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PERCEPTUAL DISTURBANCES AND ABUSES OF HOLLYWOOD

PERTURBAÇÕES PERCEPTIVAS E ABUSOS DE HOLLYWOOD

ALTERACIONES PERCEPTIVAS Y ABUSOS DE HOLLYWOOD

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ABSTRACT
Going beyond discussions on media representations, their forms, content, or societal impacts, the study addresses the intensity of stimuli in cinematic production, which can potentially affect neuronal reactions. The research aims to quantify whether there has been an increase in these stimuli (number of cuts, number of words, audio, sound levels, and colors) since 1950 in Oscar-winning feature films. Parametric and non-parametric statistics, univariate and multivariate algorithms, along with artificial intelligence, were used for film analysis. Our findings show statistically significant changes, with an increase in the number of cuts, loudness and seconds with perceptible color variation to the human eye ($\Delta E > 4$). The theories of Han, Debord, and Türcke about the overload of audiovisual information were corroborated by our empirical data.

Keywords: Communication. Data Science. Critical Theory. Movies. Machine Learning. Excitement.

RESUMO
Indo além das discussões sobre representações midiáticas, suas formas, conteúdos ou impactos sociais, o estudo aborda a intensidade dos estímulos na produção cinematográfica, que pode potencialmente afetar reações neuronais. A pesquisa busca quantificar se houve um aumento desses estímulos (número de cortes, número de palavras, áudio, níveis de som e cores) desde 1950 em filmes de longa-metragem vencedores do Oscar. Estatísticas paramétricas e não paramétricas, algoritmos univariados e multivariados, juntamente com inteligência artificial, foram utilizados para a análise dos filmes. Nossos resultados mostram mudanças estatisticamente significativas, com um aumento no número de cortes, na intensidade sonora e nos segundos com variação de cor perceptível ao olho humano ($\Delta E >$ 4). As teorias de Han, Debord e Türcke sobre a sobrecarga de informações audiovisuais foram corroboradas pelos nossos dados empíricos.

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Palavras-chave: Comunicação. Ciência de Dados. Teoria Crítica. Filmes. Aprendizado de Máquina. Excitação.

RESUMEN
Más allá de los debates sobre las representaciones mediáticas, sus formas, contenidos o impactos sociales, el estudio aborda la intensidad de los estímulos en la producción cinematográfica, que puede afectar potencialmente las reacciones neuronales. La investigación busca cuantificar si ha habido un aumento de estos estímulos (número de cortes, número de palabras, audio, niveles de sonido y colores) desde 1950 en los largometrajes ganadores del Óscar. Se utilizaron estadísticas paramétricas y no paramétricas, algoritmos univariados y multivariados, junto con inteligencia artificial, para el análisis de las películas. Nuestros hallazgos muestran cambios estadísticamente significativos, con un aumento en el número de cortes, en la sonoridad y en los segundos con variación de color perceptible al ojo humano ($\Delta E > 4$). Las teorías de Han, Debord y Türcke sobre la sobrecarga de información audiovisual fueron corroboradas por nuestros datos empíricos.

Palabras clave: Comunicación. Ciencia de Datos. Teoría Crítica. Cine. Aprendizaje Automático. Excitación.

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1 INTRODUCTION

The society we live in is fast-paced and reliant on increasingly technological, invasive, and colonizing communicative processes (Türcke, 2010). What exists within it is 'liquid,' meaning nothing endures or supports subjectivities (Bauman, 2008). While everything is transformed into a grand media and market spectacle (Debord, 1997), the screens affect human nerves (Desmurget, 2011). Constant change and neuronal excitement through communication stem from the needs of competition, business expansion, and war, shaping the new social environment and resulting in new neuronal pathologies from excess and wear (Han, 2011).

Humanity and nature are divorcing, while we assert the urgent need for their reconciliation (Goldman, Schurman, 2000). Enormous environmental challenges emerge and pressures for sustainability increase (Leff, 2019). Corporate and state communication leads people towards consumption and productivity ideologies that exacerbate environmental imbalances. It also pollutes the symbolic universe and overloads the nervous system with incessant stimuli (Türcke, 2015). A kind of audiovisual 'spray' impedes neuron rest, causing mental and cultural confusion.

With the goal of intensifying production, reduce costs, and increase profits, organizational management has plunged into a frantic search for new production arrangements, aided by algorithms, artificial intelligences (AI), and the most sophisticated knowledge in scientific, technological, and artistic fields (Alvesson, Bridgman, & Willmott, 2009). In this process, communication is a fundamental instrument of stimulation, inciting productive acceleration (Han, 2018), and promoting the ideological indoctrination it requires (Chomsky, 2017). The image of labor and the worker in the fast lines of factories and offices is transformed into a hygienic image of satisfaction and joy, conceived by marketing and advertising (Fisher, 2010). All conflict seems to vanish, replaced by sanitized scenes to promote products and production. Workers are not thought of or represented as producers but as components of the social charisma of products.

Communications activate productive and social transformations, being a relatively controllable catalyst of rhythms, emotions, thoughts, and collective imaginaries (Virilio, 2001). Communication strategies multiply, becoming more aggressive and challenging basic moral values and rules of coexistence (Han, 2018). In urban environments, state and corporate communication is practically omnipresent (Leiss et al., 1997). Their new configurations pose a theoretical challenge (Meyrowitz, 2008) and now, also an environmental one.

