

METACOGNITION AND CONSUMER DECISION-MAKING IN AI-DRIVEN FINTECH MARKETS: A STUDY OF THE PAKISTANI MARKET

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Abstract

The study focuses on exploring the connection between metacognitive awareness and consumer decision making in AI-based online markets in the Pakistani setting. Since more and more online consumer experiences are intermediated by artificial intelligence in the form of personalized recommendations, chatbots, predictive algorithms, it is necessary to understand how consumers consciously manage their cognitive processes in order to contribute to theoretical development and actual practice. Using a sample of 200 Pakistani urban digital consumers, this paper uses a quantitative research design to examine how metacognitive knowledge, metacognitive regulation, and metacognitive experiences influence the quality of decisions in AI-mediated settings. The results indicate that metacognitive awareness is a strong predictor of the quality of decision-making, and metacognitive regulation is the most powerful predictor. Nonetheless, the effect of AI personalization is rather complex: on the one hand, it enhances the efficiency of the decisions taken, whereas on the other hand, it can decrease the engagement of consumers in metacognitive monitoring. The paper recognizes an imperative conflict between the convenience of AI and the sustainability of autonomous consumer agency. The implications of this finding on Fintech marketers, the designers of AI systems, and consumer protection policymakers in emerging markets are significant.

1. INTRODUCTION

The advent of artificial intelligence in online markets has completely changed the way customers find, review, and buy goods and services (McKinsey Global Institute, 2023). Consumer decisions are now influenced by AI-driven recommendation systems, chatbots, personalized advertising, and prediction algorithms, which were inconceivable ten years ago (Davenport et al., 2020). The fast digitalization process of retailing and commerce areas in Pakistan, e-commerce websites such as Daraz and Foodpanda, as well as AI-based fintech solutions, has resulted in a new consumer experience where human reasoning and

machine cleverness more and more converge and interact (Gomber et al., 2017).

This change begs a key question: How can consumers keep a conscious and reflective control over their decision making in a world where they are surrounded by AI systems that are meant to affect their choices? The solution is found in part in the metacognition, or the ability to observe, manage and regulate one's own mechanism of thought. Metacognition involves what people are aware of their own thinking (metacognitive knowledge), how they manage their mental events (metacognitive regulation) and the subjective

emotions in connection with cognitive processes (metacognitive experiences).

Conventional models of consumer behavior, such as the AIDMA (Attention-Interest-Desire-Memory-Action), AISAS (Attention-Interest-Search-Action-Share), and SIPS (Sympathy-Interest-Persuasion-Share) models were created in media contexts where the flow of information was more or less linear and consumer agency was not a major issue (Sawut, 2021). Nonetheless, in the modern AI-driven markets, algorithms do not merely provide information, but they also fundamentally influence the form of choice, making these conventional models more insufficient and outdated (Kaplan & Haenlein, 2020).

The Pakistani market is especially a significant setting in the study of these dynamics. Pakistan being a fast-growing economy with a young digitally-conscious population has experienced a phenomenal growth in digital commerce. In a study of users of Foodpanda in Pakistan, positive relationships were significantly established between AI integration, consumer purchasing behavior, and the effectiveness of digital marketing. Likewise, a study of AI-based personalization in the Pakistani small fashion e-commerce market has found that the personalized recommendation has a strong effect on the purchase intention, especially in situations where the recommendations are culturally and religiously oriented (Moodley & Sookhdeo, 2025). These results indicate that Pakistani consumers are actively involved in AI-mediated digital spaces, which means that the country is a perfect place to explore metacognitive processes in AI-influenced decision-making.

This research will answer three research questions:

1. What is the metacognitive awareness of Pakistani online consumers?
2. What is the impact of metacognitive awareness on the quality of decision-making on AI-driven Fintech markets?
3. What is the modulation of the relationship between metacognition and decision-making outcomes by AI personalization?

This study brings novel knowledge to the developing body of consumer metacognition research in AI settings and offers valuable advice

to marketers, platform designers, and policymakers in new markets by combining the understanding of cognitive psychology, consumer behavior, and human-computer interaction.

