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BRAND IMAGE ANALYSIS OF ANDROID SMARTPHONES IN NIGERIA USING FACTOR ANALYSIS AND MULTINOMIAL REGRESSION TECHNIQUES

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ABSTRACT

Brand image encompasses consumers' perceptions and associations with a brand that is pivotal in shaping how individuals recognize and connect with products or services. This study explored the brand image of Android Smartphones in Nigeria, emphasizing the role of brand perception in shaping customer loyalty and purchasing decisions within a competitive market. A quantitative method is employed through online data collection from a sample of 100 users of Android Smartphones in Nigeria by considering a series of questions related to brand attributes. By analyzing user responses using factor analysis technique, the attributes such as product quality, competitiveness, loyalty, innovation, design and customer service support were identified as key dimensions of brand image. Multinomial regression further revealed that brand perception demographic variables significantly influences consumer choices, with Samsung being viewed as highly competitive and preferred by older age groups, while Infinix showed varied loyalty among younger users. Techno, a leading brand, generally had a neutral perception across demographic groups. These findings provide insights for Android brands to tailor their strategies, foster positive customer perceptions, and strengthen market positioning in emerging economies.

Keywords: Android smartphones, Brand Identity, Brand Image, Factor analysis, Multinomial regression.

INTRODUCTION

Brand image is the perception customer's form of a brand based on their interactions with it, shaping what comes to mind when they think about its products or business. This perception can be positive,

negative, or neutral, influencing how a brand is viewed in a competitive market. A strong, positive brand image helps a product or company stand out, supporting its success amidst market challenges. Beyond visible elements like logos, marks, or symbols, brand image encompasses the deeper, intangible aspects that drive customer interactions and shape their overall perception of a product or service. Durmaz (2017) mentioned that to respond to rapid changes in market dynamics and continuously evolving consumer expectations, a deep and up-to-date understanding of research developments related to brand image is needed.

In an increasingly competitive marketplace, understanding brand image has become essential for companies aiming to attract and retain customers. Brand image reflects consumers' perceptions, beliefs, and emotional responses associated with a brand, which collectively influence their purchasing decisions and loyalty. Analyzing brand image helps companies to uncover the strengths and weaknesses in how they are perceived by their target audience, providing insights into consumer behavior that are critical for strategic branding, product positioning, and marketing communications.

Brand image, broadly defined as consumers' perceptions and associations with a brand, plays a critical role in influencing how individuals identify and relate to a brand. The concept of Brand Image was popularized by Aaker (1991) and Keller (1993) as key components of brand management. Keller (1993) further describes brand image as part of a brand's equity, emphasizing the importance of positive brand associations in establishing a competitive advantage. Positive brand image enhances brand equity, enabling differentiation, stronger customer loyalty, and the ability to charge premium prices. C. Whan et al. (1986) mentioned that researchers have discussed brand image in various contexts, noting that it is shaped by both functional aspects, such as quality and reliability, and symbolic aspects, such as social status and emotional connection. Kapferer (2008) developed the Brand Identity Prism, a model that presents six brand facets, including physique, personality, culture, relationship, reflection, and self-image, as components contributing to the brand's identity and image in consumers' minds.

In today's competitive smartphone market, understanding and managing brand image is crucial for manufacturers aiming to capture consumer loyalty and drive market growth. Techno, a leading smartphone brand in many emerging markets like Nigeria, appeals to consumers with its focus on affordability, functionality, and innovative features tailored to local needs. Given the rapid expansion of the smartphone industry in these regions, it is essential for Techno to not only meet the functional demands of consumers but also cultivate a positive brand image that distinguishes it from other budget-friendly smartphone brands.

This study aims to conduct a brand image analysis of Android phones in Nigeria, utilizing factor analysis to explore and identify the primary dimensions shaping consumer perceptions of difference android phones. By examining factors such as product quality, design appeal, affordability, and customer satisfaction, this research seeks to uncover how these attributes contribute to android phones brand image and influence consumer purchasing decisions. Factor analysis, a statistical method for reducing data complexity, is particularly useful for this study as it helps identify the key components that drive brand image, enabling a clearer, data-driven understanding of consumer sentiments. Multinomial regression is further considered to gain insight into factors that influences choices among android phone users

Literature Review

Various methodologies have been employed by researcher to measure brand image. Both qualitative and quantitative methods have been considered in literature. Factor analysis, particularly, has been instrumental in brand image research, allowing researchers to identify core dimensions of brand image by reducing complex variables into key factors (Low et al., 2010). Faircloth et al. (2001) noted that a strong, positive brand image influences consumer behavior, including purchase intentions, loyalty, and willingness to pay a premium. Keller (2009) further stated that a favorable brand image enhances brand resonance, the level at which consumers feel a deep, personal connection with a brand.

