

PILOT STUDY

# PILOT STUDY OF THE RELATIONSHIP BETWEEN THE JUDGMENT OF LINGUISTIC FEATURES AND FACIAL EXPRESSIONS



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## ABSTRACT

This paper presents the results of a pilot study to verify if facial expressions can be clues to the social judgment of a sociolinguistic variable, making the relationship between a variable phenomenon (rotacism in Brazilian

Portuguese) and the physiological effects of variation possible. To the execution of this work, two experimental studies were elaborated: the first one had the participation of 30 university students and considered, as independent variables, judgment and response time to audio stimuli; the second one, in which 9 other students participated, considered as independent variables judgment and participants' facial expressions. The results of reaction time corroborate the stigmatized status of rotacism and show that the negative judgment attributed to this variable is evidenced by facial expressions because participants did not remain neutral when they are listening to this phenomenon.

#### RESUMO

Este artigo apresenta resultados de um estudo piloto com o objetivo de verificar se expressões faciais podem ser pistas do julgamento social de uma variável sociolinguística, tornando a relação entre um fenômeno variável do tipo estereótipo (rotacismo no português brasileiro) com os efeitos fisiológicos da variação possível. Para a execução desta pesquisa, foram elaborados dois estudos experimentais: o primeiro contou com a participação de 30 estudantes universitários e considerou, como variáveis independentes, julgamento e tempo de resposta a estímulos de áudio; o segundo, do qual participaram outros 9 estudantes, considerou, como variáveis independentes julgamento e expressões faciais dos participantes. Os resultados obtidos quanto ao tempo de resposta corroboram o *status* estigmatizado da variável. No entanto, o julgamento negativo atribuído não pode ser associado às expressões faciais, pois, embora os participantes não tenham permanecido neutros ao ouvirem realizações desse fenômeno, a limitação da amostra restringe a significância estatística.

#### KEYWORDS

Sociolinguistics; Emotions; Facial Expressions.

#### PALAVRAS-CHAVE

Sociolinguística; Emoções; Expressões Faciais.

## INTRODUCTION<sup>1</sup>

Sociolinguistic production studies aim to reveal the relationship between the social profile of speakers who use a specific variable and its contexts of occurrence to contribute to the parameterization of a community's linguistic norm. The description of uses is made using linguistic samples obtained in sociolinguistic interviews or dialectal questionnaires. On the other hand, sociolinguistic perception studies aim to reveal the social value attributed to variables and their speakers. This type of study identifies a pattern of consciousness in a community, based on judgments and associations between variables and communicative situations.

In Brazil, studies about variable phenomena and their conditioning factors - whether internal or external to the linguistic structure - have received significant emphasis. The process of linguistic change is also determined by social awareness and can be observed by the perception of the variable, which attributes status and social values to the variable phenomena. Traditionally, perception studies have used methods as matched-guise: the participants, in indirect approaches, attribute characteristics to one speaker, which reflect judgments about their linguistic variety (LAMBERT; LAMBERT, 1968). Recently, perception studies have incorporated control parameters from experimental research, which guarantees more control of variables that may influence the way speakers react to a linguistic stimulus (DRAGER, 2018). Recently, in interface with cognitive sciences (CHEVROT, DRAGER; FOULKES, 2018), sociolinguistic processing studies aims to measure the cognitive cost to process a linguistic variable. These studies consider the physiological effects of variation, as attention and processing effort, which are also indirectly measured by response time latency or variation of pupils dilatation. In this type of approach, there is more control over the variables involved.

Experimental sociolinguistic studies with online and offline approaches allow the broadening of the scope of understanding and processing of social evaluation of variable phenomena at phonological, syntactic, semantic, or pragmatic levels. It is impossible to have access to linguistic processing in loco, so researches with experimental approach allow, through the manipulation of independent variables and indirect clues as behavioral tests, the assessment of how variable linguistic phenomena are processed, what social information is associated with them and, consequently, what reactions they raise among speakers (DRAGER, 2018; FREITAG, 2020).

1 Awarded work in the "Dance Linguistics" contest, promoted by the Brazilian Linguistic Association (ABRALIN) during the 11th ABRALIN International Congress. The video is available at:  
<https://www.youtube.com/watch?v=oVbQIRCI48o>

The experimental method allows more control over the variables that may influence the answers given by the participants, as the researcher's influence. It also allows measuring the relations among cognitive, affective, and behavioral dimensions that affect processing and linguistic judgment.