2. Literature Review

2.1 Metacognition: Theoretical Foundations

Metacognition is a term coined by Flavell in 1970s as cognition about cognition or capability to think about thought processes. Modern metacognitive theory identifies three connected elements which are metacognitive knowledge, metacognitive regulation and metacognitive experiences (Tankelevitch et al., 2023). Metacognitive knowledge is the knowledge that people hold regarding their cognitive skills, the task requirements, and effective thinking strategies (Riandhi et al., 2025). In consumer situations, this involves consciousness of individual vulnerability to persuasive appeals, awareness of decision-making heuristics as well as awareness of the role of emotion in decision making (Khan et al., 2025). Metacognitive regulation is the active regulation of the cognitive processes by planning, monitoring and evaluation. Consumers are practicing metacognitive regulation when they establish goals that guide their shopping behavior, monitor their progress by performing decision tasks and evaluations of the quality of their decisions (Farooq & Yuen, 2024). Metacognition experiences are the subjective experience and judgments that accompany cognitive processes- the sense of familiarity, the experience of knowing, the experience of ease or difficulty in processing information (Mumtaz et al., 2025). These experiences are valuable indicators that direct the following behavior cognitions.

Metacognitive processing affects consumer processing of information, alternative evaluation, and final decision-making in retail setting. Studies in retail settings with augmented reality evidence that consumers mentally simulate the result before decision making, and the fluency of those simulations influences successive decisions made by consumers (Sajid Hussain, 2025). Consumers will participate in the decision task more when they think that the decision is easy and fluent, and

when they experience difficulty, they can either inhibit effortful processing or give up completely.

2.2 Decision-Making by consumers in AI-driven settings

The introduction of AI-based digital markets has radically changed the landscape of consumer decision-making. The conventional models of rational and linear processing have been replaced by the recognition of complex, non-linear and algorithmically-based choice architectures.

The AI systems affect the consumer behavior in several ways:

Personalization: Machine learning capabilities are used to analyze the data of consumers, purchase history, browsing history, demographic data, and even sentiments in the reviews to come up with a specific product proposal. A study of Pakistani market supports the claims, showing that AI personalization is a considerable improvement of the purchase intention, and the accuracy of the prediction proved to be the most powerful predictor of customer reaction. (Naz & Kashif, 2025).

Immediate response: Chatbots and virtual assistants can respond to consumer requests in real-time, which not only saves on search expenses, but also allows companies to make decisions even faster (DeZao, 2024). Real time interaction has been demonstrated to have a positive effect on the purchase intention especially when used with personalized recommendations.

Predictive analytics: AI systems anticipate consumer needs and preferences prior to the consumer stating them, and offer choices that would meet those anticipated preferences. An examination of retail consumers in Karachi established that online purchases are greatly affected by predictive analysis.

Choice architecture: Algorithms organize the display of alternatives and how buyers view them, the way alternative products are compared and the information emphasized (Riandhi et al., 2025).

Such AI interventions form what scholars refer to as algorithmic choice environments, i.e., environments in which consumer decisions are conditioned not only by their personal preferences but also by the black box computations of recommendation systems (Khan et al., 2025).

Within these conditions consumers might not be able to retain independent decision-making, and as a result they might end up following algorithmic recommendations without conscious consideration.

2.3 The use of Metacognition in AI-Mediated Decisions

The convergence of metacognition and decision-making by AI has both opportunities and challenges. On the one hand, the AI systems may facilitate the metacognitive processes by decreasing cognitive load, presenting the information that is relevant to the decision and offering the structured comparisons that make the evaluation easier. Conversely, smooth AI support can cause metacognitive atrophy the progressive loss of consumer capability to check and control their thinking in reaction to growing reliance on algorithmic advice (Sajid Hussain & Farea, 2025). Human-computer interaction studies indicate that metacognitive monitoring is critical to proper dependence on automated systems. When consumers are conscious of their knowledge boundaries and are willing to analyze AI suggestions, they will be in a better place to recognize these mistakes, avoid being swayed by manipulative advertising, and make decisions that are consistent with the real preferences. On the other hand, consumers preoccupied with algorithmic recommendations without metacognitive use might have less satisfaction with their decisions and higher post-purchase regret (Sajid Hussain & Farea, 2022).

