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Digital Transformation of Enterprises to Enhance Sustainability: How Does the Reputation of Digital Applications Influence the Attributes of E-Commerce

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Abstract: Driven by the increase in mobile applications, this study tests a conceptual model which links antecedents of Food delivery applications (FDApps) and their effect on electronic trust (eTrust) and electronic loyalty (eLoyal). By adopting a quantitative approach, we employed a self-administered questionnaire distributed among 501 regular users of FDApps. Partial least squares path modeling was used to test seven hypotheses including direct, moderating, and mediating effects. The findings reveal that eTrust significantly contributes to fostering eLoyal. Additionally, eTrust mediates the relationships between electronic privacy (ePriv), electronic security (eSec), electronic payment (ePay), usability (ULY), electronic innovativeness (eInnov), and eLoyal. Moreover, reputation (RTN) has a positive moderating effect on the relationship between eTrust and eLoyal. The research explores the core elements linked to FDApps, with the goal of improving their business and marketing strategies while increasing consumer satisfaction, thereby boosting repurchase intentions. Therefore, it provides FDApps with insights on the required elements linked to a higher eLoyal.

Keywords: e-commerce; electronic security; electronic payment; application usability; electronic loyalty; electronic trust; reputation

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1. Introduction

The Agenda 2030, established by the United Nations in September 2015, underscores the significance of industry, innovation, and infrastructure [1,2]. Particularly, sustainable development goal number 9 stresses that technology plays a pivotal role in addressing economic challenges such as employment generation [2,3]. One major technological advancement that has gained attention is electronic commerce (e-commerce). E-commerce has emerged as a vital tool for promoting sustainable and strong economic growth. The COVID-19 pandemic highlighted this role, especially for developing nations. As businesses moved their operations from physical spaces to online platforms during and after the pandemic, the importance of e-commerce in driving economic progress became clear [4,5]. Particularly, e-commerce web applications facilitate the transactions of goods and services through electronic channels [6,7]. This digital shift allows businesses to reach wider markets and operate more efficiently, contributing to economic resilience and growth.

Food delivery applications, commonly known as FDApps, have seen a remarkable increase in usage worldwide, driven by changing consumption patterns among people globally [8–10]. This surge was notably accelerated by the COVID-19 pandemic, which encouraged more individuals to rely on these apps for their food needs. FDApps work

by allowing vendors to list their products on a website or app [10,11]. Customers can then browse these offerings, evaluate the details and costs, select delivery options, make their purchases, and proceed through the checkout process [12]. Notably, the reliability of FDApps significantly influences consumers' trust in restaurants, thereby fostering continued buyer intent [13]. Additionally, how well these apps handle conflicts—like order issues or delays—can significantly affect user trust. Customers often look to online reviews to gauge this effectiveness, and positive reviews can greatly enhance their confidence in using the app [14].

Given the link between satisfaction and loyalty, organizations should focus on understanding and meeting the varied demands of their consumers [15]. Recently, the confidence of consumers in FDApps has increased in developed and developing markets. Offering a wide range of affordably priced food options can encourage more people to use these apps to order from different restaurants [16,17]. Furthermore, the intention to use such applications is positively related to the perceptions of the users of their characteristic elements [18]. Restaurant owners should note that trust is a critical factor in customers' decision-making. Trust in the app can predict whether a customer will choose to order through it [16,17]. Additionally, positive experiences with e-commerce platforms may lead to higher satisfaction with e-commerce, consequently fostering electronic loyalty (eLoyal) [19].

This article aims to investigate the features of FDApps, including electronic privacy (ePriv), electronic security (eSec), electronic payment (ePay), usability (ULY), reputation (RTN), and electronic innovativeness (eInnov). These aspects are explored in relation to electronic trust (eTrust) and eLoyal. Consumers often have various concerns about FDApps, such as data privacy and security. Addressing these concerns is a key motivation for this study. While previous research has converged on the attributes of e-commerce, it has often overlooked these issues in the specific context of FDApps. Understanding how these attributes contribute to building eTrust and eLoyal is crucial, especially since customer willingness to use FDApps depends on these factors [19,20]. To fill this research gap, we propose an integrated model that emphasizes existing e-commerce attributes. This model is particularly focused on the e-commerce dynamics of developing countries, aiming to enhance eLoyal among users of such platforms.

The research has the following structure. Initially, we offer a comprehensive literature review regarding FDApps, with a specific focus on e-commerce antecedents such as ePriv, eSec, eTrust, ePay, ULY, eInnov, and RTN. Subsequently, we formulate seven hypotheses based on existing research and describe our conceptual model. Next, we describe the methodology employed. Then, we present the data, methods, and core findings. Lastly, we highlight limitations and provide recommendations for scholars and practitioners.

2. Theoretical Background

This research draws on two complementary theories to understand consumer behavior in the e-commerce sector, specifically the use of FDApps: the Unified Theory of Acceptance and Use of Technology (UTAUT) model, and the Technology Acceptance Model (TAM). The literature suggests employing these models jointly to explore technology adoption [21–25]. The UTAUT model and TAM framework identify several key determinants including effort expectation (i.e., how easy the technology is to use), performance expectation (how well the technology is expected to perform), and social influence (i.e., how others' opinions affect the user's decisions). These factors directly impact a person's intention to use the technology and how it is implemented [26]. In particular, people are more likely to adopt new technological innovations if they believe these will improve their personal or professional lives [21,23,26].

Previous studies on the application of the UTAUT model to understand consumer behavior in the food services industry have been relatively scarce [22,23], presenting an opportunity to address consumer concerns through innovative applications [26] and foster competition among industry players [22]. Furthermore, the integration of new innovative features holds the potential to augment value creation and promote sustainable

performance in the long term [27]. Additionally, the model delineates a set of antecedents related to information quality and scrutinizes its associations with continuous use intention, effort expectancy, and performance expectancy [28]. This framework enables researchers to explore the adoption of new platforms by consumers across various industries, including the food services sector [19]. Lastly, in line with the TAM [29], effort expectancy is linked to perceived ease of use, where a greater perception of technology usability increases the likelihood of its adoption [23].

