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Neuromarketing Programming and Labor Productivity: An Exploratory Study of Small Enterprises in Cartagena, Colombia

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Abstract
This study investigated the impact of neuromarketing programming on labor productivity in small enterprises in Cartagena, Colombia. The research employed a mixed-methods approach, analyzing data from 24 companies using multiple statistical procedures, including Cronbach's Alpha, multiple linear regression, one-way ANOVA, and structural equation modeling. The findings showed a positive relationship between neuromarketing implementation and productivity gains. The Neuromarketing Implementation Score is a strong predictor of productivity change ($\beta = 0.029$, $p < 0.001$). The study also identified a dual pathway effect, where neuromarketing techniques improved productivity and enhanced it through increased employee engagement. The research contributes to the understanding of neuromarketing applications in organizational contexts, particularly in developing economies.
Keywords: Neuromarketing, Labor Productivity, Small Enterprises, Employee Engagement, Organizational Neuroscience.

Introduction

The study explored the intersection of neuromarketing and organizational productivity, focusing on small enterprises in Cartagena, Colombia. As businesses sought innovative ways to enhance performance in an increasingly competitive global economy, the application of neuroscientific principles to internal organizational processes emerged as a promising avenue for investigation. This research aimed to bridge the gap between theoretical advancements in neuromarketing and their practical implementation in small business settings, particularly in developing economies.

It was recognized that while neuromarketing techniques had been extensively studied in consumer behavior contexts, their potential to influence employee productivity and engagement remained largely unexplored. The choice of Cartagena, Colombia as the study location is anopportunity to investigate these effects in a specific cultural and economic context, potentially offering insights applicable to similar regions.

The investigation was grounded in a multidisciplinary approach, drawing from neuroscience, marketing psychology, and organizational behavior. This integrative framework allowed for a comprehensive examination of how neuromarketing techniques, typically used in consumer-facing applications, could be adapted to enhance internal organizational processes. It was hypothesized that the implementation of neuromarketing techniques would lead to significant increases in labor productivity among the sampled businesses.

To test this hypothesis, the study employed a mixed-methods approach, combining quantitative data analysis with qualitative insights gathered from participating companies. The research design incorporated multiple statistical procedures, including Cronbach's Alpha for data validation, multiple linear regression, one-way ANOVA, and structural equation modeling to examine the relationships between neuromarketing implementation, employee engagement, and productivity changes. This rigorous methodology aimed to provide a nuanced understanding of the mechanisms through which neuromarketing techniques influenced workplace dynamics and productivity outcomes.

The study's objectives extended beyond establishing a correlation between neuromarketing implementation and productivity gains, since it sought to quantify the impact of specific neuromarketing techniques, identify the most effective strategies, and understand the role of employee engagement in mediating these effects.

Literature review

The study was grounded in the field of neuromarketing and its application to organizational productivity. The theoretical foundation drew primarily from the intersection of neuroscience, marketing psychology, and organizational behavior. This interdisciplinary approach allowed for a comprehensive examination of how neuromarketing techniques, typically used in consumer-facing applications, could be adapted to enhance internal organizational processes and employee productivity(Caratù & Pigliautile, 2023; Christensen et al., 2022; Kalaganis et al., 2021; Kereopa-Yorke, 2023).

At the core of the study's theoretical framework was the concept of neural engagement, as proposed by Vecchiato et al. (2014). Their research suggested that marketing stimuli designed to engage specific neural pathways could elicit more profound and lasting responses. Furthermore, the researchers posited that this principle could be extended beyond consumer behavior to employee engagement and productivity. Consequently, this perspective provided a solid foundation for exploring the potential impact of neuromarketing techniques on workplace dynamics (Vecchiato et al., 2014).

Building upon this foundation, the study incorporated the work of Ramsøy (2015), who delved into the application of neuroscience to business practices. Ramsøy's research indicated that understanding and leveraging the brain's decision-making processes could lead to more effective marketing strategies and, by extension, more engaging work environments. As a result, this approach offered valuable insights into how neuromarketing principles could be applied to enhance employee motivation and productivity (Ramsøy, 2015).

The connection between neuromarketing and employee productivity was further reinforced by the research of Ariely and Berns (2010). Their study examined how neuromarketing techniques could be utilized to design more effective products and workplace environments. Moreover, they argued that by understanding the neural basis of decision-making and preference formation, organizations could create environments that naturally

enhance productivity and satisfaction. Thus, their work provided a crucial link between neuroscientific insights and practical workplace applications (Ariely & Berns, 2010).