Research in the Pakistani FMCG industry revealed that AI designs have an impact on consumer perception which consequently influences purchasing behavior. A closely related concept metacognitive knowledge was observed to mediate the correlation between consumer perception and purchase decision-making, with consumer literacy serving as a moderator to indicate that more knowledge consumers are in a better position to interpret AI-mediated information (Naz & Kashif, 2025).

2.4 Cultural and Contextual considerations

The Pakistani market has its own peculiarities and can soften the correlation between metacognition and decision-making mediated by AI:

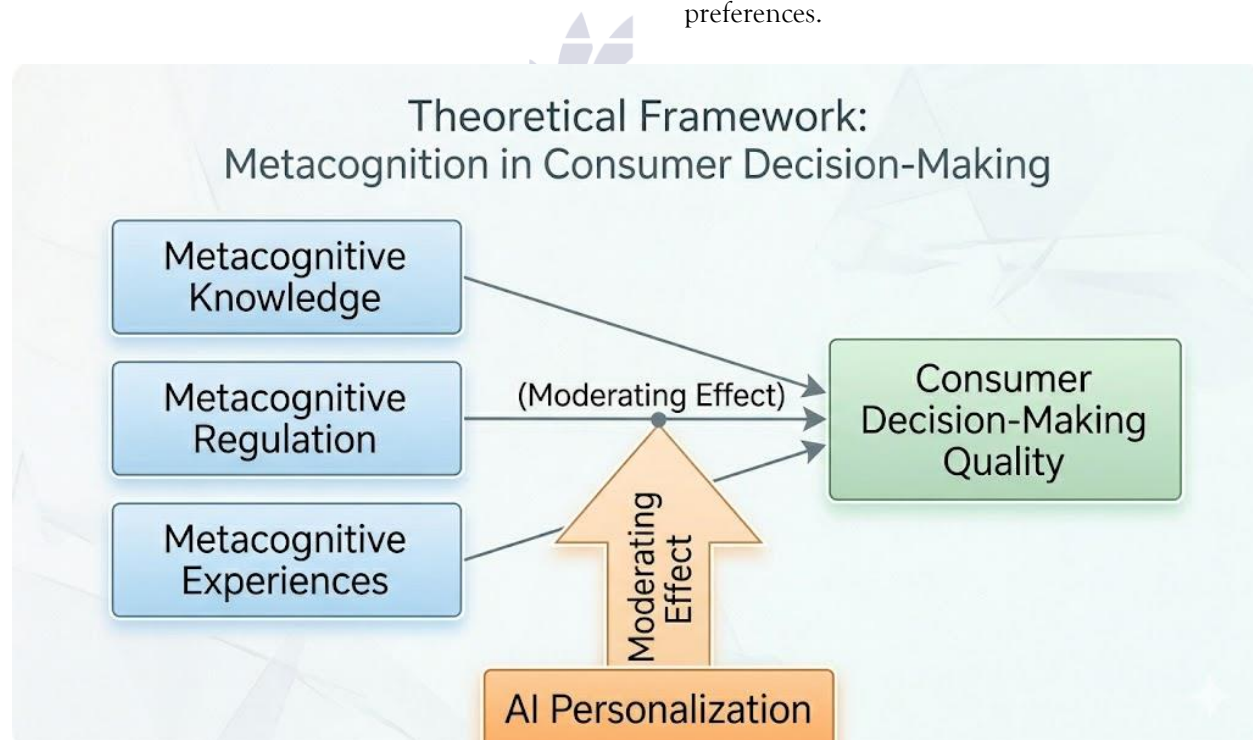
Trust relationships: Studies have shown that consumer trust is a key factor that moderates the impact of AI personalization on purchase intention. Where there is a low level of institutional trust, a consumer might have a stronger tendency to use more personal metacognitive monitoring instead of delegation to AI systems (Alam et al., 2025).