2.1. eTrust and eLoyal

Previous research suggests a positive correlation between perceived trust in mobile applications and increased loyalty [30]. Greater loyalty and trust in FDApps lead to continued purchasing intentions among consumers [14,31,32]. Moreover, some authors indicate that customers may hesitate to proceed with purchases due to perceived risks in the use of such e-commerce applications [33,34]. FDApps can address this by providing ongoing support and offering quality information, such as product characteristics and restaurant attributes, to dispel misconceptions, thereby increasing the level of perceived trust [30] and fostering consumer loyalty [35,36]. Therefore, FDApps aim to prioritize consumers' needs and develop services that enhance client trust and foster brand loyalty [34]. Ergo, we hypothesize as follows:

Hypothesis 1. *H1—eTrust has a significant positive effect on eLoyal.*

2.2. The Mediation Role of eTrust between ePriv and eLoyal

Perceived privacy plays a significant role in shaping trust within the online commercial transaction context [37,38]. Consumers naturally lean toward websites they perceive as trustworthy while showing reluctance toward those they deem insecure [39]. Higher perceptions of security and privacy are linked with the confidence that private details will be safeguarded [37,40]. Additionally, some elements of the application (such as perceived security, utility, reputation, privacy, and willingness to customize) affect the customer's online trust [41]. Additionally, purchase intention is significantly affected by concerns about ePriv and it is mediated by the perceived eTrust [37,42]. Then, we hypothesize the following:

Hypothesis 2. *H2—eTrust mediates the relationship between ePriv and eLoyal.*

2.3. The Mediation Role of eTrust between eSec and eLoyal

Given consumers' reluctance to share personal information on insecure websites [41], perceived security has become an important topic of interest [40]. This perception is closely tied to the initial trust consumers place in e-commerce, driven by concerns over the risks associated with online transactions [43]. Consequently, when an online business effectively communicates its security measures to mitigate these risks, prospective customers are more likely to trust the platform and feel comfortable making purchases [37,44]. Despite technological advances, customers remain wary about information and transaction security [45,46]. This cautiousness influences the effect of security on customers' subsequent willingness to use FDApps [43]. Therefore, we hypothesize as follows:

Hypothesis 3. *H3—eTrust mediates the relationship between eSec and eLoyal.*

2.4. The Mediation Effect of eTrust between ePay and eLoyal

Digital networks' infrastructure has undergone extensive improvement, leading to significant advancements in secure e-commerce authorization and payment options [47,48]. This progress is attributed to the improvement of secure digital transaction systems [49]. Additionally, the availability of various channel services, payment options, specific products, and delivery methods depends on technical factors, which directly influence eTrust [50].

Moreover, eLoyal is influenced by marketing tools like dynamic pricing strategies facilitated by these platforms [35,51]. Subsequently, performance expectations with the platform and eTrust in the ePay impact purchasing intentions [52]. Hence, we hypothesize as follows:

Hypothesis 4. *H4—eTrust mediates the relationship between ePay and eLoyal.*

2.5. The Mediation Effect of eTrust between ULY and eLoyal

Previous research suggests that website usability does not directly influence eLoyal [53,54] but is correlated with eTrust [55]. The usefulness of FDApps and the desire to use them are influenced by the features they offer [53]. Specifically, individuals are inclined to choose a more trustworthy and reliable platform for conducting transactions [55,56]. In online purchasing contexts, the quality of information serves as a signal about the products and services, enabling customers to make well-informed decisions regarding product attributes [57]. Consumers perceive website content that is easily readable and comprehensible, with a layout that facilitates transactions, as reflecting high-quality information [58]. Therefore, we hypothesize as follows:

Hypothesis 5. *H5—eTrust mediates the relationship between ULY and eLoyal*

2.6. The Mediation Effect of eTrust between eInnov and eLoyal

Existing research suggests that eTrust mediates the relationship between eInnov and eLoyal. This mechanism is driven by new demographic cohorts that are increasingly attracted to and inclined to adopt new technological platforms [59]. The perceived level of eInnov, which encompasses factors such as technology readiness and task–technology fit [60], influences the likelihood of the adoption of FDApps. Moreover, eTrust, influenced by external factors like social influence, subsequently impacts customer behavior [61,62]. Customers may hesitate to engage with e-commerce due to insufficient trust in the technology, potentially hindering the progress of technological advancements and infrastructure expansion in e-commerce [63]. eInnov may positively affect eTrust, while online consumer feedback and firm-generated information contribute to increasing usage intentions of FDApps [64,65]. Consequently, we hypothesize as follows

Hypothesis 6. *H6—eTrust mediates the relationship between eInnov and eLoyal*

2.7. The Moderation Effect of RTN between eTrust and eLoyal

Trust in e-commerce is positively associated with the perceived organizational RTN [37,66]. Empirical research has shown that RTN significantly impacts eLoyal, thereby enhancing the intention to use FDApps [60,67]. Specifically, RTN built on effective service quality, such as efficient registration processes and reliable payment systems, promotes an increased level of confidence in FDApps [68], thereby driving eLoyal [69]. Moreover, case evidence from the Asian region confirms that perceived RTN significantly influences buying intention, especially in situations of high perceived risk in online purchasing, where customers rely on seller reputation as a guide for their purchase intentions [42]. Additionally, some authors advocate that the RTN of the physical product (i.e., food quality) [70] and the overall application service experience enhance customer eTrust and subsequent eLoyal [71]. On this basis, we hypothesize as follows:

Hypothesis 7. *H7—RTN moderates the relationship of eTrust with eLoyal.*

Figure 1 illustrates the conceptual model developed in the hypothesis development section. The figure conceptualizes the direct effect of eTrust on eLoyal (Hypothesis 1), as well as the mediating role of eTrust concerning ePriv (Hypothesis 2), eSec (Hypothesis 3), ePay (Hypothesis 4), ULY (Hypothesis 5), and eInnov (Hypothesis 6). Finally, it illustrates the moderating role of reputation (Hypothesis 7).