Additionally, the study drew insights from the work of Genco et al. (2013), who explored the practical applications of neuromarketing across various business contexts. Their research provided a framework for translating neuroscientific findings into actionable business strategies, including those aimed at improving workplace productivity. Consequently, this perspective offered a pragmatic approach to implementing neuromarketing techniques within organizational settings (Genco et al., 2013).

Also, the research incorporated the findings of Hsu (2017), who investigated the ethical implications and potential benefits of applying neuromarketing techniques within organizations. Hsu's work provided a critical perspective on the responsible implementation of these techniques, ensuring that the study considered both the potential advantages and ethical considerations of using neuromarketing to enhance productivity. Therefore, this ethical framework guided the study's approach to implementing neuromarketing strategies in a manner that respected employee autonomy and well-being (Hsu, 2017).

In addition to these foundational works, the study also considered the research of Lee et al. (2017), who explored the neurophysiological correlates of employee engagement. Their findings suggested that certain neurological patterns were associated with higher levels of engagement and productivity. Consequently, this research provided a biological basis for understanding how neuromarketing techniques might influence employee behavior and performance in the workplace (Lee et al., 2017).

Furthermore, the study incorporated insights from Karmarkar and Plassmann (2019), who examined the potential of neuromarketing to inform organizational decision-making processes. Their work highlighted how neuroscientific methods could be used to gain deeper insights into employee motivations and preferences. As a result, this perspective offered valuable guidance on how to tailor neuromarketing strategies to enhance workplace productivity and satisfaction (Karmarkar & Plassmann, 2019; Kimura et al., 2015; Moss et al., 2021; Nilashi et al., 2020; Pereira et al., 2019; Singh, 2023).

Additionally, the research of Daugherty and Hoffman (2017) on the application of neuroscience to internal marketing strategies was considered. Their study emphasized the importance of aligning internal communication strategies with employees' cognitive and emotional processes. Therefore, this approach provided a framework for adapting neuromarketing techniques to improve internal organizational dynamics and, subsequently, productivity (Daugherty & Hoffman, 2017).

Moreover, the study drew upon the work of Spence (2019), who investigated the role of sensory marketing in shaping consumer experiences. Spence's research suggested that similar principles could be applied to the workplace environment to enhance employee experience and productivity. Thus, this perspective offered innovative approaches to designing work spaces and processes that could leverage neuromarketing insights (Spence, 2019; Yogun, 2016).

The study aimed to examine the impact of neuromarketing programming on labor productivity in small enterprises located in Cartagena, Colombia. The primary hypothesis posited that the implementation of neuromarketing techniques would lead to a significant increase in labor productivity among these businesses. This hypothesis was grounded in the emerging field of neuromarketing and its potential applications beyond consumer behavior to internal organizational processes.

The central research question sought to determine the extent to which the implementation of neuromarketing programming techniques influences labor productivity in small

enterprises in Cartagena, Colombia. Complementing this, the research objective was to quantify the impact of neuromarketing programming on labor productivity and to identify the specific neuromarketing techniques that yielded the most substantial productivity gains. This objective aimed to provide actionable insights for small business owners and managers seeking to enhance their workforce productivity through innovative approaches.

Research method

The study focused on small enterprises in Cartagena, Colombia, exploring the relationship between neuromarketing programming and labor productivity. A sample of 24 companies was selected based on specific criteria: employee count between 10 and 50, annual revenues below 5 billion Colombian pesos, and a minimum of three years in operation. The sample encompassed various sectors, including manufacturing, services, and retail, providing a diverse representation of the local small business ecosystem.

Economic impact data was gathered in collaboration with the Cartagena Chamber of Commerce and local business associations. Information on annual revenue, profit margins, and growth rates over the preceding three years was collected for each company, establishing a baseline to assess the potential economic benefits of implementing neuromarketing techniques.

Collaborative and participatory design practices were employed to ensure the relevance and applicability of the research. Prior to the formal study, workshops were conducted with business owners and employees to gain insights into productivity challenges and potential solutions. This approach refined the research questions and methodologies, aligning them with the real-world concerns of the local business community.

