



Non-verbal evaluation of consumer behavioral analytics using Facial Coding to audit e-commerce retail websites

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Abstract

Behavioral analytics using facial coding through Automatic Facial Expression Analysis (A.F.E.A) has enabled nonverbal assessment of individual behavior. Neuroscience studies cognitive and emotive responsiveness and gives deeper insight to the thought processes impacting decision making. Neural process regulates and impacts subconscious and conscious behavior. Psychology delves deeper into the emotive basis of behavior. Neuroscience and psychology assessment in individuals with behavioral data has become possible with use of artificial intelligence (A.I) based technologies. Facial Action Coding System (F.A.C.S) has enabled the tracking and coding of emotions. Action Units (A.U) tracking facial movement delves deeper into combining computer algorithms with nonverbal behavior. As online websites are favored today, consumer centric strategies based on analytics are deemed effective and targeted. The paper focuses on Facial Action Coding System in understanding consumer behavior and assessed emotive responses across gender and age ranges. Behavioral data garnered through facial coding assessment has been carried for auditing visual elements capturing consumer attention. Visual representation of information and its elicited emotive response from a consumer are nonverbal evaluative methods which have tremendous scope in the future and broadened social sciences scope as a domain.

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Introduction

Facial expressions sublimely convey individual behavior and thought processing. Understanding of nonverbal consumer expression through Automatic Facial Expression Analysis (AFEA) is pivotal in estimating the subconscious behavior of an individual. Facial movement is considered 'automatic' as anatomically facial muscles are untrammelled. Spontaneity in facial reaction reveals volumes for the subconscious thought trajectories that

process information. Algorithms recognize and comprehend facial movement which can translate facial expressions. Emotive states of individuals are expressed through facial muscle movement which assesses the expressions. Consumers have increasingly shifted to online purchase of products and services in the past. The new age consumers focus on browsing a website prior to purchase implies that attention must be given to the emotive processing of the individual when an image is in front of his eyes.



India is a lucrative market with its huge working age population for companies from consumer products to financial services. With penetration of mobile phones and data packs at competitive prices the Indian consumer has hooked on to browsing and buying products and services online. Each company seeks to maximize their website traffic and purchase percentage and keep bounce rate to the minimum.

Technology has enabled deeper understanding of consumer behavior with gaze and fixation enabling insights into the minds of the consumer. Earliest studies carried out by Carl-Herman Hjortsjö (1969) set the basis for the Facial Action Coding System (FACS) and its adoption was by Ekman and Wallace (1978) who developed the methods to measure facial behavior with facial muscle movement. This has

now evolved further with application of AI in decoding individual behavior.

Facial Action Coding System

The facial action coding system anatomically bases itself on the muscular movement of the face muscles. The facial expressions are spontaneous and are a constituent of the emotive response of an individual to a stimulus. FACS has enabled standardization of facial muscles movement into Action Units. These Action Units correspond with specific facial movements denoting specific emotions. Computer algorithms detect and track these specific facial movements and categorize them to the specified emotion. Reactions to visual elements on a screen in front of the individual can be effectively tracked in this manner.