In order to contribute to the development of research on variationist sociolinguistics that makes use of experimental psycholinguistic techniques to increase the analytical and predictive power, incorporating more reliability, this paper presents the results of a pilot study that aims to verify if facial expressions can be clues to the social judgment attributed to sociolinguistic variables.

## 1. FACIAL EXPRESSIONS AND SOCIOLINGUISTIC SALIENCE

In sociolinguistic studies, the salience level is related to the perception, that is, the way speakers judge variable linguistic features and with whom they are associated. Therefore, understanding the relationship between salience of a variable linguistic feature and the way it is perceived by a certain group of speakers is essential to set a pattern of variation and to comprehend its cognitive dimension (FREITAG, 2018). In a broad sense, classifying as salient something or someone who stands out is more common. This is valid to sociolinguistic studies, too (RÁCZ, 2013): a variable is considered salient when it strikes a specific listener, member of a determined speech community. When a variable is salient, positive or negative characteristics may be addressed to it.

Physiologically, cognitive processes activated by a trigger, as a salient or stigmatized linguistic stimulus, leave clues even when the speaker controls their reactions: the pupil dilatation or facial expressions can be considered as evidence of the underlying social judgment, which is the matrix of linguistic prejudice. For sociolinguistic perception, the effects of cognitive salience can be measured by the relationship between structural salience and the difference in the distribution of socially indexed and non-socially indexed variables (FREITAG, 2018).

Being universal, the surface effects of cognitive salience show a physiological correlate and one of them is emotions. From a cognitive perspective, emotions refer to a positive or negative evaluative pattern associated with automatic physiologic reactions caused by certain types of stimuli. All emotions are associated with a pattern of evaluation and expressions of affective states are correlated with two factors: physiological (inside out) and social (outside-in). Experimental studies have shown that physiological excitation changes can cause different conscious experiences, depending on the context (SCHACHTER; SINGER, 1962; SCHACHTER; WHEELER, 1962; REISENZEIN, 1983).

Several approaches have been developed to try to get closer to the cognitive aspect of emotions using auditory perception, visual perception, imagination and/or simulation of contexts with different techniques to measure the participants' responses, using neuroimage, observation of behavior and application of assessment tools (LANG; BRADLEY, 2010; LÖW, 2008; BRADLEY; CODISPOTI; LANG, 2006). Such procedures, when evoking the visual or auditory paradigm, bring texts or images with content that can mix emotion with a personal experience when the speaker is faced with linguistic content and semantic categories strongly associated with a socio-cultural context. We can transpose this to the study of salience and sociolinguistic perception: the auditory or visual stimulus to which a speaker is exposed can evoke emotions depending on the linguistic variable.

The recognition of facial expressions is a study field of the perception of emotions in psychology, biology, and related areas. Three components are fundamental to talk about emotions: the subjective experience, physiological changes, and cognitive appraisal. The process of facial expressions recognition is the process of decision-making based on the interpretation of the changes that the subjective experience of emotion could cause in other people's facial expressions (LENCH, TIBBETT; BENCH, 2016).

Facial expressions are universal, observable results of evolution. Emotional responses expressed by the face are automatic and involuntary caused by ambient perception (social cognition). Facial expressions transmit information that generates knowledge for social cooperation and social and moral judgments. The recognition of facial expressions may be innate but susceptible to environmental influences. Because of that, the six basic emotions that behavioral theory proposes: happiness, sadness, surprise, fear, anger, and disgust (EKMAN; FRIESEN, 1975; WOLF, 2015), suffer variations that depend on the cultural context (ANDRADE et al., 2013; CRIVELLI et al., 2016)<sup>2</sup>

The physiological changes caused by emotions are expressed by facial musculature. The expression of happiness, for example, is characterized by tense lower eyelids, raised cheeks and pulled up corners of lips. The expression of anger instead is characterized by lowered eyebrows, tense lower eyelids, pressed, or slightly open lips (EKMAN, 1972; EKMAN; FRIESEN, 1975).

