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Using Stimulus-Organism-Response (SOR) Theory to understand mobile wallet intention to use in Saudi Arabia

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Abstract: - In today's technological revolution, the use of mobile wallet (m-wallet) in monetary transactions has become increasingly popular. In its adoption of the Stimulus-Organism-Response (SOR) Theory, this study aimed to measure the impacts of relative advantage, security considerations, ease of use, favourable infrastructure, touch-free transactions, aesthetics and enjoyment on m-wallet intention to use in Saudi Arabia. This study also aimed to measure the mediate of perceived values and user demographics (age and gender) as moderators of the proposed research model. A questionnaire was distributed among Saudi citizens and 201 full responses were returned. The results showed that the factors of relative advantage, security considerations and touch-free monetary transactions had positive impacts on m-wallet intention to use while ease of effort, favourable infrastructure conditions, aesthetics and enjoyment had no impacts on m-wallet intention to use. Furthermore, the results showed that the relationship between enjoyment and m-wallet intention to use was fully mediated by perceived value but that perceived value did not mediate the relationship between m-wallet intention to use and any of the other factors examined. Gender and age significantly moderated the relationship between perceived value and m-wallet intention to use, being stronger for males and younger respondents. This study contributes to theory by addressing the literature gap in the Saudi m-wallet context and it contributes practically by helping service providers effectively and successfully implement the m-wallet platform in Saudi Arabia in the future.

Keywords: M-wallet; M-payment; Saudi Arabia; SOR theory.

I. INTRODUCTION

Mobile payment (m-payment) is currently considered to be one of the more common platforms to make monetary transactions [1]. M-payments for transactions for services and goods use mobile devices such as mobile phones and tablets [2]. In m-payment, usually in shops, the barcode on the customer's phone is scanned to make the payment [3]. Benefits of using m-payment systems include ubiquity, convenience, localization and trackable transactions [4]. Therefore, financial companies have launched a number of m-payment systems such as mobile banking (m-banking), Uni-fied Payment Interface (UPI) and m-wallet. Of all the m-payment systems currently in use, m-wallet has recently become better known and more attractive to customers [1]. This study aimed to measure the impact of a number of factors including relative advantage, ease of effort, favourable infrastructure conditions, touch-free transactions, security considerations, aesthetics and enjoyment on m-wallet intention to use in Saudi Arabia, by adopting the Stimulus-Organism-Response (SOR) Theory. This study also measured the mediating effect of perceived values and users' demographics (age and gender) as moderators. This study, therefore, had two objectives:

- To determine the factors that impact m-wallet intention to use by adopting SOR theory.
- To measure the mediating effect of perceived values and users' demographics (age and gender) as moderators in the proposed research model.

II. LITERATURE REVIEW

A. Mobile Wallet (M-Wallet)

M-wallet is a type of m-payment system that performs the same functions as a physical wallet. It is a technology that requires installation and setup on mobile devices, and it allows customers to deposit money and make financial transactions from the digital wallet [5]. M-wallet allows customers to save their credit card, debit card, and UPI information and deposit money for use [1]. M-wallet has some advantages such as time-saving, versatility, traceable transactions and no physical cash handling [6] and can be used to pay with a user's mobile device [7]. Examples of the m-wallet payment system include Free Charge Wallet, WeChat Pay, Google Pay, Apple Pay, Ali Pay, Boost, Pay Pal, Samsung Pay, Oxygen Wallet, Paytm, MobiKwik, Citrus Wallet, Android Pay, and Touch-n-Go. The m-

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wallet system is used for a variety of monetary transactions such as consumer to online (C2O), consumer-to-consumer (C2C), consumer-to-business (C2B) and consumer-to-machine (C2M) [8]. Leong et al. [8] have identified four forms of m-wallet: open wallets, closed wallets, semi-opened wallets and semi-closed wallets.

B. Theoretical Framework

Kapoor et al. [24] state that studies in m-payment have used theoretical frameworks such as the diffusion of innovation (DOI) model and technology acceptance model (TAM) to measure the intention to use m-payment by customers. In this study, a modified Stimulus-Organism-Response (SOR) Theory was used to measure the factors that may impact intention to use the m-wallet system in Saudi Arabia. SOR theory was proposed and developed by [9] and provides a clear overview of the way customers perceive a stimulus present in the environment and then respond to it. Consequently, it is considered to be an appropriate theorical base for measuring the relationship between intention to use m-wallet and antecedents [9]. The SOR framework comprises the following: a stimulus (environmental aspect), which influences an organism (individual psychology) which then responds (behavior) [10]. Stimulus refers to factors that lead customers to make a decision. The organism is considered to be an internal process of customers that intervenes between an external stimulus and an individual's response. Response refers to the result and decision based on the stimulus and the organism [10]. According to [11], "The S-O-R theory originated from environmental psychology, which integrates environmental aspects with people's attitudinal and behavioral responses". SOR is not dependent on specific factors and the classification of factors into stimuli, organism and response is a complicated process. SOR does not focus on emotion and how it is affected by environmental stimuli. SOR theory has been widely used in many previous studies in different fields, such as online purchase intention, electric vehicle adoption intention, showrooming intention, online hotel booking intention and intention to use m-commerce [12-16]. Consequently, SOR is a suitable theory to measure the impact of environmental stimuli on users' responses to the adoption and use of new technologies [17]. According to [9], "environmental cues (stimuli) impact cognitive state (organism) that drives user behavior (response)". Based on SOR theory, an individual's internal processes respond to a stimulus before a final reaction or action is undertaken. For example, trust can mediate the relationship between obstacles to buying intention (stimulus) and buying behavior (response) by decreasing the risk in an uncertain environment [18]. In the current study, the proposed model in Fig. has seven factors considered to be stimuli: ease of effort, touch-free transactions, relative advantage, favourable infrastructure conditions, security considerations, aesthetics and enjoyment. Perceived values are considered to be the organism that leads to intention to use m-wallet as a response.