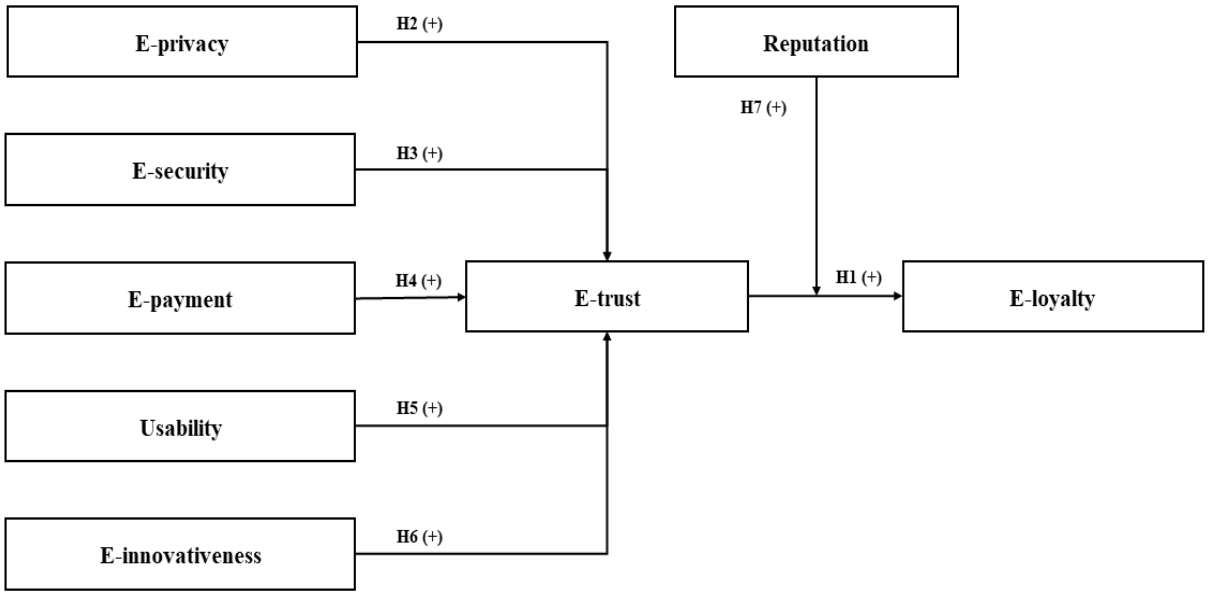

Figure 1. Conceptual model.

3. Data and Methods

3.1. Context and Sample

Since the COVID-19 pandemic, consumers have shown a change in preference for FDApps, encouraging restaurants to offer online delivery services as an organizational survival strategy. FDApps represent a market that prioritizes consumer needs, striving to provide people with their desired meals at affordable prices and with the utmost convenience, all without the need to leave their homes [72]. A self-administered online questionnaire was distributed to FDApp' users during the first quarter of 2023. Employing a convenience sampling technique is more economical and practical compared to other sampling techniques as it involves selecting individuals who are frequently and easily accessible [73]. We gathered responses from 501 FDApps located in the Federal Capital Territory (FCT) Islamabad, Pakistan. The data collection protocol underwent validation and approval by the Ethical Committee of the corresponding author.

Table 1 illustrates the demographic characteristics of the sample. The final sample (N) exhibited a gender-balanced perspective, with 55.9% female participants (N = 280) and 44.1% male participants (N = 221). In terms of age distribution, the largest proportions of participants were found within the age cohorts of 18–25 years (29.7%, N = 149), 26–35 years (24.6%, N = 123), and 36–45 years (22.6%, N = 113). Moreover, a considerable portion of the sample had achieved tertiary education, including undergraduate, graduate, or postgraduate studies (67.6%, N = 442). Lastly, most individuals in the sample reported low-income levels, with 39.1% (N = 196) earning less than PKR 60,000, while 34.5% (N = 173) reported high-income levels, earning more than PKR 300,000.

Table 1. Demographic characteristics.

Characteristics	Sample	Percentage
Gender		
Female	280	55.9
Male	221	44.1
Age Group		
Less than 18	43	8.6
18–25 years	149	29.7
26–35 years	123	24.6
36–45 years	113	22.6
More than 45 years	73	14.5

Table 1. *Cont.*

Characteristics	Sample	Percentage
Qualification		
Primary/Middle/High school	59	11.8
College/Diploma/Technical	103	20.6
Undergraduate	199	39.7
Graduate/Postgraduate	140	27.9
Monthly Income		
Less than (USD 210) PKR 60,000.	196	39.1
(USD 210) PKR 60,000 to (USD 305) 100,000.	107	21.4
(USD 305) PKR 100,000 to (USD 1000) 300,000.	25	5.0
More than (USD 1000) PKR 300,000.	173	34.5

3.2. Scales and Measurements

We employed validated scales and indicators from the literature to capture each of the constructs [74–83]. ePriv consisted of four items [80] including ePriv1 ("I think this website shows concern for the privacy of its users"), ePriv2 ("I feel safe when I send personal information to this website"), ePriv3 ("I think this website abides by personal data protection laws"), and ePriv4 ("I think that this website will not provide my personal information to other companies without my consent").

eSec comprised four items [80] including eSec1 ("I think this website has mechanisms to ensure the safe transmission of its users' information and it will not be intercepted by hackers"), eSec2 ("I think this website shows great concern for the security of any transaction"), eSec3 ("I think this website has the sufficient technical capacity to ensure that no other organization will supplant its identity on the internet"), and eSec4 ("When I send data to this website, I am sure that they will not be intercepted by unauthorized third parties").

ePay contained three items [84] including ePay1 ("E-payment system is much more efficient than traditional payment channels"), ePay2 ("I will choose the trusted e-payment to make the transaction"), and ePay3 ("I feel that a user-friendly e-payment will influence me to adopt the system").

eInnov included three items [84] including eInnov1 ("If I hear of newly available technology, I try to find a way to try it), eInnov2 ("Among my peers, I am usually the first one to explore new information technologies"), and eInnov3 ("I like to experience new information technologies").

eTrust encompassed four items [84] including eTrust1 ("In general, I believe online shopping is a secure activity), eTrust2 ("In general, e-commerce sites are trustworthy), eTrust3 ("In general, e-commerce companies give the impression that they will keep commitments"), and eTrust4 ("How would you rate your overall trust level in e-commerce").

ULY considered seven items [84] including ULY1 ("On this website, everything is easy to understand"), ULY2 ("This website is simple to use, even when using it for the first time"), ULY3 ("It is easy to find the information I need on this website"), ULY4 ("The structure and contents of this website are easy to understand"), ULY5 ("It is easy to move within this website"), ULY6 ("The organization of the contents of this site makes it easy for me to know where I am when navigating it"), and ULY7 ("When I am navigating this site, I feel that I am in control of what I can").

