

Analyzing Public Perception of Autonomous Vehicles Through Social Media Data: A YouTube Comment Study on Tesla Autopilot Accidents

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Abstract. Based on current studies related to public perception, technology acceptance, and risk communication for autonomous driving, this study examines emotional and cognitive processes of the general public regarding actual crash incidents involving Tesla's Autopilot technology. This analysis is conducted for comments surrounding three highly viewed YouTube videos on Tesla accident incidents using topic modeling analysis, sentiment analysis, and comparison of network analysis. This study clarifies the existence of four polarized themes surrounding public perception: Technological Skepticism, Satire and Comparison, Safety Concerns, and Attribution of Responsibility. Additionally, sentiment analysis indicates primarily negative emotional undertones for comments surrounding Technological Skepticism and safety concerns but shows higher levels of Rationality and Trust for comments related to Attribution of Responsibility. Utilizing Quadratic Assignment Procedure analysis, it is apparent that differences do exist for the emotional composition of comments among each of the three analyzed videos, verifying media framing's influence on overall sentiment among the masses. This study serves to validate empirical research for risk communication and corporate crisis management for Autonomous Driving Technology and develops for this field of study its "Incident-Emotional Response" paradigm and contributes to empirical advancements for emotional processes relating to acceptance for new technology development.

Keywords: Public Perception, Tesla Autopilot, Sentiment Analysis, Social Media Discourse

1. Introduction

The development of transport technology has entered a new chapter because of advancements in artificial intelligence and sensors, of which autonomous driving is one of the most prominent examples. However, this new development is also causing growing concerns among the general population. Normally, recent incidents involving Tesla's technology for autonomous driving have not only sparked concerns but have also served as points of reassessment for trust among the population within the technology domain itself because of its emotional and cognitive influence on market development and growth directions for transport technology.

While interest is growing among academics to examine acceptance of autonomously driven vehicles, it is apparent that current research exhibits significant shortcomings. Firstly, most current studies conducted have been based on surveys or lab tests, which are inefficient at conveying the organic quality and emotional intensity implicit within public discourse. Secondly, social media-based studies have been conducted on too wide a category level, for instance "autonomous vehicles" per se, and lack specificity. There exists no gap for examination at a detailed case level addressing particular successful brands such as Tesla because events at such levels have enormous influence on overall perception by the general public.

To overcome these shortcomings, this paper recommends a concrete and data-driven approach. We pick YouTube—a platform that combines videoclip storytelling with massive text-based interaction—as a natural setting to analyze genuine social debates. Via intensive case analysis, this particular paper is intended to discover themes and emotional patterning framing social debates around Tesla Autopilot-related crashes.

This paper is informed by the following central research questions: (1) What are the central thematic frames found within actual discourse surrounding YouTube videos on Tesla car accidents? (2) What is the emotional profiling associated with each of these central thematic frames? (3) How do media reporting thematic frames shape actual prevailing discourses?

By answering these questions, this paper hopes to create novel insights into how actual acceptance of new technology is culturally mediated through discourse analysis.

2. Literature review

The acceptance of self-driving technology among the general population is also a subject of interdisciplinary studies, and current studies lie largely within perception of risk, Technology Acceptance Model, or media influence. This study is primarily on events specific to brands within the social media setting and points out areas where current literature is deficient in terms of diversity of platforms examined for study, integration of approach, and intensity of analysis related to events.

2.1. Social media public opinion and sentiment analysis

As social media continues to emerge as one element of public discourse, large-scale online data is utilized to analyze emergent emotional and cognitive responses to self-driving cars. Twitter is one of the notable sources for such data because of its accessibility. Bansal & Kockelman [1] and Gupta & Sharma [2] analyze fluctuations of public sentiment based on accident-related reports on this platform. However, length limitations do not favor any extensive or logically robust discussion on social media platforms. Additionally, demographical information affects biased responses on social media platforms because participants' perceptions are thereby limited to reflective opinions and may not necessarily cover the entire range of opinions among others. On the other hand, YouTube features detailed audiovisual explanations of stories coupled with extensive text commentary to facilitate detailed information required for analysis. Das et al. [3] recognize YouTube's strengths but have hardly analyzed its preprocessing capabilities for such analysis.

