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Analysis of Perceived Risks by Online Consumers: The Case of an Exporting SME from Costa Rica

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Abstract*— This research analyzed the acceptance of e-commerce on the website of a Costa Rican SME through a mixed-method design that triangulated conscious survey data with unconscious neuromarketing metrics (Eye-Tracking, Face Reader) in a sample of 67 women. Multiple regression confirmed Perceived Utility and Usefulness as the only significant predictors of conscious acceptance. However, biometric analysis revealed a critical discrepancy: the "Refund Policy" captured 61% of the total visual time, demonstrating that risk mitigation is the dominant unconscious barrier. This finding, along with a 65% purchase abandonment rate due to usability failures, concludes that perceived risk—while consciously insignificant—generates a "Neutral" emotional experience and is the primary driver of abandonment at the unconscious behavioral level.

Keywords*— e-commerce, risks, neuromarketing, SME.

I. Introducción

E-commerce has transcended simple transactions to become a pillar of contemporary economies [1]. For Small and Medium-sized Enterprises (SMEs), it has transformed into a crucial tool that optimizes efficiency, expands reach, and maintains competitiveness [2]. The implementation of e-commerce offers these companies advantages such as access to new markets and cost reduction [3]. SMEs, which constitute 97.4% of the business sector [4] with 27,960 active firms, are fundamental for economic development [6]. This sector is further facilitated by the high broadband connectivity reported in the country [5].

Despite these advantages, e-commerce adoption faces a significant barrier: the consumer's perceived risk in online shopping. This phenomenon, which includes concerns regarding data security, product benefit quality, and website functionality [7], can negatively impact purchase intention [8], [9]. In the Costa Rican environment, this situation is exacerbated by reports of scams and fraud [10], making risk mitigation a determining factor for the success of exporting SMEs [11].

To address this challenge, the research integrates neuromarketing [12], a discipline that seeks to understand the subconscious processes that drive purchasing decisions. Among its tools, Eye-Tracking technology is used to record and study ocular movements in response to visual stimuli, providing quantitative data on behavior, attention, and website experience [13]. By correlating eye-tracking metrics with the customer's conscious perceptions, the study aims to achieve a comprehensive understanding of how User Experience (UX) influences trust and e-commerce acceptance.

The central objective of this study is to analyze the relationship between the perception of information and benefit-acquisition risks, usability, and the Usefulness of a Costa Rican exporting SME's website. The findings seek to contribute to both literature and practice, proposing a framework oriented towards improving user experience and reducing such risks.

The article is structured as follows: following the introduction, Section II provides a literature review on TAM and neuromarketing; Section III details the mixed-methodology approach; Section IV presents the statistical and biometric results; Section V discusses the findings and the risk paradox; finally, Sections VI, VII, and VIII present the conclusions, limitations, and future research directions.

II. Literature Review

This research is based on the exploration of e-commerce as a pillar of contemporary economies [1]. This process is defined as the purchase or exchange of goods and services through the internet [14], [15], which is crucial for the growth of SMEs [2], allowing them to optimize operational efficiency and expand their market reach [3]. A robust digital presence contributes to general economic development by driving

competitiveness and demand [16], facilitating access to a more diverse clientele and reducing socioeconomic inequalities [9], [17], [18].

E-commerce acceptance in SMEs is a complex process that can be analyzed through frameworks such as the Technology Acceptance Model (TAM) and Technology-Organization-Environment (TOE) [19]. Influencing factors include technological elements (such as Perceived Utility, Perceived Usefulness, or AI integration), organizational factors (innovative culture), and external factors (competitive pressure) [20]. Indeed, evidence suggests that both AI integration and an innovation culture drive digital adoption in firms, while competitive pressure is a determining factor for companies to improve their market performance [20].