Cultural critique of media productions is vast. The topics are extensive and expose numerous inconsistencies and flaws in the products disseminated daily by major communication systems. There are multiple studies, for example, on violence in television programs. George Gerbner, a pioneer in this field of research, extensively quantified televised violence events and established standards that were subsequently tested, reaffirmed, and contested by many other researchers (Morgan, 2012). Carlsson and Feilitzen (Carlsson, 1999) also studied violence in communications aimed at children. Beyond media violence, consumerism (Baudrilliard, 2008), racism (van Dijk, 2008; Sut & Lewis, 2006), gender issues (Kilbourne, 1999), homophobia (Kimmel; Mahler, 2003), class representations (Mantsios, 2003; Bullock; Wyche; Williams, 2001), militarism (Charmers, 2007; Herman; Chomsky, 1988), images of the elderly (Lewis, Medvedev, & Seponski, 2010), foreign policy news (Herman; Chomsky, 1988; Mcchesney, 2015), advertising (Williamson, 1994), and public relations (Stuart, 1996) have been extensively and carefully investigated by civil organizations, academic research, governments, and the industry itself. Often embroiled in heated controversies, the results of these studies point to significant and serious problems with potential biases in cultural industry products. Both the political right and left-wing accuse the media of distortions harmful to morality, society, and democracy. The industry almost always denies these accusations.

Regarding environmental issues, something similar occurs. There are several studies showing problems related to media presentation of environmental phenomena such as climate change (Noble, 2009), pollution (LI, 2019), deforestation (Costa, 2016), waste disposal (Silva, 2019), predatory hunting and fishing (Freeman, 2011), etc. Shanahan and McComas (1999) show a tendency among heavy TV viewers to be less sensitive to environmental issues and to believe less in the role of social mobilization in their resolution. As with other topics, the results point to a highly problematic and biased representation in media production.

Despite all this research effort, there is a relatively new and still underexplored field in communication studies. It concerns the environmental effects caused by media messages, especially in audiovisual form. In other words, it is not only the symbolic, discursive, and cultural contents that present problems, but also the very form of the messages. I this sense the study tests some hypotheses put forth by Debord (1997), Han (2018; 2019), and especially Türcke (2010; 2015) regarding communicative processes.

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According to these authors, communication is moving towards greater excitation power, more adrenaline rushes, and other neuronal stimulants. The aim is to verify if there are measurable signs in the cinema of recent decades of a communication more oriented towards human organic stimulation, instead of symbolic and cultural appeals. That is, physiological communication configured as neuronal language, advancing against cultural criticism and resistance to media messages.

It is not suggested that a more physiological communication will completely replace or even become the predominant element in communicative processes, but that it can be a new instrument for transmitting messages without passing through the filter of consciousness and cultural criticism. The language that accompanies physiological communication targets the body. The audience is treated as an organism endowed with a central nervous system but ignored as citizens, as symbolic beings, as bearers of rights, and, therefore, as human beings.

The aim is to track the growth, discriminate, and quantify some of the most evident forms of this physiological communication in Oscar-winning films. Here, we are far beyond what Packard (1957) and Brian Key (1993) called subliminal, which still falls within the realm of the cultural, although unconscious. We are also far beyond the initial observations about the cultural industry made by Adorno and Horkheimer (1985). There is a strong need to update these observations within a critical perspective, particularly through the studies of Debord (1997), Han (2018; 2019), and Türcke (2010; 2015). Based on these authors, we address machinal and potentially addictive stimuli that affect primary organic processes and, therefore, deserve the title of pollutants.

The set of variables that was used to evaluate the hypotheses pointed out by Debord, Han, and Türcke include: cuts, brightness, audio, sound quality, color composition, number of words (analyzed in this paper) as well as moving cameras, shaking cameras, out-of-focus cameras, use of zoom, multiple simultaneous screens, sliding images, rotating images, overlapping images, accelerated images, rapid photo sequences, moving subtitles, moving margins, subtitles disconnected from speech, intense images, 3D movies, shrill sounds, and speech and images without connection (not analyzed in this paper).

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2 METHODOLOGICAL STRATEGIES

The study is based on a sample of movies that won the Oscar for Best Movie, as shown in Table 1.

Table 1

Oscar winners for Best Movie by year (Research Corpus)

Year	Title
1950	All The King's Men
1951	All about Eve
1952	An American in Paris
1953	The Greatest Show on Earth
1954	From Here to Eternity
1970	Midnight Cowboy
1971	Patton
1972	The French Connection
1973	The Godfather
1974	The Sting
1990	Driving Miss Daisy
1991	Dances with Wolves
1992	The Silence of the Lambs
1993	Unforgiven
1994	Schindler's List
2010	The Hurt Locker
2011	The King's Speech
2012	The Artist
2013	Argo
2014	12 Years A Slave

In this corpus of 20 movies, 3 samples of 3 minutes each were extracted from each movie, corresponding to the intervals of 20 to 23, 40 to 43, and 60 to 63 minutes of runtime. The investigation were conducted with these samples, measuring the following items: number of cuts; number of words; variation from white to black or brightness (L); variation from green to red (a); variation from blue to yellow (b); number of seconds with perceptible color variation

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to the human eye (ΔE > 4); audio level – left channel; audio level – right channel; and loudness (Loudness Unit Full Scale – LUFS).

Counting the Cuts: it was considered as cuts only the changes in the sequence of images that were easily visible to the naked eye. A visual count was made using a manual counter. With 3 samples from the 20 films, we end up with a set of 60 data points for the cuts.

All other variables were also reduced to a set of 60 observations to enable comparisons in the multivariate analysis. However, for the variables "L," "a,", "b," and the audio channel levels, it was possible to obtain one observation per second, totaling 10,800 data points (20 films × 3 samples/film × 180 seconds/sample).

Counting the Words: using the Google search engine, the subtitles of each movie in the original language were retrieved. The subtitles were then verified for accuracy and synchronization. This was done by taking samples from the film with real-time monitoring and subtitle verification. Once accurate subtitles were obtained, all non-text symbols or values unrelated to the film were removed. This process resulted in the 60 observations related to the number of words.