Chaudhuri & Holbrook (2001) show that brands with favorable images enjoy stronger customer loyalty and repeated purchases, as consumers are more likely to stay committed to brands they perceive positively. Phau & Lau (2000) found that in the automotive industry, consumers are often drawn to brands with a strong image of innovation, reliability, and status, such as Tesla and BMW.

Hair et al. (2010) stated that exploratory factor analysis (EFA) allows researchers to explore the structure of brand image dimensions without predetermined factors, making it ideal for preliminary studies where the brand image structure is unknown. Byrne (2016) further stated that confirmatory factor analysis (CFA) on the other hand, is used to test a hypothesized model of brand image, offering a way to validate predefined brand dimensions.

In the technology sector, particularly smartphones, brand image is closely linked to product features, design, and perceived innovation. Smartphones are not only functional devices but also status symbols in many societies (Lee & Leh, 2011). A study by Karjaluoto et al. (2012) indicated that brand image is a strong predictor of consumer preferences in technology markets, especially when multiple brands offer similar functionalities. The competitive nature of the Android smartphone market highlights the need for brands to continuously innovate and reinforce their image to maintain relevance.

The Nigerian market offers a unique perspective on brand image due to its diverse consumer base and the increasing penetration of affordable Android devices. Research by Osakwe et al. (2016) revealed that affordability and accessibility are dominant factors influencing smartphone preferences in Nigeria. Furthermore, local brands such as Techno and Infinix have successfully capitalized on these preferences, while global brands like Samsung maintain their appeal through perceived quality and aspirational branding (Adewoye et al., 2021).

METHODOLOGY

This study utilizes a quantitative, cross-sectional design, focusing on factor analysis to explore and identify the primary dimensions shaping consumer perceptions of difference android phones. By examining factors such as product quality, design appeal, affordability, and customer satisfaction, this research seeks to uncover how these attributes contribute to android phones brand image and influence consumer purchasing decisions.

Participants were drawn from a diverse demographic sample within Nigeria, representative of various age groups, gender, and educational levels. Inclusion criteria required that participants to be a user of android smartphone and Nigerian nationals. A sample size of 100 participants was considered, as this is generally recommended for factor analysis to ensure stability and reliability of the factors.

Data Collection

The primary method for collecting data in this study is through an online survey (Google form), as it allows for broad reach and convenience for respondents. The survey consists of a series of questions related to the brand's attributes, with responses captured on a Likert scale (e.g., 1 to 5, ranging from Strongly Disagree to Strongly Agree). This scale provides quantifiable data on each attribute, enabling analysis of how strongly respondents associate these characteristics with the brand. The target sample includes current and past users of the brand to ensure relevance and accuracy in perceptions.

Data Analysis

The data collected from the survey were analyzed using advanced statistical techniques to uncover the relationships between brand attributes and consumer behavior. The primary goal was to identify the key dimensions of brand image and understand how they influence customer loyalty and purchasing decisions. Factor analysis was employed to explore the underlying structure of consumer perceptions by grouping related brand attributes into latent factors. This method reduces the complexity of the data while retaining meaningful patterns. Attributes such as product quality, affordability, and design were analyzed to identify common dimensions representing the brand image. The factor extraction process used principal component analysis, followed by varimax rotation to enhance interpretability.

To further examine the influence of brand perceptions on consumer behavior, multinomial regression analysis was conducted. This technique assessed how different brand attributes, such as quality, affordability, and design, impacted consumer outcomes like brand preference and switching behavior. It

also evaluated variations in brand loyalty and purchasing decisions across demographic groups, including age and socioeconomic status, providing a deeper understanding of brand performance among specific segments. The analyses were performed using SPSS

Factor Analysis Model

In a factor analysis model, we assume that each observed variable Xi (where i=1, 2, …, p for p observed variables) is influenced by m underlying, unobserved factors F1, F2, …, Fm plus an error term. The model can be expressed as:

$$X_i = \lambda_{i1}F_1 + \lambda_{i2}F_2 + \cdots + \lambda_{im}F_m + \epsilon_t \quad (1)$$

Where,

λ_{ij} are the factor loadings representing the strength of the association between observed variable Xi and factor Fj. The Fj are the latent factors (unobserved variables) common across multiple observed variables. The ϵ_t is the unique variance or error term for Xi, capturing variance not explained by the factors.