Despite its benefits, the primary obstacle to acceptance is perceived risk, understood as the expectation that online purchasing may lead to undesired outcomes [21]. Risk perception is associated with uncertainty regarding possible adverse consequences and the potential for loss [7], [11], [22], [10]. Most empirical evidence confirms that this risk negatively impacts e-commerce adoption [26], [27], [28], maintaining a negative and inverse relationship with consumer purchase intention [8], [9], [23].

This study focuses on two critical dimensions of this phenomenon. Product benefit risk arises due to the impossibility of physical inspection, generating uncertainty regarding actual quality or performance [29], [30]. This risk is particularly crucial for SMEs, as the lack of brand recognition or solid guarantees intensifies distrust and reduces the likelihood of completing a purchase [11], [31], [32]. The second dimension is information misuse risk, which includes fears such as identity theft and privacy violations [33]. These concerns are intensified because SMEs often have fewer resources to invest in cybersecurity [34]. Consumer sensitivity toward personal data heightens concerns about misuse, directly affecting purchase intention [35], [36].

In the face of risk, Perceived Utility and Perceived Usefulness are determinants of acceptance. Perceived Utility is the belief that e-commerce provides tangible benefits such as efficiency, convenience, and time savings [39], [41], positively influencing adoption [19], [24], [37], [38], [40]. Meanwhile, Perceived Usefulness refers to the degree to which a platform is considered intuitive, simple, and effort-free [42], [43], [44]. When a platform is perceived as accessible, the willingness to transact online increases, enhancing satisfaction and loyalty [43], [45], [46].

To evaluate these processes objectively, the study integrates Neuromarketing, an application of neuroscience [47] that utilizes tools such as Eye-Tracking to uncover subconscious processes in decision-making [12], [48]. Neuromarketing is vital for SMEs to design effective strategies by obtaining data on their customers' implicit reactions [49], [50], [51]. The discipline focuses on studying decision-making, emotions, and especially visual attention [52], [53], [54], [55], [56]. Visual attention acts as a filter for relevant stimuli [62], [63], where visual elements that capture greater attention are more likely to influence working memory and purchase intention [64], [65]. Eye-Tracking, as a non-invasive technique [66], quantifies this attention through metrics (fixation, time) that correlate visual exploration with subjective assessment and consumer decision-making [67], [68].

III. METHODOLOGY

The methodological strategy was designed to comprehensively address e-commerce acceptance. The study followed a mixed-methods approach, systematically combining quantitative and qualitative methods [69]. This facilitated a pragmatic triangulation of numerical data with descriptive information and users' non-conscious responses, providing a more robust understanding of the phenomenon [69]. Furthermore, the research design was non-experimental and cross-sectional, observing variables in their natural state at a single point in time to ensure external validity [69].

Hypotheses

Based on the previous review, five hypotheses are postulated to conceptualize the interrelationships in the research model, evaluating the influence of Utility, Usefulness, information and benefit risks, and visual attention on e-commerce acceptance:

H1: The perceived Utility of e-commerce has a positive relationship with e-commerce acceptance by the SME's potential customers.

H2: The perceived Usefulness of the SME's website has a positive relationship with e-commerce acceptance by the firm's potential customers.

H3: The perceived risk of not obtaining the expected benefits from products purchased on the SME's website has a negative relationship with e-commerce acceptance by its potential customers.

H4: The perceived risk of personal information misuse has a negative relationship with e-commerce acceptance by the SME's potential customers.

H5: The visual attention captured on the SME's website has a positive relationship with e-commerce acceptance by its potential customers.

Regarding the sample, the unit of analysis was the individual, specifically potential customers of the SME (women aged 25 to 50, residing in Costa Rica, with purchasing power for cosmetics). Consequently, a non-probability convenience sampling was employed, justified by the logistical limitations inherent in individual calibration and recording sessions for Eye-Tracking equipment. Nevertheless, a statistical calculation was performed to ensure reliability, establishing a required sample size of n≈59.98, with a 90% confidence level and a 10.6% margin of error.

$$n = \frac{1.645^2 \times 0{,}5(1 - 0.5)}{0{,}1062^2}$$

$$n \approx 59.98$$

The final sample recruited for the questionnaire consisted of 67 participants; following the technical data cleaning inherent to instrumental calibration, 66 valid eye-tracking records and 61 valid facial expression analysis records were obtained.