Religious and cultural values: A modest fashion e-commerce study conducted in Pakistan revealed that Sharia compliance mediates the effect of AI personalization and purchase intention, and that consumers more trust AI recommendations that are in line with Islamic principles. This implies that cultural and religious schemas can be used in metacognitive processes during the assessment of AI-generated suggestions (Saqlain et al., 2025).

Digital literacy heterogeneity: Pakistan has a large spectrum of digital literacy, comprising of both highly digital native and digitally challenged consumers who are just beginning to embrace online shopping. It is also plausible that metacognitive awareness differs at both ends of this spectrum, more advanced digital consumers may have a higher ability to monitor and control AI-influenced decisions (Farooq & Yuen, 2024).

2.5 Hypotheses and Theoretical Framework

Based on the metacognitive theory and the Technology Acceptance Model (TAM), which outlines that perceived usefulness and perceived ease of use are the main factors determining the adoption of technology, this paper will suggest that metacognitive awareness leads to better quality of decision-making in AI-based digital markets due to enhanced monitoring of algorithmic influence, increased criticality of AI suggestions, and closer alignment of decisions with individual preferences.



Source: (Author)

According to this framework the subsequent hypotheses are put forward:

H1: Metacognitive knowledge has a positive impact on the quality of consumer decisions in Fintech markets powered by AI.

H2: Metacognitive regulation has a positive effect on the quality of consumer decision-making in Fintech markets based on AI.

H3: The metacognitive experiences have a positive effect on consumer decision-making quality in AI-based digital marketplaces.

H4: AI personalization moderates the connection between metacognitive awareness and quality of decision-making, where more personalization weaker the connection between the two.

3. Methodology

3.1 Research Design

The research design was quantitative, cross-sectional and survey-based research. The questionnaire was designed as a structured questionnaire to assess metacognitive awareness, AI personalization exposure, and quality of decision making in Pakistani digital consumers. The target population was adult consumers (18 years and above) who had already made three or more online purchases within the six months before data collection. Convenience sampling method was used and information was gathered through big cities such as Karachi, Lahore, Islamabad, and Rawalpindi. The target sample of 200 respondents was selected according to the suggestions of structural equation modeling, in which sample sizes of 150-200 are often sufficient to moderate complex models. Data was collected during a 4 weeks period in March-April 2026.

3.3 Instrumentation

The survey tool was divided into four parts:

Section A: Demographic Information. They were collected according to age, the gender, the level of education, monthly income, and the city of residence.

Section B: Metacognitive Awareness Inventory (MAI). Based on the measures of Schraw and Dennison, which were validated as MAI, the following section assessed three dimensions: metacognitive knowledge (8 items, $\alpha = 0.85$), metacognitive regulation (12 items, $\alpha = 0.89$), and metacognitive experiences (6 items, $\alpha = 0.82$). The items were measured using a 5-point Likert scale (1=Strongly Disagree and 5=Strongly Agree).

Section C: Exposure to AI Personalization. The scale was measured by a 6-item scale that gauged how frequently and intensively they received personalized suggestions, AI chatbots, and targeted advertisements on online platforms ($\alpha = 0.87$).

Question: How well you make decisions.
<|human|>**Section D:** Quality of Decision-Making. A 10-item scale measured perceived decision quality along such dimensions as satisfaction with choices, confidence in decisions, alignment with preferences, and post-purchase regret ($\alpha = 0.88$).

3.4 Data Collection Procedures

The questionnaire was conducted online using Google Forms, and the links were shared on social networks (Facebook, WhatsApp), email lists, and online consumer communities. An informational sheet was used to clarify the aim of the research, provide assurance of anonymity and informed consent. There were no incentives to participate.

3.5 Data Analysis

The SPSS version 26 and AMOS version 24 were used to analyze the data. The analysis was carried out in three phases; (1) Descriptive statistics and reliability testing; (2) correlation analysis, which tested the relations among the study variables and (3) Multiple regression analysis, which tested the hypothesized relationships with moderation effects.