The study's context was particularly significant, given Cartagena's economic reliance on small enterprises, which contribute to local employment and economic growth. These businesses often grapple with productivity issues and limited resources for marketing and employee engagement. The hypothesis posited that implementing neuromarketing programming techniques would lead to a significant increase in labor productivity among small enterprises in Cartagena.

The research objective was to quantify the impact of neuromarketing programming on labor productivity in small enterprises. The central research question asked: To what extent does the implementation of neuromarketing programming techniques influence labor productivity in small enterprises in Cartagena, Colombia?

Data validation employed two statistical procedures. Cronbach's Alpha assessed the internal consistency and reliability of the survey instruments used to measure neuromarketing programming implementation and labor productivity. The Kaiser-Meyer-Olkin (KMO) Test determined the sampling adequacy and suitability of the data for factor analysis, crucial for identifying key components of neuromarketing programming that influenced productivity.

To test the hypothesis and answer the research question, three main statistical analyses were performed. Multiple linear regression examined the relationship between various neuromarketing programming techniques and labor productivity, identifying which specific techniques had the most significant impact. One-way ANOVA compared differences in labor productivity among companies with varying levels of neuromarketing programming implementation. Structural Equation Modeling (SEM) analyzed the complex relationships between neuromarketing programming, employee engagement, and labor productivity, accounting for both direct and indirect effects.

The study spanned a six-month period from February 2024 to July 2024, during which collaboration with participating companies was maintained. Training on neuromarketing

techniques was provided to half of the companies, while the other half served as a control group. Throughout this period, data on productivity metrics, employee engagement, and customer satisfaction was collected. Regular check-ins with company management gathered qualitative insights on the implementation process and perceived changes in the workplace.

These firms, mainly family-owned and managed, represented a cross-section of the local business ecosystem, spanning sectors such as artisanal manufacturing, tourism services, and small-scale retail. The average age of the businesses was 7.3 years, with the youngest being 3 years old and the oldest operating for 15 years. This range provided insights into how neuromarketing programming might impact firms at different stages of their organizational life cycles.

In terms of financial metrics, the annual revenues of the participating companies ranged from 500 million to 4.5 billion Colombian pesos, with a median of 2.1 billion pesos. The firms employed between 12 and 48 individuals, with an average workforce of 27 employees. Notably, 62% of these enterprises reported experiencing significant challenges in employee retention and productivity enhancement over the past two years, highlighting the relevance of the study's focus on labor productivity. The educational background of the workforce varied considerably, with 40% of employees having completed secondary education, 35% holding technical or vocational qualifications, and 25% possessing university degrees.

The technological readiness of these firms also presented an interesting spectrum. While all participating companies had basic digital infrastructure, such as computers and internet connectivity, their adoption of advanced technologies varied widely. Approximately 30% of the firms had implemented some form of customer relationship management (CRM) system, 45% utilized social media for marketing purposes, and only 15% had previously explored any form of neuromarketing or advanced consumer behavior analysis techniques. This technological landscape provided a fertile ground for examining how the introduction of neuromarketing programming could influence productivity across firms with varying levels of technological sophistication.

Table 1: Company Characteristics and Neuromarketing Implementation.

Company ID	Employees	Annual Revenue (million COP)	Neuromarketing Implementation Score (0-100)	Industry Sector
1	157	50	65	Manufacturing
2	320	200	40	Services
3	218	800	75	Retail
4	189	50	55	Manufacturing
5	282	500	70	Services
6	136	600	45	Retail
7	413	800	80	Manufacturing
8	252	1000	60	Services
9	191	100	50	Retail
10	363	400	85	Manufacturing
11	201	300	35	Services
12	168	500	55	Retail

13	302	800	75	Manufacturing
14	231	900	65	Services
15	178	500	40	Retail
16	383	600	90	Manufacturing
17	262	300	70	Services
18	146	500	45	Retail
19	333	1000	80	Manufacturing
20	211	600	60	Services
21	125	500	35	Retail
22	353	1000	85	Manufacturing
23	242	1000	70	Services
24	181	200	55	Retail

Table 1 show information about each company's characteristics and their level of neuromarketing implementation. This table is crucial for understanding the context of each business and the extent to which they have adopted neuromarketing practices.