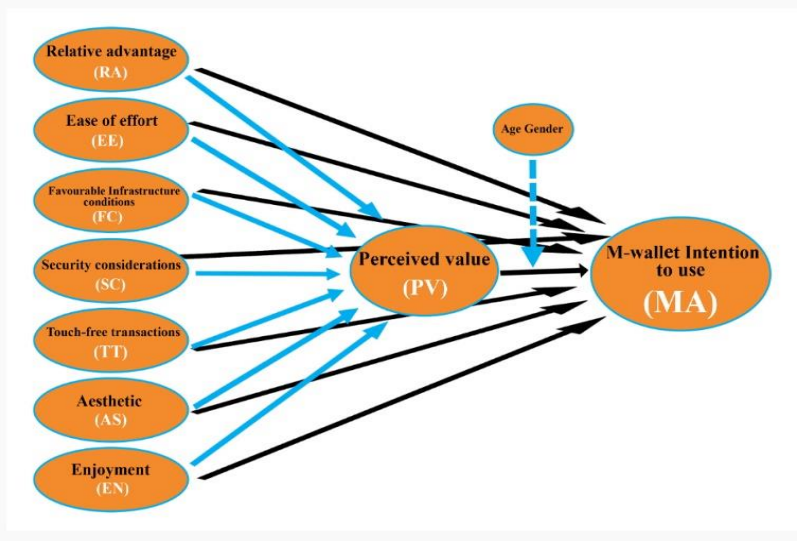

Fig. 1 Proposed research model.

C. Development of Hypothesis

1) Relative advantage (RA)

Relative advantage has been defined as the extent to which users believe that using an identified system can improve job productivity [19]. Shankar and Datta [3] claim that in previous studies, relative advantage was the same as

perceived usefulness. It is considered to be one of the main factors that impact users' attitudes toward and acceptance of the use of new technologies. Users are likely use m-payment when they believe it is to their advantage [20]. Okonkwo et al. [21] claimed that relative advantage had a significant impact on the adoption of cell phone banking in South Africa. Other studies revealed that relative advantage had a positive impact on users' intentions to use new technology [20, 22-25]. Consequently, the following is hypothesized:

H1: Relative advantage (RA) will have a positive impact on m-wallet intention to use (MA).

2) Ease of effort (EE)

Ease of effort is defined as the extent to which users believe that using technology will be straightforward and present no difficulties [19, 26]. In the context of m-wallet, the likelihood of m-wallet use will increase when it has a user-friendly layout and can be used anywhere. In other words, the ease of effort to use m-wallet may encourage users to use it, whereas, if there are difficulties, such as in data entry, users will not use it [3]. Previous studies have found that ease of effort has a positive effect on users' intention to use new technology [27-29]. A recent study found that ease of use had a significant positive impact in m-commerce adoption in Saudi Arabia [30]. Consequently, the following is hypothesized:

H2: Ease of effort (EE) will have a positive impact on m-wallet intention to use (MA).

3) Favourable Infrastructure Conditions (FC)

Infrastructure conditions are defined as the extent to which users believe that organizational and technical infrastructure is available to help them use m-wallet [31]. Environmental factors that impact on customers are also considered relevant to their implementation of the tasks [32]. It has been found that increased technology use requires the provision of resources, knowledge and support [33]. In previous studies, favourable infrastructure conditions had a positive effect on users' intention to use m-commerce, mobile banking, mobile payments and e-learning [20, 33-35]. A recent study found that ICT infrastructure played a key role in the adoption of m-commerce in Angola [36]. Consequently, the following is hypothesized:

H3: Favourable infrastructure conditions (FC) will have a positive impact on m-wallet intention to use (MA).

4) Security considerations (SC)

Security considerations represent the extent to which customers believe that their monetary transactions using m-wallet are safe [37]. Security considerations are also related to customers' feelings of security and enjoyment in the aspects of technology, confidentiality and authentication [37]. It has been noted that trust is a key factor when making monetary transactions. Customers have to feel that these channels are safe and their private information will not be disclosed to other parties when they make monetary transactions [38]. Other studies have found that security considerations are positively correlated with users intention to use new technology [39]. A recent study found that security factors play a key positive role in the use and acceptance m-commerce in Jordan [40]. Consequently, the following is hypothesized:

H4: Security considerations (SC) will have a positive impact on m-wallet intention to use (MA).

5) Touch-free transactions (TT)

Touch-free monetary transactions were widely used by consumers during the COVID-19 pandemic because they wanted to protect themselves from illness [41, 42]. The World Health Organization stated that one of main means of transmission of COVID-19 was by exchanging physical cards, paper money and coins between buyers and sellers [43]. Monetary transactions via m-wallet are healthier than other monetary transactions because they are executed as touch-free or contactless transactions between people [44]. Advantages of touch-free transactions are that they are safe, convenient, environmentally friendly and efficient. Therefore, countries such as India have made digital payment compulsory to minimize contact between people [45]. According to [46], touch-free payment is widely used globally these days. Consequently, the following is hypothesized:

H5: Touch-free transactions (TT) will have a positive impact on m-wallet intention to use (MA).

6) Aesthetics (AS)

Aesthetics is defined as "the style of self-presentations embedded in the visual communication strategies of the presenter and the extent to which other users perceive these presentations to be visually appealing and aesthetically impressive" [47]. Design aesthetics have been reported to have a positive impact on customers' trust [48]. Previous studies found that aesthetic characteristics, such as contrast and color, are key factors that encourage customers to interact successfully and effectively with websites [49]. Aesthetic graphics were found to have a positive effect on mobile application usability [50]. The results in the study by [51] revealed that aesthetics had a significant effect on intention to buy in social commerce. Consequently, the following is hypothesized:

H6: Aesthetics (AS) will have a positive impact on m-wallet intention to use (MA).

7) Enjoyment (EN)

Enjoyment is the "degree to which an activity is perceived to be enjoyable, apart from its performance consequences" [52]. It was found that enjoyment had a positive effect on m-commerce usability in India [53]. Perceived enjoyment is also considered an intrinsic motivational factor that encourages customers' intention to continue to use m-commerce and experience satisfaction with that use [54, 55]. Perceived enjoyment also has a significant effect on new technology adoption and its continued use [56]. Consequently, the following is hypothesized:

H7: Enjoyment (EN) will have a positive impact on m-wallet intention to use (MA).