2.2. Risk perception and trust

Trust in technology is one of the key drivers for Autonomous Vehicle adoption. This is supported by studies conducted by Choi and Ji [4] and Kaur and Rampersad [5]. An increase in social media use contributes to awareness of the technology, but raises concerns regarding safety to create "cautious

optimism" around its use, as is also argued by Panagiotopoulos and Dimitrakopoulos [6]. However, trust antecedents have been largely viewed from static points of reference while processes related to trust decay following negative incidents still remain unmapped as dynamic points of projective deduction. This is crucially dependent on transparent communication to highlight risks to restore trust perceptions to normalcy for both trust decay and maintenance of referential points for normal perception by the audience/consumers. Trust changeover points consequent to Tesla car incidents are key to this study statement.

2.3. Identified research gaps

Notwithstanding this increased interest, several crucial areas remain underdeveloped or ignored altogether. First is platform: most of this research is necessarily based on data derived from Twitter itself—inevitably limited by its lack of population representativeness and its brevity of text length. How YouTube comments, for instance—their length offering a potentially much richer commentary context—are analyzed is crucial to filling this representativeness gap. Second is its lack of focus on events and chronology: most of this analysis to date is based on one-off events or very short-term observations—in reality grouped around events spaced out through several months to several years—how consistently or notably attitude evolves as events recur and technology advances being nowhere near as significant because it is highly correlated to economic development itself.

Third is its bias toward method: most analysis thus far is split equally between quantitative analysis for large-scale observations and narrative analysis for smaller observations to fill needed information gaps—but insufficiencies between these two remain largely unbridged to this point. Henceforth, employing both quantitative text analysis for theme and sentiment measurements combined with narrative analysis for deeper motives is clearly the methodological contribution of this proposal itself.

2.4. Summary and contribution of the present study

Based on the discussion provided above, this paper hopes to address these gaps by examining YouTube news coverage and comments surrounding three significant Tesla Autopilot incidents (2016-2025).

This study hopes to harness the naturalistic insights provided by spontaneous discourses on this social media platform to better reflect on perceptions surrounding self-driving cars than any information alone before could. It addresses concerns from several perspectives: from empirical analysis to its methodology by bringing together sentiment analysis and text analysis techniques to provide new insights by covering ground on all sides of each discourses' concerns while considering its approach based on its primary subject matter to improve its major concerns by exploring new pathways for systematic thinking to gain exploratory insights into new knowledge at its roots by providing new contexts for all major concerns to arise inside its definitions by applying its approach for its major subject matter while addressing its primary concerns while being broken down to five major points: (1) It adds new information to prevailing thoughts by providing new information for novel combinations of its primary subject matter to raise new exploratory insights while constructing new pathways for thinking while exploring its primary concerns to gain exploratory insights into new information surrounding its major subject matter while applying its approach for new information to raise new exploratory insights inside its major subject matter to give new information to its primary concerns to improve its major subject matter while being unbroken to five major points: (1) It adds new information to prevailing thoughts by providing new information for

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3. Data and study design

3.1. Data collection and processing

Videos on YouTube were selected through three criteria: (1) a high number of views, (2) variety of Tesla Autopilot accident types (fatal and nonfatal), and (3) variety of sources (mainstream and independent technology channels). The comments on these videos were extracted using the tuber R package and resulted in 455 comments for analysis before being pared down to 437 comments after removing duplicates and comments presented in languages other than English. Video information and comment information were extracted at the same time to allow for analysis between both sources.

3.2. Text analysis and sentiment computation

Text preprocessing involved processes such as tokenization, lemmatization, and stop-word elimination. Topic analysis was achieved through Latent Dirichlet Allocation (LDA). The number of topics was identified to be four based on perplexity and coherence measures. Sentiment analysis was done through SENA software, which is based on NRC Emotion Lexicon and generates eight primary emotion categories (anger, anticipation, disgust, fear, joy, sadness, surprise, trust) and overall sentiment polarity measures.

3.3. Data analysis

3.3.1. Part 1: LDAvis analyze

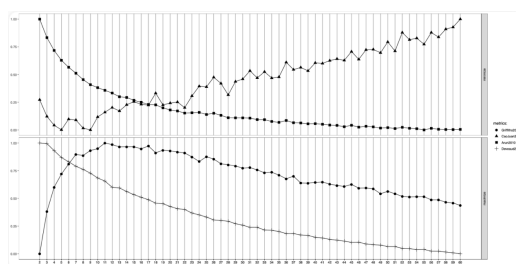


Figure 1. Metrics plot

This part of the LDAvis table is based on comments extracted from three major videos featuring Tesla's cases of autonomous driving incidents on YouTube. Through clustering and analysis provided by LDA and MDcores-Sena, four major themes have been extracted: V1: Technological Skepticism, V2: Satire and Comparison, V3: Safety Concerns, and V4: Assignment of Responsibility. These themes cover all aspects and sentiment associated with discussion on autonomous driving technology features among the masses. The following sections shall elaborate further on each theme's features and meaning.