With respect to variables and measurement, E-commerce Acceptance (Dependent Variable) was measured at a conscious level using a Likert scale [70]. Similarly, the key independent variables (Perceived Utility [37], [38], [39], Perceived Usefulness [42], [44], [72], Product Benefit Failure Risk [29], [73], and Information Misuse Risk [33]) were evaluated consciously through Likert-type questionnaires. In contrast, the Visual Attention variable [71] was measured non-consciously using Tobii Pro Lab software and quantified through the Total Visit Duration metric [79], [80] during a purchase simulation that included site exploration and reading the refund policies. Finally, demographic control variables such as Age, Gender, Income Level, Educational Level, and Residence were included.

In the analysis strategy, quantitative, biometric, and behavioral data were integrated. Thus, questionnaire responses were processed using Stata to obtain descriptive statistics and execute multiple regression models to test the hypotheses. Complementarily, biometric metrics from Tobii Pro Lab (Total Visit Duration) and Face Reader (predominant emotions) were extracted and processed. Simultaneously, Verbal and Behavioral Protocol Analysis was applied through a detailed review of video recordings and the use of checklists, seeking to identify behavioral patterns associated with difficulty and risk perception. Finally, for the purpose of integrating the findings, a Triangulation Comparative Matrix [81] was constructed to contrast declared (conscious) responses with observed (non-conscious) reactions, offering an in-depth understanding of the e-commerce acceptance process.

IV. Results

The analysis was conducted through the processing of quantitative data (Stata) and biometric/behavioral data (Eye-Tracking and verbal protocols), applied to a sample of 67 women (middle-aged, high educational level, and focused in San Carlos) representing the SME's target audience.

A. Demographic Characterization of the Sample

The study was conducted with a sample of 67 female participants. The demographic profile indicates 86% of the participants are between 26 and 50 years old, with the largest concentration (54%) in the 26–40 age bracket, and 75% held completed university degrees (Bachelor's or Licentiate). Geographically, most of the subjects reside in the province of Alajuela, with a significant concentration in the cantons of San Carlos (84%).

Regarding socioeconomic status, the distribution is concentrated within the middle-income brackets; approximately 70% of the participants report monthly incomes between ₡360,000 and ₡1,320,000, with the most frequent range being ₡360,000 to ₡660,000 (29%).

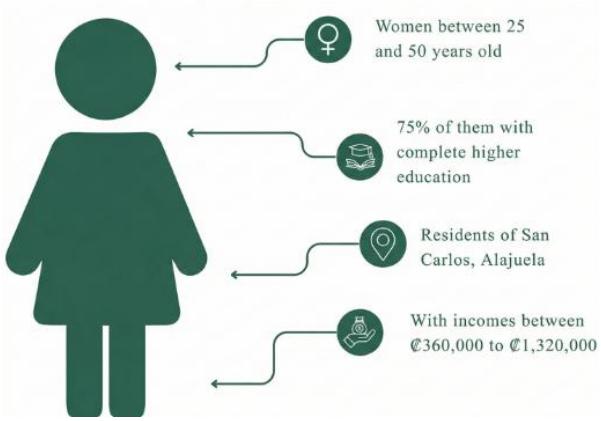

Fig. 1 Demographic Characterization

A. Construct Validation and Correlations

Factor and reliability analyses confirmed that all conscious construct scales—Information Misuse Risk (RUI), Benefit Failure Risk (RFB), Usefulness (FU), Perceived Utility (UP), and E-commerce Acceptance (ACE)—are statistically robust (all Cronbach's $\alpha > 0.77$).

