated values reveal that VIFs are even below the significance threshold level, which is ≤5 (see Table 3), while the average variance inflation factor (AVIF) is 2.04 (see Table 7). According to previous studies, the optimum level of AVIF value should be less than or equal to 3.3 (Kock, 2014). So, no variable needs to be removed from the proposed model. Similarly, if the value of VIFs of the inner model is equal to or less than VIF ≤ 3.3, the proposed model may be considered appropriate and free of 'common methods bias' (see Table 3) (Kock, 2015). Harman's 'single-factor test' (Podsakoff et al., 2003) was executed to measure the common method bias (CMB). The computed results (47% of variance) exhibited that CMB was not a concern or significant issue for the current study.

The used PLS tool for estimation also generates other measures to ensure a level of quality, i.e., average R^2 = 0.445, ≤0.00, average adjusted-R^2 = 0.434, ≤0.00, and average-Q^2 = 0.443 ≤ 0.00, respectively. The model fit was also calculated using 'standardised root mean square residual' (SRMR) and GoF (Tenenhaus et al., 2005; Wetzels et al., 2009) criterion GoF = $\sqrt{(0.799)\times(0.445)}$ = 0.599. In the existing literature (Wetzels et al., 2009; Hair et al., 2019), the investigators explained the GoF standards as follows: sufficient ≥ 0.10, moderate ≥ 0.25, and strong ≥ 0.36. Moreover, the computed value of SRMR was also noted to be less than ≤ 0.08, indicating model fit (see Table 7). All the execrated values show notable values that describe the good quality fit. The present work applies the abovementioned conditions or criteria to validate the proposed research model. For more model fit measures, see Table 7. However, these model fit indicators are not fully applicable and transfer to PLS-SEM (Hair et al., 2017, 2019).

3.3 Structure model

When the estimation of the measurement model is completed satisfactorily, the next phase is to evaluate the structure model (Hair et al., 2017, 2019). The structure model mainly labels the association between the employed construct (Hair et al., 2017, 2019). So, it is useful to determine the strength (degree) of association among the constructs to develop new theories (Hair et al., 2017, 2019). The criteria to ensure the assessment of the structure model generally includes the criteria, i.e., 'coefficient of determination' (R2), 'blindfolding-based cross-validated redundancy measure' (Q2), the relevance of measures path coefficients, and statistical significance (Hair et al., 2017, 2019). After confirming the collinearity and significance (t-values and p-values), the next step is to compute the variance explained or R^2 in each one of the employed constructs, which is, consequently, a gauge of the model's descriptive or explanatory power (Hair et al., 2017,

2019). It is also known as predictive power, normally ranging from 0 to 1. The values of R^2 describe the value or amount of explained variance of the constructs in the inner model (Hair et al., 2017, 2019). As a result, the developed model explains 65% of the variation of positive emotions, 12% of negative emotions, and 56% of purchase intention, respectively (see Table 8). Anyhow, it is not easy to describe the rule of thumb or standard criteria for the lowest acceptable value of variance (Hair et al., 2017, 2019). As a guideline, the value of $R^2 \geq 0.75$ = strong, $R^2 \geq 0.45$ = moderate, and $R^2 \geq 0.25$ = weak (Hair et al., 2017, 2019). In this study, both positive emotions and purchase intention have reasonable levels of variance except for the negative emotions, which revealed a weak level of variance (see Table 8) (Hair et al., 2019). However, satisfactory R^2 values normally depend on the context of the study, as in some disciplines, the 0.10 value is regarded as acceptable (Hair et al., 2017, 2019).

Table 8 R and Q squared

Construct	*The coefficients of determination (R-squared)*	*Adjusted R-squared*	*Q-squared criterion*
Positive emotions	0.652	0.643	0.659
Negative emotions	0.122	0.099	0.109
Purchase intention	0.562	0.560	0.563

The effect size (f^2) is slightly redundant or close to the size of the computed path computed coefficients (Hair et al., 2017, 2019). The f^2 allows for analysing the relevance of factors or constructs in explaining particular endogenous constructs (Hair et al., 2017, 2019). As a guideline, the effect values above 0.02, 0.15, and 0.35 depict modest, moderate, and strong, respectively (Cohen, 1988; Hair et al., 2019). The computed coefficients for f^2 are presented in Table 9. Lastly, to evaluate the employed path model's extrapolative and predictive accuracy was assessed by examining the Stone-Geisser Q-squared (Q^2) (Geisser, 1974; Hair et al., 2019). This criterion is primarily grounded on the blindfolding method that calculates and eliminates single points in the matrix of data, imputes the eliminated points with the average, and evaluates the model parameters (Hair et al., 2017, 2019). The blindfolding process calculates the data points removed for variables (Hair et al., 2017, 2019). Thus, the small difference between the expected and the actual values yield a greater Q^2 value, implying a better predictive accuracy.

The higher value of Q^2 from the minimum threshold, which is 0.00, means an acceptable level of predictive validity or relevance (see Table 8) (Hair et al., 2017, 2019). Primarily, Q^2 values (coefficients) greater than the value of 0.25 and 0.50 portray the model's week, average, and strong predictive relevance (Hair et al., 2017, 2019).

4 Discussion

The result of this study partially supports the proposed research framework and hypotheses. To explore the purchase intention, we studied the influential role of mobile design and usability artefacts and the strength of the association of these design elements with emotions (i.e., positive and negative) leading to buying/purchase intention for risk avoidance cultures. This section depicts some remarkable findings (see Table 9).