8) Mediating role of perceived values (PV)

Perceived values refer to values and benefits anticipated by customers when spending money on services or products [57]. It refers to the weighing-up of customers' sacrifices, efforts, time and money and the benefits anticipated, for example, from utilities purchased and their quality [58]. In the m-wallet context, there are two types of values, i.e., utilitarian and hedonic. Utilitarian values relate to the evaluation of functional sacrifices and benefits as a whole while hedonic values relate to the evaluation of experimental sacrifices and benefits as a whole [59, 60]. Perceived cost refers to the price paid and the effort and time expended by customers [45]. Perceived value may be considered an important mediator that impacts on customers' m-wallet intention to use. The motivation for customers' intentional behavior is that they will receive many advantages, such as greater efficiency and effectiveness of m-wallet compared to other payment channels [61, 62]. Customers feel that m-wallet is easy to use and it saves time and effort [42, 63]. Technical and organizational aspects are important in the support of m-wallet use [39]. The availability of required resources is important in the creation of a positive perception toward technology [1]. In the m-wallet context, security plays a key role in users' behavioral intentions. Monetary transactions using m-wallet are confidential and sensitive, thereby eliminating some of the risk involved in making transactions [61]. Touch-free monetary transactions may play a key role in customers' intention to use an m-wallet because they are keen to avoid infection or disease resulting from exchanging cash [45]. Based on the above discussion, perceived values may mediate the relationships between the elements of perceived values (relative advantage, security considerations, ease of effort, touch-free transactions, favourable infrastructure conditions, aesthetics and enjoyment) and m-wallet intention to use. Consequently, the following are hypothesized to measure these mediating impacts:

H8: The relationship between relative advantage and m-wallet intention to use (MA) will be mediated by perceived values (PV).

H9: The relationship between ease of effort and m-wallet intention to use (MA) will be mediated by perceived values (PV).

H10: The relationship between favourable infrastructure conditions and m-wallet intention to use (MA) will be mediated by perceived values (PV).

H11: The relationship between security considerations and m-wallet intention to use (MA) will be mediated by perceived values (PV).

H12: The relationship between touch-free transactions and m-wallet intention to use (MA) will be mediated by perceived values (PV).

H13: The relationship between aesthetics and m-wallet intention to use (MA) will be mediated by perceived values (PV).

H14: The relationship between enjoyment and m-wallet intention to use (MA) will be mediated by perceived values (PV).

9) Moderating role of age and gender

Demographic attributes are considered to be the main moderators in the technological services field [43]. There may be differences between males and females due to differences in psychology [64]. The results of other studies have revealed that, compared with males, females consider that selling and buying online is more secure [65]. Males considered mobile banking, m-commerce and internet banking more favorably than females did [66]. Shin [37] found that gender has a significant moderating effect on the use of new technology. Gender also has a significant moderating effect on the relationship between factors and attitudes in the adoption of new technologies [61]. There is digital gap between males and females due to a shortage in technological skills, loss of passion and privacy and security concerns [67]. Consequently, the following is hypothesized to measure these moderating impacts of gender:

H15: The relationship between perceived values (PV) and m-wallet intention to use (MA) will be moderated by gender and the effect is greater for males.

It has been confirmed that age plays a key role in the relationship between perceived value and adoption behavior for users [68] with younger users adopting new technologies more readily than older users [31, 61]. Thus, age has a significant effect on new technology adoption. Reasons that older people do not adopt new technologies as readily as young people include a lack of relevance, lack of technological skills and technophobia [69]. Younger users are more likely to identify the usefulness and perceived value of new technologies than older users [70]. Consequently, the following is hypothesized to measure these moderating impacts of age:

H16: The relationship between perceived values (PV) and m-wallet intention to use (MA) will be moderated by age and the effect is greater for younger users.

III. Materials and Methods

A. Research design and data collection

Research design is "a framework for the collection and analysis of data" [71]. Fig.2 describes the research design in this study that has four main phases. Quantitative methods were employed to gather data. In this case, a questionnaire was used to collect data from participants. This questionnaire has been used in previous studies [45, 72] and was modified for use in this study context. In this study, the questionnaire has three parts. The first presents general information about the study and ethical clearance. The second focuses on the collection of demographic data. The third has 30 items to measure the factors that may impact intention to use m-wallet in Saudi Arabia using five-Likert scale questions (5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree). A random sampling technique was used to reach the target population, namely, Saudi citizens. This technique was used to enable the generalization of results [73]. One thousand questionnaires were distributed via social platforms such as WhatsApp and Twitter with 201 questionnaires being received with full responses.

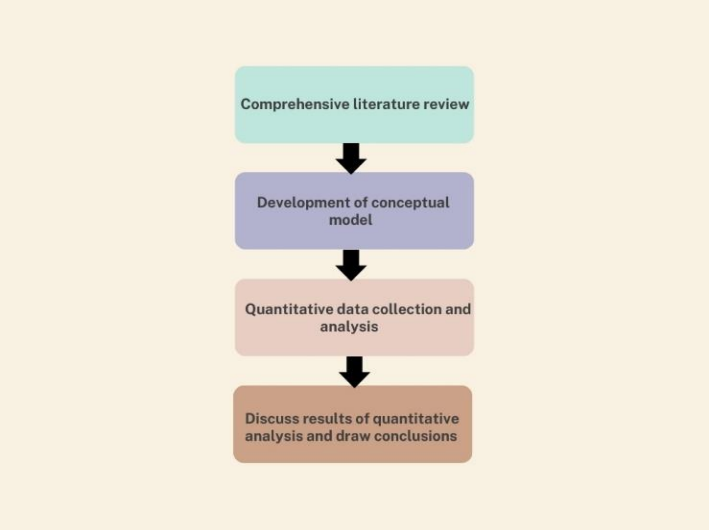

Fig. 2 Research design for this study

B. Data Analysis

Descriptive analyses were first employed to analyze the demographic data. Exploratory factor examination analysis of the correlation coefficient was used to assess unit dimensionality and scale validity. Discriminant and convergent validity were assessed using confirmatory factor analysis (CFA). Structural Equation Modelling (SEM) was used to evaluate the whole model and analyze the data. SEM was employed using the Partial Least Square (PLS) method with the smart PLS package. There were two phases of SEM analysis: (1) involved assessment of the measurement model (outer model) and (2) assessed the structural model (inner model). The path coefficient was used to test the hypotheses using smart PLS.