2 There is no consensus on the amount of basic emotions. In studies carried out in the 1960s, Ekman (1972) assumes that there are five expressions shared by an entire human species. Posteriorly, this amount increases in the works of the same author and other authors. However, happiness, fear, sadness, surprise and disgust are always systematically listed by different researchers in their typologies of emotions.

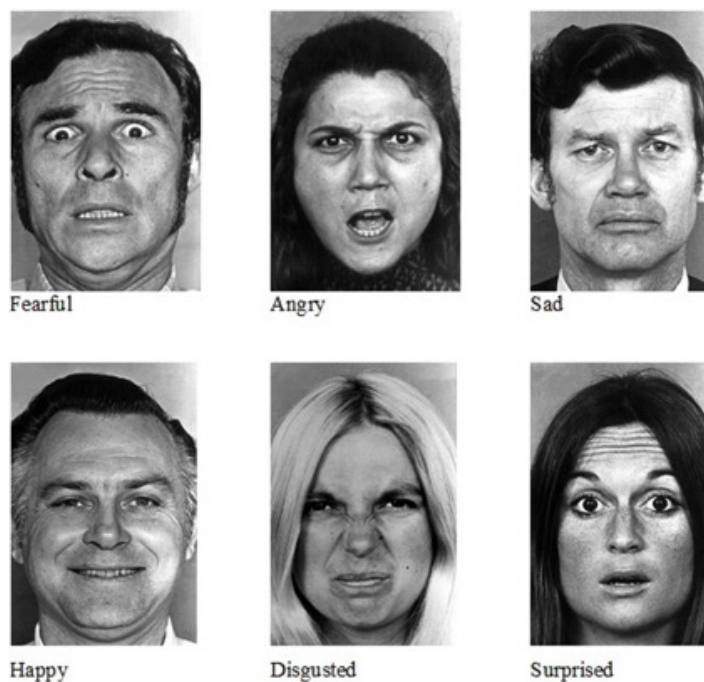


Figure 1. facial expressions. Source: (Ekman; Friesen, 1975)

Physiological changes caused by the expression of emotions as a response to a given stimulus can be an online parameter to assess the speakers' sensitivity to linguistic variables, especially the most salient and/or stigmatized.

The rotacism, a stigmatized phenomenon in Brazilian Portuguese is characterized by the replacement of /l/ by /r/. Because of the articulatory proximity (both are lateral consonants), in sequences with /l/ or /r/ exchanges like *amarelo* > *amalero*, *acerola* > *acelora* can happen. In Portuguese, the /r/ sound is a cluster that has late acquisition. Therefore, this is a salient context from the structural point of view (LAMPRECHT, 1993).

From a sociolinguistic point of view, in Brazilian Portuguese, rotacism systematically occurs in consonant clusters attacks (*bloco* > *broco*) or in coda (*calda* > *carda*) (GIORDANI, 2005; COSTA, 2007; 2013; COX, 2009; REIS, 2010; CASTRO, 2013; ROMANO; FONSECA, 2015), with strong social conditioning associated with linguistic contact varieties (COX; SANTIAGO-ALMEIDA, 2005; ARAÚJO; SANTIAGO ALMEIDA; ZAMBOTTO-LIMA, 2009; ABREU; FURTADO, 2019). According to Amaral (1976), rotacism is typical of the countryside, which gives it a negative judgment.

The variation is sensitive to schooling effects (MOLLICA, 2001; GOMES; PAIVA, 2002; SCHWINDT et al., 2007; SANTANA, 2008; FREITAG et al., 2010; FREITAG, 2011): rotacism is currently associated with less educated speakers (SILVA; ALONSO, ONOFRE, 2010), is consciously marked, suffers metalinguistic comments, and is used to build the

representation of social stereotypes, as the character "Chico Bento"<sup>3</sup> (FERREIRA; BARBOSA, 2017). The rotacism social stratification is traced by both percentual distribution in speech communities where this variable is used (away from urban centers) and speakers' schooling profile (in general, we compare the occurrence of the phenomenon among more and less educated speakers, with and without the mastery of the standard norm of Brazilian Portuguese, respectively).