Factor Extraction

To determine the factors, several methods can be used, such as Principal Component Analysis (PCA), often used to initially determine the number of factors, although it's technically not a factor analysis method. It is a statistical technique used to reduce the dimensionality of data by transforming a large set of variables into a smaller set of uncorrelated variables called principal components. This is done while retaining as much of the original data's variance as possible.
Before performing PCA, it's common to standardize the data if the variables are on different scales. For an n × p data matrix X with n observations (rows) and p variables (columns), the standardized matrix Z is:

$$Z_{ij} = \frac{X_{ij} - \mu_j}{\sigma_j} \quad (4)$$

Where, μ_j and σ_j are the mean and standard deviation of variable j, respectively. This ensures that each variable has a mean of 0 and a standard deviation of 1.

Principal Components

The principal components are the projections of the original data onto the eigenvectors of the covariance matrix. To get the k^{th} principal component PC_k for each observation, we multiply the standardized data matrix Z by the eigenvector v_k corresponding to the k^{th} largest eigen value:

$$PC_k = Zv_k \quad (7)$$

For all principal components, we can write:

$$PC = ZV \quad (8)$$

Where, V is the matrix of eigenvectors (each column of V is an eigenvector v_k), and PC is the matrix of principal component scores.

Selecting Principal Components

To decide how many principal components to retain, we examine the eigen values. The proportion of variance explained by each principal component is:

$$\frac{\lambda_k}{\sum_{j=1}^{p} \lambda_j} \quad (9)$$

Where, λ_k is the eigen value for the k^{th} component.
To determine the optimal number of components to retain in a factor analysis, three key criteria are often used. The Kaiser Criterion suggests retaining components with eigen values greater than 1, as these components account for more variance than a single variable. Additionally, the Scree Plot involves plotting the eigen values in descending order and identifying an "elbow" point, where the slope levels off, indicating the optimal number of components. Finally, the Cumulative Variance criterion recommends retaining enough components to explain a substantial percentage of the variance, such as 90%, ensuring that the model sufficiently captures the data's complexity.

Rotation of Factors

Once factors are extracted, a rotation is often applied to make interpretation easier. Two main types of rotation are Orthogonal rotation (e.g., Varimax): Assumes factors are uncorrelated and maximizes the variance of loadings within each factor and Oblique rotation (e.g., Oblimin, Promax): Allows factors to be correlated, which is often more realistic in personality and psychological research.
The rotation helps redistribute variance among factors, improving interpretability by maximizing high loadings and minimizing low loadings within each factor.

Factor Scores

Factor scores are the estimated values of the latent factors for each observation. Factor scores provide a quantifiable measure of how much each observation scores on each latent factor identified in the analysis.

Multinomial Regression

A multinomial regression is performed to create a model of the relationship between the predictor variables and membership in the groups. The model is used when the outcome predicted is normal with more than two categories without a given rank or order. It can also be used with any number of independent variables which may be continuous or categorical.

Assumptions of Multinomial Regression

The following assumptions of multinomial regression are specified:

(i) There is an independence of observations
(ii) The categories of the outcomes variable are mutually exclusive and exhaustive
(iii) Non-existence of multi- collinearity between independent variables
(iv) There is a linear relationship between continuous variables and the logit transformation of the outcome variable
(v) There are no outliers or highly influential points for the scale or continuous variables

Data Analysis and Discussion of Results

The respondent demographics in Table 1.1 reveal insights into Android phone preferences, age distribution, gender, and education level. The most common brand used by respondents is Techno (41%), followed by Samsung (23%), Infinix (20%), and other brands (16%).The largest age group is 35-44 years (41%), followed by 25-34 years (33%). Smaller proportions fall into the 45-54 (16%), 16-24 (7%), and 55+ (3%) age groups. Males constitute a majority at 61%, while females make up 39%. Most respondents hold a first degree (52%), while 42% have a higher degree, and only 6% completed up to secondary school.