IV. RESULTS

A. Demographic data

Most study participants were female (57.2%) (Table 1), and young (18-40 years) (81.6%).

Table 1: Demographic data of study participants

Group		Number of participants	Percentage of sample
Gender	Male	86	42.8
	Female	115	57.2
	Total	201	100
Age	Young (18-40 years)	164	81.6
	Old (over 40 years)	37	18.4
	Total	201	100

B. Testing the measurement model (outer model)

It is crucial to evaluate the validity and reliability of the instrument before testing the path coefficients in the model [74]. PLS-SEM was used to assess the proposed model and test the instrument, nine structures and 30 indicators. In this study we used the criteria adopted by [74] (see Table2)

Table2. Checking reliability and validity. Source: [74]

What to Check?	What to look for in smart Pls?	Where is it in the Report?	Is it ok?
		Reliability	
Indicator Reliability	"Outer Loadings" numbers	PLS→Calculation Results→Outer Loadings	Square each of the outer loadings to find the indicator reliability value. 0.70 or higher is preferred. If it is exploratory research, 0.4 or higher is acceptable.
Internal consistency Reliability	"Reliability" numbers	PLS→Quality Criteria→Overview	Composite Reliability should be 0.7 or higher. If it is exploratory research, 0.6 or higher is acceptable. (Bagozzi and Yi, 1988)
		Validity	
Convergent validity	"AVE" numbers	PLS→Quality Criteria→Overview	It should be 0.5 or higher (Bagozzi and Yi, 1988)
Discriminant Validity	"AVE" numbers and Latent Variable Correlations	PLS→Quality Criteria→Overview (for the AVE numbers as shown below) PLS→Quality Criteria→ Latent Variable Correlations	Fornell and Larcker (1981) suggests that the " SQUARE ROOT " of AVE of each latent variable should be greater than the correlations among the latent variables.

1.) Reliability

The stability and consistency of an instrument can be measured by measuring its reliability [74, 75]. The internal consistency and indicator reliability of the instrument were measured as shown in Fig. 3.

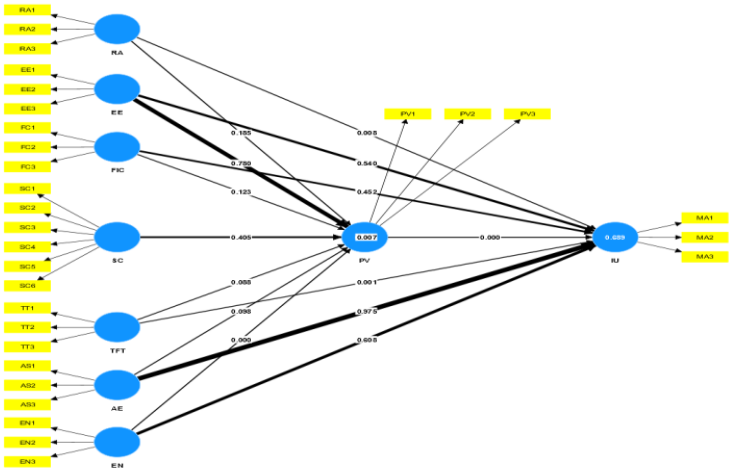

Fig. 3 Inner model testing result.

a.) Indicator Reliability

According to [74], the reliability of construct items is evaluated by measuring the loading indicator correlations. In this study, reliability was assessed by using loading of indicators. To obtain satisfactory results, an item's loading has to be greater than 0.70 [76]. In this study, all items' loadings were higher than 0.70 (Table 3).

Table 3: Instrument reliability and validity

Construct	Item	Loadings	Cronbach's Alpha	AVE	CR
Relative advantage	RA1	0.88	0.757	0.676	0.772
	RA1	0.85			
	RA1	0.88			
Ease of Effort	EE1	0.88	0.849	0.767	0.86
	EE2	0.9			
	EE3	0.83			
Favourable Infrastructure Conditions	FC1	0.77	0.762	0.67	0.809
	FC2	0.81			
	FC3	0.86			
Security considerations	SC1	0.71	0.879	0.623	0.888
	SC2	0.8			
	SC3	0.85			
	SC4	0.78			
	SC5	0.77			
	SC6	0.79			
Touch-free Transaction	TT1	0.88	0.764	0.683	0.807
	TT2	0.89			
	TT3	0.71			
Enjoyment	EN1	0.92	0.895	0.826	0.897
	EN2	0.91			
	EN3	0.89			
Aesthetics	AS1	0.87	0.868	0.792	0.871
	AS2	0.9			
	AS3	0.89			
Perceived Values	PV1	0.76	0.805	0.722	0.814
	PV2	0.89			
	PV3	0.88			
M-Wallet Intention to use	MA1	0.86	0.873	0.798	0.875
	MA2	0.91			
	MA3	0.9			

b.) Internal Consistency Reliability

Internal Consistency Reliability of constructs must be evaluated by assessed the composite Reliability (CR) and CR required to be higher than 0.7 [74]. Cronbach's alpha must be assessed for variables with composite reliability of variables to obtain the correct assessment of the Internal Consistency Reliability of variables. Both values must be greater than 0.70 [77, 78]. In Table 3, the values of Composite Reliability and Cronbach's alpha are higher than 0.70 (the acceptable level).