RTN comprised three items [76] including RTN1 ("This store is well known"), RTN2 ("This store has a bad reputation in the market"), and RTN3 ("This store has a good reputation").

Finally, eLoyal included four items [83] including eLoyal1 ("I seldom consider switching to another website and I like using this website"), eLoyal2 ("As long as the present service continues, I doubt that I would switch websites"), eLoyal3 ("I try to use the website whenever I need to make a purchase"), and eLoyal4 ("When I need to make a purchase, this website is my first choice").

The final questionnaire involved some basic demographic questions, including gender, education level, age group, and monthly income range. Participants were then presented with the constructs by using a strongly disagree–strongly agree 7-point Likert scale. The Supplementary Material presents a copy of the instrument.

3.3. Methods

Partial least squares path modeling (PLS-PM) estimation was utilized due to its empirical robustness compared to covariance-based approaches (covariance-based structural equation modeling, CB-SEM) and its statistical advantages, such as non-distributional assumptions [85–87]. To validate the distributional assumptions, we ran a Shapiro–Wilk test (W) [88] on the average indicators of our latent variables. The Shapiro–Wilk test results are as follows: $W_{eInnov} = 0.97$ ($p = 0.00$); $W_{eLoyal} = 0.92$ ($p = 0.00$); $W_{ePay} = 0.98$ ($p = 0.00$); $W_{ePriv} = 0.96$ ($p = 0.00$); $W_{eSec} = 0.97$ ($p = 0.00$); $W_{ULY} = 0.97$ ($p = 0.00$); $W_{eTrust} = 0.95$ ($p = 0.00$); $W_{RTN} = 0.99$ ($p = 0.04$). Based on the test results, we reject the null hypothesis for all latent variables, indicating evidence of their non-normal distribution. Additionally, we have included a Supplementary Material that illustrates the distribution of each variable (Figures S1–S8). Visually, these results provide further evidence of the non-normal distribution of the variables.

PLS-PM is a useful approach for simultaneously modeling the causal paths described in the conceptual model (outer model) while accounting for the measurement model for each construct (inner model) [87]. Previous methodological research suggests that under normal conditions (e.g., sample sizes lower than 10,000 observations and models with a low number of indicators with high loadings), PLS-PM and CB-SEM parameters do not significantly differ from their theoretical values [89]. The method was estimated by employing the Smart-PLS 4.0 software.

4. Results

4.1. Convergent Validity

Initially, we verified the validity and reliability of the scales by conducting a confirmatory factor analysis (CFA). Convergent validity was evaluated by ensuring that individual item loadings and the scale average variance extracted surpassed conventional thresholds. Additionally, we observe that composite reliability, Cronbach's alpha values, and construct reliability surpassed conventional thresholds, suggesting satisfactory convergent validity [85]. All factor loadings in our analysis were greater than or equal to 0.70, except for ULY5 and ULY7. Consequently, these two items were excluded from further analysis. Detailed information regarding the inner model is presented in Table 2.

Table 2. Measurement model (estimates).

Constructs	Items	Loadings	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
ePriv	ePriv1	0.788	0.759	0.845	0.576
	ePriv2	0.729			
	ePriv3	0.778			
	ePriv4	0.744			
eSec	eSec1	0.802	0.800	0.869	0.625
	eSec2	0.781			
	eSec3	0.806			
	eSec4	0.771			
ePay	ePay1	0.843	0.801	0.883	0.716
	ePay2	0.819			
	ePay3	0.876			

Table 2. *Cont.*

Constructs	Items	Loadings	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
ULY	ULY1	0.773	0.840	0.886	0.608
	ULY2	0.741			
	ULY3	0.819			
	ULY4	0.762			
	ULY6	0.803			
eInnov	eInnov1	0.822	0.784	0.874	0.698
	eInnov2	0.870			
	eInnov3	0.814			
eTrust	eTrust1	0.831	0.852	0.900	0.693
	eTrust2	0.776			
	eTrust3	0.880			
	eTrust4	0.840			
eLoyal	eLoyal1	0.837	0.827	0.885	0.659
	eLoyal2	0.778			
	eLoyal3	0.846			
	eLoyal4	0.783			
RTN	RTN1	0.872	0.759	0.862	0.677
	RTN2	0.738			
	RTN3	0.852			

Note: ePriv = electronic privacy, eSec = electronic security, ePay = electronic payment, ULY = usability, eInnov = electronic innovativeness, eTrust = electronic trust, eLoyal = electronic loyalty, RTN = reputation.

4.2. Discriminant Validity

Secondly, we explore whether each variable was independent of the others by using a discriminant validity assessment. Table 3 shows the Fornell and Larcker criterion [90] of these scales. Particularly, we observe that all diagonal values are higher than the non-diagonal values, so discriminant validity is supported.

Table 3. Fornell and Lacker's criterion.

Constructs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) eInnnov	0.836							
(2) eLoyal	0.505	0.811						
(3) ePay	0.456	0.643	0.846					
(4) ePriv	0.379	0.394	0.414	0.759				
(5) eSec	0.396	0.318	0.382	0.449	0.790			
(6) eTrust	0.683	0.698	0.614	0.577	0.535	0.833		
(7) RTN	0.138	0.222	0.124	0.077	−0.060	0.078	0.823	
(8) ULY	0.476	0.474	0.506	0.557	0.467	0.643	0.027	0.780

Note: ePriv = electronic privacy, eSec = electronic security, ePay = electronic payment, ULY = usability, eInnov = electronic innovativeness, eTrust = electronic trust, eLoyal = electronic loyalty, RTN = reputation.

Moreover, we performed a discriminant assessment based on the Heterotrait–Monotrait (HTMT) ratio. Table 4 presents the ratios obtained for each pairwise latent variable. Following conventional thresholds about this discriminant measure, we do not observe that any surpasses the 0.85 value. Therefore, we confirm the validity of the model.

Table 4. HTMT ratio.

Constructs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) eInnnov								
(2) eLoyal	0.622							
(3) ePay	0.578	0.784						
(4) ePriv	0.475	0.482	0.521					
(5) eSec	0.500	0.384	0.473	0.572				
(6) eTrust	0.833	0.827	0.740	0.696	0.641			
(7) RTN	0.187	0.276	0.158	0.108	0.076	0.097		
(8) ULY	0.571	0.551	0.606	0.687	0.566	0.742	0.057	

Note: ePriv = electronic privacy, eSec = electronic security, ePay = electronic payment, ULY = usability, eInnov = electronic innovativeness, eTrust = electronic trust, eLoyal = electronic loyalty, RTN = reputation.