Color Analysis: the files were extracted from the original DVDs using DVD Shrink (2004) software in VOB format. To obtain numerical data, the VOB files were merged and converted to MPEG-4 (MP4) format. A Python (Van Rossum, 2020) script was then applied to extract and analyze color data. The OpenCV (cv2) library (Bradski, 2000) was utilized to open the MP4 files.

In order to process the data, one frame per second was selected from these files and resized to 100 × 100 pixels. Next, the k-means algorithm in the scikit-learn (sklearn) library (Pedrogsa, 2011) was used to identify the five main color groups in the RGB space (k = 5) for each frame. The one with the highest number of pixels was then identified. This was considered the main color of the frame. The main colors of all the frames in each film can be seen in Figure 1.

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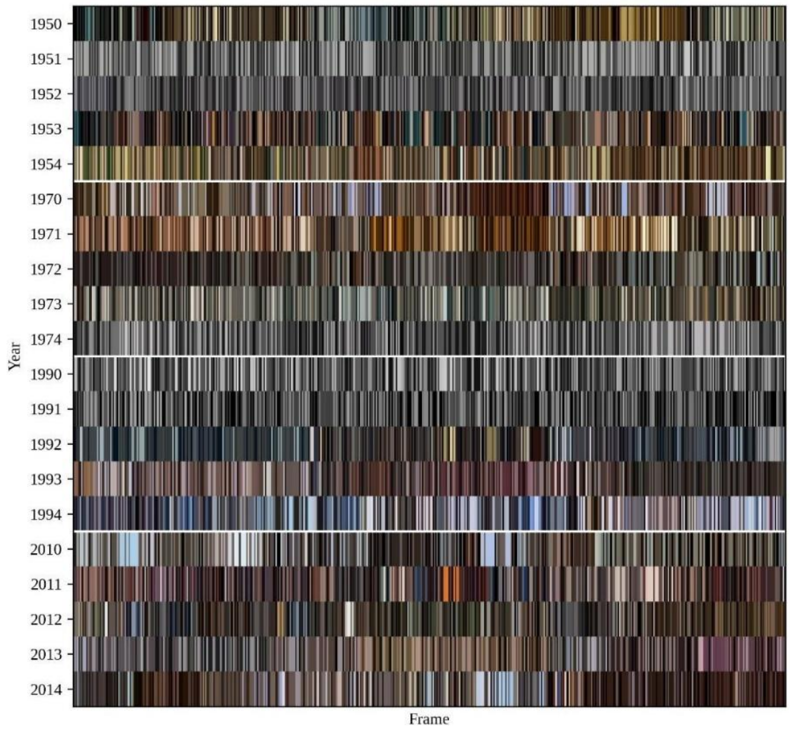
Figure 1

Main Colors of all the frames from each movie, based on k-means



Source: authors (2024).

These data were converted from the RGB system to the CIE-Lab system, and the averages per segment of the components L (lightness, that is, white to black); a (green to red); and b (blue to yellow) were computed. Additionally, the color difference (ΔE) between each frame and the next (that is, every second) was calculated using the CIEDE2000 standard (Gaurav, 2020). This methodology was chosen because it is closer to what is perceived by the human eye compared to the RGB system. Then, the number of frames (seconds) showing $\Delta E > 4$, which represents a significant color change perceptible by the human eye (MOKRZYCKI, 2011), was counted.

Audio Data: two sets of audio data were collected.

2.1 LOUDNESS UNIT FULL SCALE (LUFS)

The audio files were extracted from the DVD and converted to WAVEform Audio Format (WAV). These files were read with the help of the SciPy library (Virtanen et al., 2020) in Python.

For each three-minute segment, the Loudness Unit Full Scale (LUFS) value was computed using the pyloudnorm library, according to the ITU-R BS.1770-4 methodology

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(INTERNATIONAL TELECOMMUNICATION UNION, 2015). LUFS is an absolute measure on a logarithmic scale that represents loudness – the physiological perception of sound. As this value is given in decibels relative to full scale, that is, relative to the maximum possible digital level, the numbers are usually negative.

LUFS was originally developed to facilitate the standardization of audio in audiovisual broadcasts (such as television). Thus, it is a useful measure for comparing different audio tracks in terms of human subjective perception and can consider up to five audio channels.

2.2 AUDIO CHANELS

The original audio tracks of the films were used. The software Format Factory (Chen, 2008) was used to extract and concatenate the audio tracks. All files were converted with the same MP4 quality (optimum quality and size). The only setting changed was the audio stream index, which determines which audio track would be used. All segments were analyzed at 22.050 Hz, except for a three-minute segment, which was subsequently converted to this frequency, with the others used in their original format.

The obtained data were processed with the ffmpeg (Ffmep Developes, 2019) software, configured by a Python script to separate the segments we would use from each film and convert the film's audio tracks to WAV files, which were then processed with Audacity (The Audacity Team, 2000) software. For this extraction, only the two stereo channels of each film (right and left) were used. Since the audio channels showed high correlation, only the left channel was kept for most analyses.

Exact 20-second segments were selected, and sample data were exported from them. Within this option, the data output was set to the first 1,000,000. This was done for all 20-second segments of the 9-minute sample from each film.

The data contained in the WAV file are represented as PCM (Pulse Code Modulation). This encoding allows storing the instructions sent to the speaker in a digital format, with values ranging from -1 to 1. PCM data represent the sound signal that will be read by a sound device. The maximum power it can reproduce is represented by 1 in PCM, with values less than 1 being fractions of the device's total power. Audacity converts these values to decibels. Thus, when PCM is 1, it is displayed as 0 dB, and from there, negative values are assumed as PCM moves away from its maximum value (dBFS).

Ranking: the data were ranked from 1st to 20th based on the year, using the value of each variable: “number of cuts,” “number of words,” “L value,” “a value,” “b value,” “seconds

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with ΔE > 4,” “audio level – left channel,” and “LUFS.” The ranks for the variable “number of words” were assigned inversely, as we believe that the lower this value, the greater the organic stimulus on the viewer. Additionally, the average of the ranks was calculated to indicate a stimulation level for each film.