2.) Validity of scales

Discriminant and convergent measurements were assessed to confirm that the reflective measurements for the model were sufficient. The analysis of relevance of the scales and unidimensionality and corresponding coefficients were also assessed. The merged and discriminating viability of the estimate scales was assessed by Confirmatory factor analyses. Confirmatory factor analysis (CFA) was used to evaluate the constructions' validity.

a.) Convergent validity

The convergent validity was assessed using the average variance extracted (AVE) value while the capacity of the model was assessed using convergent validity to explain the indicator's variance [74, 77]. To obtain an acceptable level of convergent validity, the AVE value must be greater than 0.50 [74]. The results in Table 3 showed that all AVE values are greater than 0.50, which confirms the convergent validity results.

b.) Discriminant validity

According to [79], discriminant validity is the degree to which items and constructs can be distinguished from each other. It has been stated that discriminant validity is of more importance than other analytic tests [76]. In this study, discriminant validity was determined by the correlation between measurements of each category and the building construct itself to confirm that no issues exist regarding overloading the measured objects. Two analytical tests were conducted to measure discriminant validity, namely, cross-loading criteria and Fornell-Larcker. The Fornell-Larcker test is a conservative and normative method to measure discrimination [80]. Latent variables must be of greater value than their correspondence with all other latent variables in order to achieve discriminant validity (see Table 4). The cross-loading analysis is an approach that examines whether the loading value exceeds their loading with other latent variables for each construct with its associated latent variable [81]. As seen in Table 5, all objects satisfy this test.

Table 4: Latent variable correlations

	RA	EE	FC	SC	TT	EN	AS	PV	MA
RA	1.000								
EE	0.393	1.000							
FC	0.617	0.455	1.000						
SC	0.442	0.645	0.484	1.000					
TT	0.532	0.525	0.642	0.520	1.000				
EN	0.590	0.529	0.718	0.579	0.757	1.000			
AS	0.328	0.779	0.386	0.607	0.535	0.487	1.000		
PV	0.591	0.450	0.694	0.501	0.675	0.631	0.390	1.000	
MA	0.497	0.411	0.551	0.446	0.633	0.574	0.296	0.640	1.000

Table 5: Matrix of cross-loadings

	AS	EE	EN	FC	MA	PV	RA	SC	TT
AS1	0.874	0.336	0.501	0.430	0.466	0.478	0.269	0.523	0.471
AS2	0.904	0.351	0.590	0.391	0.484	0.550	0.307	0.533	0.408
AS3	0.891	0.363	0.553	0.361	0.468	0.544	0.299	0.521	0.450
EE1	0.343	0.884	0.384	0.591	0.467	0.461	0.683	0.380	0.415
EE2	0.383	0.905	0.409	0.603	0.491	0.525	0.706	0.411	0.317
EE3	0.300	0.838	0.406	0.494	0.418	0.391	0.659	0.395	0.355
EN1	0.540	0.454	0.921	0.463	0.601	0.675	0.388	0.646	0.544
EN2	0.548	0.389	0.911	0.405	0.555	0.607	0.328	0.604	0.431
EN3	0.594	0.396	0.894	0.448	0.592	0.672	0.335	0.640	0.522
FC1	0.360	0.448	0.301	0.779	0.319	0.365	0.388	0.306	0.314
FC2	0.365	0.417	0.380	0.813	0.370	0.420	0.419	0.374	0.338
FC3	0.366	0.666	0.472	0.862	0.539	0.587	0.627	0.507	0.423
MA1	0.384	0.445	0.503	0.469	0.863	0.650	0.470	0.548	0.557

MA2	0.515	0.498	0.606	0.473	0.911	0.700	0.496	0.660	0.529
MA3	0.520	0.463	0.608	0.453	0.905	0.677	0.469	0.598	0.611
PV1	0.524	0.414	0.614	0.427	0.560	0.763	0.302	0.523	0.489
PV2	0.437	0.455	0.587	0.515	0.650	0.892	0.432	0.504	0.473
PV3	0.543	0.475	0.631	0.527	0.709	0.888	0.495	0.580	0.503
RA1	0.326	0.704	0.334	0.488	0.478	0.420	0.859	0.356	0.319
RA2	0.282	0.738	0.334	0.543	0.446	0.439	0.881	0.302	0.237
RA3	0.190	0.454	0.283	0.466	0.393	0.336	0.718	0.304	0.161
SC1	0.482	0.304	0.456	0.317	0.419	0.386	0.307	0.714	0.321
SC2	0.494	0.385	0.610	0.430	0.613	0.518	0.357	0.803	0.585
SC3	0.488	0.430	0.598	0.473	0.583	0.585	0.404	0.858	0.547
SC4	0.490	0.335	0.518	0.394	0.526	0.515	0.263	0.787	0.579
SC5	0.379	0.235	0.478	0.335	0.446	0.421	0.192	0.772	0.422
SC6	0.462	0.408	0.594	0.393	0.568	0.528	0.297	0.793	0.520
TT1	0.474	0.397	0.443	0.395	0.595	0.558	0.323	0.560	0.885
TT2	0.420	0.369	0.453	0.377	0.542	0.500	0.220	0.511	0.894
TT3	0.320	0.229	0.500	0.336	0.411	0.334	0.169	0.531	0.682

C. Testing the inner model (the structural model)

1.) Coefficient of determination (R2)

The Coefficient of Determination (R-Square, R2) is one of the main parameters to evaluate structural models using PLS-SEM [82, 83]. As PLS-SEM aims to understand the latent variance of the endogenous variables, the value of R2 must be high. According to [81], the value of R2 is considered high if it is greater than 0.67, medium if it is between 0.33 and 0.67 and low if it is between 0.19 and 0.3. The results in Table 6 show that all R2 values are high, which means these variables explain the model

Table 6: Results of the endogenous latent variables

	R square (R^2)	**Result**
MA	0.810	High
PV	0.750	High

2.) The effect size (f2)

After evaluating R2, the assessment of effect size (f2) is used to calculate the effect of R2 to confirm whether the impacts on the internal variables of a given external variables are significant [82].The formula below is used to measure f2 [79]:

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}}$$

If the f2 value is greater than 0.35, it has a significant impact, f2 values between 0.15 and 0.35 show a medium impact and f2 values between 0.02 and 0.15 show a small impact [84]. The values of f2 for this study are presented in Table 7.