4.3. Bivariate Analysis

Table 5 displays the Pearson correlation coefficient (PCC) between the variables. There is a positive and statistically significant correlation between consumers' ePriv concerning FDApps with eTrust (PCC = 0.553) and eLoyal (PCC = 0.378). Similarly, eSec exhibits a positive and statistically significant correlation with both eTrust (PCC = 0.531) and eLoyal (PCC = 0.311). Likewise, ePay demonstrates a positive and statistically significant correlation with both eTrust (PCC = 0.613) and eLoyal (PCC = 0.638). Usability shows a positive correlation with both consumers' eTrust (PCC = 0.624) and eLoyal (PCC = 0.454). Finally, eInnov indicates a positive correlation with both eTrust (PCC = 0.682) and eLoyal (PCC = 0.502).

Table 5. Pairwise correlation.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) ePriv	1.000							
(2) eSec	0.436 **	1.000						
(3) ePay	0.404 **	0.380 **	1.000					
(4) ULY	0.546 **	0.463 **	0.493 **	1.000				
(5) eInnov	0.364 **	0.395 **	0.456 **	0.460 **	1.000			
(6) eTrust	0.553 **	0.531 **	0.613 **	0.624 **	0.682 **	1.000		
(7) eLoyal	0.378 **	0.311 **	0.638 **	0.454 **	0.502 **	0.694 **	1.000	
(8) RTN	0.072	−0.059	0.123 **	0.024	0.139 **	0.078	0.219 **	1.000

Note: ePriv = electronic privacy, eSec = electronic security, ePay = electronic payment, ULY = usability, eInnov = electronic innovativeness, eTrust = electronic trust, eLoyal = electronic loyalty, RTN = reputation. Correlation is significant at the 0.01 level (**) (2-tailed).

4.4. Structural Model and Path Coefficients

We evaluated the conceptual model by considering the outer model [85]. The algorithmic analysis is depicted in Figure 2, which also includes the item loadings and the R square. Subsequently, we explored testing each path using a bootstrapping technique with 5000 samplings. Figure 3 displays the bootstrapping results and the *p*-values of each parameter. This assessment provides support on the level of significance of each construct in the model.

Table 6 summarizes the significance level, t-values, and standardized parameters for the path coefficients. According to the UTAUT model, trust is crucial in influencing customer satisfaction with FDApps [91]. The results support Hypothesis 1 as we observed a positive effect of eTrust on eLoyal ($\beta = 0.651$, $p < 0.001$). Similarly, the results support Hypothesis 2 as ePriv influences eLoyal via eTrust ($\beta = 0.115$, $p < 0.001$).

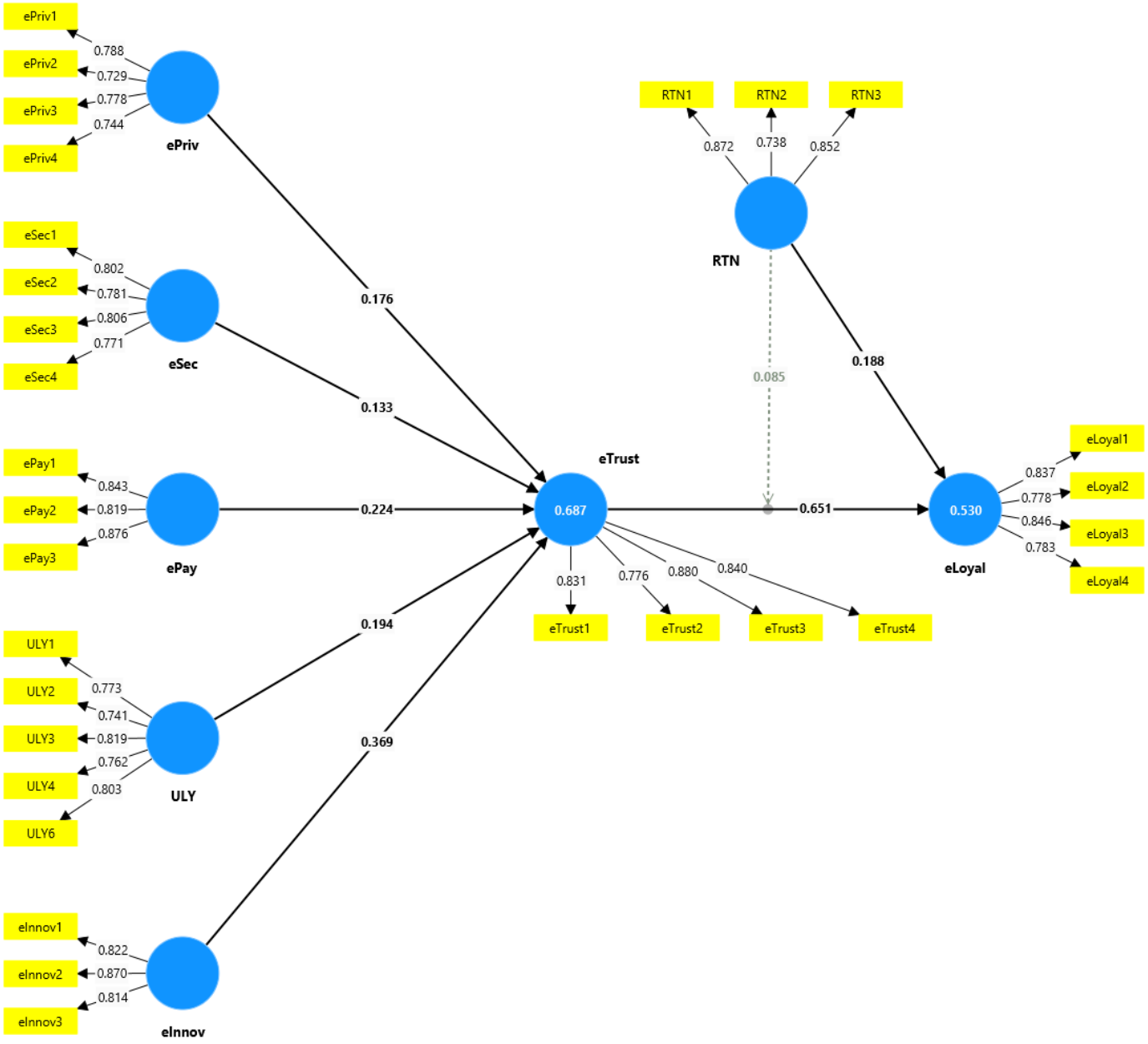

Figure 2. Structural model (algorithmic analysis). ePriv = electronic privacy, eSec = electronic security, ePay = electronic payment, ULY = usability, eInnov = electronic innovativeness, eTrust = electronic trust, eLoyal = electronic loyalty, RTN = reputation.