Statistical Analyses and Machine Learning: the data were initially analyzed using the Kruskal-Wallis Test (NPANOVA, Non-Parametric Analysis of Variance). Box and whisker plots were created, and unsupervised machine learning was applied: Principal Components Analysis – PCA (Izenman, 2008) with biplot and cluster analysis, and MANOVA (Multivariate Analysis of Variance) (Izenman, 2008), which were conducted using R (R Core Team, 2019), R-Action (Team Estatcomp, 2014), SAS (SAS Institute, 2012), and Excel (Microsoft, 1985) - pivot tables. Subsequently, supervised machine learning algorithms (Pratap, 2017) were used, including Neural Networks, Random Forest, and Naive Bayes, using the Weka software.

Regression Analyses: regression analyses were conducted based on the year with two data sets: (1) one with 10,800 observations (one per second from 3 segments of 3 minutes each from 20 films) testing the variables “audio level – left channel,” “audio level – right channel,” “L value,” “a value,” “b value,” and “ΔE value”; and (2) another with 60 observations (one for each of the three segments of each of the 20 films studied), testing the variables “number of cuts,” “number of words,” in addition to those previously mentioned.

The regression analyses and figure production were performed using the R52 software and the ggplot2 package (Wickham, 2016). A significance level of α = 5% was adopted.

Sampling: sample representativeness was estimated using stratified sampling algorithms (Barnabas, 2014).

3 RESULTS AND DISCUSSION

3.1 NON-PARAMETRIC ANALYSIS OF VARIANCE

The phenomena studied were initially analyzed from a univariate perspective to identify non-significant response variables. All response variables were significant for the Decade factor ($p < 0.05$), except for the “L value” ($p = 0.2699$), as shown in Table 1.

The Time factor was not significant, nor was the interaction between the Decade and Time factors for all response variables ($p > 0.05$).

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Table 2

Median of each analyzed variable and p-values from the Kruskal-Wallis non-parametric test. Medians followed by a common letter do not differ according to Dunn's non-parametric multiple comparison test

Variable	Decade				p-value (Kruskal-Wallis)
	1950	1970	1990	2010	
Number of cuts	15.00 c	20.00 bc	31.00 ab	41.00 a	<0.0001*
Number ofwords	362.00 a	171.00 b	257.00 b	211.00 b	0.0049*
L value	37.80 a	34.09 a	35.05 a	33.22 a	0.2699
A value	-2.66 ab	-0.43 a	0.66 a	-3.37 b	0.0348*
B value	-2.79 b	1.27 ab	3.43 a	2.43 a	0.0318*

*significance = 5%.
Source: authors.

For no variable did the 1970s significantly differ from the 1990s (Table 1). The 2010s showed a significantly lower a value and higher audio level and LUFS compared to the 1970s and 1990s. Additionally, the 2010s had a significantly higher number of cuts, b value, number of seconds with ΔE > 4, and LUFS, and a significantly lower number of words compared to the 1950s. There was no significant difference in audio level and a value between the 2010s and the 1950s.

The box and whisker plots (Figure 2) represent the data distribution across decades for each response variable studied (number of cuts, number of words, etc.). For example, the number of cuts shows an increasing central tendency (median) over time. Variability also increases, with data from the 1950s being more concentrated and less dispersed compared to the 2010s.

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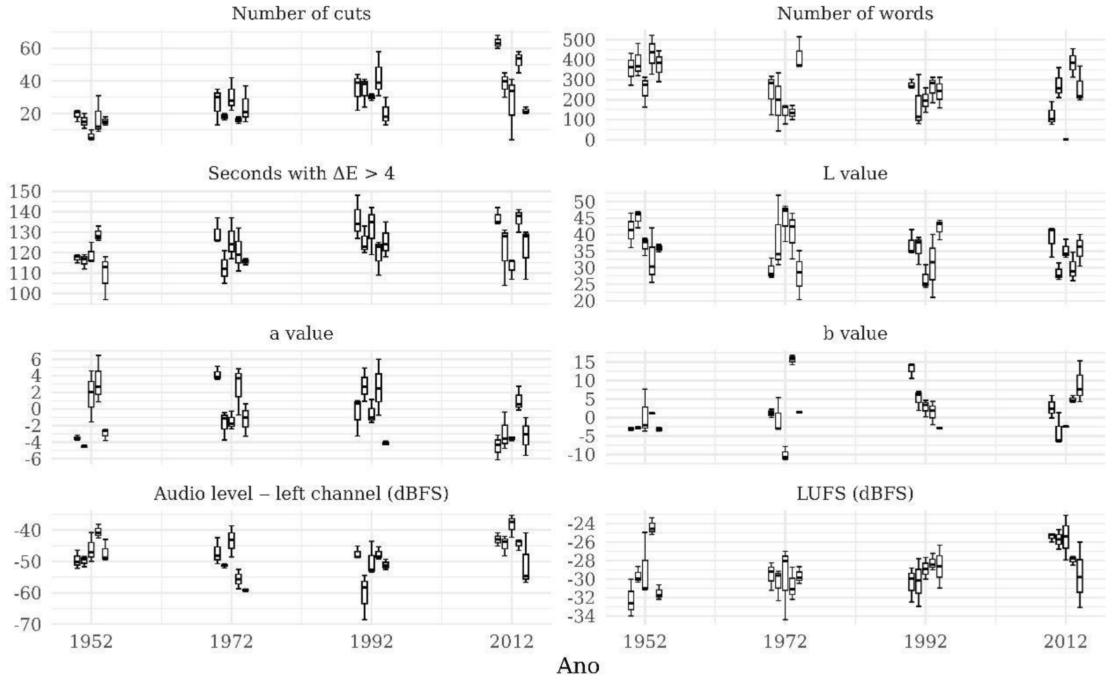
Figure 2

Boxplot of each analyzed variable (number of cuts, number of words, L value, a value, b value, seconds with ΔE > 4, audio level - left channel, and LUFS) by year



Source: authors.