Table 1: Respondent Demography

Case Processing Summary			
		N	Marginal Percentage
Andriod Phone Types	Samsung	23	23.0%
	Techno	41	41.0%
	Infinix	20	20.0%
	Others (Itel, Oppo, Redmi & Gionee)	16	16.0%
Age	16 -24	7	7.0%
	25 - 34	33	33.0%
	35 - 44	41	41.0%
	45 - 54	16	16.0%
	55 and above	3	3.0%
Gender	Male	61	61.0%
	Female	39	39.0%
Education Level	Secondary School	6	6.0%
	First degree	52	52.0%
	Higher degree	42	42.0%

Table 2: Rotated Factor Matrix

	Factor					
	1	2	3	4	5	6
Q: My Android phones are durable and can handle daily use	.744	.264	.265	.184	.323	.150
Q: My Android phones provide reliable call quality and connectivity	.714	.195	.332	.374	.184	.153
Q: My Android phones meet my basic needs in terms of performance	.623	.324	.257	.226	.336	.261
Q: I trust the quality of my Android phones	.610	.297	.454	.326	.220	.121
I: I feel that my Android phone is committed to improving its technology	.584	.225	.333	.339	.245	.269
R: My Android phone is a trustworthy brand	.565	.283	.495	.199	.274	.262
R: My Android phone has a good reputation in the market.	.562	.266	.343	.320	.219	.179
R: My Android phone is recognized as a quality budget brand	.546	.316	.505	.257	.175	.107
Q: My Android phones perform well without frequent technical issues.	.448	.443	.321	.253	.128	.268
C: My Android phone offers better quality than other budget Android brands	.222	.835	.211	.051	.149	.177
C: My Android phone provides more value for money compared to other brands.	.144	.758	.264	.253	.124	.033
C: Customer service is better than that of other brands.	.123	.639	.255	.042	.447	.101
C: My Android phone features are competitive with other budget phone brands.	.434	.578	.259	.185	.255	.044
R: People in my community think positively of my Android phones	.302	.517	.316	.243	.233	.184
I: My Android phone is innovative compared to other budget brands.	.456	.485	.026	.299	.256	.180
L: I would consider buying another of my Android phone in the future	.188	.324	.693	.151	.235	.142
L: I am satisfied with my choice to use my Android phone	.327	.341	.665	.347	.237	.046
L: I would recommend my Android phones to others looking for a budget option	.350	.241	.648	.323	.127	.118
L: I feel a connection to my Android phone as a brand	.361	.254	.611	.240	.305	.207

D: My Android phones have an attractive design.	.323	.127	.332	.730	.165	.218
D: My Android phones look modern and stylish	.292	.262	.255	.712	.301	.082
D: My Android phones feel comfortable and user-friendly	.420	.146	.411	.491	.182	.188
D: The design of my Android phones meets my aesthetic preferences	.338	.389	.326	.448	.210	.113
S: I am satisfied with my Android phone warranty and repair policies.	.315	.178	.271	.204	.760	.241
S: My Android phone is responsive to my questions and concerns.	.242	.375	.164	.256	.738	.054
S: My Android phone provides reliable customer service	.331	.321	.355	.222	.558	.120
I: My Android phones includes modern features in its phones	.420	.238	.278	.245	.246	.743
I: My Android phones keep up with the latest technology trends	.366	.414	.137	.348	.210	.424

Table 3: Extracted factors

Factor 1	Product quality and reputation
Factor 2	Competitive
Factor 3	Loyalty
Factor 4	Design
Factor 5	Customers service support
Factor 6	Innovation

The rotated factor matrix in Table 2 highlights six main factors shaping consumer perceptions of Android smartphones. Each factor groups together attributes that align with common themes consumers associate with brand image in the Android market. The extracted factors were listed in Table 3. These six factors explain a significant portion of the variance (76.26%) in consumer perceptions, indicating their critical role in shaping brand image and influencing purchasing decisions.

Table 4a: Multinomial model of customer perceptions by Samsung

Android[a]		B	Std. Error	Wald	DF	Sig.
Samsung	Intercept	-19.541	1.417	190.051	1	.000
	Product Quality/Reputation	.097	.502	.037	1	.847
	Competitive	1.212	.505	5.771	1	.016
	Loyalty	-.277	.509	.296	1	.586
	Design	.531	.474	1.254	1	.263
	Customers service support	.300	.420	.509	1	.476
	Innovation	.727	.464	2.453	1	.117
	16 - 24	.227	7980.246	.000	1	1.000
	25 - 34	19.776	1.560	160.625	1	.000
	35 - 44	19.727	1.548	162.360	1	.000
	45 - 54	19.754	.000	.	1	.
	55 and above	0[c]	.	.	0	.
	Male	1.005	.807	1.550	1	.213
	Female	0[c]	.	.	0	.
	Secondary school	-.027	1.640	.000	1	.987
	First degree	-.418	.915	.209	1	.648
	Higher degree	0[c]	.	.	0	.