Table 9 Structural relationships

(H)	*Construct*	*β*	*IE*	f^2	*SD*	*t-value*	*(Sig)*	*Results*
H1a	Animation → Positive emotions	0.203		0.047	0.048	4.191	0.001***	Supported
H1b	Animation → Negative emotions	–0.078		0.003	0.063	1.246	0.213	Unsupported
	Animation → Purchase intention		0.157		0.039	4.056	0.000	
H2a	Font → Positive emotions	0.043		0.004	0.034	1.268	0.205	Unsupported
H2b	Font → Negative emotions	–0.217		0.035	0.043	5.062	0.001***	Supported
	Font → Purchase intention		0.010		0.025	0.403	0.687	
H3a	Colour → Positive emotions	0.135		0.024	0.042	3.234	0.001***	Supported
H3b	Colour → Negative emotions	–0.030		0.030	0.052	0.586	0.558	Unsupported
	Colour → Purchase intention		0.102		0.031	3.258	0.001***	
H4a	Aesthetic graphics → Positive emotions	0.057		0.004	0.047	1.203	0.229	Unsupported
H4b	Aesthetic graphics → Negative emotions	–0.207		0.019	0.059	3.500	0.001***	Supported
	Aesthetic graphics → Purchase intention		0.062		0.036	1.734	0.083	
H5a	Transition → Positive emotions	0.232		0.056	0.063	3.662	0.000***	Supported
H5b	Transition → Negative emotions	–0.054		0.001	0.063	0.868	0.385	Unsupported
	Transition → Purchase intention		0.175		0.047	3.739	0.000	
H6a	Hierarchy → Positive emotions	0.120		0.020	0.047	2.543	0.011**	Supported
H6b	Hierarchy → Negative emotions	–0.199		0.021	0.052	3.791	0.001***	Supported
	Hierarchy → Purchase intention		0.069		0.036	1.935	0.053*	

Notes: β – paths coefficient, IE – indirect effect, f^2 – effect size, SD – standard deviation direction ratio, SRMSR – standardised root means square residual.
***Correlation is significant at the 0.01.
**Correlation is significant at the 0.01 level.
*Correlation is significant at the 0.05 level.

Table 9 Structural relationships (continued)

(H)	*Construct*	*β*	*IE*	f^2	*SD*	*t-value*	*(Sig)*	*Results*
H7a	Control → Positive emotions	0.183		0.028	0.060	3.056	0.002**	Supported
H7b	Control → Negative emotions	–0.135		0.006	0.069	1.961	0.050**	Supported
	Control → Purchase intention		0.147		0.045	3.264	0.001***	
H8	Positive emotions → Purchase intention	0.734		1.219	0.027	27.547	0.001***	Supported
H9	Negative emotions → Purchase intention	–0.110		0.022	0.027	3.601	0.001***	Supported

Notes: β – paths coefficient, IE – indirect effect, f^2 – effect size, SD – standard deviation direction ratio, SRMSR – standardised root means square residual.
***Correlation is significant at the 0.01.
**Correlation is significant at the 0.01 level.
*Correlation is significant at the 0.05 level.

- H1a-b: Animation is an important design aspect of the mobile application interface and is considered an appropriate method to manipulate and convert graphics into moving images (Hoehle et al., 2016). It is a unique design feature to enhance the presentation and draws individuals' attention toward important information (Yoo and Kim, 2005). The impact of animation on positive emotions is observed to be positive (β = 0.203, t-value 4.191, p-value ≤ 0.001). However, no relationship was observed (β = –0.078, t-value 1.246, p-value ≤ 0.213) between animation and negative emotions (see Table 9). The results demonstrate that animation is associated with positive emotions. Thus, appropriate and meaningful animations draw the individual's attention toward important information and satisfy their information needs through effective communication. Otherwise, a poor and vague style of animation consumes excessive mental resources, consequently irritating and distracting them. Yoo and Kim (2005) studied different processing mechanisms for different animation levels. They observed that under high animation levels, individuals experienced negative valence thoughts along with unfavourable feelings. In this regard, it is noticeable that Hoehle et al. (2016) observed a positive influence of animation on continued use intention and brand loyalty. The authors further discussed that animation should be subtle in the context of smartphone applications; otherwise, they might feel exhausted due to distraction (Hoehle et al., 2016).
- H2a-b: font is a set of characters having similar shapes (Hoehle et al., 2016; Faisal et al., 2017, 2018). It is referred to the appearance, arrangement, layout, and organisation of related characters to improve information processing and legibility. It is also considered an important visual aspect, so changing the typeface or font may alter the appearance (i.e., look and feel). The effect of the font on negative emotions is observed to be negative (β = –0.217, t-value 5.062, p-value ≤ 0.001) (see Table 9). However, this study observed no association between font and positive emotions (see Table 9). The results demonstrate that suitable font with precise organisation heightens legibility to satisfy the customers' information needs. Otherwise, poor organisation and layout of typographical aspects may stimulate negative emotions or

irritation, ultimately affecting customer purchase intention. Faisal et al. (2020) discussed font quality as a pleasing aspect and considered it as a precursor of continued intention to use. So, the font type, layout, similarity, and organisation increase the purchase intention. A well-presented text that is easy to remember and perceive resultantly produces less visual fatigue than a small screen (Al Ghamdi et al., 2016; Kim and Sundar, 2016).

- H3a-b: colour is a component of light consisting of hues. It is strongly associated with appeal, attractiveness, and emotions and helps users to recognise and understand the function of visual aspects such as buttons, boxes, and icons (Hoehle et al., 2016; Faisal et al., 2017). The influence of colour on positive emotions is observed to be positive ($\beta = 0.135$, t-value 3.234, p-value ≤ 0.001) (see Table 9). However, no association was found between colour and negative emotions (see Table 9). The results demonstrate that using a precise colour scheme with fair contrast improves the user experience while navigating the system. In the same vein, Chen et al. (2016b) also found a strong association between colour schemes and positive emotions in online shopping contexts.