3.2 PRINCIPAL COMPONENT ANALYSIS AND BIPLOT

With these results, we used multivariate statistical tools and machine learning to discriminate the decades. Initially, the unsupervised machine learning algorithm (Principal Component Analysis - PCA) with biplot was applied (Figure 3).

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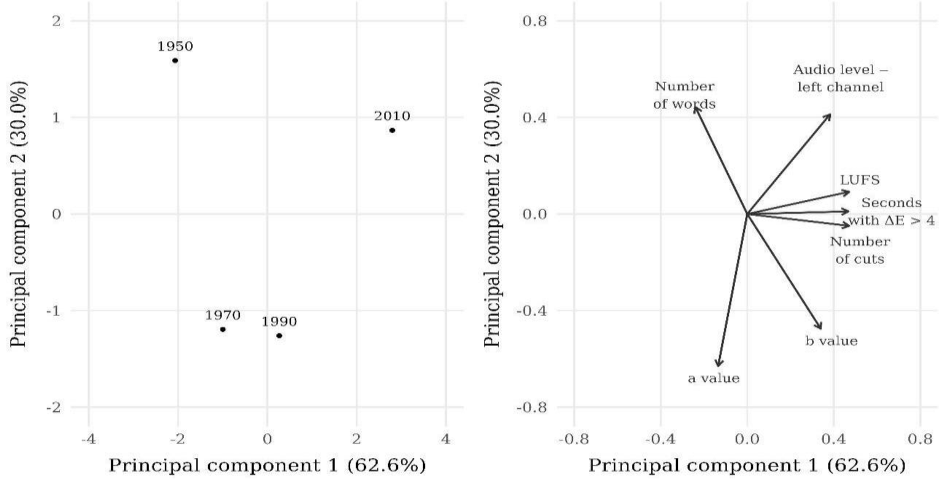
Figure 3

Biplot with the results of the Principal Component Analysis (PCA). On the left, the coordinates of each decade provided by the analysis are shown, while on the right, the loadings of the studied variables are displayed



Source: authors.

We captured 92.6% of the information using the first two principal components, with 62.6% of the information coming from the first component and 30.0% from the second component.

The biplot (Figure 3) shows that in the 1950s, the variables "number of cuts," "b," and "ΔE" had low values, while the "number of words" variable had high values.

For the 1970s and 1990s, which are close on the principal components graph, the "a" values are high and the LUFS values are low. The 2010s are characterized by high Left audio levels and LUFS and low "a" (red to green) values.

The shortest distance between decades occurred between the 1970s and 1990s (smallest multivariate, Euclidean distance between points). The 1950s and 2010s were distant from the 1970-1990 grouping.

3.3 MULTIVARIATE CONTRASTS (MANOVA)

The results of the multivariate tests to check for equality are presented in Table 2.

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Table 3

Multivariate Contrasts between Decades using MANOVA

Contrast	p-value
1950 vs. 1970	0.0010
1950 vs. 1990	< 0.0001
1950 vs. 2010	< 0.0001
1970 vs. 1990	0.2770 ns
1970 vs. 2010	< 0.0001
1990 vs. 2010	0.0032
1970 e 1990 vs. 1950	< 0.0001
1970 e 1990 vs. 2010	< 0.0001

Source: authors.

The difference between the 1970s and 1990s was the only non-significant one ($p = 0.2770$). All other contrasts were significant ($p < 0.0040$), which corroborates the analysis of Euclidean distances in Figure 3.

3.4 CLASSIFICATION ALGORITHMS

The results of applying Machine Learning to discriminate decades are presented in Table 3.

It can be observed that the accuracy of the machine learning was relatively low (Table 3). The highest accuracy was 90% for the Random Forest method (2010 vs. Others).

All machine learning methods for all confusion matrix strategies provided accuracy values lower than the confidence obtained in the multivariate contrasts (MANOVA) for rejecting the null hypothesis, i.e., that the tested decades are the same. This can be explained by the small number of points common to all response variables ($n = 60$).

The sample size used in this analysis characterizes a small dataset. In this situation, the confidence of multivariate statistical analysis is usually higher than the precision of Machine Learning, as occurred in this case.

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Table 4

Comparison of Decades: Precision (Machine Learning) and Confidence (MANOVA)

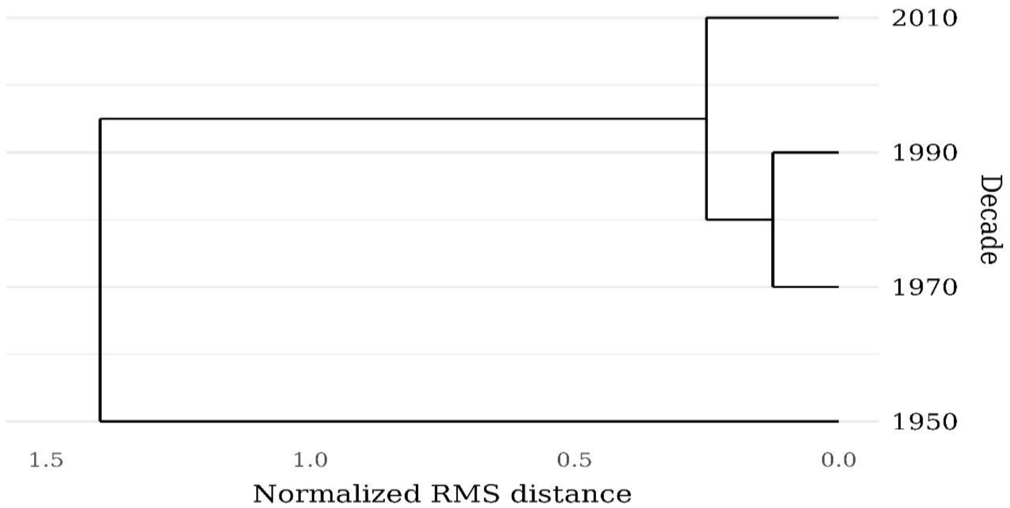
Comparison of decades	Machine Leargning Algorithm			MANOVA
	Neural Networks	Random Forest	Naive Bayes	
	Precision (%)			Confidence* (%)
1950 vs. Others	81.7%	81.7%	83.3%	99.99%
1970 vs. Others	68.3%	73.3%	68.3%	95.98%
1990 vs. Others	68.3%	80.0%	75.0%	98.40%
2010 vs. Others	85.0%	90.0%	86.7%	99.99%
1950 vs. (1970 and 1990) vs. 2010	68.3%	61.7%	76.7%	99.99%
1950 vs. 1970 vs. 1990 vs. 2010	51.7%	55.0%	56.7%	99.99%

