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ORIGINAL

Neuromarketing mixes its statistical analysis and Business Intelligence in the SMEs of the Province of Chimborazo- Ecuador

Neuromarketing mix su análisis estadístico y la Inteligencia de Negocios en las Mypimes de la Provincia de Chimborazo - Ecuador

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ABSTRACT

The objective of the study "Neuromarketing Mix and Business Intelligence in MSMEs in the Province of Chimborazo" is to investigate the intersection between the Neuromarketing Mix and Business Intelligence systems, with the aim of optimizing data collection by the BI DATA research team at the Escuela Superior Politécnica de Chimborazo (ESPOCH). This team aims to provide accurate information on the consumption of basic family food products, thereby supporting public institutions and MSMEs in the region in developing innovative strategies that strengthen their market position. The study focuses on addressing the limitations of the previously used data collection instrument, which did not consider emotional factors in respondents' responses, thereby introducing bias into the results. To improve the accuracy of data collection, advanced Neuromarketing technologies are incorporated, such as Face Coding biometric equipment, which allows the capture of respondents' real emotions during the survey process. This facilitates a more in-depth analysis of purchasing decisions, thereby reducing data bias. Adopting a mixed methodological approach that combines qualitative and quantitative analysis, the study evaluates how consumers' emotions and unconscious reactions influence their purchasing behavior. This perspective not only seeks to optimize MSMEs' marketing strategies, but also to improve their operational efficiency and foster economic growth in the region. The study's findings indicate that the integration of the Neuromarketing Mix with Business Intelligence significantly transforms data collection, providing more accurate and reliable information to ESPOCH's BI DATA team. This information will be shared free of charge with MSMEs in Chimborazo, thus contributing to improved decision-making and market positioning. Furthermore, the study highlights the relevance of these tools for analyzing spatial consumption patterns, generating valuable insights for the implementation of Neuromarketing technologies and Business Intelligence systems. In conclusion, the proposed integration is presented as a crucial element for successful data collection within a Business Intelligence system, improving accuracy and reducing bias in the data obtained by the ESPOCH BI DATA team, the results of which will benefit MSMEs and public institutions in the province of Chimborazo.

Keywords: Financial Management; Budget; Planning; Research; Resource Allocation; Budget Execution.

RESUMEN

El objetivo de estudio de el "Neuromarketing Mix y la Inteligencia de Negocios en las MIPYMES de la Provincia de Chimborazo" investiga la intersección entre el Neuromarketing Mix y los sistemas de Inteligencia de

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Negocios, con el propósito de optimizar la recolección de datos por parte del equipo de investigación BI DATA de la Escuela Superior Politécnica de Chimborazo (ESPOCH). Este equipo tiene como objetivo proporcionar información precisa sobre el consumo de productos de la canasta básica familiar, apoyando así a las instituciones públicas y a las MIPYMES de la región en el desarrollo de estrategias innovadoras que fortalezcan su posición en el mercado. El estudio se centra en abordar las limitaciones del instrumento de recolección de datos previamente utilizado, que no consideraba los factores emocionales en las respuestas de los encuestados, lo que introducía sesgos en los resultados. Para mejorar la precisión de la recolección de datos, se incorporan tecnologías avanzadas de Neuromarketing, como el equipo biométrico Face Coding, que permite capturar las emociones reales de los encuestados durante el proceso de encuesta. Esto facilita un análisis más profundo de las decisiones de compra, reduciendo así los sesgos en los datos. Adoptando un enfoque metodológico mixto que combina análisis cualitativo y cuantitativo, el estudio evalúa cómo las emociones y las reacciones inconscientes de los consumidores influyen en su comportamiento de compra. Esta perspectiva no solo busca optimizar las estrategias de marketing de las MIPYMES, sino también mejorar su eficiencia operativa y fomentar su crecimiento económico en la región. Los hallazgos del estudio indican que la integración del Neuromarketing Mix con la Inteligencia de Negocios transforma significativamente la recolección de datos, proporcionando información más precisa y confiable al equipo de BI DATA de la ESPOCH. Esta información será compartida de manera gratuita con las MIPYMES de Chimborazo, contribuyendo así a la mejora en la toma de decisiones y al posicionamiento en el mercado. Además, el estudio subraya la relevancia de estas herramientas para el análisis de patrones de consumo espacial, generando insights valiosos para la implementación de tecnologías de Neuromarketing y sistemas de Inteligencia de Negocios. En conclusión, la integración propuesta se presenta como un elemento crucial para el éxito en la recolección de datos dentro de un sistema de Inteligencia de Negocios, mejorando la precisión y reduciendo los sesgos en los datos obtenidos por el equipo de BI DATA de la ESPOCH, cuyos resultados beneficiarán a las MIPYMES e instituciones públicas de la provincia de Chimborazo.