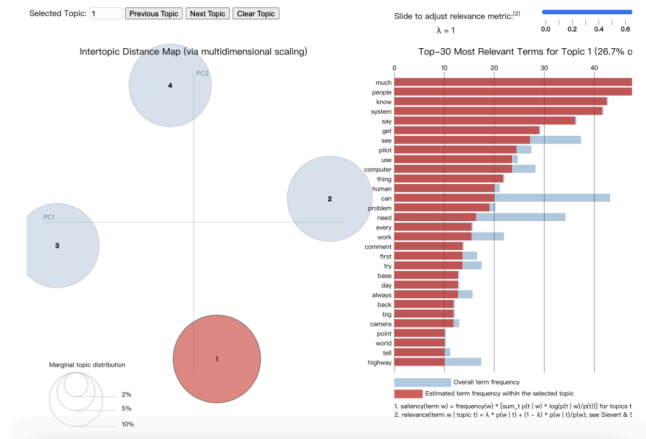


Figure 2. V1: technical skepticism

All comments belong to V1. This group repeatedly refers to key words such as "system," "computer," "pilot," and "human" to draw parallels between the reliability of automatic driving systems and human drivers' capabilities. While commenters recognize Tesla's advancements, overall they tend to remain very skeptical about its viability and safety performance for road use. The sentiment is negative but not aggressive or emotional. They are calmly skeptical and very logic-driven, questioning only its reliability while maintaining an active discussion forum. One may conclude that they have a reserved but very interested attitude toward its future development stages. Overall, V1 is the most extensive and significant discussion group because it represents general public concerns about whether this technology is capable of replacing human drivers at all.

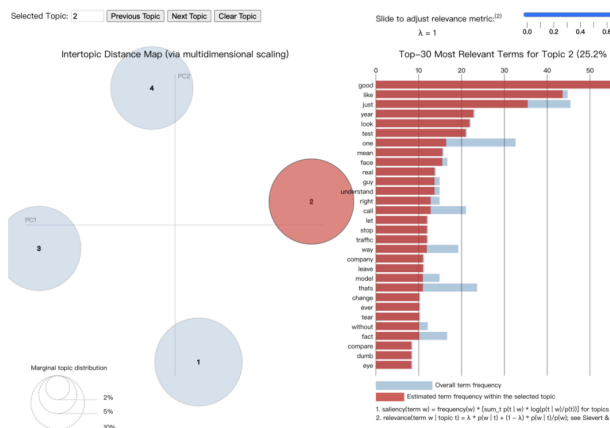


Figure 3. V2: Jokes and comparisons

The V2 group is reflective of the comical or satirical discussion that takes place among car buyers. Usually, these comments contain jokes or brands to compete against Tesla. Many of these comments contain jokes or remarks on Tesla's interior or quality of its cars. Others link Tesla's accident cases to its market performance and operations. These comments have serious undertones but have to do with jokes and comparisons of brands for entertainment among buyers. Since they are not all negative comments against Tesla's cars but rather have an intention to entertain buyers by making jokes out of serious contexts, what is depicted by V2 is banter or joking discussion among car buyers to create entertainment out of serious incidents like car accidents.

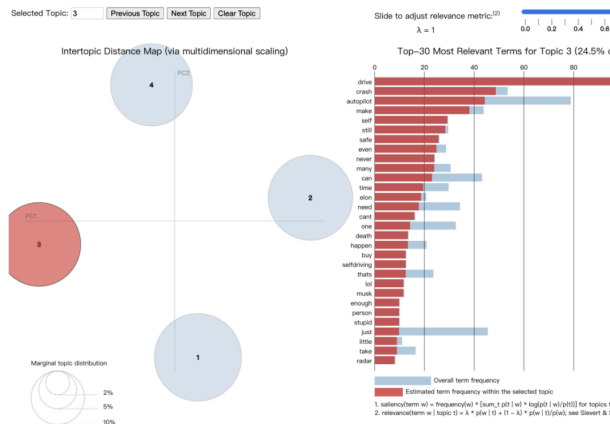


Figure 4. V3: safety concerns

The group V3 shows the most emotional expression of feelings. The comments include expressions such as "crash," "death," and "self-driving car," among others, expressing feelings of fear and anger emanating from road accidents. Many responders questioned Musk's assertion that self-driving cars are statistically safer than human drivers. Some responders expressed condolences to those affected while wondering whether it is morally right to pursue self-driving cars at all. Concluding, V3 is clearly the most emotional theme among all others central to this discussion and shows clearly that safety and life remain very dominant factors in public sentiment.