3.6 Ethical Considerations

The institutional ethics review board gave this study its approval. Each participant gave an informed consent, was guaranteed confidentiality and notified about their right to withdraw without repercussions at any given time.

4. Results

4.1 Sample Characteristics

Of the 200 questionnaires distributed, 184 were returned (92% response rate). After screening for incomplete responses and straight-lining, 172 valid cases remained for analysis (86% effective response rate).

Table 1 presents the demographic characteristics of the final sample.

Table 1: Sample Demographics (N=172)

Characteristic	Category	Frequency	Percentage
Gender	Male	98	57.0%
	Female	74	43.0%
Age	18-25 years	67	39.0%
	26-35 years	72	41.9%
	36-45 years	24	14.0%
	46+ years	9	5.2%
Education	Intermediate/Diploma	31	18.0%
	Bachelor's degree	78	45.3%
	Master's degree	52	30.2%
	Doctorate	11	6.4%
Monthly Income	< PKR 50,000	43	25.0%
	PKR 50,000-100,000	67	39.0%
	PKR 100,001-200,000	42	24.4%
	> PKR 200,000	20	11.6%
City	Karachi	58	33.7%
	Lahore	52	30.2%
	Islamabad/Rawalpindi	44	25.6%
	Other	18	10.5%

The sample was predominantly young (80.9% under 35 years), well-educated (81.9% with bachelor's degree or higher), and distributed across Pakistan's major metropolitan centers. This profile aligns with the demographic characteristics of active digital consumers in Pakistan.

4.2 Descriptive Statistics of Study Variables

Table 2 presents mean, standard deviations, and reliability coefficients for the primary study variables.

Table 2: Descriptive Statistics and Reliability

Variable	Mean	SD	Cronbach's α	Items
Metacognitive Knowledge	3.78	0.67	0.85	8
Metacognitive Regulation	3.62	0.72	0.89	12
Metacognitive Experiences	3.45	0.70	0.82	6
AI Personalization Exposure	3.89	0.74	0.87	6
Decision-Making Quality	3.71	0.68	0.88	10

The average scores of all variables were moderate-high (3.45-3.89, a 5-point scale). The highest mean score ($M=3.89$, $SD=0.74$) was given to the exposure of AI personalization, which means that Pakistani digital consumers are often exposed to AI-based personalization when making online purchases. The lowest mean score ($M=3.45$, $SD=0.70$) was metacognitive experiences, which

might explain why consumers might be less conscious of the subjective emotions that come with the process of cognitive processing. The alpha of all the Cronbach's was above the 0.80 mark and this shows that the internal consistency is excellent.

4.3 Correlation Analysis

Table 3 presents Pearson correlation coefficients among study variables.

Table 3: Correlation Matrix

Variable	1	2	3	4	5
1. Metacognitive Knowledge	1				
2. Metacognitive Regulation	.62**	1			
3. Metacognitive Experiences	.48**	.55**	1		
4. AI Personalization	.31**	.28**	.35**	1	
5. Decision Quality	.54**	.61**	.49**	.42**	1

**p < 0.01 (2-tailed)

All the correlations were positive and significant at the $p < 0.01$ level. Decision-making quality correlated with metacognitive regulation ($r = 0.61$, $p < 0.01$), metacognitive knowledge ($r = 0.54$, $p < 0.01$) and metacognitive experiences ($r = 0.49$, $p < 0.01$). These moderate-strong relations give some initial evidence of the hypothesized relations. AI personalization exposure showed moderately positive correlations with metacognitive variables and decision quality, indicating that AI use is

linked with increased not decreased metacognitive awareness, but not causally.

4.4 Regression Analysis

Hierarchical multiple regression was conducted to test the hypotheses. Control variables (age, gender, education, income) were entered in Model 1, followed by metacognitive variables in Model 2. Table 4 presents the regression results.