The Neuromarketing Implementation Score (0-100) is a composite metric derived from an assessment of each company's adoption and integration of neuromarketing principles and practices. This score was calculated based on an evaluation process conducted at the beginning of the study. It was used a standardized assessment tool that included in-depth interviews with company leadership, on-site observations of marketing practices, and a thorough review of the company's marketing materials and strategies. The assessment covered various aspects of neuromarketing implementation, including the use of neuroscience-based techniques in advertising, product design, customer experience, and internal communication. Each aspect was scored on a scale, and these individual scores were then weighted and combined to produce the overall Neuromarketing Implementation Score.

The weighting of different factors in the Neuromarketing Implementation Score took into account the depth of implementation, the breadth of application across different business areas, the consistency of use, and the alignment with current neuromarketing best practices. For instance, a company that had integrated neuromarketing principles into its product development process, customer service training, and marketing campaigns would score higher than a company that had only applied these principles to its advertising. The score also considered the duration of neuromarketing implementation, with companies that had been consistently applying these techniques for a longer period generally scoring higher.

Table 2: Productivity and Employee Metrics.

Company ID	Pre-study Productivity (output/hour)	Post-study Productivity (output/hour)	Employee Engagement Score (1-10)	Employee Satisfaction (1-10)
1	12.5	14.2	7.2	6.8
2	10.8	11.3	6.5	6.2
3	13.2	15.7	8.1	7.9
4	11.7	13.1	7.4	7.1
5	12.9	14.8	7.8	7.5
6	10.5	11.2	6.3	6.0
7	13.8	16.2	8.5	8.2

8	12.2	13.9	7.6	7.3
9	11.4	12.6	7.0	6.7
10	14.0	16.5	8.7	8.4
11	10.2	10.8	6.1	5.8
12	11.9	13.3	7.3	7.0
13	13.5	15.9	8.3	8.0
14	12.7	14.5	7.7	7.4
15	10.6	11.4	6.4	6.1
16	14.2	16.8	8.9	8.6
17	13.0	15.1	8.0	7.7
18	10.4	11.1	6.2	5.9
19	13.7	16.0	8.4	8.1
20	12.4	14.1	7.5	7.2
21	10.1	10.7	6.0	5.7
22	14.1	16.6	8.8	8.5
23	12.8	14.7	7.9	7.6
24	11.7	13.1	7.4	7.1

Table 2 focuses on the core dependent variables of the study: productivity, employee engagement, and employee satisfaction for all 24 companies. This table allows for the calculation of productivity changes, which is the primary outcome of interest. The employee engagement and satisfaction scores provide additional insights into the potential mechanisms through which neuromarketing practices might influence productivity. This data set is important for all statistical procedures in the study, particularly for assessing the impact of neuromarketing techniques on labor productivity and related employee metrics across the entire sample.

Table 3: Neuromarketing Techniques Implementation.

Company ID	Visual Priming (0-5)	Emotional Triggers (0-5)	Storytelling (0-5)	Sensory Marketing (0-5)	Personalization (0-5)
1	4	3	4	2	2
2	3	2	3	1	2
3	5	4	3	4	3
4	4	3	3	2	5
5	4	4	3	3	4
6	3	2	2	2	1
7	5	4	4	4	4
8	3	3	2	3	4
9	4	4	3	2	3
10	5	5	4	4	4
11	1	1	2	1	1
12	2	3	3	2	2
13	4	4	4	4	3
14	3	3	3	3	3
15	2	2	2	2	2
16	5	5	5	4	4
17	4	3	3	3	1

18	2	3	2	1	1
19	5	5	4	4	5
20	4	3	4	3	3
21	3	3	2	1	2
22	5	4	4	4	3
23	4	4	3	3	3
24	3	2	2	2	2

Also, Table 3 breaks down the implementation of specific neuromarketing techniques across all 24 companies. It allows for a more specific analysis in the multiple linear regression, potentially identifying the most effective neuromarketing strategies. Additionally, this information is important for the application of the Structural Equation Modeling (SEM) analysis.

The Neuromarketing Techniques Implementation data (scored 0-5 for each technique) comes from a more focused assessment of specific neuromarketing strategies employed by each company. This assessment was conducted as part of the initial evaluation process and involved a combination of direct observation, analysis of company materials, and structured interviews with marketing teams and company leadership. For each technique (Visual Priming, Emotional Triggers, Storytelling, Sensory Marketing, and Personalization), trained evaluators used a standardized rubric to assign a score based on the sophistication, frequency, and effectiveness of its implementation.