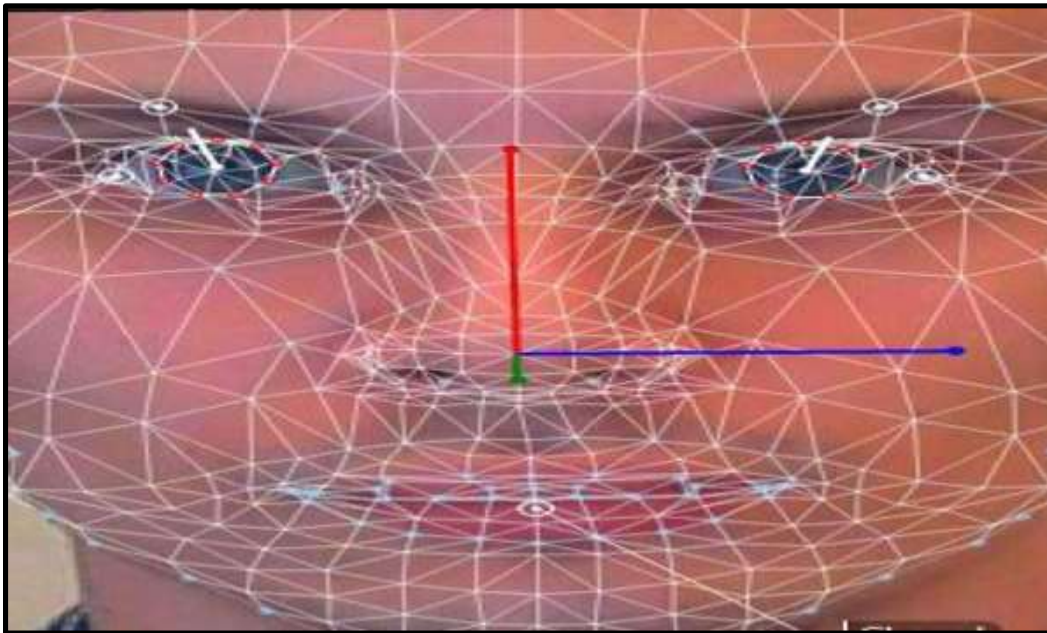


Fig 1: Representation of gaze and muscle coordinates for FACS

Facial coding focuses on the metrics of analyzing the expressions on the face, brow, and mouth enabling spontaneous changes in these movements to be recorded on an automatic basis. This gives an array of moment by moment information of the emotional responses. This is relevant as reactions to the

stimuli observed may be fleeting and subconscious with the individual being unaware about the reaction themselves. Unfiltered reactions enable effective measurement of emotive and cognitive metrics. Engagement levels and valency is also tracked and can be used for various studies.



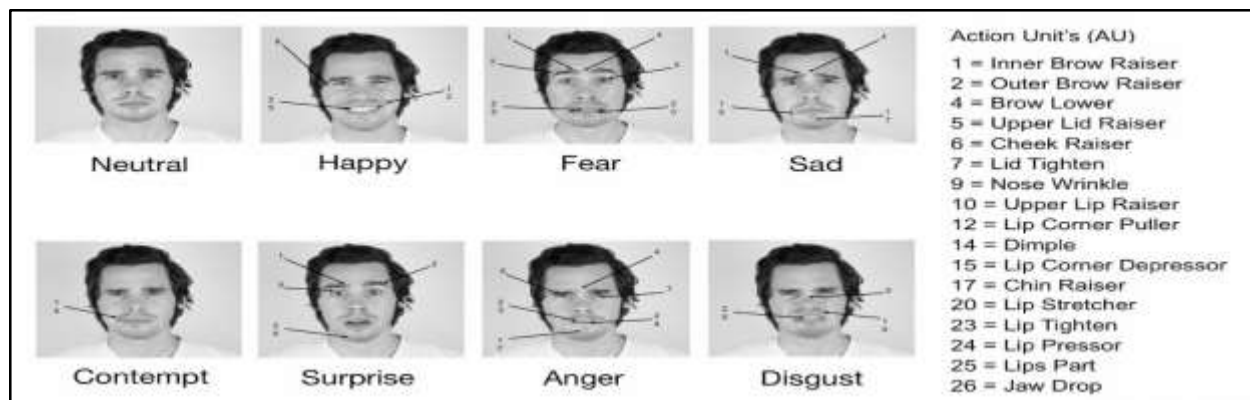


Fig 2: Action Units and muscle coordinates for Facial Coding (Reference: E.I.A)

Review of Literature

Kodra et al (2013) have studied facial expression for audience measurement. Quantification of facial responses has enabled comprehensive study on individual behavior. Implications on the face expression data give insights on the panelists behavior. Correlation was found when facial coding was carried moment to moment. Zaalberg (2004) assessed the relationship between emotions and facial behavior. Laboratory experiments were conducted to assess the emotive responses of the participants. Questionnaire was also taken to assess the respondents in further detail. Path analysis was carried to assess the further detail of the emotive responses.

Neudecker et al (2021) have determined that there is realistic application of facial analysis. Automation in understanding emotive responses can have implications on the engagement of consumers and brands. Implications can be observed across domains. Reaction to a stimulus can be beneficial to assess as decoding these observations and can have benefits to companies and to the consumers. Optimization of content and advertising can be significant in reducing cost to the companies.

Elizabeth et al (2020) have assessed that AFEA automating FACS has investigated the characterization of emotive responses on consumer products. Conceptualizing the experience with better understanding of each emotion can give a specific response. Likert scales were also used along with the FACS

methodology so that deeper understanding of the consistencies and inconsistencies were observed. Multitude of information can be obtained from the expression that can be given as a response. Biele C (2022) has studied emotional processes that outline the emotive process and facial movement recognition. Brain process and human interaction with automated processes was observed in the process. Each gesture and movement designating a specific aspect was human and computer interaction was assessed. The future of the FACS domain in cognitive processing was determined.