Palabras clave: Gestión Financiera; Presupuesto; Planificación; Investigación; Asignación de Recursos; Ejecución Presupuestaria.

INTRODUCTION

In a globalized and competitive environment, micro, small, and medium enterprises (MSMEs) must adapt to the changing needs of the market and the expectations of consumers. By analyzing emotions and purchasing decisions, Neuromarketing has established itself as an essential tool for understanding consumer behavior. The combination of Neuromarketing with business intelligence strategies allows MSMEs not only to capture the attention of their customers but also to establish more lasting relationships.

This study, entitled "Neuromarketing Mix and Business Intelligence in MSMEs in the Province of Chimborazo," explores how the integration of Neuromarketing into business intelligence systems can transform data collection and analysis, focusing on the consumption of products from the basic family shopping basket. The province of Chimborazo offers an ideal setting to investigate how MSMEs can benefit from advanced methodologies that allow them to understand their customers' needs better.

The BI DATA research team at ESPOCH seeks to overcome the limitations of traditional data collection methods, which often ignore the role of emotions in purchasing decisions. This study uses advanced technologies such as biometric Face Coding equipment to capture authentic emotional reactions and offer a deeper understanding of consumer behavior. Combining qualitative and quantitative analysis seeks to evaluate the impact of emotions on purchasing decisions.

The findings of this research have the potential to transform the marketing strategies of MSMEs in Chimborazo, facilitating more informed decision-making based on accurate data. This will improve data collection and enable the design of personalized and effective marketing strategies, demonstrating the importance of integrating Neuromarketing with business intelligence for business success in the digital age.

Problems

Chimborazo's MSMEs face significant challenges in accessing and adopting business intelligence systems, which are mainly limited by resources. This situation has led to a dependence on traditional approaches, such as surveys, which lack detailed analysis and often fail to integrate aspects of neuroscience crucial to understanding consumer behavior. The lack of integration between neuromarketing and business intelligence has resulted in generic research that does not address the particularities of the population, which has limited the quality of the information collected.

Therefore, the question of implementing a neuromarketing mix in the business intelligence of MSMEs in Chimborazo arises. The lack of this fusion has made a contextualized evaluation difficult and has led to the

generation of studies that ignore the psychological complexities in research. Thus, there is a need to identify solutions that overcome these limitations, allowing the effective incorporation of neuromarketing elements into business intelligence systems, improving the quality of business analysis, and facilitating strategic decision-making based on a deeper understanding of consumer emotional and cognitive responses.

METHOD

The research was quasi-experimental, as interventions were carried out with biometric equipment without altering the study variables. A cross-sectional design was used, with the research being carried out in a single session. In addition, an analytical-synthetic method was applied to handle the large amount of data collected, facilitating its analysis and interpretation. This approach allowed for an in-depth understanding of how the Neuromarketing Mix influences Business Intelligence in MSMEs, obtaining insights into consumer preferences for essential products. A mixed approach was adopted to integrate quantitative and qualitative data, facilitating a deeper understanding of the subject. The quantitative information was obtained using visual tracking equipment from surveys, while the qualitative information was collected from experts' narratives in a Focus Group.

RESULTS

Table 1 below presents the comments and conclusions derived from the Focus Group conducted.