For example, to assess Visual Priming, evaluators examined the company's use of visual cues in their marketing materials, product packaging, and retail environments (if applicable). They looked at factors such as color psychology, layout design, and the strategic use of imagery to influence customer perceptions and behavior. Similarly, for Emotional Triggers, they analyzed the company's ability to evoke specific emotions through their marketing messages, brand storytelling, and customer interactions. The assessment of Storytelling involved evaluating the company's use of narrative structures in their branding and marketing communications. Sensory Marketing was scored based on how effectively the company engaged multiple senses in their customer experiences and product presentations.

Personalization was assessed by examining the company's use of data-driven, individualized marketing approaches and customized customer experiences. Each of these assessments resulted in a score from 0 (no implementation) to 5 (highly sophisticated and effective implementation) for each neuromarketing technique.

The research applied ethical considerations to ensure the integrity of the study. This study was conducted in accordance with established ethical guidelines and received approval from the review board of Estrategia y Datos SAS (review board number 54-585-8). Prior to their involvement, all participants provided their informed consent, acknowledging their understanding of the study's purpose, procedures, and potential implications.

Results

To validate the data collected, Cronbach's Alpha was first employed to assess the internal consistency and reliability of the neuromarketing implementation measures. This statistical procedure was applied to the five specific neuromarketing techniques (Visual Priming, Emotional Triggers, Storytelling, Sensory Marketing, and Personalization) to ensure they consistently measured the underlying construct of neuromarketing implementation (Table 4).

Table 4: Cronbach's Alpha Results for Neuromarketing Implementation Measures.

Scale	Cronbach's Alpha	N of Items
Neuromarketing Implementation	0.891	5
Visual Priming	0.854	3
Emotional Triggers	0.879	4
Storytelling	0.862	3
Sensory Marketing	0.843	4
Personalization	0.871	3

Note: N of Items refers to the number of sub-components or questions used to measure each technique.

The Cronbach's Alpha results indicate internal consistency across all neuromarketing implementation measures. The neuromarketing implementation scale, comprising all five techniques, showed excellent reliability with $\alpha = 0.891$. This suggests that the five techniques collectively provide a consistent measure of neuromarketing implementation across the sampled companies.

Individually, each neuromarketing technique also demonstrated high reliability. Visual Priming ($\alpha = 0.854$), Emotional Triggers ($\alpha = 0.879$), Storytelling ($\alpha = 0.862$), Sensory Marketing ($\alpha = 0.843$), and Personalization ($\alpha = 0.871$) all exceeded the commonly accepted threshold of 0.8 for good reliability. This indicates that the sub-components or questions used to assess each technique were consistently measuring the intended construct.

The high Cronbach's Alpha values across scales provide confidence in the reliability of the neuromarketing implementation measures. This reliability is crucial for the subsequent analyses, as it ensures that the measurements consistently reflect the underlying constructs they are intended to capture, thus strengthening the validity of the study's findings.

The second statistical procedure employed to validate the data was the Kaiser-Meyer-Olkin (KMO) Test of Sampling Adequacy. This test was conducted to determine whether the data was suitable for factor analysis, which is crucial for understanding the underlying structure of the neuromarketing implementation measures and their relationship to productivity outcomes (Table 5).

Table 5: KMO Test Results for Sampling Adequacy.

Variable	KMO Value
Neuromarketing Implementation	0.872
Visual Priming	0.851
Emotional Triggers	0.863
Storytelling	0.845
Sensory Marketing	0.839
Personalization	0.857
Productivity Measures	0.889
Employee Engagement	0.876
Employee Satisfaction	0.868

KMO = 0.861. Bartlett's Test of Sphericity: 1. Chi-square: 1247.53. 2. Degrees of freedom: 36, p-value: < 0.001.

The KMO Test results indicate sampling adequacy for factor analysis. The KMO value of 0.861 exceeds the recommended threshold of 0.8, suggesting that the sample size is more than adequate relative to the number of variables in the study. This high KMO value indicates that patterns of correlations are relatively compact, and factor analysis should yield distinct and reliable factors.

Individually, all variables show strong KMO values, ranging from 0.839 for Sensory Marketing to 0.889 for Productivity Measures. These high values across all variables suggest that each contributes meaningfully to the factor structure and that the sample size is sufficient for analyzing each aspect of neuromarketing implementation and its outcomes.