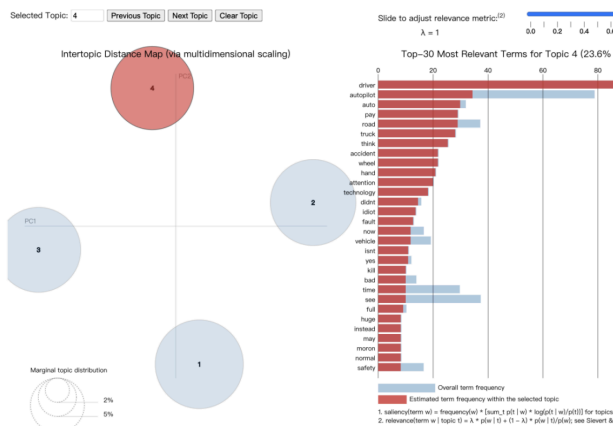


Figure 5. V4 – attribution of responsibility

The last theme is V4, which focuses on liability while considering other factors involved too. This theme also takes note of all those terms: "driver," "wheel," "attention," "truck," and "road

In comparison to V1 and V3, V2 (Teasing and Brand Complaints) shows a more complex emotional profile. It is confirmed to include not only anger and disgust but also to have higher values for anticipation and surprise. This may indicate the presence of users discussing different topics in a humorous or sarcastic manner or even through teasing in threads meant to revolve around accident reviews rather than genuine safety concerns.

Finally, V4 stands out because it addresses Responsibility Attribution and Driver Factors. Trust and Expectation reach their peak in this category. Expectations presented in this category seem genuine to some extent because individuals stress that blame for any accident should not lie exclusively on the system but should also take into account various factors like the concentration of the drivers and environmental factors. This shows that at some point, the general public trusts self-driving technology and follows its expectations to some extent.

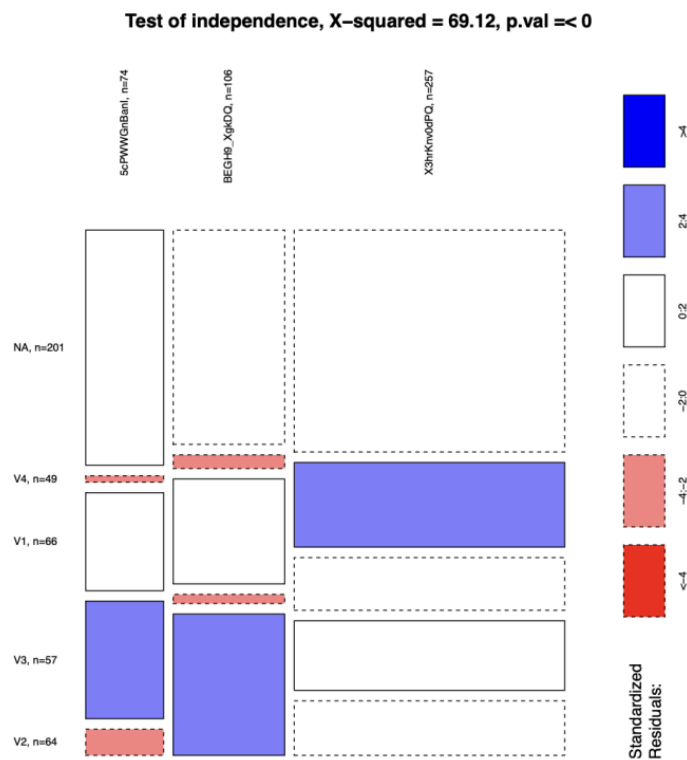


Figure 9. Test of independence

Based on the four topics, negative emotions have a slight edge over positive emotions, but it is not significant. It is demonstrated by this image that for each topic, there is one dominant emotion but also variety in each topic. The result of the test for each theme to determine whether the differences between V1 and V4 are significant supports that each theme is associated with its own unique emotional state.

To conclude, there is a polarized but diverse opinion among the general population concerning Tesla's Autopilot accident. V1 and V3 represent the majority opinions against Tesla's Autopilot accident and depict general fear and disbelief in its safety and trustworthiness. V2 embraces the sentiment associated with entertainment on social communities by mocking Tesla's Autopilot accident. V4 depicts rationale, trustworthiness, and responsibility associated with safety concerning self-driving cars.