Table 7: The results of effect size

	MA	**PV**
AS	0.001	0.024
EE	0.002	0.001
EN	0.002	0.174
FC	0.004	0.031
MA		

PV	0.203	
RA	0.071	0.013
FC	0.051	0.004
TT	0.078	0.031

3.) Predictive relevance of the model (Q2)

Predictive validity of the model (Q2) is used to assess consistency of the structural model [81]. If the redundancy value of cross-validity is below zero (Q2<0), the model is not predictive and if Q2>0, it will be predictive [85]. Based on the results in Table 8, the proposed model can predict adequately.

Table 8: The results of Cross-validity redundancy

	Q^2	**Results**
MA	0.580	predictive relevance
PV	0.570	predictive relevance

4.) The goodness of fit of the model (GoF)

According to [86] the goodness of fit (GoF) is used to measure the fitness of the model. The following is the formula used to calculate GoF [79]:

$$GOF = \sqrt{(\overline{R^2} * \overline{AVE})}$$

$$GOF = \sqrt{(0.661 * 0.760)} = 0.708$$

GoF values greater than 0.35 are highly significant, values between 0.10 and 0.25 are at a medium level of significance and values less than 0.10 are of low significance [87]. The value of GoF in this study was 0.708, which is highly significant with regard to the model validity.

D. Structural model analysis

CFA models are used to explore the relationships between autonomous and contingent constructs. Before analyzing relationships between structures, it is important to create the relationships of the proposed model [82]. In this study, the hypotheses were formulated based on the proposed model which was derived from the literature review. A path analysis was also conducted in this study on the proposed model to test the hypotheses and model suitability.

1.) Collinearity assessment

In this section, collinearity is evaluated. According to [83] an excellent Variance Inflation Factor (VIF) value of 5 or more means that problems may arise. Table 9 indicates that there is no evidence of collinearity between predictor sets because all VIF values are less than 5.

Table 9: Variance Inflation Factor (VIF) results

	MA	**PV**
AS	1.868	1.823
EE	3.050	3.048
EN	2.724	2.320
FC	2.115	2.052
MA		
PV	2.727	
RA	2.751	2.714
FC	2.551	2.540

2.) Structural model result

Gefen et al. [88] claimed that SEM is a popular method used to produce results in the IT/IS field. It was, therefore, used for the proposed research model. The Smart PLS package using the Partial Least Square (PLS) method was applied to SEM as that package is the best method to explore latent variables in complex models [89, 90].

a.) Hypothesized structural model (Hypothesis testing)

In this section, the proposed hypotheses were tested. Figure 4 shows how the hypotheses were tested based on rejecting or accepting standardized route coefficients and p-values and the results are summarized in Table 10. The results revealed that, relative advantage has a positive impact on m-wallet intention to use. Therefore, H1 is accepted. It also showed that security considerations have a positive impact on m-wallet intention to use. Therefore, H4 is accepted. In addition, the results in Table 10 showed that touch-free monetary transactions have a positive impact on m-wallet intention to use. Therefore, H5 is accepted. The results show that H2, H3, H6 and H7 are rejected.

Table 10: The results for each hypothesis

Path (hypothesis)		Std. Error	T-Value	P-Values	Decision
H1	RA → MA	0.093	2.655	0.008	Accepted
H2	EE → MA	0.078	0.612	0.540	Rejected
H3	FC → MA	0.071	0.753	0.452	Rejected
H4	SC → MA	0.074	2.703	0.007	Accepted *
H5	TFT → MA	0.066	3.281	0.001	Accepted ***
H6	AS → MA	0.064	0.032	0.975	Rejected
H7	EN → MA	0.076	0.513	0.608	Rejected

*** Correlation is significant at <0.001
** Correlation is significant at <0.01
* Correlation is significant at <0.05

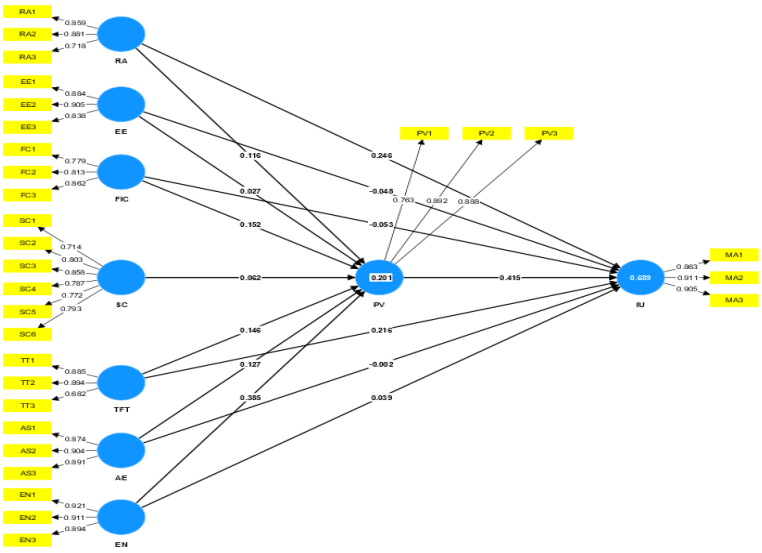

Fig. 4 Testing the hypotheses

The mediation analysis was performed, with the results in Table 11 showing that H8, H9, H10, H11, H12 and H13 are rejected, which means that perceived value did not mediate the relationship between relative advantage, ease of effort, favourable infrastructure conditions, security considerations, touch-free transactions and aesthetics and m-wallet intention to use. The results also showed that H14 is accepted. This result means that the relationship between enjoyment and m-wallet intention to use is fully mediated by perceived value.