  Furthermore, prominent colours increase information processing and draw users' attention toward content. Faisal et al. (2017) argue that picking a suitable and right colour scheme and visuals for a web ensures the website's beauty, attractiveness, and supportiveness. Bonnardel et al. (2011) observed the effect of colour on web usability. In contrast, Hoehle et al. (2016) do not consider colour an important element in improving behaviour intention in the online context.

- H4a-b: aesthetic graphics refers to the extent or level to which users feel that the application uses graphics appropriately (Hoehle et al., 2016; Faisal et al., 2017; Kim et al., 2020). It is a core design element that includes pleasing qualities, i.e., emotional appeal, balance, and beauty, and is considered a crucial concept when assessing mobile application usability (Hoehle et al., 2016; Faisal et al., 2017). The effect of aesthetic graphics on negative emotions is observed to be negative ($\beta = -0.207$, t-value 3.500, p-value ≤ 0.001) (see Table 9). However, this study observed no relationship between aesthetic graphics and positive emotions. Pleasing, attractive, and well-organised graphics increase an application's visual appeal and help to decrease the level of annoyance. Loureiro and Roschk (2014) also observed no association between graphics design and emotion and loyalty in the online retailing context. They further observed that visual aspects (e.g., aesthetic graphics and colour) to present the products are not crucial to pleasure, happiness, and arousal. This is because unpleasant and complex visual aspects having vague and messy graphics may upset consumers and bring about feelings of irritation. However, Hoehle et al. (2016) discussed aesthetic graphics as an important design aspect for continued use intention but not for brand loyalty.

- H5a-b: transition refers to the flow of elements and facilitates the individuals to configure the style of appearance of the mobile user interface (Hoehle et al., 2016). The effect of transition on positive emotions ($\beta = 0.232$, t-value 3.662, p-value ≤ 0.001) is observed to be strong and positive (see Table 9). But this study observed no affiliation between transition and negative emotions (see Table 9). Thus, the user interface should facilitate the smooth transition from one screen to another

to satisfy the individuals to continue their activities smoothly. Smooth transition or ease in navigation without effort captures efficiency and ultimately creates a sense of pleasure. Hoehle et al. (2016) considered transition as an influential design aspect in predicting acceptance or continued intention to use mobile applications.

- H6a-b: hierarchy is also an important concept related to the organisation and structural arrangement of contents and pages (Hoehle et al., 2016; Faisal et al., 2017). The effect of hierarchy on positive emotions is observed to be positive (β = 0.120, t-value 2.543, p-value ≤ 0.011) and negative (β = –0.199, t-value 3.791, p-value ≤ 0.001) on negative emotions (see Table 9). The association between hierarchy and negative emotions is observed to be stronger than between hierarchy and positive emotions. Thus, the structural arrangement and hierarchical order make it easy for individuals to access the required contents conveniently and trigger positive emotions. A clear path that uses good clues satisfies the user while experiencing a system; otherwise, a poor or undefined hierarchical structure leads to irritation. In several studies, the researchers highlight the use of a structured hierarchy to avoid any risk. Hoehle et al. (2016) also observed a positive association between hierarchy and brand loyalty.
- H7a-b: control is an important element of navigation that allows the users to take the appropriate action and make suitable choices through taping (Hoehle et al., 2016). In the present study, control is observed to be associated with both positive (β = 0.183, t-value 3.056, p-value ≤ 0.002) and negative emotions (β = –0.135, t-value 1.961, p-value ≤ 0.050) (see Table 9). The results demonstrate that obvious and large controls (prominent buttons) fit as per fingertip size, support the convenience to use, and reduce errors because proper size and obviousness ultimately trigger positive emotions. In the literature, obvious control was considered an important criterion for mobile usability assessment (Hoehle et al., 2016).
- H8a-b: purchase intention predicts customers' future purchases (Chen et al., 2016a; Dedeke, 2016; Ganguly et al., 2010; Kuo and Wu, 2012). It refers to customers' loyalty and willingness to buy from the same online stores (Chen et al., 2016a; Dedeke, 2016; Ganguly et al., 2010; Kuo and Wu, 2012). The results demonstrate the influence of both positive and negative emotions (β = 0.734, t-value 27.547, p-value ≤ 0.000 and β = –0.110, t-value 3.601, p-value ≤ 0.001) on purchase intention. It is observed to be positive and negative, respectively (see Table 9). Thus, both positive and negative emotions are crucial to motivating customers to purchase. Jin and Oh (2021) observed that positive emotions as more vital to shape positive attitudes than negative ones. In contrast, Kuo and Wu (2012) considered negative emotions more crucial to purchase intention than positive emotions via satisfaction. Thus, the design and functional aspects used to develop a user interface improve user experiences through interaction and evoke positive emotions that lead to purchase intention.

4.1 Theoretical implications

Finally, this study explores purchase intention by finding the design strategies and providing a broad insight into individuals' perceptions. Theoretically, this study contributes by determining the association between design characteristics and emotions

using the SOR framework. Although numerous studies (Ali, 2016; Rodríguez-Torrico et al., 2019), among others) were conducted related to design and purchase intention, very rare studies discuss the direct association between interface characteristics and emotions (Éthier et al., 2008). Moreover, emotions are considered important to recognise the customers' experiences and were observed as a strong predictor of purchase intention (Kuo and Wu, 2012; Loureiro and Roschk, 2014; Nabeela et al., 2019).