Table 4: Hierarchical Regression Analysis Predicting Decision-Making Quality

Variable	Model 1 (β)	Model 2 (β)	Model 3 (β)
Controls			
Age	0.08	0.05	0.04
Gender	0.06	0.04	0.03
Education	0.12	0.08	0.07
Income	0.14*	0.09	0.08
Metacognitive Variables			
Metacognitive Knowledge		0.23**	0.21**
Metacognitive Regulation		0.35***	0.32***
Metacognitive Experiences		0.18*	0.16*
Moderator			
AI Personalization			0.19*
Interaction			
Metacog × AI Personalization			-0.15*
R ²	0.06	0.48	0.53
ΔR^2		0.42***	0.05*
F	2.41	18.64***	16.23***

*p < 0.05, **p < 0.01, ***p < 0.001

Findings

Only the model 1 explained 6% of the variance in the quality of decision-making using control variables. Income had a significant positive impact

(= 0.14, $p = 0.05$) implying that consumers with higher income report more positive results in decision outcomes.

When metacognitive variables were added to Model 2, model fit significantly increased, explaining an extra 42% of the variance ($\Delta = 0.42$, $p < 0.001$). All three metacognitive elements were significant and had a positive predictive impact on the quality of decision making, which favors H1, H2, and H3:

- The strongest predictor ($\beta = 0.35$, $p < 0.001$) was metacognitive regulation suggesting that the active planning, monitoring, and evaluating of cognitive processes have the highest potential to optimize the quality of decisions.

The significant moderate effect ($\beta = 0.23$, $p < 0.01$) of metacognitive knowledge confirmed the fact that being aware of own cognitive abilities and strategies helps to make better decisions.

- Metacognitive experiences showed a lesser yet significant difference ($\beta = 0.18$, $p < 0.05$) indicating

that subjective emotions regarding cognitive processing are also significant in shaping the decision.

Model 3 added AI personalization exposure and its interplay with metacognitive awareness in general. There was a positive direct effect of AI personalization on the quality of decisions ($\beta = 0.19$, $p < 0.05$). Nevertheless, the interaction term was negative and significant ($\beta = -0.15$, $p < 0.05$), which confirms H4: the high AI personalization weakens the relationship between the metacognitive awareness and the quality of decisions.

4.5 Moderation Analysis

To further explore the moderation effect, simple slopes analysis was conducted. The sample was divided into high and low AI personalization groups based on a median split (median = 3.92).

Table 5: Simple Slopes Analysis

AI Personalization Level	β (Metacog $\rightarrow$ Decision Quality)	p-value
Low (below median)	0.58	< 0.001
High (above median)	0.31	< 0.01

The metacognitive awareness impact on the quality of the decision was meaningful ($\beta = 0.58$, $p < 0.001$) in consumers who had low AI exposure to personalization. This impact was significantly lower ($\beta = 0.31$, $p < 0.01$) but still important to consumers who have a high AI personalization exposure. This trend suggests that although metacognitive awareness is useful in any case, irrespective of exposure to AI systems, it becomes less important when decision support through AI systems is widespread.

4.6 Additional Findings: The "Metacognitive Atrophy" Pattern

Exploratory analysis (post-hoc) investigated whether high AI personalization exposure was related to reduced absolute levels of metacognitive awareness. Results of independent samples t-tests of low and high AI personalization groups showed: High AI personalization group featured much lower scores on metacognitive regulation ($M = 3.48$ vs. $M = 3.76$, $t = 2.89$, $p = 0.01$)

- No important differences in metacognitive knowledge or experiences.

This trend indicates a possible mood of metacognitive atrophy: consumers with a high-dependence on AI personalization might eventually diminish their active metacognitive regulation, which could weaken their abilities to independently make decisions.

5. Discussion

5.1 Interpretation of Findings

This paper explored the connection between metacognitive awareness and consumer decision-making in digital markets that are powered by AI in the Pakistani context. The results provide some valuable insights.

The Pivotal Component of Metacognitive Regulation

The strongest predictor of quality of decision-making was metacognitive regulation that was found in all analyses. This result is consistent with

potential hypotheses that active regulation of mental activities planning shopping strategies, tracking progress, and assessing choice outcomes are essential in orienting in a complex online surrounding (Mainali & Weber, 2025). Pakistani consumers who are more consciously in charge of their decision-making processes seem more capable of assessing AI suggestions critically, being less susceptible to potentially manipulative personalization, and making decisions based on their genuine preferences.