Table 1. Comments, discussions and conclusions of the Focos Group

	Question	Comments	Conclusion
1	¿ Do you know about the products that make up the basic family shopping basket?	The participants in the Focus Group showed varying degrees of knowledge about the products that make up the basic family shopping basket. Most recognized the presence of items such as dairy products, rice, oil and other everyday products. Although some did not know all the specific products, there was a consensus that these should be basic necessities, essential for daily sustenance.	Although there was widespread recognition of the importance of the products in the basic basket, there was room for improvement in the detailed understanding of the specific items. The discussion highlighted the need to clarify and promote awareness of the products that make up the basic family basket. This deeper knowledge could empower informed decision-making about purchases and spending, thus contributing to the effective management of family resources.
2	What is your general perception of the quality of the products included in the basic family shopping basket?	The participants' perceptions of the quality of the products in the basic family shopping basket varied. The influence of the brand on the perception of quality was highlighted, with some participants considering that there were companies that offered cheaper products, but of lower quality. In addition, there was a complex relationship between price and quality, with some participants suggesting that, in general, people looked for quality products, but that price could sometimes influence the choice.	The quality of the products in the basic family shopping basket was perceived in different ways, influenced by factors such as the brand, the place of purchase and the relationship between price and quality. The conclusion highlighted the need for greater consumer awareness and education about the relationship between these elements. It also emphasized the importance of considering the economic diversity of consumers and how it influences their purchasing decisions. Improved understanding of these factors could contribute to more informed choice and the promotion of quality products in the basic shopping basket.
3	Are you aware that there are categories of products in the basic family shopping basket?	Participants showed a general understanding of the existence of categories in the basic family shopping basket, although most had a superficial and undifferentiated knowledge of these categories. Some mentioned specific products such as bread, cereal and coffee, but most did not have a detailed knowledge of the categories that made up the basic shopping basket.	Although some participants recognized common products, the lack of detailed knowledge suggested the need for information campaigns that provide details about the various categories. A deeper understanding of these categories could help consumers make more informed decisions when selecting essential products for their daily needs.
4	Can you identify specific products within the basic family shopping basket that you consider essential or preferable?	The participants showed a general awareness of specific products that they considered essential or preferred within the basic family shopping basket. Items such as dairy products (milk, cheese), eggs, meat, bread, cereals, legumes and vegetables stood out. There was a certain consistency in the responses, indicating that these products were perceived as fundamental by the participants in the context of the basic shopping basket.	The conclusion emphasized the consistency in the perception of essential or preferred products within the basic basket, such as dairy products, eggs, meats, bread and cereals. The diversity of preferences highlighted the need for a flexible basic basket adapted to individual needs. This data could be valuable for the planning and management of policies related to the basic family basket, ensuring the inclusion of essential items and consideration of the population's food preferences.

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6	How does the price of products in the basic family shopping basket affect your purchasing decision?	The participants' responses underlined the importance of price in the decision to purchase the basic family shopping basket. There was a general consensus that price significantly influenced purchasing decisions, and several participants highlighted the direct relationship between price and quality. The preference for shopping at markets due to lower prices and fresher products compared to supermarkets was mentioned.	The conclusion emphasized the centrality of price in the decision-making process of purchasing the basic family basket. The preference for affordable and fresh products was evident, and the choice between supermarkets and markets depended to a large extent on the perceived relationship between price and quality. The variability in decisions based on purchasing power highlighted the importance of considering the different economic realities of families and couples when developing marketing strategies and pricing policies for basic products.
10	How does the accessibility and availability of the basic family shopping basket affect your purchasing decisions?	Participants highlighted the significant influence of accessibility and availability on their purchasing decisions for the basic family shopping basket. The availability of products in nearby places was perceived as a key factor, and the lack of accessibility or variety could lead to the search for alternatives or the limitation of options.	The conclusion emphasized the crucial importance of accessibility and availability in past purchasing decisions for the basic family shopping basket. Lack of access to nearby options could limit consumer choices and affect the availability of specific products. These insights highlighted the past need for efficient distribution and an adequate variety of essential products to meet the needs of consumers in diverse locations.
11	Do you prefer to buy products from the basic family shopping basket in specific shops or do you use several places for your shopping?	The participants expressed a preference for not limiting themselves to a single shop when purchasing products from the basic family shopping basket. Instead, they chose to explore different places in search of the best quality. The general trend was towards flexibility in purchasing options, prioritizing quality over loyalty to a single shop.	The conclusion emphasized the past preference of the participants for not limiting themselves to a single store when purchasing products from the basic family shopping basket. Flexibility and the search for quality were determining factors in the choice of multiple shopping locations. This gave us a clearer view, highlighting the importance of offering variety and quality in different establishments to satisfy the changing preferences and needs of consumers in the past.
12	How does geographical location influence your choice of where to buy basic food products?	Participants emphasized the significant influence of geographical location on their past decisions about where to buy basic goods. Familiarity with certain places and the perception of quality varied according to location, which directly affected participants' choices.	The conclusion underlined the importance that geographical location had in the past on purchasing decisions for basic food items. Familiarity with specific places, availability and trust were key factors influencing the participants' choices. These insights highlighted the need to understand local dynamics and perceptions of quality in different locations in order to adapt marketing strategies and meet the specific needs of consumers.
16	How do promotions and discounts influence your decision to buy basic food items?	The participants unanimously stated that promotions and discounts do influence their purchasing decisions regarding basic food items. The concise and affirmative response from all the participants suggests that offers and discounts are determining factors in purchasing decisions in this context.	In conclusion, the unanimous response of the participants underlined the critical importance of promotions and discounts in the decision to purchase basic goods. This conclusion reinforced the idea that promotional strategies were effective and meaningful for consumers when considering essential products. These insights highlighted the relevance of implementing attractive pricing strategies to meet the expectations and needs of consumers in the basic goods market.
17	Are you influenced by specific advertising campaigns when choosing products from the basic family shopping basket?	The participants stated that specific advertising campaigns do not significantly influence their decisions when choosing products from the basic family shopping basket. Most perceive that companies do not focus much attention on campaigns for these essential products, as they trust in their constant demand. Instead, the importance of strategies such as promotions, discounts and offers visible in various media is highlighted.	In conclusion, the unanimous opinion of the participants emphasized that specific advertising campaigns were not decisive in the choice of products in the basic family shopping basket. Confidence in the constant demand for these products and greater attention to pricing strategies and promotions indicated the need for marketing approaches adapted to the essential nature and consumer perception of these products. These insights suggested that conventional advertising strategies might not be the main influence in this specific purchasing context.
19	What do you know about business intelligence?	The participants in the Focus Group demonstrated a general understanding that business intelligence involves using data to improve decision-making and design more	