* Confidence (%) = (1 - p-value) x 100.
Source: authors.

In Figure 4, it is observed that the cluster analysis by RMS (root-mean-square) distance also indicates that the distance between the 1970s and 1990s is smaller than the others. Additionally, it is noted that, according to this analysis, the 1950s is the most distant decade.

Figure 4

Dendrogram indicating the clustering between decades based on the normalized Root-Mean-Square (RMS) distance



Source: authors.

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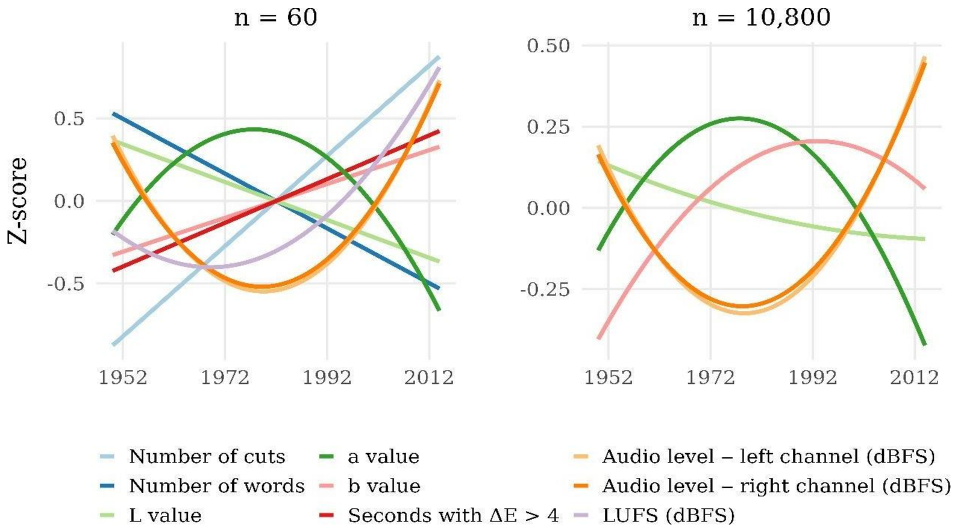
3.5 REGRESSION ANALYSIS

The results of the regression analyses for each variable based on the year are shown in Figure 5 and Table 4. It is noted that, in the set with 60 data points, the variables "number of cuts" (p-value < 0.0001) and "seconds with ΔE > 4" (p-value = 0.0202) showed a trend of increasing over time. Meanwhile, the number of words (p-value = 0.0032) and the L value (p-value = 0.0455) showed a decreasing trend. The variables "LUFS" (p-value of the slope = 0.0459; p-value of the quadratic term = 0.0445) and the left (p-value of the slope = 0.0004; p-value of the quadratic term = 0.0004) and right (p-value of the slope = 0.0010; p-value of the quadratic term = 0.0009) audio levels showed a trend of decreasing followed by an increasing trend. Finally, the "a value" variable (p-value of the slope = 0.0077; p-value of the quadratic term = 0.0076) showed an increasing trend in the early decades, then decreased. The "b" variable (p-value = 0.0750) did not show a significant trend, with α > 0.05.

In the set with 10,800 data points, the "a value" and audio level showed similar trends to those in the set with 60 data points. The "L value" also showed a decreasing trend but stabilized according to the parabola observed in Figure 5. The regression analysis for the "b value" in the set of 10,800 points indicated a trend of increasing until around the 1990s, then decreasing.

Figure 5

Equalized (normalized) graph of the equations for each variable over time for the two datasets (n = 60 and n = 10,800)



Source: authors.

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Table 5

Selected regression models based on the R^2 value for the different response variables studied and for the two datasets (n = 60 or n = 10,800)

N points	Variable	Regression Formula	Linear p-value	Quadratic p-value
60	Number of cuts	-807.58 + 0.42 Years	<0.0001	—
60	Number of words	4 511.91 - 2.15 Years	0.0032	—
60	Audio level – left channel	26 834.21 - 27.16 Years + 0.0069 Years²	0.0004	0.0004
60	Audio level – right channel	25 011.64 - 25.33 Years + 0.0064 Years²	0.0010	0.0009
60	Seconds with ΔE > 4	-157.32 + 0.14 Years	0.0202	—
60	L value	197.54 - 0.08 Years	0.0455	—
60	A value	-10 585.03 + 10.71 Years - 0.0027 Years²	0.0077	0.0076
60	B value	-126.64 + 0.06 Years	0.0750	—
60	LUFS	6 232.50 - 6.36 Years + 0.0016 Years²	0.0459	0.0445
10.800	Audio level – left channel	23 168.42 - 23.47 Years + 0.0059 Years²	<0.0001	<0.0001
10.800	Audio level – right channel	21 588.95 - 21.88 Years + 0.0055 Years²	<0.0001	<0.0001
10.800	L value	4 297.56 - 4.22 Years + 0.0010 Years²	0.0414	0.0455
10.800	A value	-10 548.90 + 10.67 Years - 0.0027 Years²	<0.0001	<0.0001
10.800	B value	-11 704.72 + 11.75 Years - 0.0029 Years²	<0.0001	<0.0001

Source: authors.