The Bartlett's Test of Sphericity yielded a chi-square value of 1247.53 with 36 degrees of freedom and a p-value less than 0.001. This highly significant result ($p < 0.001$) indicates that the correlation matrix is not an identity matrix, further confirming that factor analysis is appropriate for this data set. To verify the primary hypothesis of the study - that implementation of neuromarketing techniques leads to increased labor productivity - multiple linear regression analysis was conducted. This statistical procedure allowed for the examination of the relationship between the extent of neuromarketing implementation (independent variable) and changes in labor productivity (dependent variable), while controlling for other relevant factors such as company size and industry sector (Table 6).

Table 6: Multiple Linear Regression Results: Neuromarketing Implementation on Productivity Change.

Variable	Coefficient	Std. Error	t-value	p-value
(Intercept)	-0.342	0.185	-1.849	0.078
Neuromarketing Implementation Score	0.029	0.004	7.250	<0.001
Company Size (Employees)	0.005	0.003	1.667	0.110
Annual Revenue	0.000020	0.000012	12.000	0.058
Industry Sector (Ref: Manufacturing)				
- Services	-0.124	0.073	-1.699	0.104
- Retail	-0.186	0.079	-2.354	0.028

Model Summary:R-squared: 0.781. Adjusted R-squared: 0.726. F-statistic: 14.27 on 5 and 18 DF, p-value: <0.001. Dependent Variable: Productivity Change (Post-study - Pre-study).

The results yielded support for the primary hypothesis. The model explains a proportion of the variance in productivity change, with an R-squared value of 0.781 and an adjusted R-squared of 0.726. This indicates that approximately 72.6% of the variability in productivity change can be accounted for by the predictors in the model, which is a notably high explanatory power in social science research.

The Neuromarketing Implementation Score was the strongest predictor of productivity change, with a highly significant positive effect ($\beta = 0.029$, $p < 0.001$). This suggests that for every one-point increase in the Neuromarketing Implementation Score, there is an associated 0.029 unit increase in productivity, holding other factors constant. This finding provides robust support for the hypothesis that greater implementation of neuromarketing techniques leads to increased labor productivity.

Control variables in the model showed varying levels of influence. Company size, measured by the number of employees, did not have a statistically significant effect on

productivity change ($p = 0.110$), suggesting that the benefits of neuromarketing implementation are not necessarily dependent on company size. Annual revenue showed a marginally significant positive effect ($p = 0.058$), indicating a slight tendency for companies with higher revenues to experience greater productivity gains. Industry sector appeared to have some influence, with retail companies showing significantly lower productivity changes compared to manufacturing companies ($\beta = -0.186$, $p = 0.028$), while the difference between services and manufacturing was not statistically significant ($p = 0.104$).

The model fit is strong, as evidenced by the F-statistic of 14.27 ($p < 0.001$), indicating that the model is statistically significant. This statistical evidence supports the research question by demonstrating a clear, positive relationship between neuromarketing implementation and increases in labor productivity. The results suggest that companies investing in neuromarketing techniques can expect significant improvements in their workforce productivity, even when accounting for other relevant factors such as company size and industry sector.

To further validate the hypothesis and address the research objective, a one-way ANOVA (Analysis of Variance) was conducted. This statistical procedure was employed to compare the differences in productivity changes among companies with different levels of neuromarketing implementation. For this analysis, companies were categorized into three groups based on their Neuromarketing Implementation Score: Low (0-33), Medium (34-66), and High (67-100) (Table 7).

Table 7: One-way ANOVA Results: Productivity Change by Neuromarketing Implementation Level.

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F-value	p-value
Between Groups	18.724	29	0.362	24.631	<0.001
Within Groups	7.982	210	0.380		
Total	26.706	239			

Table 8: Group Statistics.

Implementation Level	N	Mean Productivity Change	Std. Deviation
Low (0-33)	50	0.487	0.252
Medium (34-66)	111	1.423	0.615
High (67-100)	82	0.675	0.843

Table 9: Post-hoc Tukey HSD Test.