Table 11: Mediation hypothesis results

Path (hypothesis)		Std. Error	T-Value	P-Values	Decision (mediation)
H8	RA →PV→ MA	0.038	1.274	0.203	Rejected
H9	EE →PV→ MA	0.041	0.273	0.785	Rejected
H10	FC → PV→ MA	0.043	1.478	0.140	Rejected
H11	SC → PV→MA	0.032	0.815	0.415	Rejected
H12	TFT → PV→ MA	0.042	1.447	0.148	Rejected
H13	AS → PV→MA	0.037	1.446	0.148	Rejected
H14	EN → PV→MA	0.049	3.273	0.001	Accepted***

*** Correlation is significant at <0.001
** Correlation is significant at <0.01
* Correlation is significant at <0.05

The results of the moderation analysis are presented in Table 12 and Figures 6, 7 and 8. The results show that the relationship between perceived value and m-wallet intention to use was significantly moderated by gender and age and was strong for males and younger respondents. Therefore, H15 and H16 are supported.

Table 12: Analysis of gender and age moderators

Path (hypothesis)		Std. Error	t-value	P-value	Decision (Moderators)
H15	Gender × PV → MA	0.114	3.239	0.001	Accepted***
H16	Age × PV → MA	0.120	2.766	0.006	Accepted ***

*** Correlation is significant at <0.001
** Correlation is significant at <0.01
* Correlation is significant at <0.05

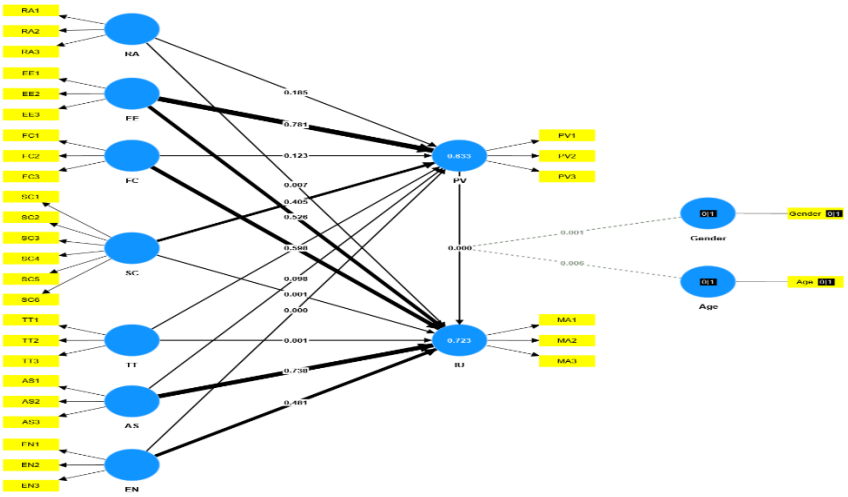

Fig. 5 Analysis of the moderators of gender and age

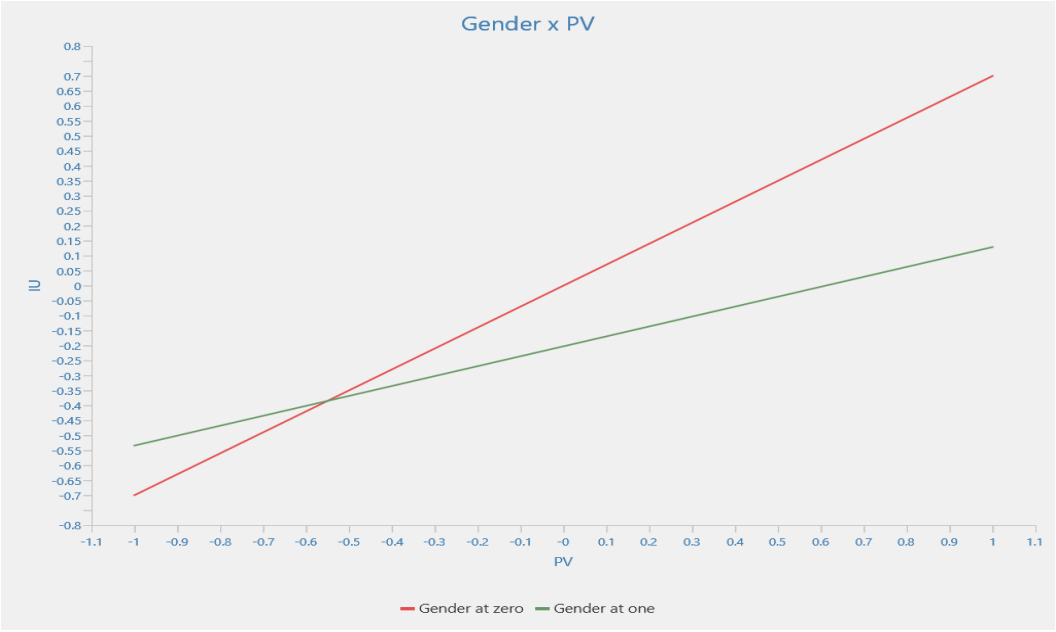

Fig. 1 Difference between males (gender at zero) and females (gender at one)

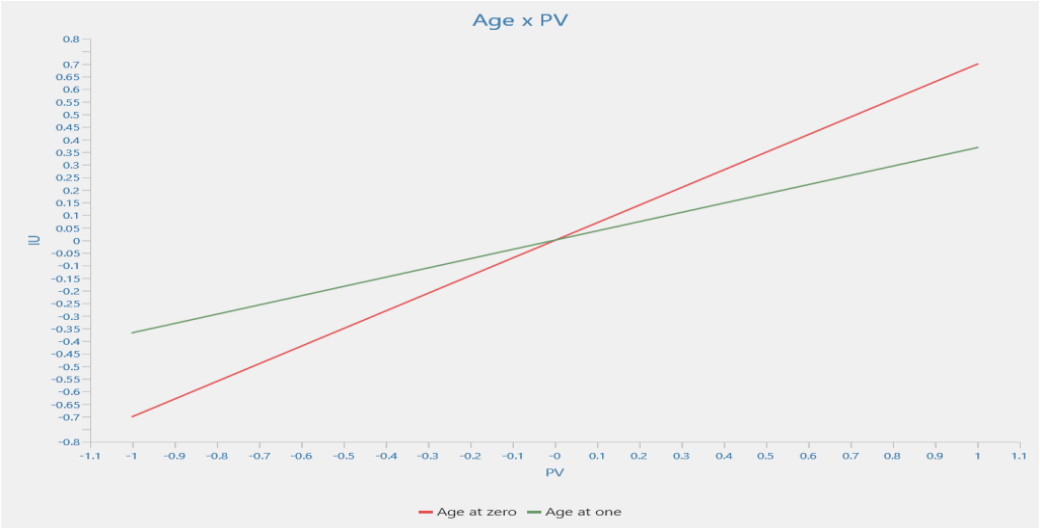

Fig. 2 Difference between younger (age at zero) and older (age at one) respondents