Moreover, the model supports Hypothesis 3 as eSec has a positive effect on eLoyal through eTrust (β = 0.087, $p < 0.001$). Additionally, we found evidence of the effect of ePay on eLoyal (β = 0.146, $p < 0.001$) via eTrust, which supports Hypothesis 4. Similarly, the model supports Hypothesis 5 as ULY demonstrated a positive effect on eLoyal (β = 0.126, $p < 0.001$) through eTrust. Likewise, the model supports Hypothesis 6 as eTrust acts as a mediator between eInnov and eLoyal (β = 0.24, $p < 0.001$). Finally, we found support for Hypothesis 7 as RTN acts as a moderator on the relationship between eTrust and eLoyal (β = 0.085, $p < 0.01$).

Subsequently, we plotted the moderation effect of RTN on the relation between eTrust and eLoyal considering both one minus and plus standard deviation (SD). The analysis is illustrated in Figure 4. It suggests that RPT serves as a positive moderator, enhancing the association between eTrust and eLoyal.

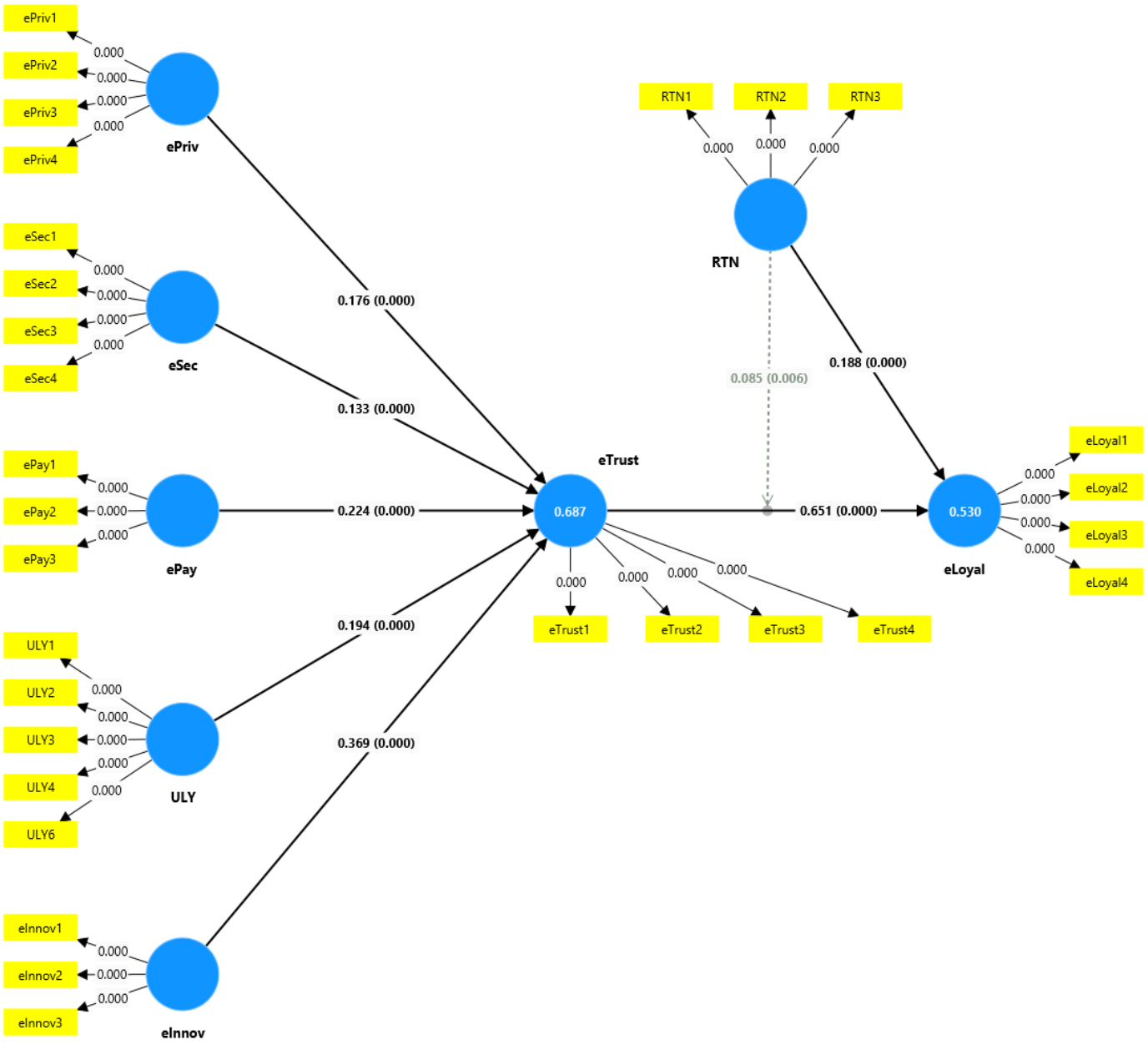

Figure 3. Structural model (bootstrapping). ePriv = electronic privacy, eSec = electronic security, ePay = electronic payment, ULY = usability, eInnov = electronic innovativeness, eTrust = electronic trust, eLoyal = electronic loyalty, RTN = reputation.

Table 6. Hypotheses testing.