This observation is especially important in new markets where there might be a significant difference in digital literacy. To marketers and platform designers, aiding metacognitive control (by providing tools that help consumers reflect on their decisions, justify them, and easily compare alternatives) can, instead of weakening consumer decision quality, improve it.

The Two-Sided Impact of AI Personalization

Perhaps, the most theoretical finding is that of the dual impact of personalization of AI. On the one hand, the quality of decisions is directly enhanced by AI personalization, in line with the previous studies, which revealed that personalized recommendations decrease the cost of search, enhance relevancy and satisfaction. Conversely, high AI personalization neutralizes the positive correlation between metacognitive awareness and quality of decision-making - in other words, it lowers the payoff that consumers receive as a result of their metacognitive activities.

This implies that there is a possible efficiency-agency trade-off. AI-based systems that intuitively direct consumers to choices can enhance short-term satisfaction and decreases cognitive load, but also can deter the metacognitive processes involved in autonomous and reflective choice. In the long run, this may result in such a state what we would call as metacognitive atrophy - the slow decline of our ability to make independent decisions as we turn more and more to algorithmic advice.

The Pakistani Market Contextual Factors

The moderate to high metacognitive awareness average scores (mean scores 3.45-3.78) can be

interpreted as the specifics of Pakistani online consumers. The sample is young and educated, urban-based, which indicates that it has a moderate level of awareness of their cognitive processes, which may be explained by a fairly high level of digital literacy and exposure to various online platforms. The reduced scores on the metacognitive experiences, however, indicate that Pakistani consumers might be less sensitive to subjective affect that comes with decision making, the sense of ease or difficulty, familiarity or novelty, confidence or doubt that directs the cognitive behavior.

This finding may have cultural dimensions. Collectivist cultures such as that of Pakistan, might emphasize more on societal communication and social normative pressure than on self-reflective practices. Assuming that consumers are habitually dependent on social evidence, family endorsement or societal confirmation instead of individual metacognitive surveillance, the sensitivity of metacognitive experiences might be diminished in line with these results.

5.2 Theoretical Contributions

This paper contributes to the body of literature in a number of ways:

To start with, it applies metacognitive theory to the AI-mediated consumer settings. Earlier studies of metacognition in a retail context concentrated more on augmented reality and information presentation; the current study shows that metacognition processes are still applicable, in fact, more crucial, when algorithms are actively used to influence choice architecture.

Second, it defines a hitherto unreported relationship between AI personalization and metacognitive awareness. Although previous studies determined that AI moderates the consumer behavior and other isolated studies determined that metacognition moderates the quality of decisions, the study is one of the first to investigate the interaction between the two. The negative moderation effect: AI personalization has a potential to partially replace consumer metacognitive processing instead of complementing it.

Third, it adds to the new criticism of classic models of consumer behavior in AI settings. The linearity and rationality models of consumer behavior are becoming less and less useful in the explanation of consumer behavior as the algorithms organize the choice, as observed in recent theoretical research. The findings of this study justify the need to develop new frameworks that consider the interaction of consumers with AI, the effect of algorithms, and the presence of metacognitive adaptation or atrophy.

5.3 Practical Implications For Digital Marketers

The results indicate that successful digital marketing in AI-driven worlds cannot merely be aimed at the highest levels of personalization, but must strike the right balance between efficiency and empowering consumers. The strategies which facilitate metacognitive regulation, including giving clear explanations to the recommendations, providing means to compare alternatives, and promoting reflection before purchase, can lead to more sustainable customer relationships than strategies maximizing conversion alone.

In the context of Pakistani markets in particular, the personalization of AI algorithms, with cultural and religious considerations, as proposed by the study of Sharia-compliant AI, can contribute to the increase of trust and lessen the necessity of defensive metacognitive surveillance.

To AI System Designers

Algorithms of personalization and recommendation systems should be developed with so-called metacognitive affordances, i.e. with those characteristics that make algorithmic processes visible, controllable by users, and reflective. Instead of smoothly leading consumers to choices, AI systems could use a few metacognitive prompts to prompt the users to clarify their preferences, to deliberate on alternatives, or to justify recommendations.