4.2 Practical implications

Regarding practical implications, these findings proposed foundation-based guidelines for interface design. Accordingly, the designers can benefit from this study by employing the proper interface design strategies, patterns, and interaction styles to attract new and retain existing users. The results suggest that the designer should use simple and meaningful animations when designing mobile applications. Animation cues draw the individual's attention toward specific information, which is a useful way to demonstrate concrete procedures and helps to understand them. Otherwise, subjects experienced negatively valence thoughts and unpleasant feelings while using complex animation (Yoo and Kim, 2005). Using appropriate and legible font aspects (size and type) for designing a mobile application is important to minimise negative emotions. It is a critical design aspect to improve usability and information processing. However, inappropriate typographical aspects may visually confuse the readers and bring about feelings of irritation (Faisal et al., 2018). The colour schemes with complementary aspects used o the design of the experimental prototype design were observed as influential factors in evoking positive emotions. Likewise, Kuo et al. (2022) argue that a design's beauty and attractiveness primarily depend on shoppers' positive emotions in relation to colour. Colours are associated with emotion, attention, trustworthiness, and colours help customers quickly to understand the information and meaning of buttons and links (Heidig et al., 2015; Faisal et al., 2017; Kuo et al., 2022). The aesthetic graphics dimension is also important in ensuring the application's usability.

The designer should adopt well-designed graphics based on gestalt principles to offer pleasing experiences. Heidig et al. (2015) argue that aesthetics with good usability facilitate more positive emotions. Transition is a key component of navigation that enables the individual to access information transitioning from one page to another quickly. The design should use a simple transition style so the user can easily navigate the mobile application. In several studies (Faisal et al., 2020; Hoehle et al., 2016; Huhtala et al., 2009), various researchers also emphasised the use of transitions that allow the users to navigate between scenes easily, ultimately changing their perception of the system quality. Donati et al. (2020) argue that properly designed transitions could improve systems usability and affective motivation. The hierarchy structure of links, pages, navigation, and logical organisation are directly associated with usability because the structural organisation provides a clear way to access the contents sequentially. The size of the links, controls, and buttons is crucial to improve individuals' experiences. Moreover, the placement of the buttons and controls on suitable areas of mobile applications allows the users to access the required information conveniently. The prior studies (Faisal et al., 2020; Fang and Holsapple, 2007; Hoehle et al., 2016; Lim et al., 2014) also highlighted the effect of navigational features (e.g., navigation scheme, structure, organisation, cues, size, and placement of controls, links, and buttons) on

cognitive, emotional and individuals behaviour. Navigation features are very important, so designer ignorance by adopting poor navigation guidelines may seriously affect usability. Likewise, Dailey (2004) argues that restrictive navigation clues minimise the users' control over navigation, which, in turn, arouses negative emotions and attitudes, ultimately leading to avoidance behaviour. Especially in risk avoidance cultures, designing usable and better-quality applications using appropriate design elements is critical to evoke positive emotions and to provide a pleasing and exciting online shopping experience. These emotions and exciting experiences positively influence purchase intention.

5 Conclusions, limitations and future work

Design is a useful strategy to improve customers' association, satisfaction, and purchase intention by incorporating beauty, attractiveness, appeal, and well-organised content. This is because a proper design strategy creates an interactive environment that arouses basic emotions in the individuals, and these emotions, in turn, affect the purchase behaviour. These interactions and usability aspects are considered important predictors of online shopping behaviour (Koo and Ju, 2010). This current study aims to harness emotions and information processing to improve the interface design leading to purchase intention. In several studies (Éthier et al., 2008; Kuo and Wu, 2012; Loureiro and Roschk, 2014; Heidig et al., 2015; Faisal et al., 2018; Nabeela et al., 2019; Deng and Gu, 2021; Jin and Oh, 2021; Kuo et al., 2022), various researchers also emphasise the need to determine the association of design elements with emotions. The applications having emotional designs successfully grab the customers' attention through heightened interactivity and attractiveness. Ultimately, these emotions positively influence the consumer purchase intention on a travel website (Chen et al., 2016b). Thus, exploring the relationship between emotions and design elements to understand users' experiences is an important contribution of this study. An experimental working prototype was designed to gather the users' perceptions and experiences related to employed aspects. The study findings somewhat support the intended study. The results imply that interface design elements and patterns enhance emotions, leading to purchase intention. This study draws the attention of experts to the users' experience and perceptions related to design elements. This is because usability and understandable processes using logical terms arouse pleasure and excitement, leading to purchase intention. Therefore, the design elements that evoke emotions increase the purchase intention. Accordingly, online service providers should consider design aspects important to improve usability while developing shopping applications.

Bhandari et al. (2019), Éthier et al. (2008) and White and Yu (2005) argue that interface design features determine the cognitive procedures that generate positive emotions during online shopping because emotions are a better forecaster or determinant of behaviour intention than other cognitive aspects. Koo and Ju (2010) also observed the impact of web atmospheric cues (e.g., link, menu, graphics, and colour) on emotions. Hausman and Siekpe (2009) discuss that the designer should design menus simple and clear because unstructured navigation with broken links irritates the customers. Accordingly, emotions can influence judgement, thinking, and decision marking; in short positive emotions bring excitement, whereas negative emotions are associated with avoidance. Likewise, Dedeke (2016) emphasised that online retail services providers

should be careful not to underestimate the effect of having a site that establishes an attractive design because a well-designed interface controls the emotions and development of purchase intentions. Éthier et al. (2008) observed interface design elements such as navigation, design orientation, and information structure as important predictors of the cognitive or related mental processes that generate emotions. However, the authors do not observe the impact of visual aspects on cognitive appraisals (Éthier et al., 2008). In contrast, Mummalaneni (2005) did not observe a significant association between interface design factors and arousal in the online shopping environment. Similarly, Loureiro et al. (2014) did not observe any association between visual design (such as colour and graphics) and emotions and loyalty intention in the online shopping environment.