Culey (2021) has studied that facial coding provides objectivity to the data that is quantified. Newer ways of assessment for an individual have been obtained such that deeper understanding of the markets can take place. Contradiction in the behavior of customers is an interesting concept assessed in the paper. Usage of science and technology has enabled understanding of the linkage of quantification measures that can be used to garner deeper insight into the mind processing of the consumer. Dalvi (2021) have found that emotion based facial expressions have determined the behavior process of the individual. Usage of AI has enabled the comprehensive understanding of facial expression across age brackets. FER analysis with visual information have become crucial in garnering information and expression identification.

Objectives



- To study the relationship of facial expression with likes and dislikes of products placed on e-commerce websites (flipkart/ amazon)
- To analyze the changes in facial expressions with change in offers across gender.
- To study the relationship between consumers' emotions and willingness to buy products across age ranges.

Hypothesis

H01: There is no relationship of facial expression with likes and dislikes of products placed on e-commerce websites (flipkart/ amazon)

H02: There is no relationship of facial expressions with change in offers across gender.

H03: There is no relationship between consumers' emotions and willingness to buy products across age ranges.

Research Gap

Research on nonverbal facial assessment is in its emerging stages. Consumer behavioral analytics through facial coding gives deeper insights to individual behavior. As neuroscience is the most emerging area with advanced technology, the study can be further extended to record the consumer's neural-signals as well with the help of reliable and portable devices.

Research Methodology

Sample size 200 with 106 males and 94 females across age ranges from 18 to 60 years. Structured questionnaire was taken along with the visual assessment test through software with an AI algorithm for facial coding and tracking emotive responses online. Analysis of Variance (ANOVA) has been carried out to

understand the conscious responsiveness of individuals to selected parameters.

Significance

- This research would largely help the direct marketers to plan the strategies while launching any sale, discount offers or end season sale for e-commerce websites.
- The researcher intended to contribute in the area of consumer neuroscience.
- The study will be beneficial to analyze the placements of different categories of products.
- It will also help marketers to analyze accurately the consumer insights in real-time.
- The study will help advertisers for improving advertising effectiveness.

Scope

The study is conducted within the vicinity of Navi Mumbai. The e-commerce websites taken for the study are flipkart and amazon. The study is limited to analyzing the facial expressions of consumers while watching and shopping on e-commerce websites. Facial expressions were tracked through an online facial coding application.

Data Analysis

Heat maps effectively show aggregate gaze and the visualized object. Facial expressions are tracked with the help of action units that show different facial muscles movement. Action Units are based on measuring points and its corresponding coordinates. The mapping of an individual's emotions acts as a window to a person's subconscious assessment of a stimulus.





Fig. 3: Heat map assessment for FACS assessment



Fig. 4: Assessment of Facial emotions

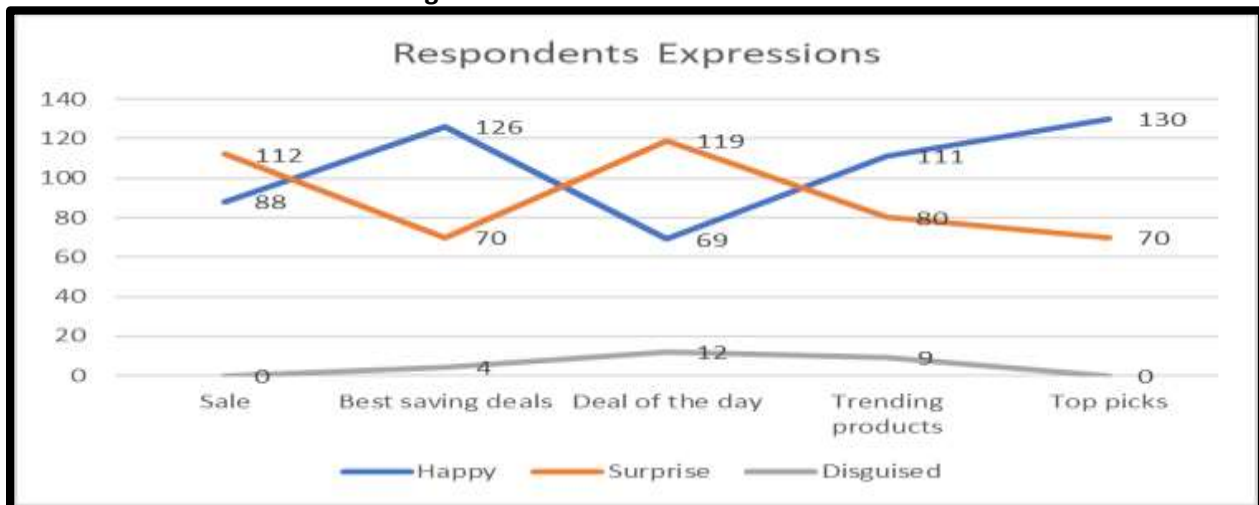


Fig 5 : Respondents expressions tracked while surfing Flipkart and Amazon





Fig 6: Ideal Actions units calculated while facial expressions analysis

Validation of basic emotions into emotive units have been assessed in tabular form. Visual images conveys complex information in a concise manner, they are processed quickly by the brain in comparison and can stimulate emotions and cognition faster. The respondents' age ranges for study were taken