V. DISCUSSION

The results showed that relative advantage had a positive impact on m-wallet intention to use (H1 accepted). This result is consistent with previous studies [20, 22-25]. This result indicates that, when users believe that using m-wallet will be useful, they will have greater intention to use it. Ease of effort did not have a positive impact on m-wallet intention to use (H2 rejected). This result contradicts the findings of some previous studies [27-29]. However, this result is consistent with the study by [91], who did not find that perceived ease of use had significant positive impact on intention to use mobile government applications. Similarly, the recent study by [92] found that perceived ease of use had no significant influence on mobile commerce use. This result may indicate that, while m-wallet is a new technology, users do not focus on ease of use of this technology, rather, they are more focused on the usefulness of the service. It may also indicate that users now have high technology skills, so they do not face any difficulties when they use m-wallet and they do not care about this factor. Alternatively, it may indicate that users may struggle and face difficulties when using m-wallet and they accept these difficulties because they focus only on service. Favourable infrastructure conditions did not have a positive impact on m-wallet intention to use (H3 rejected). This result is inconsistent with previous studies [20, 33-35] and it may indicate that customers focus on service and do not care about infrastructure. Furthermore, it may indicate that m-wallet has good infrastructure and it has not been disconnected, therefore, users do not care about infrastructure. This result may be due to the fact that technical and organizational infrastructure in Saudi Arabia is available and at a high level of readiness, so users care less about this factor. Security considerations had a positive impact on m-wallet intention to use (H4 accepted). This result is consistent with other studies [39, 40] and may indicate that users believe using m-wallet is safe and they trust it. It may also indicate that users have a high level of awareness regarding security issues.

Touch-free transactions had a positive impact on m-wallet intention to use (H5 accepted). This result may indicate that since COVID-19, users now have a high level of awareness regarding disease protection. In addition, it may indicate that users believe that m-wallet is considered both user-friendly and safe. Aesthetics and enjoyment do not have a positive impact on m-wallet intention to use (H6 and H7 rejected). These results are inconsistent with previous studies [50, 51, 54-56] and may indicate that users do not focus on aesthetics and enjoyment when they are using m-wallet because they are focused on service. It may also indicate that m-wallet has good aesthetics and users enjoyed using it. Alternatively, this result may indicate that m-wallet does not have a good aesthetics and users do not enjoy using it. Perceived value did not mediate the relationship between relative advantage, ease of effort, favourable infrastructure conditions, security considerations, touch-free transactions and aesthetics and m-wallet intention to use (H8, H9, H10, H11, H12 and H13 rejected). These results are inconsistent with previous studies [1, 93] which found that perceived value is a fundamental mediator. These results mean that perceived value did not play a key role in enhancing intention to use m-wallet. Therefore, users' values regarding their intention to use m-wallet will not help service providers to encourage the adoption of the m-wallet platform among users. The relationship between enjoyment and m-wallet intention to use was fully mediated by perceived value (H14 accepted). This result may indicate that the role of perceived value make factor of enjoyment may help to enhance the intention to use m-wallet.

The relationship between perceived values and m-wallet intention to use was moderated by gender (H15 accepted), with the effect being higher for males. This result is consistent with previous studies [66, 67] and indicates that males have a stronger intention to use m-wallet than females and that they appear to value m-wallet more than females in the m-wallet context. The relationship between perceived values and m-wallet intention to use was also moderated by age (H16 accepted) and that the effect is higher for younger users than for older users. This result is consistent with previous studies [31, 61, 70] and indicates that younger users appear to value m-wallet experience more than older users when they are using technology, because they usually tend to like to use new technologies more than older users.

VI. CONCLUSION

In this study, SOR theory was adopted to measure the impact of relative advantage, favourable infrastructure conditions, security considerations, ease of effort, touch-free transactions, aesthetics and enjoyment on m-wallet intention to use. This study also evaluated the mediation of perceived values and users' demographics as moderators in the research model. The results revealed that relative advantage, security considerations and touch-free monetary transactions have a positive impact on m-wallet intention to use. Furthermore, they showed that ease of effort, favourable infrastructure conditions, aesthetics and enjoyment did not have a positive impact on m-wallet intention

to use. The results also showed that the relationship between enjoyment and m-wallet intention to use was fully mediated by perceived value but that perceived value did not mediate the relationship between relative advantage, favourable infrastructure conditions, ease of effort, touch-free transactions, security considerations and aesthetics and m-wallet intention to use. The results revealed that the relationship between perceived value and m-wallet intention to use was significantly moderated by gender and age and was stronger for males and younger respondents. This study makes a theoretical contribution to the literature by addressing the knowledge gap identified in the literature review in the Saudi m-wallet context. It further contributes to theory by measuring the impact that relative advantage, favourable infrastructure conditions, ease of effort, security considerations, touch-free transactions, aesthetics and enjoyment have on m-wallet intention to use, by adopting the Stimulus-Organism-Response (SOR) Theory. By measuring the mediation of perceived values and users' demographics (age and gender) as moderators, the study also contributes to practice by revealing the factors that impact on m-wallet intention to use in the Saudi context. Addressing and acknowledging these factors will support service providers of future m-wallet services in their implementation.

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