3.6 SAMPLING

The sample size was sufficient, with the optimal size estimated at n = 42, with p = 0.05. The sample size used for machine learning and multivariate statistics was n = 60. For regression models, n = 60 and n = 10,800 were used.

3.7 RANKING

Figures 6 and 7 show the differences in the average ranks over the years. It is noted that the year with the highest average rank and, therefore, we assume, the highest level of stimulation was 2010 (The Hurt Locker), while the lowest was 1954 (From Here to Eternity).

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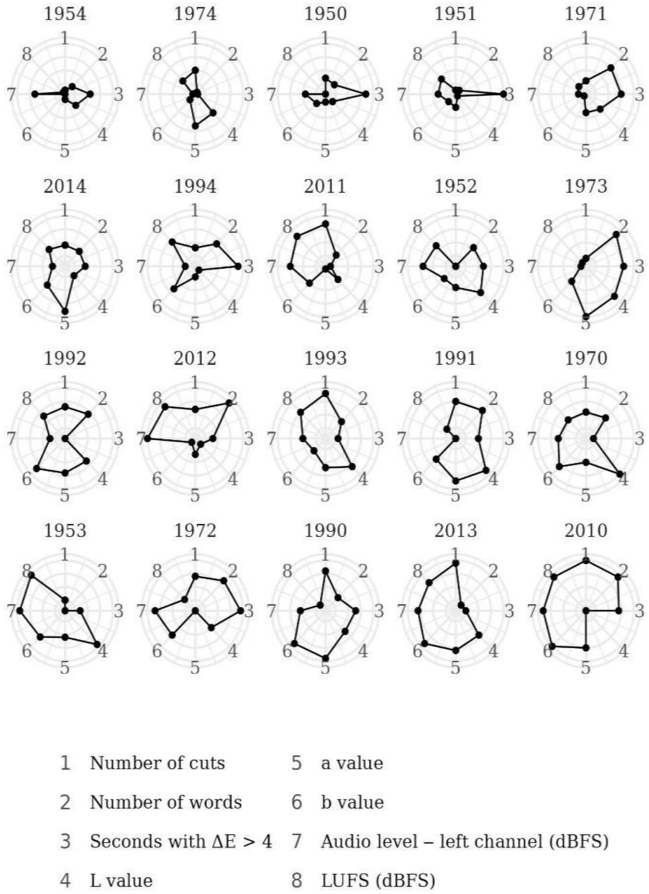
The film “The Greatest Show on Earth” (1953) is also among the top 5 with the highest average ranks of the studied variables, standing out from other films of the 1950s. Additionally, the film “12 Years a Slave” (2014) is the sixth with the lowest level of stimulation, along with other films of the 1950s. Furthermore, a regression analysis of the average ranks over time was conducted. As shown in Figure 7, there was a trend of increasing this value (p = 0.0136).

Figure 6

Ranks for each variable by year, ordered from the year with the lowest average ranks to the year with the highest average ranks



Source: authors.

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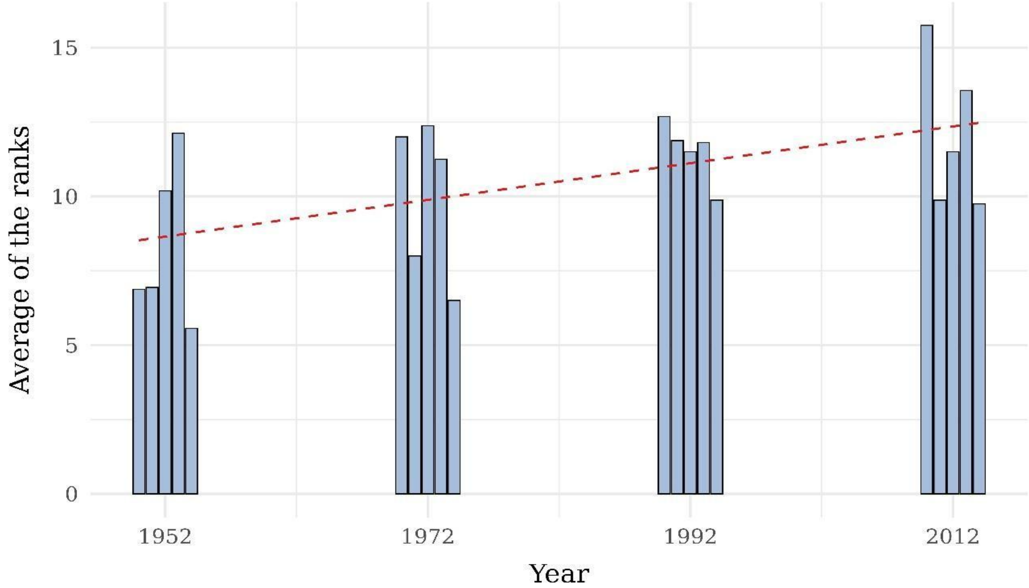
Figure 7