3.3.3. Part 3: Quadratic Assignment Procedure analyze

This study used the Quadratic Assignment Procedure (QAP) to examine the emotional differences in the comment sections of three news videos.

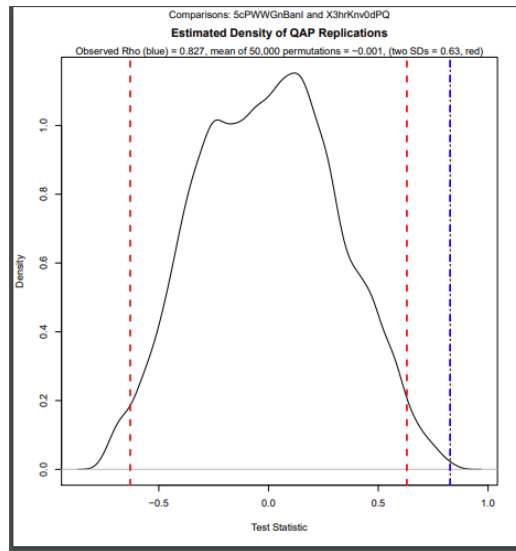


Figure 10. Test of independence

The comparison between Videos A and Video B is shown in this graph. A Rho of 0.827 is depicted, which denotes "Not Significantly Different Emotions," so emotions experienced while watching both videos were mostly similar to each other. People reacting to Videos A and Video B mainly showed similar emotional expression, mostly revolving around concerns for safety and disbelief towards Tesla's Autopilot technology introduction. This showed intensity and expression of emotions to be highly similar to each other, and no significant gap between public sentiment is found.

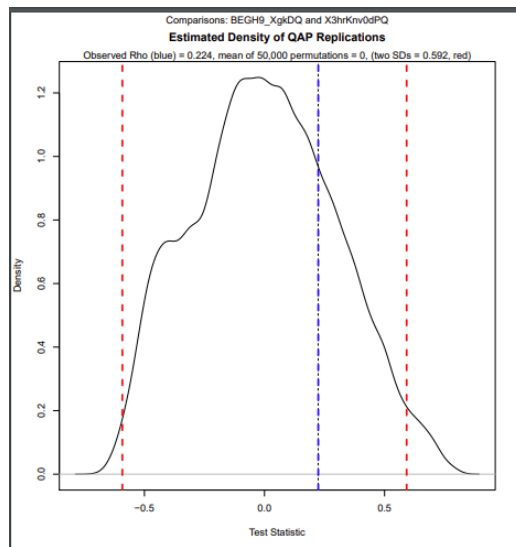


Figure 11. Test of independence

By contrast, the emotion conveyed through Videos B and C, having $Rho = 0.224$, depicts "Significantly Different Emotions." The comments related to Video B demonstrated higher levels of sympathy for the accident, fear, and disbelief about the technology, while comments on Video C demonstrated significant shifts to other emotional directions embodied by feelings of responsibility for drivers and others associated with road environments or ridicule and conclusions of conspiracy theories being at work.

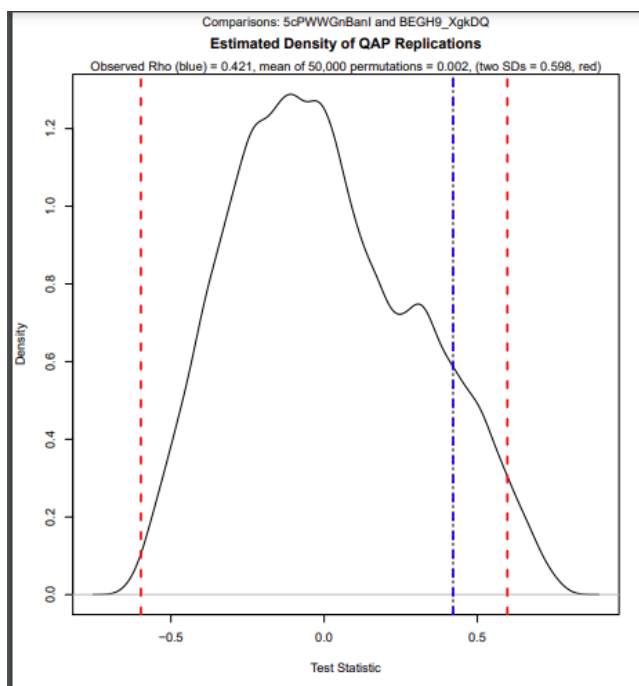


Figure 12. Test of independence

The correlation coefficient for Videos A and C is $Rho = 0.421$, which shows very different emotional expressions. Just like Video A's graphs, Video C's emotional expression is very different from Video A's. This particular graph makes it very obvious that Videos A and B belong to one emotional group because they both focus on security concerns and are very skeptical about technology, while Video C is from another emotional group because it changes the emotional expression of the audience to adopt another point of view.