Table 4a revealed that competitive stands out as a significant factor for Samsung Android phone. It is perceived as being more competitive by users. Age groups 25 – 34 and 35 – 44 also have p-value < 0.05, suggesting a strong likelihood of brand association within these age ranges.

Table 4b: Multinomial model of customer perceptions by Techno

Techno	Intercept	1.110	1.788	.385	1	.535
	Product Quality/Reputation	.114	.431	.071	1	.790
	Competitive	.265	.438	.366	1	.545
	Loyalty	-.451	.442	1.042	1	.307
	Design	.360	.382	.885	1	.347
	Customers service support	.102	.361	.080	1	.777
	Innovation	.096	.334	.082	1	.775
	16 - 24	-.470	1.690	.077	1	.781
	25 - 34	-.410	1.578	.068	1	.795
	35 - 44	.086	1.621	.003	1	.958
	45 - 54	1.210	2.038	.353	1	.553
	55 and above	0[c]	.	.	0	.
	Male	.761	.731	1.083	1	.298
	Female	0[c]	.	.	0	.
	Secondary school	-1.350	1.462	.853	1	.356
	First degree	-.647	.833	.602	1	.438
	Higher degree	0[c]	.	.	0	.

Table 4b revealed no factors are statistically significant for Techno at p-value < 0.05. This implies relatively neutral perception across the attributes.

Table 4c: Multinomial model of customer perceptions by Infinix

Infinix	Intercept	-19.778	1.463	182.751	1	.000
	Product Quality/Reputation	-.085	.481	.031	1	.860
	Competitive	.186	.501	.138	1	.710
	Loyalty	-1.099	.522	4.436	1	.035
	Design	.762	.462	2.723	1	.099
	Customers service support	.025	.420	.003	1	.953
	Innovation	.705	.419	2.830	1	.093
	16 - 24	18.329	2.271	65.139	1	.000
	25 - 34	18.132	1.673	117.466	1	.000
	35 - 44	17.572	1.677	109.857	1	.000
	45 - 54	19.686	.000		1	
	55 and above	0[c]			0	
	Male	1.218	.903	1.819	1	.177
	Female	0[c]			0	
	Secondary school	-18.336	9952.272	.000	1	.999
	First degree	1.950	1.201	2.636	1	.104
	Higher degree	0[c]			0	

Pseudo R-Square: Cox and Snell = 0.44; Nagelkerke = 0.48; McFadden = 0.22

Table 4c revealed Loyalty has a significant negative impact for Infinix at p-value < 0.05, indicating lower perceived customer loyalty. Age categories 16 – 24, 25 – 34, and 35 – 44 have p-values < 0.05, indicating strong Infinix brand association among younger users.
Overall, Competitive and demographic factors like age significantly influence brand perception for Samsung, while Infinix shows a mixed perception of loyalty and patronage among younger age users. Techno's attributes are generally perceived neutrally across users.

CONCLUSION AND RECOMMENDATIONS

In conclusion, this study emphasizes the importance of brand image as a central component in consumer decision-making and loyalty within the competitive Android smartphone market in Nigeria. The demographic analysis and statistical findings provide valuable insights into consumer perceptions and brand preferences in the Android smartphone market. Techno emerged as the most commonly used brand, with a substantial share among respondents, while Samsung and Infinix followed. The use of factor analysis provided valuable insights into the primary dimensions driving brand perception, such as loyalty, design, and innovation and multinomial regression further revealed how demographic factors influence these perceptions. The analysis shows that while Techno exhibits relatively neutral perceptions across key attributes, Samsung's brand image benefits from its perceived competitiveness among older consumers, and Infinix appeals more to younger age groups but with varying loyalty levels. These insights offer practical implications for Android brands aiming to strengthen their market position by aligning branding strategies with consumer expectations, which is particularly critical in rapidly growing markets like Nigeria.
These findings suggest that brands like Samsung should continue leveraging their competitive image to solidify loyalty, particularly among middle-aged consumers. For Infinix, addressing loyalty concerns while building stronger brand associations could enhance market standing. Techno may benefit from strategic branding initiatives that create a unique identity to appeal to its broad but neutral users. Overall, demographic factors such as age and specific brand attributes play a pivotal role in consumer behavior, offering actionable insights for Android brands to refine their strategies and improve market positioning.

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Conflict of Interest

The authors declare that there is no conflict of interest**.**

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