Initial correlation analysis revealed that Perceived Utility (ρ=0.730, p<0.001) and Usefulness (ρ=0.626, p<0.001) showed the strongest and most significant positive associations with E-commerce Acceptance (ACE). Benefit Failure Risk (BFB) showed a significant, though weaker, negative correlation (ρ=−0.269, p=0.036).

TABLE 1.

CORRELATION ANALYSIS

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) E	1.000						
(2) NI	0.220	1.000					
	(0.073)						
(3) NE	-0.183	0.517	1.000				
	(0.139)	(0.000)					
(4) RUI	0.198	-0.034	0.039	1.000			
	(0.117)	(0.791)	(0.761)				
(5) RFB_fs	0.033	-0.123	0.023	0.502	1.000		
	(0.800)	(0.335)	(0.858)	(0.000)			
(6) FU_fs	0.068	0.005	0.099	0.067	-0.122	1.000	
	(0.587)	(0.968)	(0.425)	(0.596)	(0.339)		
(7) UP_fs	-0.108	-0.085	0.161	0.179	-0.177	0.443	1.000
	(0.384)	(0.496)	(0.193)	(0.156)	(0.165)	(0.000)	
(8) ACE_fs	-0.054	-0.111	-0.044	0.118	-0.269	0.626	0.730
	(0.668)	(0.379)	(0.729)	(0.361)	(0.036)	(0.000)	(0.000)

B. Robust Multiple Regression and Hypothesis Testing (Conscious)

The robust multiple regression model estimation for ECA demonstrated an excellent global fit (Prob > F = 0.0000), explaining 66% of the variability in ECA (R^2 =0.66). Examination of individual predictors confirms:

TABLE 2.

ROBUST MULTIPLE REGRESSION

	(1) ACE_fs
RUI_fs	.043
	(.119)
RFB_fs	-.086
	(.102)
FU_fs	.376***
	(.09)
UP_fs	.491***
	(.099)
E	-.119
	(.105)
NI	.077
	(.069)
NE	-.224**
	(.097)
ACE	1.333**
	(.611)
Observations	59
R-squared	.66

Robust standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1*

Perceived Utility (UP): The strongest positive predictor (β=0.491, p<0.01), validating H1.

Usefulness (FU): Showed a significant positive effect (β=0.376, p<0.01), validating H2.

Perceived Risk (RUI and BFB): Were not statistically significant predictors (RUI: β=0.043; RFB: β=−0.086), leading to the rejection of H3 and H4.

Educational Level (NE): Surprisingly, this demographic variable showed a significant negative effect (β=−0.224, p<0.05).

C. Biometric, Behavioral, and Triangulation Analysis (Non-conscious)

Behavioral and Eye-Tracking protocol analysis revealed a profound discrepancy between declared perceptions and actual behavior:

1. Visual Attention Hierarchy and Risk Priority

The Eye-Tracking study (Total Fixation Duration metric) demonstrated a visual attention pattern highly concentrated on risk mitigation. 61% of the total fixation time was concentrated on the "Refund Policy" Area of Interest (AOI), highlighting the priority users place on evaluating safety and trust. In contrast, primary shopping elements like the product image (32%), price (2%), and product details (2%) received secondary attention.

2. Usefulness Friction and Purchase Abandonment

Despite conscious validation of Usefulness (H2 accepted), behavioral evidence revealed critical friction:

Initial Exploration (Task 1): 75.8% success rate, consistent with positive EU perception.

Risk Search (Task 2 - Policy): 57.6% failure rate or difficulty finding the policy document, identifying a usability barrier.

Final Conversion (Task 3 - Payment): The primary friction point was the checkout form, with 65% of observations recording "Does not complete the purchase form." This high abandonment qualifies H2, proving that perceived Usefulness during exploration does not translate to transactional Usefulness.