		effective strategies. Although some had limited prior knowledge, all recognized the importance of data collection to improve business decision-making.	
20	Why do you think business intelligence is important?	Focus group participants expressed a clear understanding of the retrospective importance of business intelligence (BI). In their responses, they highlighted its value in improving business strategies, optimizing time through the collection of accurate data, and ensuring efficiency in decision-making. The connection between BI and improved product visibility was also mentioned, indicating a positive perception of the comprehensive usefulness of business intelligence.	In conclusion, the participants in the Focus Group retrospectively emphasized the importance of business intelligence in improving strategies, optimizing time through accurate data and making decisions based on technical expertise. The discussion strengthened the positive perception of BI as a key element for business efficiency.
21	Do you think data is important in business?	All the participants showed a clear consensus in stating that they considered data to be fundamental elements in business. The unanimity of the responses indicates a shared perception of the crucial importance of data in the business world.	The unanimity of the responses during the Focus Group reflects a clear awareness among the participants of the past importance of data in business.

DISCUSSION

Analysis of the data obtained from the focus group has made it possible to identify crucial elements in consuming essential food basket products, revealing significant heterogeneity in consumer knowledge of these products. This variability in perception suggests that, although there is a general understanding, the depth of knowledge about specific products can have a decisive influence on purchasing decisions. This finding underlines the need for further research into how individual perceptions affect consumer behavior. This could offer micro, small, and medium-sized enterprises (MSMEs) a competitive advantage when adapting their marketing and communication strategies.

The results also indicate that price and accessibility are key to purchasing decisions. Flexibility in the choice of points of sale highlights the importance of an efficient and adaptive distribution strategy. In this context, MSMEs must consider not only price competitiveness but also the optimization of their logistics and supply chain to guarantee the freshness and availability of their products. Participants› positive response to promotions and discounts emphasizes the role of pricing strategies in attracting consumers while suggesting that the effectiveness of advertising campaigns could be improved by aligning more closely with the expectations and needs of the target audience.

Participants' limited experience with business intelligence platforms indicates a significant opportunity for MSMEs to integrate these tools into their operations. Adopting business intelligence systems could facilitate a more rigorous analysis of consumption patterns, allowing companies to adapt their offerings more effectively. Likewise, implementing strategies based on neuromarketing can enrich the understanding of consumers' emotions and subconscious responses, a fundamental aspect often overlooked in traditional marketing approaches.

As evidenced in this study, the Neuromarketing Mix is presented as an innovative approach that can complement business intelligence strategies. The incorporation of sensory stimuli in the design of marketing campaigns, as suggested by Flores (2022) and Casa (2022), could improve the consumer experience and encourage more favorable purchasing decisions. Furthermore, the findings of Morales et al (2020) reinforce the idea that purchasing decisions are not only rational processes but are deeply influenced by emotional factors.

The combined use of business intelligence and neuromarketing, as suggested in the work of Viteri et al. (2021), provides a robust framework for analyzing consumption patterns and optimizes MSMEs' ability to align with their consumers' emotional needs. This synergy between the two strategies represents a comprehensive solution that could be fundamental for MSMEs to face the challenges of today's market, characterized by its dynamism and fierce competition.