In the countryside, because of the expressive realization of rotacism by relatives, it is only in school that a student, in contact with other norms, becomes aware that this variable is salient and, in specific social contexts, it is negatively evaluated. The high frequency among less educated speakers makes the rotacism in this group a variable rule relatively stable, with a social status not as prominent as among university students, who master the prestigious linguistic variety, and thus have other values and automated judgments. In this perspective, when university students listen to rotacism realizations, a variable that acts as a cognitive trigger, we expect an emotional reaction. There are not any records that correlate emotional responses to sociolinguistic triggers, which reveals the originality of this proposal: a pilot study that relates the reaction to a trigger as a clue to the rotacism social assessment.

## 2. METHOD

### 2.1 INSTRUMENT

The experiment to measure the relation between the rotacism social judgment, facial expressions, and sociolinguistic processing was developed in the software OpenSesame, v. 3.1 (MATHÔT; SCHREIJ; THEEUWES, 2012), with auditory stimuli that generated a numerical response.

The stimuli were produced with simple phrases elaborated to neutralize other linguistic variables, and spoken by the same interlocutor, recognized as a speaker of the prestigious variety of the community by its members. The stimuli were divided into three groups, each one with two phrases, referring to cognitive triggers:

- Target: occurrence of rotacism
- Parallel: occurrence of complex cluster with /l/ and /r/ in the same phrase.

<sup>3</sup> Chico Bento is a character from the "Turma da Mônica" comics, produced by Mauricio de Souza. Chico is a boy who lives in the countryside and speaks a stigmatized variety, associated with less educated speakers.

- Control: without the occurrence of rotacism or another sociolinguistic variable in the phrase.

The stimuli were randomized and the participant judges could listen to them only once. On the screen, one fixation point was centralized to direct the participants' look and to make it easy the calibration of the procedure of recording the facial expression. After hearing the stimuli, the participant judges had to answer the question: "how much this way of speak is pleasant for you?" as a task, registering on a numerical keyboard a rate in a scale from 1 to 7 points, where 1 is less pleasant and 7 more pleasant.

The experiment was used in two studies. The first one measures the relationship among the pleasant evaluation attributed to the stimuli and the participants' time of response. 36 university students (none of them were Letters or Pedagogy students) from the Federal University of Sergipe participated in this study voluntarily. They identified themselves as sergipanos who live in Aracaju, capital of the state of Sergipe, and were balanced by self-identification in sex/gender.

This independent variable of this study is the type of stimulus (cognitive process' trigger), and the dependent variables are the judgment rate (dependent variable off-line) and the time between the end of the auditory stimuli and the registering of the answer on the keyboard.

The second study has a more restricted sample and measures the relationship between the pleasant rate and the probability of the facial expression registered. The independent variable is the type of stimuli, the dependent variables are the judgment rate (dependent variable off-line) and the percentual probability of the facial expression registered (dependent variable on-line). 9 university students from the Federal University of Sergipe (none of them were Letters or Pedagogy students), self-identified as sergipanos who live in Aracaju, 4 men, and 5 women participated in this study.

In the second study, the recording of the participants' image was done as they were performing the task, which did not occur in the first study. The video records were encoded in a script of facial recognition. First, the videos were clipped in critical points of the auditory stimuli and after that, they were submitted to a script written in Phyton language, based on Van Gent (2016). The participants' expressions were detected by the Haar classifier algorithm (VIOLA; JONES, 2001) that extracts 68 points on the line of eyebrows, mouth, nose, eyes, and chin. The expressions were classified through their comparison to images of CK+ database (KANADE; COHN; TIAN, 2000), developed to analyze the expressions of happiness, disgust, neutral, fear, and surprise (Figures 2-6).

The images showed below were produced by the script written in Phyton language with the extraction of 68 points, in triggers moments: when the participants listened to the auditory stimuli. All the university students who participated in this experiment signed a consent term allowing the use of their images and data, according to (CAAE: 0386.0.107.000-11).



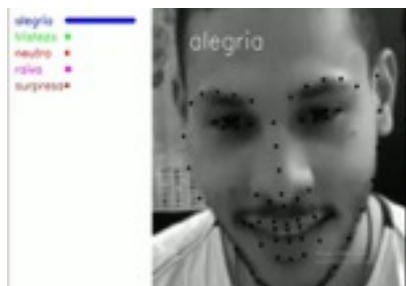


Figure 6. Expression of happiness detected by the script. Source: Elaborated by the authors.



Figure 7. Expression of disgust detected by the script. Source: Elaborated by the authors.