3. Emotional Analysis and Rejection of H5 Facial expression analysis (Face Reader) showed Neutrality as the predominant emotional state, suggesting that most of the time was spent in a state of low emotional arousal.

H5 (Visual attention has a positive relationship with acceptance) was rejected. This is justified because the high duration of visual attention did not correlate with greater acceptance; instead, it evidenced a defensive relationship

(security seeking). The attention was a sign of caution and cognitive friction, rather than positive purchase intention.

In conclusion: The findings confirm that the SME's user arrives at the site with a high non-conscious need to mitigate risk (61% visual attention). However, the current design fails in critical tasks (65% abandonment at checkout), which exacerbates friction and results in purchase desertion.

V. Discusión

At the level of Declared Intention (conscious analysis), the study validates hypotheses H1 (Perceived Utility) and H2 (Perceived Usefulness), confirming the applicability of the Technology Acceptance Model (TAM). Robust multiple regression demonstrated that Perceived Utility (UP) and Usefulness (FU) are the most significant predictors of Purchase Acceptance. This result is consistent with literature defining PU as the perception of concrete benefits such as convenience and time savings [22], [37], and EU as the perception of a simple and intuitive system [42], [43].

However, at this same conscious level, hypotheses H3 and H4 were rejected, as Perceived Risk (PR) did not show a statistically significant relationship with Acceptance. This result aligns with minority findings in the literature [25] but opposes the prevailing stance that PR negatively and significantly impacts e-commerce adoption [26], [27], [23], [11]. This apparent irrelevance of risk at the conscious level is the methodological anomaly that non-conscious analysis resolves.

Furthermore, the Triangulation Matrix exposes the "risk paradox," resolving its apparent irrelevance in the TAM model, and leads to the rejection of H5 (Positive visual attention), albeit with a crucial nuance: high visual attention predicts abandonment, not acceptance. This result is grounded in the theory that visual attention reflects mental processing [66]; in this study, fixations were directed toward elements of anxiety rather than value.

Despite the rejection of H3 and H4 in the regression, Eye-Tracking analysis demonstrated that the search for risk mitigation is the primary concern of non-conscious behavior. The critical area of the "Refund Policy" accounted for 61% of total visual fixation time, proving that PR does not affect intention (conscious component) but is the main factor generating friction and abandonment in the behavioral process.

This behavior is due to the vulnerability of SMEs, which must actively earn trust as they lack brand recognition [11], [34]. The current system forces the user to "hunt" for information that mitigates uncertainty regarding product quality [29] and the risk of information misuse [22], [35]. Since 57.6% of users failed to find the refund policy (Task 2), anxiety prevails, and conversion is frustrated.

A second paradox relates to Usefulness. The high conscious valuation of EU (H2 accepted) is completely nullified by the failure in transactional usability. The positive perception of ease refers only to initial exploration (Task 1, 76% success), but this ease does not hold at critical points of high risk perception: locating the refund policy and the checkout. The massive 65% abandonment rate at the purchase form (Task 3) demonstrates that perceived EU during exploration does not translate into conversion.

Finally, emotional analysis (Face Reader) showed a predominance of Neutrality, interpreting "Anger" intensity as cognitive effort and concentration [47]. This finding suggests that the massive abandonment is not motivated by strong emotional frustration but rather by a combination of confusion and a lack of motivation.

VI. Conclusion

The study concludes that the primary factor affecting e-commerce acceptance for the SME is not the absence of positive intention, but rather the critical friction and transactional anxiety caused by risk. Acceptance—initially driven by high Perceived Utility (UP) and Perceived Usefulness (FU) (conscious factors)—is nullified by the website's inability to mitigate risk at a behavioral level, resulting in a 65% cart abandonment rate. The influence of acceptance factors manifests in a dual, antagonistic dimension. In the Conscious Dimension (Intention), regression results conclude that PU and EU are the strongest predictors of declared purchase intention; consequently, Perceived Risk (IMR and BFR) does not influence conscious intention. However, in the Non-conscious Dimension (Behavior), the influence of risk is dominant and absolute, as Eye-Tracking analysis revealed that the "Refund Policy" area captured 61% of total visual fixation time, demonstrating that risk is the dominant concern during the evaluation phase, despite users declaring low concern for this factor.