as 18-26 years, 27-41 years and 42-60 years. Self-evaluation of the respondents on parameters along with the facial coding data gives us assessment of the conscious and subconscious responses.

Table 1: Perceived self-evaluation of emotion for parameters across age ranges

Parameter	F calculated	F critical	Result	df
Sale	3.9012	3.88529	Reject Ho	@2,12
Best saving deals	5.465	5.14325	Reject Ho	@2,6
Deal of the day	4.0123	4.2564	Accept Ho	@2.9
Trending products	6.24397	5.14325	Reject Ho	@2,6
Top picks	4.9884	4.2564	Reject Ho	@2, 9

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Table 2: Perceived self-evaluation of emotion (Happy, Surprised , Neutral) across gender

Parameter	F calculated	F critical	Result	df
H1: Gender: Male consumer and female consumer	4.9543	4.74722	Accept Ho	@1
H2: Emotions: Happy/ Surprised/ sadness/ disgust	5.8850	3.88529	Accept Ho	@2
H3: Gender and emotion	3.9834	3.88529	Accept Ho	@2



Results and discussion

From the above tables and figures obtained from the FACS analysis, following are the results:

- In an experimental context for facial coding, researchers have tried to track the emotions through facial expressions using Facial Action Coding of the respondents. Facial emotions included emotive states which were Disgust, happiness and Surprise.
- The two retail websites which respondents viewed for a specific time frame, elicited emotive responses which have varied across gender and age ranges.
- In the two e-commerce websites which the respondents viewed for a specific time frame, Using Facial coding software - respondents facial expressions- the average gaze count, average fixation counts were obtained. Gaze is tracked even in FACS, as eye movement makes sure the respondent's face is in the correct position. Heat maps provided further facial movement data.
- Across age cohorts, Surprise and disgust was a common emotive expression in comparison to the other emotive states for a longer duration during the experimental period.
- While facial coding gave the subconscious information of respondents, structured questionnaires elicited conscious responses on selected parameters. In some parameters, contradiction was observed in conscious and subconscious responses
- The usage of computer algorithms enabled us to quantify subconscious aspects of individual behavior which was earlier not possible. This quantification has opened pathways to deeper neural processing of the individual consumer. Even the contradictions observed are interesting to assess as there apart from the existing parameters there might be more which can be elicited to garner data.

Hence, based on the study the following results were obtained:

H01: There is a significant relationship of facial expression with likes and dislikes of products placed on e-commerce websites (flipkart/ amazon)

H02: There is a significant relationship of facial expressions with change in offers across gender.

H03: There is a significant relationship between consumers' emotions and willingness to buy products across age ranges

The study has found that facial expressions of individuals showed emotive changes when they visualized various products and mentally absorbed visual information. The emotions effectively showed the likes and dislikes which a person subconsciously expressed through their facial expression.

Facial expressions showed variations across gender when faced with the same visual stimuli subconsciously when different offers were presented to the consumer. The structured questionnaire responses also showed variation across gender when assessed with two way ANOVA.

When consumers' emotions and their self-perception on their receptiveness towards buying the product was assessed across age ranges, there were differences observed in the manner the visual information was perceived and conscious decision making was carried out by the individual cognitively.

Future Scope

Automatic Facial Coding System and its integration with Artificial Intelligence has opened avenues for a plethora of research across domains. Behavioral analytics tools such as A.F.E.A has enabled marketers and researchers to apply the information garnered from such studies into making effective strategies and improving decision making.

Conclusion

The research on nonverbal evaluation of consumer behavior gives marketers across



domains deep insight on rethinking strategies for capturing consumer's attention. The present technology focuses squarely on digitization. Systematic efforts are taken to retain consumer attention and convert it effectively into revenue by companies. This underscores the relevance of companies targeting consumers to track the consumer's behavior effectively. Behavioral analytics tools and methods like facial coding will further expand the insight into the consumers mind and broaden the horizon of consumer behavior.

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