Figure 8. Neutral expression, detected by the script. Source: Elaborated by the authors.

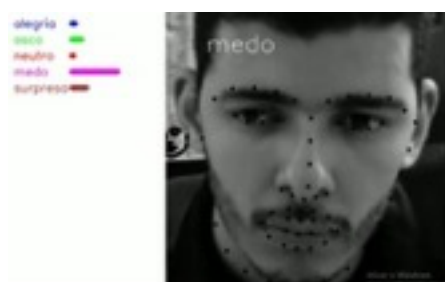


Figure 9. Expression of fear detected by the script. Source: Elaborated by the authors.



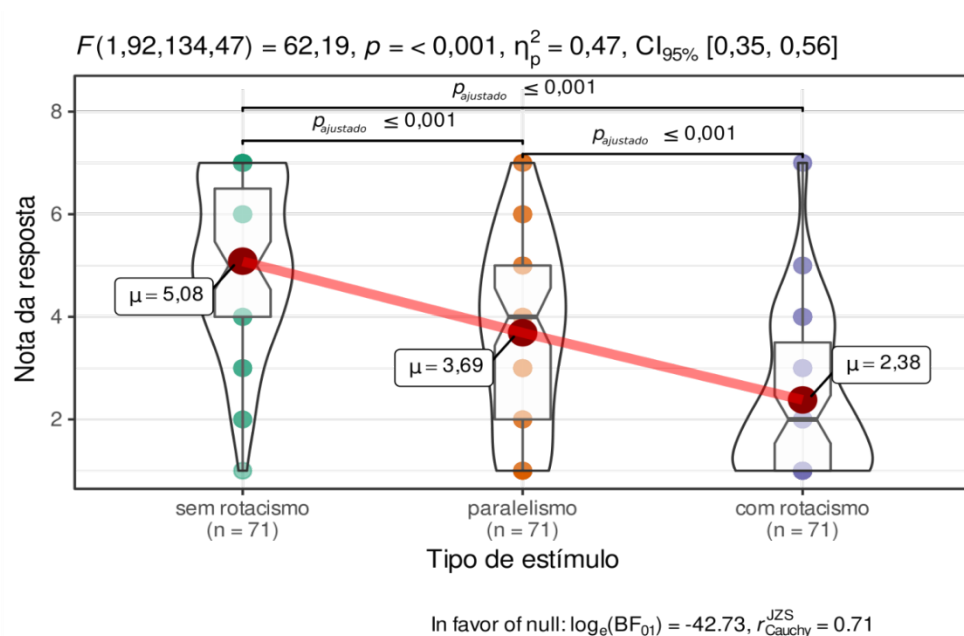
**Figure 10.** Expression of surprise detected by the author. Source: Elaborated by the authors.

The classification of facial expressions was made by the technique Support Vector Machine - SVM (VAPNKI, 1995), based on statistical learning, which establishes principles for obtaining classifications with good generalization using algorithms capable of predicting the class of new data from the same domain in which the learning took place. One SVM was used to learn the expressions from the CK+ database, associating the features extracted by the Haar classifier with emotion labels. To each emotion analyzed, the SVM learned with imagens previously classified by the 68 points distributed on the face. This mechanism allowed the identification of the facial expressions showed by the participants of the study in the images recorded by the webcam.

The data collected was statistically analyzed in a design within-subjects with t-test to repeated measures (the same participants tested for all conditions) considering the mean of pleasant judgment and response time in function of the set of stimuli in the first study. In the second one, we tested the mean of the probability of emotion in function of stimuli. The graphic visualization of the results was developed using the ggstatsplot (PATIL; POWELL, 2018) package for the R platform (R CORE TEAM, 2019).

### 3. RESULTS AND DISCUSSIONS

How a variable is judged by a speech community gives clues about its pattern of social conscience and shows how much it is salient. Rotacism is a phenomenon whose sociodemographic pattern of distribution is characterized as socially salient and stigmatized by more educated speakers. The experimental task measures the participants' sensitivity to rotacism trigger and the context of parallels structurally salient occurrences.