Finally, this study validates existing theories on Neuromarketing and Business Intelligence. It demonstrates their applicability in a real-world context, offering a clear path for MSMEs in Chimborazo to adapt their strategies to an ever-evolving market environment. This proactive approach could open up new opportunities and strengthen the sustainability of these companies in an increasingly competitive business landscape.

CONCLUSIONS

The study shows that the Neuromarketing Mix improves data collection in business intelligence systems, especially in analyzing consumption patterns, by overcoming the limitations of traditional surveys. Unlike the

conventional methods used by ESPOCH's BI DATA, which emotional and contextual factors can influence, the Neuromarketing Mix allows for creating more accurate and valid surveys.

The Face Coding technique, which evaluates emotions through facial expressions, has been successfully integrated into the BI DATA system, enriching the reliability of the data collected. This methodology helps to identify and mitigate biases in survey responses, providing a more authentic view of consumer behavior and allowing for adjustments in data collection.

In summary, the implementation of the Neuromarketing Mix in ESPOCH's BI DATA represents a significant advance in the analysis of consumption patterns in Chimborazo. It improves the quality of information and facilitates effective marketing strategies for MSMEs, public institutions, and other beneficiaries. This contributes to a deeper understanding of consumer needs, strengthening local competitiveness.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest

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ANNEXES

Data collection

As can be seen in figure 1, the quasi-experiment carried out in this research using the Face Reader biometric equipment yielded a large amount of data, which comes from the test subjects' completion of the survey, the same survey that was used by the ESPOCH research team to collect information regarding the consumption of products in the basic family shopping basket.