In the case of Consumer Protection Policy

The possibility of metacognitive atrophy brings up the issue of consumer welfare in the long term in more AI-mediated markets. In case consumers

slowly lose the ability to make independent, reflective choices, they can be more susceptible to manipulative design, less able to recognize mistakes in AI advice, and more prone to post-purchase regrets. Policymakers in developing countries such as Pakistan ought to think about the need to have transparency on AI personalization, have cool-off periods on algorithmically-mediated purchases, and have digital literacy initiatives that explicitly target metacognitive skills.

5.4 Limitations and Future Research

There are a number of restrictions that should be noted:

To begin with, the cross-sectional design does not allow causal inference. Although we hypothesize that metacognitive awareness affects the quality of decisions, it is not possible to eliminate the possibility of reverse causation or explanations by a third variable. Causal claims would be reinforced by longitudinal studies that follow metacognitive development and exposure to AI over time.

Second, the convenience sample of the largest cities restricts the generalizability. Other patterns may be shown by Pakistani consumers in smaller cities or rural areas, or less digital literate. Further studies need to be conducted on metacognitive process within various Pakistani consumer groups. Third, self-reported metacognitive measures might not be able to adequately reflect real metacognitive processes. The complementary evidence could be in the form of behavioral measures, including think-aloud protocols, eye-tracking, or search and comparison behavior analysis.

Fourth, the research did not look at objective decision outcomes (e.g., actual purchase satisfaction, financial consequences) but instead used perceived decision quality. Further studies are needed to connect the metacognitive processes to the objective measures.

Fifth, the research failed to differentiate various kinds of AI systems (recommendation engines vs. chatbots vs. dynamic pricing algorithms). The effects of various AI applications on metacognitive processing can vary.

Future areas of research include: (1) experimental studies that can manipulate AI personalization

levels to understand causal impacts on metacognitive engagement, (2) longitudinal studies of metacognitive changes as consumers gain experience with AI systems, (3) cross-cultural studies that consider how collectivism versus individualism moderates metacognitive processing in AI systems, and (4) design research that develops and tests metacognitive affordances.

6. Conclusion

This paper has explored the connection between metacognitive awareness and consumer decision making in AI-based digital markets in the Pakistani context. The study, based on the data collection of 172 digital consumers in the key urban centers in Pakistan, provides three key findings.

First, metacognitive awareness has a great impact on the quality of decision making, and the active planning, monitoring, and evaluation of cognitive processes (metacognitive regulation) is the most important predictor. Pakistani consumers who are aware of the decision processes they should control in order to achieve better results show improved results, even in the environment of AI systems which are created to control their choices. Second, AI personalization has a dual impact, as on the one hand, it directly enhances the quality of decisions by lowering the costs of search and increasing their relevance, and on the other hand, high AI personalization cancels the positive correlation between metacognitive awareness and decision outcomes. This implies that efficiency and agency may be in tension, where smooth algorithmic control may deter the metacognition required to make an independent decision.

Third, they found signs of possible metacognitive atrophy: high-exposure consumers to AI personalization had much lower scores on metacognitive regulation, and this suggests that consumer welfare might be jeopardized in the long term in more AI-mediated markets.

These results are of great importance to digital marketers, designers of AI systems, and policymakers in consumer protection. Instead of doing all they can to become as personalized as possible, good digital strategies must be efficient but empowering, creating AI systems that can

reinforce consumer metacognition processing as opposed to replacing it. The development of metacognitive skills in consumers can be as significant as developing technological infrastructures in the emerging markets such as Pakistan where digital commerce is growing notably fast.

The era of human-AI co-existence in online markets is not an issue in the future but a reality today. To advance the theoretical and practical levels, it is critical to have an insight into how consumers may have conscious, reflective control over their choices under algorithmically-shaped environments. This paper proposes that metacognition, which is the ability to think about thinking, can be one of the most important skills that consumers can possess in the digital market in the twenty-first century.

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