In conclusion, the design strategy to develop a retailing environment evokes positive emotions and improves the usability of shopping applications on small-screen devices. In a study, Natarajan et al. (2018) argue that the interface design of online shopping applications should fit according to the device's screen size so the customer can conveniently proceed with the shopping activities. Because the device type has a small screen, the design element is not properly adjusted resulting in less precision. The designer should design all touchable elements large with proper spacing so the user can easily and efficiently trigger them (Ribeiro and Carvalhais, 2012). Yuan et al. (2020) argue that interface design should be easy to navigate and well-organised to satisfy customers while making online transactions. Several related studies (Dunaway and Soroka, 2021; Al Ghamdi et al., 2016; Kim and Sundar, 2016; Park et al., 2018; Raptis et al., 2013; Tuli and Mantri, 2021) also discussed the impact of mobile design patterns in terms of activation, arousal, attractiveness, enjoyment, engagement, and information seeking visual fatigue, and usability. Moreover, the cultural differences also underscore the requirement for a tailored design. Especially in a risk-avoidance culture, a structured and controlled interaction develops trust and positive feelings. Likewise, Faisal et al. (2017) argue that particular selection design attributes for uncertainty avoidance cultures may reduce risk perception for e-commerce.

The current study also has some recognisable limitations. First, an experimental prototype of an online airline ticket booking application was developed and used with no real transactions. Even though this practice is consistent and frequently used in prior online shopping-related studies (i.e., Faisal et al., 2017), this way may limit the generalisability of the results to actual e-ticket booking situations. Second, we include the important design aspects ensuring usability, such as interactivity, system, and information design, which may also restrict the applicability. Lastly, selecting the types of mobiles is only based on screen size; other characteristics and aspects such as speed, processing capabilities, memory, and operating system may also change the shopping experience. In the future, we plan to continue this experiment by incorporating other mobile and design aspects to determine users' experiences and their changing perceptions to improve the usability of commercial applications.

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References

Adipat, B., Zhang, D. and Zhou, L. (2011) 'The effect of tree-view based presentation adaptation on mobile web-browsing', *MIS Quarterly*, Vol. 35, No. 1, pp.99–121.

Agarwal, R. and Venkatesh, V. (2002) 'Assessing a firm's web presence: a heuristic evaluation procedure for the measurement of usability', *Information Systems Research*, Vol. 13, No. 2, pp.168–186.

Al Ghamdi, E., Yunus, F., Da'ar, O., El-Metwally, A., Khalifa, M., Aldossari, B. and Househ, M. (2016) 'The effect of screen size on mobile phone user comprehension of health information and application structure: an experimental approach', *Journal of Medical Systems*, Vol. 40, No. 1, p.11.

Albert, M. and Russell, J.A. (1974) *An Approach to Environmental Psychology*, The MIT Press, Cambridge, MA.

Alexander, R., Thompson, N. and Murray, D. (2017) 'Towards cultural translation of websites: a large-scale study of Australian, Chinese, and Saudi Arabian design preferences', *Behaviour and Information Technology*, Vol. 36, No. 4, pp.351–363.

Alexander, R., Thompson, N., McGill, T. and Murray, D. (2021) 'The influence of user culture on website usability', *International Journal of Human Computer Studies*, Vol. 154, pp.1–14.

Ali, F. (2016) 'Hotel website quality, perceived flow, customer satisfaction and purchase intention', *Journal of Hospitality and Tourism Technology*, Vol. 7, No. 2, pp.213–228.

Ashraf, N., Faisal, C.N., Jabbar, S., Habib, M.A., Kiran, I. and Ahmad, M. (2019) 'The effect of website design artifacts and emotions on behavioral purchase intention in M-Commerce', *2019 8th International Conference on Information and Communication Technologies (ICICT)*, Karachi, Pakistan, pp.100–105, doi: 10.1109/ICICT47744.2019.9001986.

Bagozzi, R.P. and Yi, Y. (1988) 'On the evaluation of structural equation models', *Journal of the Academy of Marketing Science*, Vol. 16, No. 1, pp.74–94.

Bagozzi, R.P., Gopinath, M. and Nyer, P.U. (1999) 'The role of emotions in marketing', *Journal of the Academy of Marketing Science*, Vol. 27, No. 2, pp.184–206.

Bayer, M., Sommer, W. and Schacht, A. (2012) 'Font size matters – emotion and attention in cortical responses to written words', *PLoS ONE*, Vol. 5, No. 7, pp.1–6.

Bhandari, U., Chang, K. and Neben, T. (2019) 'Understanding the impact of perceived visual aesthetics on user evaluations: an emotional perspective', *Information and Management*, Vol. 56, No. 1, pp.85–93, Elsevier B.V.

Bhandari, U., Neben, T., Chang, K. and Chua, W.Y. (2017) 'Effects of interface design factors on affective responses and quality evaluations in mobile applications', *Computers in Human Behavior*, Vol. 72, pp.525–534.

Bonnardel, N., Piolat, A., Le Bigot, L., Le Bigot, L. and Le Bigot, L. (2011) 'The impact of colour on Website appeal and users' cognitive processes', *Displays*, Vol. 32, No. 2, pp.69–80.

Brewster, S. (2002) 'Overcoming the lack of screen space on mobile comp', *Personal and Ubiquitous Computing*, Vol. 6, No. 188, pp.188–205.

Briz-Ponce, L., Pereira, A., Carvalho, L., Juanes-Méndez, J.A. and García-Peñalvo, F.J. (2017) 'Learning with mobile technologies – students' behavior', *Computers in Human Behavior*, Vol. 72, pp.612–620.

Carlson, J., Rahman, M., Voola, R. and De Vries, N. (2018) 'Customer engagement behaviours in social media: capturing innovation opportunities', *Journal of Services Marketing*, Vol. 32, No. 1, pp.83–94.

Chen, J.V, Rungruengsamrit, D., Rajkumar, T.M. and Yen, D.C. (2013) 'Success of electronic commerce websites: a comparative study in two countries', *Information & Management*, Vol. 50, No. 6, pp.344–355.

Chen, J.V, Yen, D.C., Kuo, W., Paolo, E. and Capistrano, S. (2016a) 'The antecedents of purchase and re-purchase intentions of online auction consumers', *Computers in Human Behavior*, Vol. 54, pp.186–196.