Hypothesis	Relationship	OS	SM	SD	*p* Values
H1	eTrust → eLoyal	0.651	0.646	0.035	0.000
H2	ePriv → eTrust → eLoyal	0.115	0.115	0.027	0.000
H3	eSec → eTrust → eLoyal	0.087	0.086	0.019	0.000
H4	ePay → eTrust → eLoyal	0.146	0.144	0.024	0.000
H5	ULY → eTrust → eLoyal	0.126	0.125	0.024	0.000
H6	eInnov → eTrust → eLoyal	0.240	0.238	0.024	0.000
H7	RTN x eTrust → eLoyal	0.085	0.083	0.031	0.005

Note: OS = original sample, SM = sample mean, SD = standard deviation, ePriv = electronic privacy, eSec = electronic security, ePay = electronic payment, ULY = usability, eInnov = electronic innovativeness, eTrust = electronic trust, eLoyal = electronic loyalty, RTN = reputation.

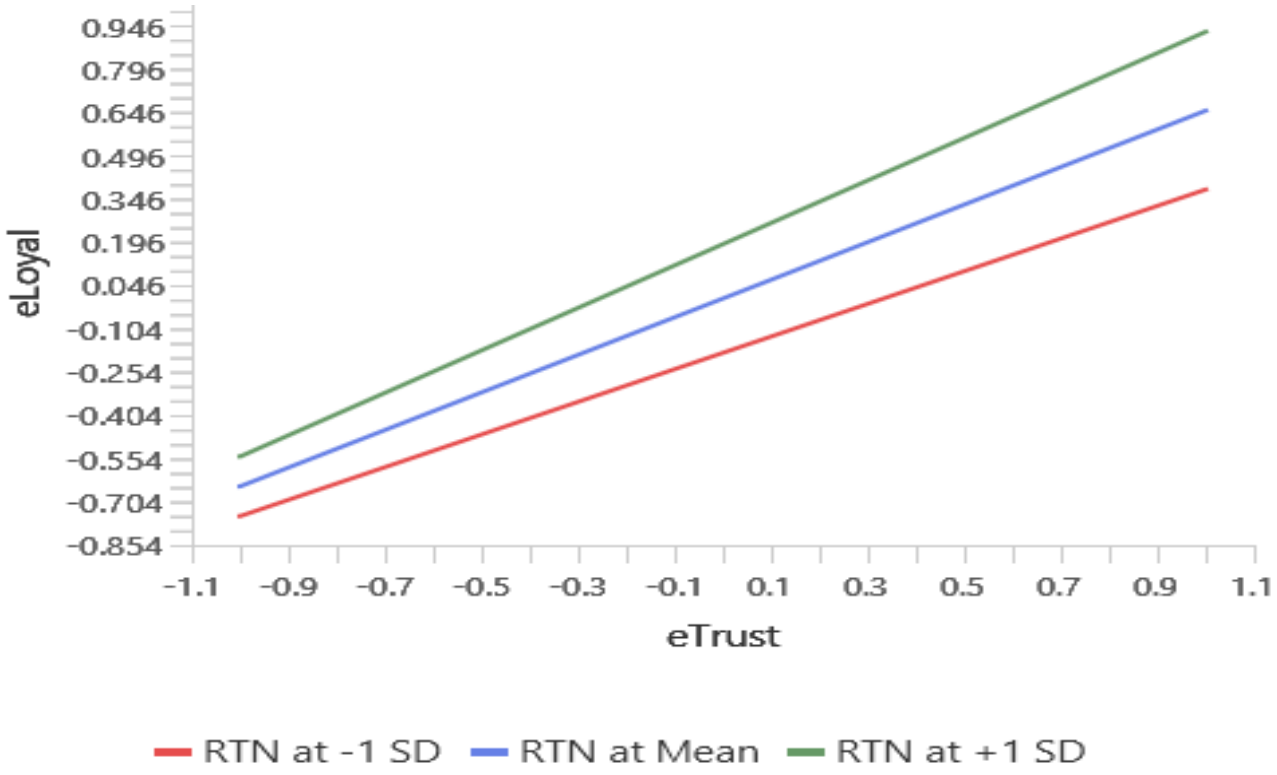

Figure 4. Moderation analysis RTN x eTrust. Note: eTrust = electronic trust, eLoyal = electronic loyalty, RTN = reputation.

5. Discussions

External shocks, such as the COVID-19 pandemic, have disrupted food manufacturing systems, including household food management, which serves as the final link in food supply networks [92]. This research aimed to explore how FDApps' attributes influence customer loyalty. Our first hypothesis revealed a significant impact of eTrust on eLoyal. Customers' perception of trust in an online store fosters a sense of comfort and confidence in using mobile apps, ultimately resulting in satisfaction with their purchases [93]. Consequently, online food suppliers recognize the importance of implementing customer loyalty programs, which hinge on establishing initial trust and familiarity with the platform [35].

Effective management of information and knowledge strategically drives organizational, financial, technological, and innovative advantages, thereby enhancing productivity and value creation [94]. The second hypothesis confirmed that ePriv influences eLoyal via eTrust, so eTrust significantly mediates the relationship between ePriv and eLoyal, which somehow aligns with the results of [74,95]. Organizations must continuously innovate and leverage their knowledge and capabilities to bolster their competitive edge, integrating advancements in technology, information, and competitiveness into their strategies [96]. The results of the third hypothesis indicate that eSec influences eLoyal through eTrust; therefore, eTrust significantly intervenes in the association of eSec and eLoyal. Previously, it was revealed that eTrust significantly impacts eLoyal via eSec [95,97]. This suggests a similarity between FDApps and those in other online/offline businesses, highlighting the comparability of consumer behaviors in Pakistan with that of the international market.

Furthermore, the fourth and fifth hypotheses indicate that ePay and ULY indirectly impact eLoyal through eTrust, suggesting that a positive user experience contributes to loyalty by fostering trust. Specifically, the study highlights the connection between usability, eTrust, and eLoyal as the primary mechanism for building loyalty, consistent with prior research [66,98]. Additionally, the sixth hypothesis revealed that eInnov indirectly influences eLoyal through eTrust, as FDApps rely on innovative applications for ordering,

payment, and monitoring, as noted by [48]. Finally, the research reveals the effect of RPT on purchasing behavior through FDApps from the perspective of eTrust and eLoyal.

Finally, the seventh hypothesis reveals the effect of RPT on purchasing behavior through FDApps from the perspective of eTrust and eLoyal. Within the FDApps industry, such organizations should consider the characteristics of their website and their reputation in the market. A strong reputation signals trustworthiness and outstanding capabilities, while flexibility to customize demonstrates customer focus [37]. Overall, consumer purchasing behaviors toward FDApps are influenced by increased reputation, which enhances the relationship between eTrust and eLoyal, ultimately leading to repurchase intent through the same application.