Bar chart of the average of the ranks by year

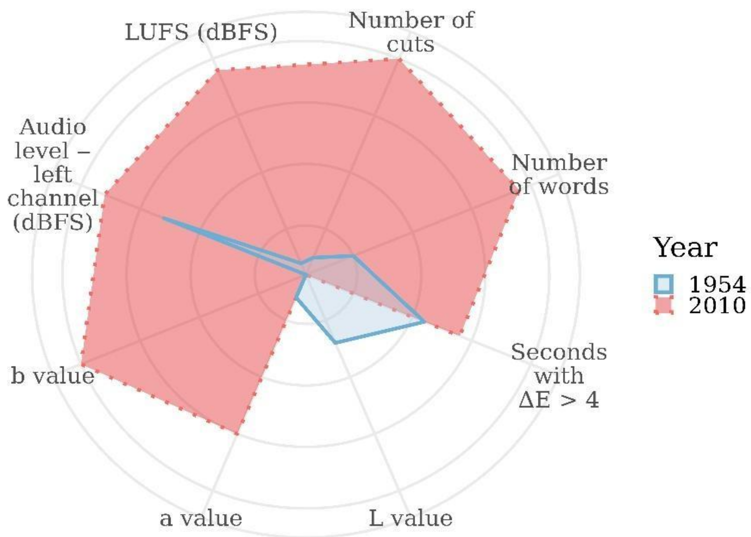


Source: authors.

Finally, Figure 8 compares the radar chart of the film with the lowest level of stimulation (1954) to that with the highest (2010). It is noted that the only point where the 1954 film surpassed the 2010 film was in the “a” variable (color variation from green to red). As shown in Figure 5, there was a trend of reduction in the “a” value in the 2010s after an increase up to the 1970s.

Figure 8

Comparison of the lowest average ranks (1954) and the highest average ranks (2010)



Source: authors.

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4 FINAL REMARKS

We believe we have established some scientific bases for evaluating the stimulation potential in cinematic productions, both for the Oscars and any other similar productions. Our variables measured the number of cuts, number of words, audio channels, LUFS, brightness, “a” value, “b” value, and ΔE. Although revealing, fundamental, and in many cases statistically significant, these variables only partially reflect the audiovisual stimulation phenomenon we intend to quantify. For future evaluations of the stimulation level, we consider that we should add measurements of zoom use, camera movement, background noise, the use of strong images (fires, murders, explosions, etc.), simultaneous screens, among other possibilities, which also derive from the deductive use of theories by Debord, Han, and Türcke.

Despite the still preliminary nature of hypothesis construction, the measures, and methods employed, we consider that the results achieved are sufficient to highlight the need for a careful evaluation of the phenomena we tried to draw attention to. There is a strong differentiation in the stimulation potential of the various films analyzed, as shown by the ranks. Over the past few decades, there has also been a clear trend of increasing stimulation processes caused by some of the variables analyzed (number of cuts, LUFS, audio levels, and seconds with ΔE > 4). However, not everything Türcke points out is fully confirmed by our analyses. For example, Türcke claims that stimulation will still have a strong expansion in the coming years. But we cannot overlook that some variables (“a” and “L”) seem to have already reached their maximum stimulation and are entering a slight retraction or stabilization phase. Therefore, it seems necessary to advance the quantitative and qualitative evaluation of these phenomena to produce the due theoretical refinement.

Despite these constraints, the hypotheses ventured by Debord, Han, and Türcke's theories could not be dismissed by our study; quite the opposite. They seem to organize and coincide with the material we found in our samples. Their explanatory potential for what has occurred in recent decades is surprising, and we consider that applying them to other samples may yield even more compelling results than those we achieved. Therefore, we emphasize the relevance of scientific investigations on media production from this neuronal/environmental perspective. Here, we only touched on some examples based on films, but there is a need for a broad, careful, and sophisticated evaluation of the evolution of audiovisual communication and its effects on the organism and society. Nevertheless, our results could serve as a basis for adopting regulatory measures and constructing responsible public policies on non-symbolic interaction instruments that degrade communication to the point of becoming environmental pollutants.

The ranking we established forms a kind of synthesis of the stimulation potential of the Oscar-winning films evaluated. It showed a statistically significant trend of increase with a p-value of 0.0136. However, we consider that this procedure needs to be improved, including variables we could not measure for this article (zoom use; camera movement, strong images, etc.) and establishing different weights for the various variables. In our evaluation, all variables received equal weights, but we know this representation can be better weighted.

The use of supervised machine learning classification processes was not the most appropriate for our samples. This was mainly due to the small dataset (n = 60), which barely meet the basic requirements for artificial intelligence analysis. This indicates that in our future studies, we should expand this database to allow more effective use of artificial intelligence tools and establish evaluation methodologies compatible with these tools. In the case of PCA analysis with biplot, the results were consistent with the probabilistic approach of multivariate statistical analyses.

Our analyses also point to an experimental nature of Oscar-winning films. Some clearly deviate from other representatives of their decade, either advancing to stimulation levels corresponding to future decades or retreating in time. The recurring presence of some outliers proved to be a challenging problem for our analyses. We controlled this using robust statistics. Perhaps the presence of outliers can be better studied by measuring the new variables we proposed. This also suggests that there is a constant search for language innovation in awarded films.

Based solely on our results, we are compelled to think that audiovisual communication tends to be a disturbance capable of disrupting sensory and perceptual processes. We are also forced to reflect on the reasons driving the industry down this tortuous path, finding only critical theorists like Debord, Han, and Türcke as support for our reflections. We also perceive the philosophical nature of these authors' arguments and believe that these topics should receive precise empirical evaluations, entering a public investigation agenda and, if necessary, regulation.

Finally, we emphasize the environmental and not just cultural importance of media messages. From early childhood, our neurons are exposed to audiovisual stimuli propagated by mainstream media, and there does not seem to be greater concern about this fact. When

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it comes to television, cell phones, and computers, our reaction seems to be numbed, and we do not easily realize the risks involved - cultural and potentially organic risks, as discussed. But, on the same principle, would we passively allow strangers to conduct sensory experiments on our children? It is in light of this that we assert that new investigations into the promotion of perceptual disturbances and other abuses by the cultural industry are necessary, as well as making denunciations and regulations when there are verifiable threats.

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