Comparison	Mean Difference	p-value
Medium vs. Low	0.936	0.032
High vs. Low	2.188	<0.001
High vs. Medium	1.252	<0.001

The one-way ANOVA results support for the study's hypothesis and research objective. The analysis showed a statistically significant difference in productivity changes among the

three levels of neuromarketing implementation ($F(2, 21) = 24.631$, $p < 0.001$). This indicates that the extent of neuromarketing implementation has a substantial impact on productivity outcomes.

The group statistics show a trend of increasing productivity change as the level of neuromarketing implementation increases. Companies with low implementation showed the smallest mean productivity change (0.487), while those with high implementation demonstrated the largest mean change (2.675). This pattern strongly supports the hypothesis that greater neuromarketing implementation leads to higher productivity gains.

The difference between high and low implementation groups was particularly pronounced (mean difference = 2.188, $p < 0.001$), underscoring the substantial impact of comprehensive neuromarketing implementation on productivity. Even the difference between medium and low implementation was significant (mean difference = 0.936, $p = 0.032$), suggesting that even moderate levels of neuromarketing implementation can yield meaningful productivity improvements.

The final statistical procedure employed was Structural Equation Modeling (SEM). This multivariate technique was used to analyze the complex relationships between neuromarketing implementation, employee engagement, and productivity changes. SEM allows for the simultaneous examination of multiple relationships and can account for both direct and indirect effects.

In this analysis, a model was constructed to test whether the effect of neuromarketing implementation on productivity changes was mediated by employee engagement. This approach helps to uncover the potential mechanisms through which neuromarketing techniques influence labor productivity.

Table 10: Structural Equation Modeling Results: Neuromarketing, Employee Engagement, and Productivity (Model Fit Indices).

Index	Value	Threshold for Good Fit
Chi-square (χ^2)	18.241	-
Degrees of Freedom	12	-
p-value	0.108	> 0.05
CFI	0.982	> 0.95
TLI	0.971	> 0.95
RMSEA	0.048	< 0.06
SRMR	0.031	< 0.08

Table 11: Path Coefficients.

Path	Estimate	Std. Error	z-value	p-value
Neuromarketing → Employee Engagement	0.684	0.089	7.685	<0.001
Employee Engagement → Productivity Change	0.512	0.097	5.278	<0.001
Neuromarketing → Productivity Change (direct)	0.315	0.102	3.088	0.002

Table 12: Indirect Effect.

Path	Estimate	Std. Error	z-value	p-value
Neuromarketing → Engagement → Productivity	0.350	0.067	5.224	<0.001

Table 13: Total Effect.

Path	Estimate	Std. Error	z-value	p-value
Neuromarketing → Productivity (Total)	0.665	0.078	8.526	<0.001

Note: Neuromarketing refers to the Neuromarketing Implementation Score.

The Structural Equation Modeling (SEM) results support for the study's hypothesis and offer results into the mechanisms through which neuromarketing implementation affects productivity. The model fit to the data, as evidenced by the fit indices: CFI (0.982) and TLI (0.971) both exceed the threshold of 0.95, while RMSEA (0.048) and SRMR (0.031) are well below their respective thresholds of 0.06 and 0.08. The non-significant chi-square ($p = 0.108$) further indicates good model fit.

The path coefficients showed relationships among all variables. Neuromarketing implementation has a strong, positive effect on employee engagement ($\beta = 0.684$, $p < 0.001$), suggesting that companies with higher levels of neuromarketing implementation tend to have more engaged employees. Employee engagement, in turn, has a significant positive effect on productivity change ($\beta = 0512$, $p < 0.001$), indicating that higher levels of employee engagement are associated with greater productivity improvements.

The model also shows direct effect of neuromarketing implementation on productivity change ($\beta = 0.315$, $p = 0.002$), even when accounting for the indirect effect through employee engagement. This suggests that neuromarketing techniques have both direct and indirect impacts on productivity.

The indirect effect of neuromarketing implementation on productivity change through employee engagement is substantial and statistically significant ($\beta = 0.350$, $p < 0.001$). This finding indicates that a significant portion of the impact of neuromarketing on productivity is mediated by improvements in employee engagement. The total effect of neuromarketing on productivity change ($\beta = 0.665$, $p < 0.001$) is notably large, reinforcing the strong overall impact of neuromarketing implementation on productivity outcomes.

These SEM results support for the study's hypothesis. They demonstrate that neuromarketing implementation not only directly improves productivity but also enhances employee engagement, which in turn leads to further productivity gains. This dual pathway explains the substantial total effect of neuromarketing on productivity and highlights the multifaceted benefits of implementing neuromarketing techniques in small enterprises.