Chen, Y., Yuan, C. and City, T. (2016b) 'Influence of website design on consumer emotion and purchase intention in travel websites', *International Journal of Technology and Human Interaction*, Vol. 12, No. 4, pp.15–29.

Chin, W.W. (1998) 'The partial least squares approach to structural equation modeling', *Modern Methods for Business Research*, pp.295–336, G.A.M., Lawrence Erlbaum Associates Publishers, Mahwah, NJ, USA.

Cohen, J. (1988), *Statistical Power Analysis for the Behavioral Sciences*, 2nd ed., Lawrence Erlbaum Associates, New York.

Cyr, D. (2013) 'Website design, trust and culture: An eight country investigation', *Electronic Commerce Research and Applications*, Vol. 12, No. 6, pp.373–385.

Dailey, L. (2004) 'Navigational web atmospherics: explaining the influence of restrictive navigation cues', *Journal of Business Research*, Vol. 57, No. 7, pp.795–803.

Dedeke, A. (2016) 'Travel web-site design: information task-fit, service quality and purchase intention', *Tourism Management*, Vol. 54, pp.541–554.

Deng, M. and Gu, X. (2021) 'Information acquisition, emotion experience and behaviour intention during online shopping: an eye-tracking study', *Behaviour and Information Technology*, Vol. 40, No. 7, pp.635–645, Taylor & Francis.

Dijkstra, T.K. and Henseler, J. (2015) 'Consistent partial least squares path modeling', *MIS Quarterly*, Vol. 39, No. 2, pp.297–316.

Donati, M., Mori, G. and Paternò, F. (2020) 'Understanding the transitions between web interfaces designed to stimulate specific emotions', *Universal Access in the Information Society*, Vol. 19, pp.391–407.

Dunaway, J. and Soroka, S. (2021) 'Smartphone-size screens constrain cognitive access to video news stories', *Information Communication and Society*, Vol. 24, No. 1, pp.69–84, Taylor & Francis.

Éthier, J., Hadaya, P., Talbot, J. and Cadieux, J. (2008) 'Interface design and emotions experienced on B2C Web sites: Empirical testing of a research model', *Computers in Human Behavior*, Vol. 24, No. 6, pp.2771–2791.

Faisal, C.M.N., de Andres-Suarez, J., Gonzalez-Rodriguez, M., Fernandez-Lanvin, D., Ahmad, M. and Habib, M.A. (2018) 'Impact of web design features on irritation for e-commerce websites', *Proceedings of the 33rd Annual ACM Symposium on Applied Computing – SAC '18*, ACM Press, New York, New York, USA, pp.656–663.

Faisal, C.M.N., Fernandez-Lanvin, D., De Andrés, J. and Gonzalez-Rodriguez, M. (2020) 'Design quality in building behavioral intention through affective and cognitive involvement for e-learning on smartphones', *Internet Research*, Vol. 30, No. 6, pp.1631–1663.

Faisal, C.M.N., Gonzalez-Rodriguez, M., Fernandez-Lanvin, D. and de Andres-Suarez, J. (2017) 'Web design attributes in building user trust, satisfaction, and loyalty for a high uncertainty avoidance culture', *IEEE Transactions on Human-Machine Systems*, Vol. 47, No. 6, pp.847–859.

Fang, X. and Holsapple, C.W. (2007) 'An empirical study of web site navigation structures' impacts on web site usability', *Decision Support Systems*, Vol. 43, No. 2, pp.476–491.

Fornell, C. and Larcker, D.F. (1981) 'Evaluating structural equation models with unobserved variables and measurement error', *Journal of Marketing Research*, Vol. 18, No. 1, pp.39–50.

Ganguly, B. and Nag, T. (2021) 'Does culture influence the website design of schools? A cross-cultural comparative study in the Indian, Chinese and American context', *Global Business Review*, pp.1–14.

Ganguly, B., Dash, S.B., Cyr, D. and Head, M. (2010) 'The effects of website design on purchase intention in online shopping: the mediating role of trust and the moderating role of culture', *International Journal of Electronic Business*, Vol. 8, Nos. 4–5, p.302.

Gefen, D. and Straub, D. (2005) 'A practical guide to factorial validity using PLS-Graph: tutorial and annotated example', *Communications Association Information Systems*, Vol. 16, pp.91–109.

Geisser, S. (1974) 'A predictive approach to the random effect model', *Biometrika*, Vol. 16, No. 1, pp.101–107.

George, D. and Mallery, P. (2003) *SPSS for Windows Step by Step: A Simple Guide and Reference, 11.0 Update*, University of Michigan, Michigan.

Hair, J.F., Anderson, R.E. and Tatham, R.L. (1987) *Multivariate Data Analysis with Readings*, Macmillan Publishing, New York, NY, USA.

Hair, J.F., Hult, G.T.M., Ringle, C.M. and Sarstedt, M. (2017), *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*, 2nd ed., Sage, Thousand Oaks, California.

Hair, J.F., Risher, J.J., Sarstedt, M. and Ringle, C.M. (2019) 'When to use and how to report the results of PLS-SEM', *European Business Review*, Vol. 31, No. 1, pp.2–24.

Hamborg, K-C.C., Bruns, M., Ollermann, F. and Kaspar, K. (2012) 'The effect of banner animation on fixation behavior and recall performance in search tasks', *Computers in Human Behavior*, Vol. 28, No. 2, pp.576–582.

Hasan, B. (2016) 'Perceived irritation in online shopping: the impact of website design characteristics', *Computers in Human Behavior*, Vol. 54, pp.224–230.

Hausman, A.V. and Siekpe, J.S. (2009) 'The effect of web interface features on consumer online purchase intentions', *Journal of Business Research*, Vol. 62, No. 1, pp.5–13.