5.1. Theoretical Implications

Initially, this research deepens the theoretical understanding of technology adoption by developing a framework to explain eLoyal in applications. Additionally, it contributes to the UTAUT literature by clarifying antecedents that impact the consumers' intentions to those applications. Furthermore, the research contributes to the expanding research of risk analysis in e-commerce attributes, particularly exploring the interactive impact of RPT on eTrust and eLoyal.

Secondly, recent research highlights the importance of usability in addressing customer apprehension towards mobile applications and mitigating potential perceived risks to customers. Service providers should continuously emphasize the benefits and user-friendliness of their products to attract more users to mobile applications. Despite the widespread use of mobile phones and increasing tech adoption, individuals tend to experience heightened anxiety when adopting new applications compared to simply making purchases [26]. Our findings align with previous research. For example, ref. [24] underscored the crucial significance of application quality in technology adoption. Likewise, ref. [25] explored food applications and determined that TAM constructs are predominantly impacted elements related to quality and type of information. Moreover, in line with previous research on FDApps [10], our article highlights the role of satisfaction as a principal determinant of application usage. While our study utilized the UTAUT model, there remains a need for systematic investigation and theoretical exploration of essential factors concerning consumer technology utilization in several specific business contexts [23].

Thirdly, we contribute to the literature regarding technological adoption by examining constructs that influence customers' attitudes and behavioral intentions toward FDApps. Specifically, our conceptual model enriches the UTAUT framework by integrating elements that influence consumers' intentions to use mobile applications. These factors include eSec, ePriv, ePay, eInnov, and usability, which collectively contribute to the development of eTrust and eLoyal among consumers for making purchasing decisions through FDApps and increasing the likelihood of repeat purchases. Our findings indicate a significant association between consumer information sharing and the innovation of new services. Additionally, consumers engage in information sharing, which is utilized by organizations to benefit new service development. In conclusion, consumers' post-service information and contact behaviors offer positive support for new service development. However, contrary to previous research findings [56], consumers' pre-service information showed no association in this study.

5.2. Practical Implications

Initially, we provide valuable insight to FDApps' executives in assessing determinants of eLoyal, as much of the prior research has primarily concentrated on purchasing behaviors or purchase intent alone. Moreover, it provides marketing professionals with a framework to comprehend the impact of e-commerce attributes, such as ePriv, eSec, usability, time-saving features, and eInnov, on consumers' perceptions of eTrust and eLoyal through online platforms. Additionally, fostering a one-time purchase motivation is not sufficient; rather, maintaining consumers' loyalty to regularly purchase a specific product is crucial. As many

marketing professionals rely on electronic word-of-mouth content [32], they could also strategize toward enhancing the quality, reliability, and usefulness of information with the aim of bolstering consumer loyalty.

Furthermore, this study proposes various implications for the service industry. For instance, customer feedback serves as a crucial indicator when organizations intend to engage in product or service innovation. Leveraging customer experiences facilitates the creation of products or services that align closely with consumer preferences. Therefore, encouraging consumer learning behaviors can enhance organizational knowledge and facilitate value creation [56]. Therefore, organizations should continuously update the attributes of the platforms to increase loyalty in their customer base.

Lastly, social media exerts a significant influence on consumer intentions, which are often shaped by cultural and societal factors. Marketing professionals typically place high importance on social media elements such as brand consciousness and brand awareness. Similarly, consumers make choices regarding OFDS based on these social factors. Therefore, organizations should bolster their social media presence by ensuring the authenticity of their application attributes. The digital transformation and technological innovation undertaken by companies provides opportunities to enhance analytical resources for information management and decision-making.

5.3. Limitations and Future Research

This research is restricted to consumers of FDApps in FCT Islamabad, Pakistan, thus restricting the generalizability of the findings to FDApps operating in similar economic and institutional contexts. Moreover, user perception in relation to security is neither excessively complex nor less secure in terms of usability; the need to keep up with an evolving market through constant innovation is hardly affordably for smaller rivals. Finally, there is a restriction in the challenge of attaining a balance between all the discussed variables, without favoring, for instance, usability against security or privacy against usability. Future research endeavors could extend our conceptual framework to diverse world regions (e.g., European countries such as Austria, Germany, France, Poland or Spain) to compare our findings across different socio-economic backgrounds. Moreover, there is an opportunity for further investigation into the role of additional factors such as information quality, familiarity, timesaving, and perceived risk in elucidating the determinants of purchases in several e-commerce business models. Additionally, as previous research suggests [54], the ease of use of applications strongly shapes their utility of the interaction and influences customers' intentions to use them. Future research could explore consumer perceptions of individual and bundled attributes and how FDApps position themselves to capture a larger market share. Moreover, researchers should focus on eTrust and eLoyal in cultural and regional aspects influencing consumption behavior as well as the influence of FDApp users' reviews and marketing recommendations on eTrust and eLoyal.

6. Conclusions

This research aimed to investigate the attributes of e-commerce, namely electronic ePriv, eSec, ePay, usability, and eInnov, in the context of eTrust and eLoyal within FDApps. The results indicate that eTrust significantly influences eLoyal, and reputation strengthens this association, thereby influencing consumers' intention to purchase food through FDApps. Moreover, eTrust mediates the relationship between ePriv, eSec, ePay, usability, and eInnov with eLoyal. Enhancing reputation to foster eLoyal and trust in the app's attributes for purchasing and repurchasing decisions can bolster the strengthening of food delivery services. Additionally, credibility, quality, and expected utility are critical factors influencing customer loyalty within the FDApps context.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su16177365/s1, Figure S1: eInnov Latent Variable Distribution, Figure S2: eLoyal Latent Variable Distribution, Figure S3: ePay Latent Variable Distribution, Figure S4: ePriv Latent Variable Distribution, Figure S5: eSec Latent Variable Distribution, Figure S6: eTrust Latent Variable Distribution, Figure S7: ULY Latent Variable Distribution, Figure S8: RTN Latent Variable Distribution, and Questionnaire

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The datasets presented in this article are not directly available because of ethical compliance. Requests to access the datasets should be directed to the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

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