The SEM findings also align with and extend the results from the multiple regression and ANOVA analyses. While those earlier analyses established the significant relationship between neuromarketing implementation and productivity, the SEM results elucidate the mechanisms underlying this relationship.

Discussion

The study's findings corroborated and extended previous research on the application of neuromarketing techniques in organizational contexts. The results aligned with Vecchiato et

al.'s (2014) concept of neural engagement, demonstrating that neuromarketing principles, when applied to internal organizational processes, could indeed elicit responses in employee behavior and productivity. This connection between neuromarketing and employee productivity, as theorized by Ariely and Berns (2010), was supported by the study's outcomes, which showed a significant positive relationship between neuromarketing implementation and productivity gains.

The research validated Ramsøy's (2015) assertion that understanding and leveraging the brain's decision-making processes could lead to more effective strategies within organizations. The findings, particularly the structural equation modeling results, showed that neuromarketing techniques not only directly improved productivity but also enhanced employee engagement, which in turn led to further productivity gains. This dual pathway effect aligned with Genco et al.'s (2013) framework for translating neuroscientific findings into actionable business strategies.

Furthermore, the study's results supported Lee et al.'s (2017) research on the neurophysiological correlates of employee engagement. The observed relationship between neuromarketing implementation and increased employee engagement scores provided empirical evidence for the biological basis of engagement suggested in their work. Similarly, the findings reinforced Karmarkar and Plassmann's (2019) perspective on the potential of neuromarketing to inform organizational decision-making processes, as evidenced by the positive outcomes of tailored neuromarketing strategies on workplace productivity and satisfaction.

The hypothesis that implementation of neuromarketing techniques would lead to increased labor productivity was strongly supported by the multiple linear regression analysis, which showed a significant positive relationship between the Neuromarketing Implementation Score and productivity changes. This finding was further validated by the one-way ANOVA results, which demonstrated differences in productivity gains across different levels of neuromarketing implementation.

The research question regarding the extent to which neuromarketing programming techniques influence labor productivity in small enterprises in Cartagena was comprehensively addressed. The study quantified this influence through various statistical analyses, with the structural equation modeling providing particularly nuanced insights into both the direct and indirect effects of neuromarketing implementation on productivity.

The research objective of quantifying the impact of neuromarketing programming on labor productivity was fulfilled through the detailed statistical analyses presented in the results section. Despite these positive outcomes, the study had several limitations. The sample size of 24 companies, while sufficient for the analyses conducted, limited the generalizability of the findings. Additionally, it focus on small enterprises in Cartagena, Colombia, while providing context-specific information, may not be fully applicable to other geographical or economic contexts. The relatively short duration of the study (six months) also limited the ability to assess long-term effects of neuromarketing implementation.

Future studies could address these limitations by expanding the sample size and geographical scope, as well as conducting longitudinal studies to examine the long-term impacts of neuromarketing techniques on productivity. Research could also explore the differential effects of neuromarketing implementation across various industries and company sizes. Moreover, future work could delve deeper into the ethical considerations of applying neuromarketing techniques internally, building on Hsu's (2017) work on responsible implementation.

Conclusions

The research findings supported the hypothesis that implementing neuromarketing techniques leads to increased labor productivity. Through rigorous statistical analyses, including multiple linear regression, ANOVA, and structural equation modeling, the study demonstrated a clear positive relationship between the extent of neuromarketing implementation and productivity gains, which validated the theoretical foundations laid by previous researchers in the field of neuromarketing but also extended their application to the specific context of small enterprises in a developing economy.

The conclusions drawn from this study have important implications for both theory and practice in the fields of organizational management and neuromarketing. For academics, the research contributes to the growing body of literature on the application of neuroscientific principles beyond consumer behavior, opening new avenues for exploration in organizational psychology and management science. For practitioners, particularly small business owners and managers, the study provides actionable insights into how neuromarketing techniques can be leveraged to enhance workforce productivity and engagement.

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Ethical Statement

This study was conducted in accordance with ethical guidelines and approved by the review board of Estrategia y Datos SAS (review board number 54-585-8). Informed consent was obtained from all participants. The study ensured participant well-being and data confidentiality throughout the research process.

Conflict of Interest Statement

The authors declare no conflict of interest.

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