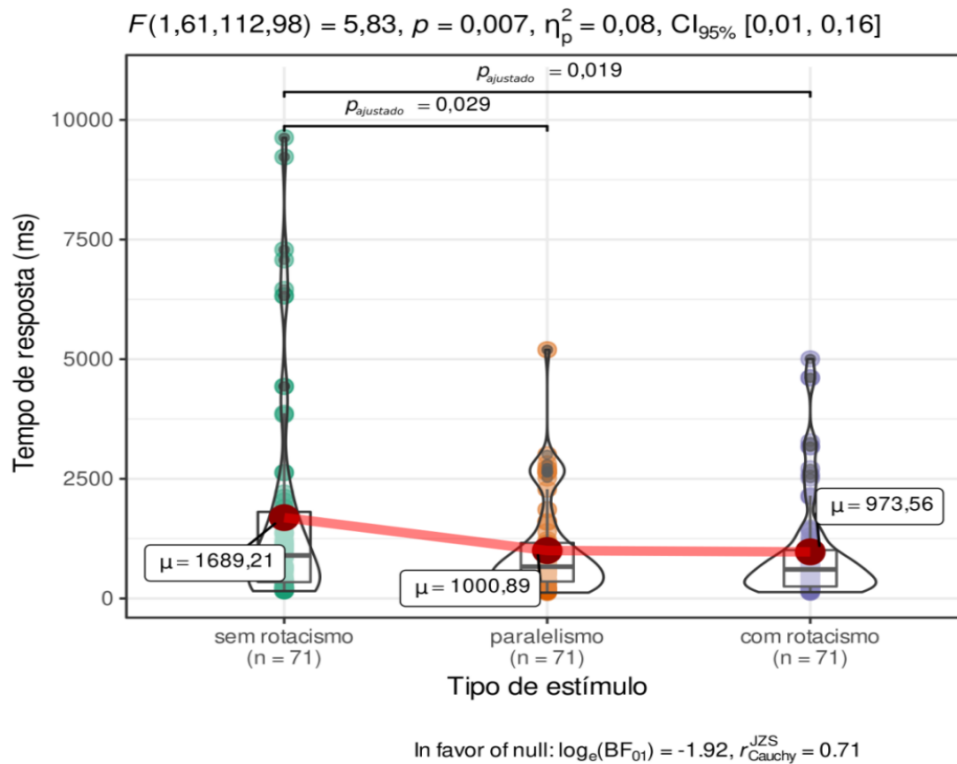
**Graph 1.** Diagram of boxes and violin of the linguistic stimulus judgment notes. The  $\mu$  represents the average of the judgment score. Source: Elaborated by the authors.

The set of linguistic stimuli with rotacism showed a lower pleasantness average (2,38), in consonance to the negative social evaluation made by the speakers to the target stimuli. All differences are statistically significant ( $p > 0,001$ ) (graph 1). The average of pleasantness judgment shows a distribution that reflects the results inferred by production studies, signaling a negative social evaluation. The results reinforce the salient aspect of rotacism among university students, a sample of speakers who represents a prestigious urban variety: as the phenomenon disappears in the set of stimuli, the averages of rates stabilize (with parallelism and without rotacism). Descriptive studies about this variable suggest that this phenomenon is less common among university students, thus presumably salient, what has been corroborated by the obtained results.

The effect of articulatory proximity in sequences of complex attack with /l/ and /r/ also showed effect: lower mean in relation to the set of control stimuli, with mean (5,08) and higher mean in relation to the set of target stimuli (3.69) ( $p > 0.001$ ) (graph 2). The participants were capable of recognizing the manipulation of rotacism, occasionally being a negative stereotype to the academic community, revealing a stigmatized perception of the stigmatized variable. These results suggest a structural salience effect in the processing of sociolinguistic information, which is even more affected by the response time.

The response time corresponds to the time taken between the stimulus and the execution of an association task. It reflects the effect of evaluative priming: an auditory stimulus after the response time of the automatic activation of the association used to

measure the response time is paired with a polarized target scale (the pleasantness rate), and the participant judge is instructed to associate the stimulus with the target.



**Graph 2.** Diagram of boxes and violins of response times in relation to sets of stimuli. The  $\mu$  represents the mean of response time. Source: elaborated by the authors.