Heidig, S., Müller, J. and Reichelt, M. (2015) 'Emotional design in multimedia learning: Differentiation on relevant design features and their effects on emotions and learning', *Computers in Human Behavior*, Vol. 44, pp.81–95, Elsevier Ltd.

Henseler, J., Ringle, C.M. and Sarstedt, M. (2015) 'A new criterion for assessing discriminant validity in variance-based structural equation modeling', *Journal of the Academy of Marketing Science*, Vol. 43, No. 1, pp.115–135.

Ho, A.G. (2013) 'Typography today: emotion recognition in typography', *Proceedings of 5th International Association of Societies of Design Research*, Tokyo. Japan, Vol. 20, No. 3, pp.5573–5582.

Hoehle, H., Aljafari, R. and Venkatesh, V. (2016) 'Leveraging Microsoft's mobile usability guidelines: conceptualizing and developing scales for mobile application usability', *International Journal of Human Computer Studies*, Vol. 89, pp.35–53, Elsevier.

Huhtala, J., Mäntyjärvi, J., Ahtinen, A., Ventä, L. and Isomursu, M. (2009) 'Animated transitions for adaptive small size mobile menus', *Human-Computer Interaction – Interact*, Uppsala, Sweden, pp.772–781.

Huifeng, P. and Ha, H-Y. (2022) 'The effect of mobile interactivity and customised information on repurchase intentions', *International Journal of Mobile Communications*, Vol. 20, No. 3, pp.349–366.

Jiang, Z., Chan, J. and Tan, B. (2010) 'Effects of interactivity on website involvement and purchase intention', *Journal of the Association for Information Systems*, Vol. 11, No. 1, pp.34–59.

Jin, E. and Oh, J. (2021) 'The role of emotion in interactivity effects: positive emotion enhances attitudes, negative emotion helps information processing', *Behaviour and Information Technology*, Vol. 41, No. 16, pp.3487–3505, Taylor and Francis Ltd.

Joseph, F.H. (2009) *Multivariate Data Analysis: A Global Perspective.*, 7th ed., Prentice Hall, Upper Saddle River, NJ, USA.

Kaiser, H.F. (1960) 'The application of electronic computers to factor analysis', *Educational and Psychological Measurement*, Vol. 20, No. 1, pp.141–151.

Kim, D., Hyun, H. and Park, J. (2020) 'The effect of interior color on customers' aesthetic perception, emotion, and behavior in the luxury service', *Journal of Retailing and Consumer Services*, Vol. 57, pp.1–10.

Kim, H., Kim, J. and Lee, Y. (2005) 'An empirical study of use contexts in the mobile Internet, focusing on the usability of information architecture', *Information Systems Frontiers*, Vol. 7, No. 2, pp.175–186, Spec. Iss.

Kim, K.J. and Sundar, S.S. (2016) 'Mobile persuasion: can screen size and presentation mode make a difference to trust?', *Human Communication Research*, Vol. 42, No. 1, pp.45–70.

Kock, N. (2014), *WarpPLS 5.0 User Manual*, Laredo, Texas USA [online] http://www.scriptwarp.com/warppls/ (accessed 11 June 2016).

Kock, N. (2015) 'Common method bias in PLS-SEM: a full collinearity assessment approach', *International Journal of E-Collaboration*, Vol. 11, No. 4, pp.1–10.

Koo, D-M. and Ju, S-H. (2010) 'The interactional effects of atmospherics and perceptual curiosity on emotions and online shopping intention', *Computers in Human Behavior*, Vol. 26, No. 3, pp.377–388.

Kuo, L., Chang, T. and Chun, C. (2022) 'Multimedia webpage visual design and color emotion test', *Multimedia Tools and Applications*, October, Springer US, pp.2621–2636.

Kuo, Y.F. and Wu, C.M. (2012) 'Satisfaction and post-purchase intentions with service recovery of online shopping websites: perspectives on perceived justice and emotions', *International Journal of Information Management*, Vol. 32, No. 2, pp.127–138.

Kurniawan, S. (2008) 'Older people and mobile phones: a multi-method investigation', *International Journal of Human Computer Studies*, Vol. 66, No. 12, pp.889–901.

Lee, J., Ahn, J-H. and Park, B. (2015) 'The effect of repetition in internet banner ads and the moderating role of animation', *Computers in Human Behavior*, Vol. 46, pp.202–209.

Lee, S., Shin, B. and Lee, H.G. (2009) 'Understanding post-adoption usage of mobile data services: the role of supplier-side variables', *Journal of the Association for Information Systems*, Vol. 10, No. 12, pp.860–888.

Lee, S.B., Yang, S-B. and Suh, Y-H. (2021) 'Exploring the impact of interactivity on loyalty toward online-to-offline services: a case of mobile taxi hailing application', *International Journal of Mobile Communications*, Vol. 19, No. 5, pp.564–588.

Li, Y. and Yeh, Y. (2010) 'Increasing trust in mobile commerce through design aesthetics', *Computers in Human Behavior*, Vol. 26, No. 4, pp.673–684, Elsevier Ltd.

Lim, Y.M., Ayesh, A. and Stacey, M. (2014) 'The effects of menu design on users' emotions, search performance and mouse behaviour', *Proceedings of 2014 IEEE 13th International Conference on Cognitive Informatics and Cognitive Computing, ICCI*CC 2014*, pp.541–549.

Lottridge, D., Chignell, M. and Jovicic, A. (2011) 'Affective interaction: understanding, evaluating, and designing for human emotion', *Reviews of Human Factors and Ergonomics*, Vol. 7, No. 1, pp.197–217.

Loureiro, S.M.C. and Roschk, H. (2014) 'Differential effects of atmospheric cues on emotions and loyalty intention with respect to age under online/offline environment', *Journal of Retailing and Consumer Services*, Vol. 21, No. 2, pp.211–219.