The relationship between usability, risk perception, and acceptance reveals that while PU and EU are the strongest predictors of purchase intention (Conscious Finding), this relationship breaks down in practice (Behavioral Finding). This annulment occurs because website usability fails precisely at the moments where risk perception is highest: 56.72% of subjects experienced difficulties or failed to locate the refund policy access button, and a massive 65% abandonment occurred at the payment form. High visual attention did not translate into greater acceptance—leading to the rejection of Hypothesis H5 (Visual Attention)—but instead evidenced an inverse relationship by focusing on

anxiety. Finally, the dominance of the "Neutrality" emotion during checkout suggests that abandonment is driven by confusion or a lack of positive reinforcement (Emotional Finding).

In synthesis, this dichotomy of results empirically demonstrates that for an SME, traditional acceptance models (TAM), by focusing on declared intention, are insufficient for diagnosing the main behavioral barrier. This validates the necessity of integrating risk assessment with biometric methods. It is recommended that future lines of research focus on evaluating the impact of defensive usability (designs prioritizing easy accessibility to policies and guarantees) on conversion rates in SMEs, as well as conducting a longitudinal study comparing visual attention and abandonment metrics before and after website optimization.

VII. LIMITATIONS

As this research is framed as a single-case study, the scope was restricted to this e-commerce platform of one specific exporting SME. Consequently, the findings may reflect design-specific attributes and usability flaws unique to this site rather than universal patterns across the SME sector.

During the development of the research, several methodological and technical limitations were identified. For the purchase simulation (Task 3), a controlled protocol was implemented in which subjects were required to enter the researcher's personal data into the payment form to safeguard confidentiality and prevent fraudulent orders. Furthermore, the analysis of visual attention was constrained by the technical capabilities of the Tobii software, which did not provide tools for generating aggregate heatmaps. This necessitated an analysis based on the individualized review of each participant's gaze recordings.

Finally, intermittent technical failures were experienced in both biometric software suites (Tobii and Face Reader), resulting in the loss of data from some sessions. This incident accounts for the variation in the sample size (N) reported across the different analyses, a factor that was strictly considered when interpreting the results.

VIII. FUTURE RESEARCH DIRECTIONS

For future research, it is essential to advance along three key axes. First, it is recommended to expand the demographic representativeness of the sample to include male participants. Second, the measurement of non-conscious risk must be strengthened. Rather than relying solely on standard surveys, in-depth interviews are suggested to construct new questionnaires that capture distrust more effectively. Furthermore, to validate the interpretation of "Anger" as "Concentration" (an inference in this study), a subsequent study could combine Facial Coding with a Galvanic Skin Response (GSR) sensor. This would measure arousal levels and allow for an objective differentiation between simple concentration and actual frustration.

Third, research should move toward the validation of solutions through controlled experiments. It is proposed to create two versions of the website—one with a hidden refund policy and another with easy access from the main menu—to scientifically measure whether defensive design changes increase usability and business outcomes. Finally, a comparative Eye-Tracking study is suggested between the SME's website and that of a well-known multinational brand to determine if high risk-related anxiety (61% attention) is a problem specific to SMEs or a generalized trend in e-commerce.

Finally, it is proposed to replicate this study across a broader range of SMEs within different industries. Conducting multi-site validation studies would allow for a comparative analysis to determine if the behavioral patterns identified here are consistent across the sector. This would facilitate the development of generalizable frameworks for e-commerce acceptance that can be applied to the digital transformation of small and medium enterprises on a larger scale.

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