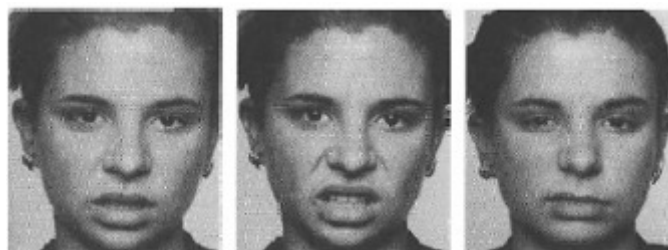
The result of the mean of response time in function of the type of set stimuli shows the same pattern found to the mean of pleasantness rate: the mean of response time to the set of control stimuli (1689.21ms) ( $p = 0.0029$ ) is higher than the mean of time of the set of stimuli with parallel occurrences (1000.89) ( $p = 0.029$ ) and than the set of target stimuli with rotacism ( $p = 0.019$ ). This result may contradict the expectation that a stigmatized variable would demand more response time, but it follows the same tendency found in a study of sociolinguistic monitor: stigmatized variable have lower judgment rates and response time than the prestigious ones (FREITAG, 2020).

The results reinforce the social status of the sociolinguistic variable because the processing time of the set of stimuli with rotacism was fast and automatic, showing that there is a strong social conscience and judgment about it: this phenomenon does not belong to variety spoken by university students.

Assuming the cognitive process trigger is a sociolinguistic auditory input (segmented into target, parallel, and control sets) the facial expressions can function as a response to

these external stimuli, demonstrating the participants' emotional state about them. The participant judge would demonstrate disgust, an emotion described as a feeling of aversion while listening to the rotacism, (EKMAN; FRIESEN, 1975), as evidence of the negative judgment attributed by university students to this variable. When participants listened to stimuli with no occurrences of rotacism and parallelism, on the contrary, they would maintain neutral expressions.

According to Ekman (2003), the expression of disgust, characterized by the contraction of the nose, arching eyebrows, and rounding of the mouth can be a kind of gradient or intensity, since this emotion can be elicited by stimuli relative to all senses (figure 7). A participant exposed to an unpleasant smell would show a more intense expression than if exposed to a stigmatized auditory stimulus.

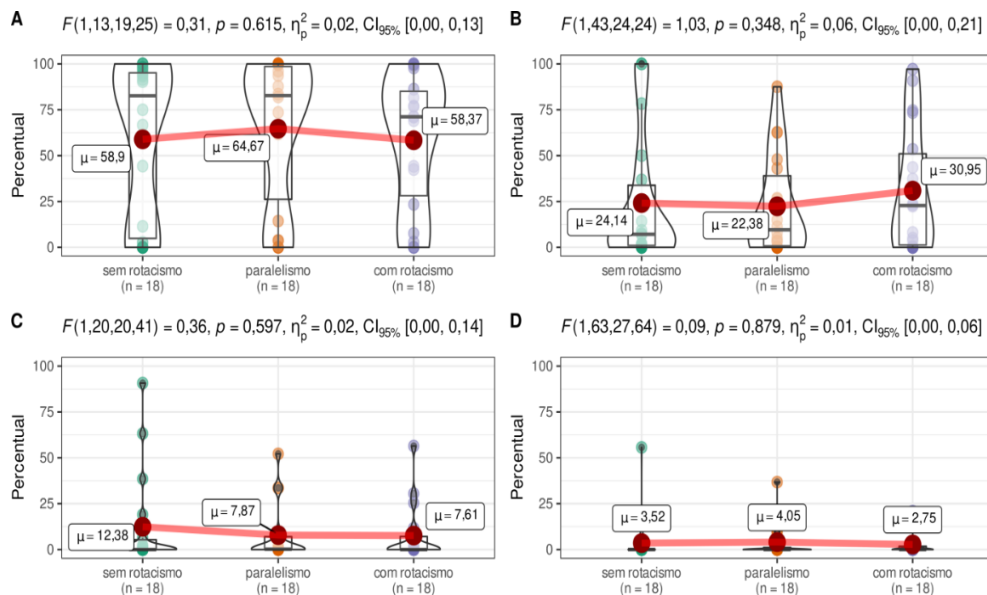


**Figure 11.** Gradience of disgust. Source: Ekman (2003).

Considering that the experimental task is an auditory priming, we can expect in responses to rotacism stimulus (target) less intense, more subtle expressions of disgust, and neutral expressions to the other stimuli (control and parallel).