Loureiro, S.M.C. and Roschk, H. (2014) 'Differential effects of atmospheric cues on emotions and loyalty intention with respect to age under online/offline environment', *Journal of Retailing and Consumer Services*, Vol. 21, No. 2, pp.211–219.

Lowe, R.K. (2003) 'Animation and learning : selective processing of information in dynamic graphics', *Learning and Instruction*, Vol. 13, No. 2, pp.157–176.

Lu, Q., Pattnaik, C., Xiao, J. and Voola, R. (2018) 'Cross-national variation in consumers' retail channel selection in a multichannel environment: evidence from Asia-Pacific countries', *Journal of Business Research*, October, Vol. 86, pp.321–332, Elsevier.

Marcus, A. (2014) 'Cross-cultural user-experience design for work, home, play, and on the way', *ACM SIGGRAPH ASIA 2014 Courses on – SA10*, ACM, Shenzhen, China, pp.1–160.

Money, R.B. and Crotts, J.C. (2003) 'The effect of uncertainty avoidance on information search, planning, and purchases of international travel vacations', *Tourism Management*, Vol. 24, No. 2, pp.191–202.

Mummalaneni, V. (2005) 'An empirical investigation of web site characteristics, consumer emotional states and on-line shopping behaviors', *Journal of Business Research*, Vol. 58, No. 4, pp.526–532.

Natarajan, T., Balasubramanian, S.A. and Kasilingam, D.L. (2018) 'The moderating role of device type and age of users on the intention to use mobile shopping applications', *Technology in Society*, Vol. 53, pp.79–90, Elsevier Ltd.

Park, E., Han, J., Kim, K.J., Cho, Y. and Del Pobil, A.P. (2018) 'Effects of screen size in mobile learning over time', *ACM International Conference Proceeding Series*.

Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y. and Podsakoff, N.P. (2003) 'Common method biases in behavioral research: a critical review of the literature and recommended remedies', *Journal of Applied Psychology*, Vol. 88, No. 5, pp.879–903.

Raptis, D., Tselios, N., Kjeldskov, J. and Skov, M.B. (2013) 'Does size matter? Investigating the impact of mobile phone screen size on users' perceived usability, effectiveness and efficiency', *MobileHCI 2013 – Proceedings of the 15th International Conference on Human-Computer Interaction with Mobile Devices and Services*, pp.127–136.

Ribeiro, J. and Carvalhais, M. (2012) 'Web Design Patterns for Mobile Devices', *18th Conference on Pattern Languages of Programs*, ACM New York, NY, USA, Arizona, pp.1–41.

Rodríguez-Torrico, P., San-Martín, S. and José-Cabezudo, R.S. (2019) 'What drives m-shoppers to continue using mobile devices to buy?', *Journal of Marketing Theory and Practice*, Vol. 27, No. 1, pp.83–102, Routledge.

Saadé, R.G. and Kira, D. (2009) 'The emotional in e-learning', *Journal of Asynchronous Learning Network*, Vol. 13, No. 4, pp.57–72.

Shaouf, A., Lü, K. and Li, X. (2016) 'The effect of web advertising visual design on online purchase intention: an examination across gender', *Computers in Human Behavior*, Vol. 60, pp.622–634.

Tenenhaus, M., Vinzi, V.E., Chatelin, Y.-M. and Lauro, C. (2005) 'PLS path modeling', *Computational Statistics & Data Analysis*, Vol. 48, No. 1, pp.159–205.

Tuli, N. and Mantri, A. (2021) 'Evaluating usability of mobile-based augmented reality learning environments for early childhood', *International Journal of Human-Computer Interaction*, Vol. 37, No. 9, pp.815–827, Taylor & Francis.

Webster, J. and Ahuja, J.S. (2014) 'Enhancing the design of web navigation systems: on the influence of user disorientation and performance', *MIS Quarterly*, Vol. 30, No. 3, pp.661–678.

Weiss, R.E., Knowlton, D.S. and Morrison, G.R. (2002) 'Principles for using animation in computer-based instruction: theoretical heuristics for effective design', *Computers in Human Behavior*, Vol. 18, No. 4, pp.465–477.

Wetzels, M., Odekerken-Schröder, G. and van Oppen, C. (2009) 'Using PLS path modeling for assessing hierarchical construct models: guidelines and empirical illustration', *MIS Quarterly*, Vol. 33, No. 1, pp.177–195.

White, C. and Yu, Y.T. (2005) 'Satisfaction emotions and consumer behavioral intentions', *Journal of Services Marketing*, Vol. 19, No. 6, pp.411–420.

Yin, C., Ma, H., Chen, Q., Gong, Y. and Shu, X. (2021) 'Mobile interactivity and perceived waiting time: the role of cognitive absorption and perceived procedural justice', *Journal of Global Information Management*, Vol. 29, No. 6, pp.1–20.

Yoo, C.Y. and Kim, K. (2005) 'Processing of animation in online banner advertising: the roles of cognitive and emotional responses', *Journal of Interactive Marketing*, Vol. 19, No. 4, pp.18–34.

Yoon, C. (2009) 'The effects of national culture values on consumer acceptance of e-commerce: online shoppers in China', *Information and Management*, Vol. 46, No. 5, pp.294–301.

Younas, A., Faisal, C.M.N., Habib, M.A., Ashraf, R. and Ahmad, M. (2021) 'Role of design attributes to determine the intention to use online learning via cognitive beliefs', *IEEE Access*, Vol. 9, pp.1–1, IEEE.

Young, P.T. and Murray, E.J. (1965) 'Motivation and Emotion', *The American Journal of Psychology*, Vol. 78, No. 4, p.696.

Yuan, S., Liu, L., Su, B. and Zhang, H. (2020) 'Determining the antecedents of mobile payment loyalty: cognitive and affective perspectives', *Electronic Commerce Research and Applications*, Vol. 41.