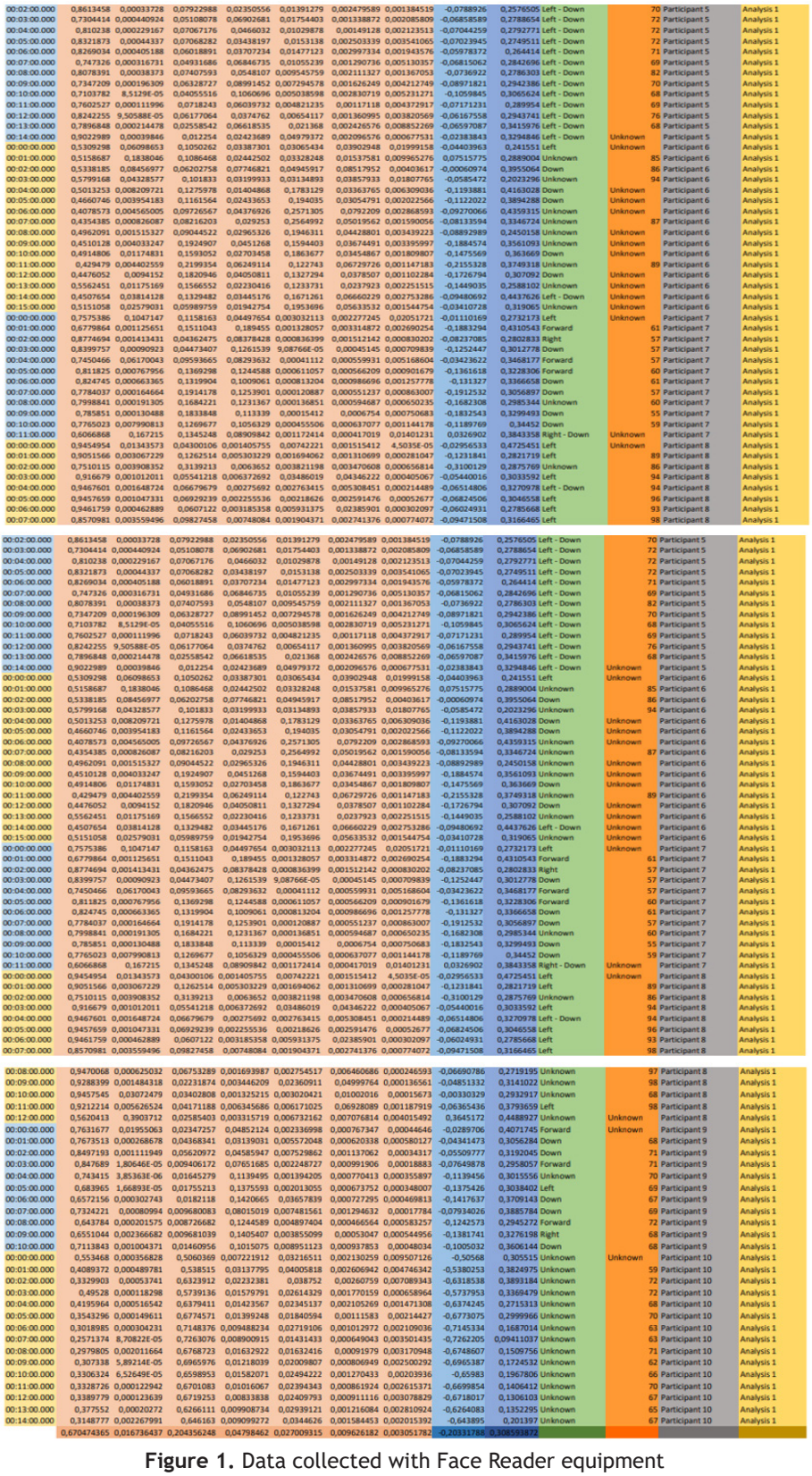

Figure 1. Data collected with Face Reader equipment

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Analysis and interpretation of the data collected by the biometric Face Reader device

FaceReader, an advanced tool for analyzing facial expressions in its ninth version, facilitated extracting and analyzing data from a study with 10 participants. This study focused on evaluating the emotional reactions triggered by a survey aimed at exploring the consumption of products from the basic family shopping basket, with the specific objective of identifying the threshold from which the subjects begin to experience stress. The findings obtained through this analysis provided significant insights, revealing the precise moments when participants showed apparent signs of discomfort, fatigue, or anxiety.

The methodology used made it possible to determine the specific points within the survey that were stressful for the respondents through the analysis of facial expressions. This information is of great value, as it improves the elaboration of future surveys. The objective is to design data collection instruments that generate more accurate results and minimize the biases associated with the emotional response to stress in the participants. To achieve this end, it was considered essential to adopt a research structure that meticulously addressed the following dimensions, which are shown in the table 2.

Table 2. description of variables

Country	Description
Video time	Video timestamp
Neutral	Proportion of neutral facial expression detected at each moment
Happy	Proportion of happy facial expression detected at each moment
Sad	Proportion of sad facial expression detected at each moment
Angry	Proportion of angry facial expression detected at each moment
Surprised	Proportion of surprised facial expression detected at each moment
Scared	Proportion of scared facial expression detected at each moment
Disgusted	Proportion of disgusted facial expression detected at each moment
Valencia	A measure of the positivity or negativity of the emotion experienced
Excitement	A measure of emotional activation or arousal
Direction of gaze	Direction of the participant's gaze
Heart rate	Participant's heart rate
Participant's name	Participant's name
Analysis index	Analysis index or session to which the data belong

Each participant showed a unique pattern of emotional response over time, with variations in negative emotions, valence, arousal and changes in heart rate. To better understand the values, a data dictionary was created, which is shown below in the table 3.

Table 3. data dictionary

Column	Range of Values	Description
Neutral	0 a 1	A value close to 1 suggests a neutral facial expression or one with no obvious emotions.
Happy	0 a 1	Values close to 1 indicate a strong presence of smiles or expressions of joy.
Sad	0 a 1	Higher values indicate a greater expression of sadness, characterized by gestures such as frowning or downturned lips.
Angry	0 a 1	Higher values suggest facial expressions of anger, such as furrowed brows or intense stares.
Surprised	0 a 1	High values are associated with facial features of surprise, such as open eyes and mouth.
Scared	0 a 1	A high value indicates facial expressions of fear or fright.
Disgusted	0 a 1	Higher values indicate a clear expression of disgust, such as wrinkles on the nose or raising of the upper lip.
Valencia	-1 a 1	Positive values indicate positive emotions; negative values, negative emotions.
Excited	0 a 1	Higher values indicate greater arousal or alertness.
Heart rate	Numeric	An increase may indicate stress, excitement or physical activity.

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As demonstrated in table 4, the moments of greatest stress varied significantly between participants, reflecting individual differences in the perception of the stimulus or resistance to stress. For example, some participants showed signs of stress from the beginning of the survey, while others experienced these signs later.