The facial recognition script generated probability data from the expression demonstrated by the participants, taking as basis the expressions of happiness, disgust, fear, neutral, and surprise provided by the CK + database (KANADE; COHN; TIAN, 2000).

In the execution of this study, the script recognized as more probable the neutral and happiness expressions, associated with rotacism stimuli. The other emotions showed a lower mean of probability. The mean of surprise, for example, was near zero, and because of that, it was excluded from the analysis. None of the predominant emotions had a statistically significant result, possibly due to the sample limitation, with only 9 participants.



**Graph 3.** Diagram of boxes and violins of the percentages of the probability of predominant emotions: A. neutral, B. happiness, C. disgust and D. surprise. The n represents the number of stimuli of each type presented, and the  $\mu$  the mean of the percentages. Source: elaborated by the authors.

The predominance of neutral expression with means of probability varying from 64.67 to 58.37 suggests that the salience effect of the phenomenon is not as strong as expected. It is important to remember that this sample is formed by university students and the university can be an environment more conducive to diversity, which minimizes strangeness and prejudice. If the test were developed with participants from other social groups, with schooling diversity and experience with variation and diversity, the results could present changes in the most expressive facial expressions.

Differently from what was expected, the higher probability of expression recognized by the script while the rotacism stimuli were played was the one of happiness. According to Ekman and Friesen (1975), happiness is one of the ways to demonstrate contentment to something. This expression is characterized by a smile, which causes, as a result of the corner of the mouth contraction, the subtle raise of cheeks and the lines of the eyebrows. However, given the stigmatized rotacism status, the participants' smiles may not be related to some type of contentment, but irony. We emphasize that irony is an attitude, not an emotion. We believe that the recognition of happiness associated with rotacism can be understood as irony (the recognition made by the script was of happiness, but the participants showed an expression of laughter at the time of the test).

The recognition of happiness could be related to a methodologic limitation: the script based on CK+ (KANADE; COHN; TIAN, 2000) database only recognizes happiness, disgust, fear, neutral and surprise. The contraction of the facial muscles recognized as happiness may in fact show irony, a reaction in which the individual expresses mockery to the linguistic phenomenon analyzed, a hypothesis that is more adherent to the status of salience and

stigma of rotacism evidenced by descriptive studies and the rates assigned by the participants. This variability may also be a consequence of cultural contexts variability (ANDRADE et al., 2013; CRIVELLI et al., 2016). Besides not considering the expression of irony in the detection of emotions, the CK+ database is constituted only by European participants. Anthropometric measures and socio-cultural values of sergipanos may also have interfered with the result, which highlights the need for facial expressions databases that consider the Brazilian anthropometric diversity.

## 5. CONCLUSIONS

The social judgment attributed to a variable can be directly measured through interviews and indirectly, through tasks whose responses give hints about the social status of a certain phenomenon. Production studies on rotacism demonstrate a specific distribution pattern: this variable is more frequent among speakers who live in the countryside, in isolated regions, and who have a less education, which contributes to the automatic stigmatization of this phenomenon, as evidenced by the means of the judgment rates given by the participants of this study, university students.

The stigma attached to rotacism is demonstrated by the participants' facial expressions, which did not remain neutral when they listened to the target phenomenon, even though the results have not been statistically significant: (i) by the limited sample (only 9 participants), the reason why we did not choose a statistical treatment with mixed linear models because it would not be possible to establish random variables; (ii) by the specificity of irony, not considered in the construction of the database; or (iii) by the distinct anthropometric characteristics between the participants of this experiment and the ones included in CK+ database.

The response time of pleasant judgment attributed by the university students to rotacism stimuli reveals the difference in processing speed of this type of variable, which highlights the need for studies about the relationship between processing and social meaning of variable phenomena in a speech community.

When a speaker hears a linguistic variable other than theirs, they evoke, even unconsciously, prejudices or linguistic stereotypes about that variety. Physiologically, cognitive processes activated by the trigger of linguistic stimulus, despite being consciously controlled leave clues, such as pupil dilation and facial expressions. The results of this pilot study suggest that there is potential for the investigation of the relationship between judgment and facial expressions, which enables more detailed observations about the social fitting of variable phenomena because speakers do not remain neutral to salient variables.

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