Table 4. arousal of the participants

Participant	Arousal at the Start	Arousal in the Middle	Arousal at the End
Participant 1	0,258	0,276	0,295
Participant 2	0,335	0,291	0,314
Participant 3	0,425	0,290	0,378
Participant 4	0,394	0,313	0,364
Participant 5	0,294	0,284	0,329
Participant 6	0,242	0,245	0,319
Participant 7	0,273	0,337	0,384
Participant 8	0,473	0,279	0,449
Participant 9	0,407	0,304	0,361
Participant 10	0,306	0,094	0,201

On the other hand, the correlations revealed significant data between Arousal and various emotions, highlighting how emotional activation is interrelated with specific emotional responses in the participants. A strong and positive correlation between Arousal and anger indicated that situations that generated anger also elevated emotional arousal, reflecting an intense emotional response. Likewise, it was observed that negative emotions, such as sadness, were associated with an increase in Arousal, underlining how emotional activation intensified in response to negative experiences.

The following graph showed the variability and the trend towards increased disgust among participants as they progressed through the survey. Each point represented an instantaneous measurement of disgust, and the line connecting these points indicated an overall trend towards an increase in this emotion, as shown in figure 2.

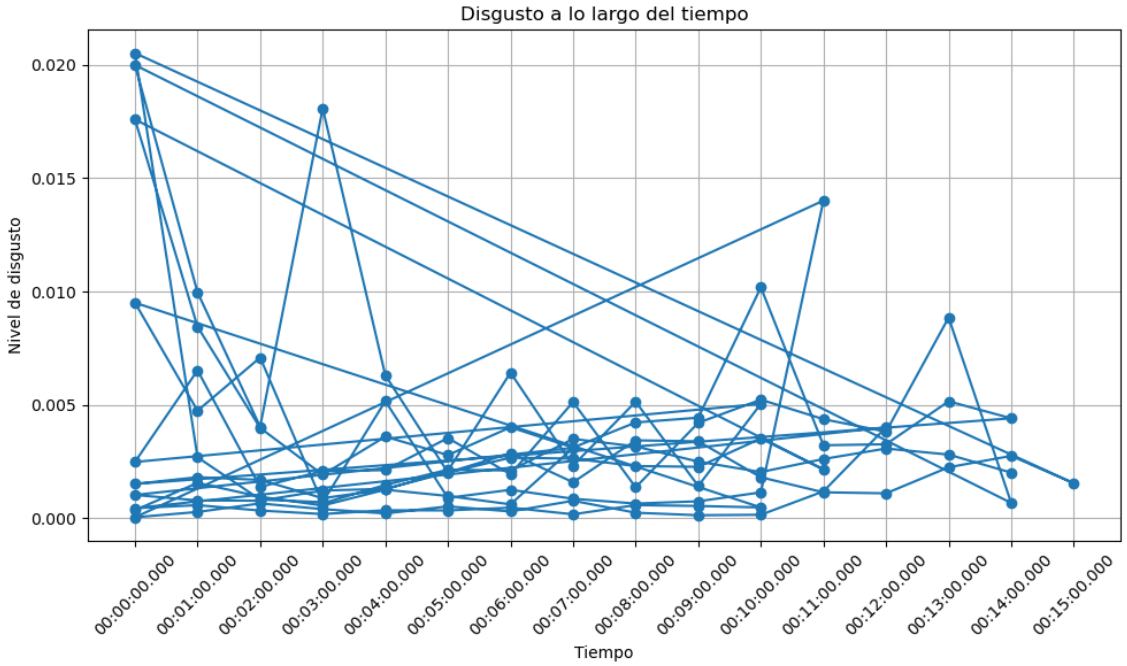

Figure 2. Variability and increasing trend in the level of dislike among participants as they progressed through the survey

The analysis of disgust about time revealed several essential aspects. At the beginning of the survey, it was observed that some participants already showed varying levels of disgust, which could suggest emotional predispositions that influenced how they approached the study from the start. During the survey, peaks of disgust were identified that could be correlated with specific questions or sections that were particularly aversive for the participants. Likewise, decreases in levels of disgust were noted, which could indicate questions or sections perceived as less stressful or moments when participants may have taken a break or recovered from a previous question.

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In his book "The Face of Emotions," Ekman (2013) argued that increases in levels of disgust could be associated with specific microexpressions detected by the Face Reader, reflecting an automatic emotional response to harmful stimuli present in the survey content. According to Ekman, these microexpressions are quick and often go unnoticed without specialized training, indicating an immediate reaction to the questions asked. Ekman's theory of the universality of facial expressions would imply that the detected disgust would be similar among individuals, reflecting its innate nature.

There was also a significant correlation between Arousal and Valence, which indicated that as emotional experiences became more negative, the level of Arousal tended to increase. This showed that emotions or situations perceived as negative or stressful provoked a more fantastic emotional activation response in individuals.

As shown in figure 3, the following graph provided a general overview of how Valence and Arousal were altered throughout the experiment.

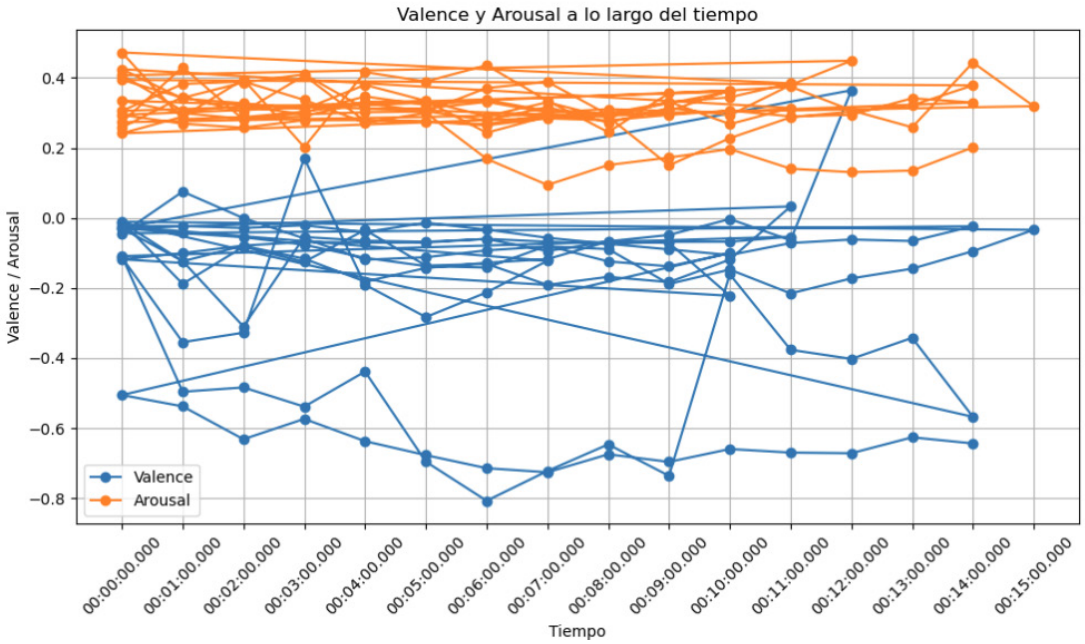

Figure 3. Variability and increasing trend in the level of dislike among participants as they progressed through the survey

The downward trend in emotional valence indicated that the positive emotional perception of the respondents decreased over time, which could reflect a negative emotional response to the content or structure of the survey. In his book, Ekman (2013) mentioned that negative emotions could be identified through micro facial expressions, suggesting that participants could be experiencing emotions such as discontent, boredom, or disgust as the survey progressed.

Table 5. Time of strongest negative valence

Participant	Time of the most negative Valence	Valence Value
Participant 1	00:01:00	-0,354729
Participant 10	00:07:00	-0,726221
Participant 2	00:08:00	-0,073931
Participant 3	00:06:00	-0,807519
Participant 4	00:10:00	-0,222379
Participant 5	00:00:00	-0,118182
Participant 6	00:11:00	-0,215533
Participant 7	00:07:00	-0,191253
Participant 8	00:02:00	-0,310013
Participant 9	00:06:00	-0,141764

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In terms of activation, fluctuations could be interpreted as variations in emotional intensity. An initial increase followed by a decrease suggested that respondents began the survey with some level of interest or anticipation, which faded as they continued. Ekman links high activation levels with intense positive and negative emotions. The decrease in activation may have reflected a drop in emotional intensity, possibly due to fatigue or monotony.

The causes of the decrease in valence and activation included cognitive fatigue, as the prolonged burden of responding to the survey could lead to exhaustion that affects emotional perception. The study's design also played a role where poorly structured, repetitive, or confusing questions could contribute to a negative experience involving valence and emotional activation. In addition, content that did not engage respondents or lacked personal relevance could lead to a decrease in both measures.

As shown in table 5, by analyzing the values of each individual (see ANNEX), the moment in which each participant experienced the strongest negative feelings was determined based on the most negative Valence value recorded.

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