3.3.4. Part 4: an in-depth analysis of public commentary—a multi-dimensional framework

Based on the result of sentiment analysis and topic modeling presented above, this study proposes a multi-dimensional analysis framework to uncover the cause behind particular comments and emotional preferences of users from five different dimensions: technology, communication, ethics, platform, and media.

3.3.4.1. Technological reliability deficits and safety anxieties

Technological limitation factors for current self-driving technology in complex situations involving "Long-Tail" scenarios are major reasons for negative user ratings. Misidentification of situations by perception algorithms may happen during improper weather or while encountering unusual static objects. This performance gap between user expectations and actual technology performance

directly affects safety concerns expressed by ratings, highlighting high frequency keywords "system failure" and "sudden braking" for V1 (Technological Skepticism) and V3 (Safety Concerns) themes. The uncertainty and instability of technology performance are most significant drivers for damaging initial trust.

3.3.4.2. The gap between company promise and user experience

Car manufacturers' overstated advertising claims like "Full Self-Driving" create irony between what is expected and what is fulfilled because of continuous system disengages and required human intervention for takeovers as shown in V2 (Satire and Comparison). Users experience deception to find themselves having feelings of dissatisfaction expressed through humor and sarcasm.

3.3.4.3. Ambiguous responsibility attribution and ethical dilemmas

It is because of lack of clarity regarding accident causation between or among the drivers, manufacturers, and environmental components that many debates have taken place. Lack of clarity among users regarding accident causation makes it difficult to have widespread acceptance of any new technology developed because users become defensive between criticizing and justifying the new technology (V4) and criticizing (V3). 4. Platform Algorithms and Group Polarization Effects Recommendations generated by algorithms for social network sites may influence and reinforce group polarizations through repeated exposure to similar information. This may result in stronger feelings of fear (e.g., in V3) or joking disdain (e.g., in V2). A person's acceptance of technology may also differ based on his or her respective culture and setting. World-wide social web sites (e.g., YouTube) bring new viewpoints into one universally shared social setting and further add to reasons behind comments against viewpoints. 5. Media Framing, Risk Perception Amplification, and Comment Management The analyzed YouTube news videos concerning Tesla Autopilot incidents are mainly from credible sources or official news agencies. The framing technique adopted by these sources while reporting Tesla Autopilot incidents mainly impacts risk perception among the audience to a large extent. News articles focusing on tragedies or company-specific negligence create or highlight a "risk-conflict" frame for explanation of audience-specific emotions like fear, sadness, or anger associated with theme V3: "Safety Concerns." It should also be noted that any video being published on social media platforms by official media may also come under comment management processes, such as removing highly negative comments or focussing on logical comments to create a conducive comment section ecosystem. It is also noted that institutional media use comment filters to have control of their narrative. This particular strategy may minimize discourse polarity but may also result in limiting accessibility to actual public opinions, thereby causing a latent bias at the data level and also failing to tap into actual opinions of the masses.

4. Result

This paper investigates the emotional response of the public to Tesla Autopilot-related accidents and their attitude towards these incidents. Using techniques of topic modeling, sentiment analysis, and network comparison, it brings to fore the emotional response of the public to the use of self-driving systems and AI technology.

Results indicate that public discourses surrounding Tesla Autopilot technology extend beyond merely being safe and include many emotional components: fearfulness, lack of trust, curiosity, and even joke-making. While negative feelings centering on safety concerns and technology reliability

prevail among the general public's perception of autonomous driving technology, informed as well as cautiously optimistic opinions do exist too. There exist concerns and dissatisfaction regarding performance capabilities among car users, but also shared responsibility between drivers and technology and limited but optimistic trust among others.

Emotionally speaking, the response to accident cases involving self-driving cars is also subject to the dynamic interplay between hopes for technology and concerns for risks. Initially, after experiencing an accident, fear and complaints arise to encourage further concerns regarding whether self-driving cars are truly developed at a mature level or not. When discussing further, diverse opinions rise: reasoning, jokes, and even insights into encountering failure and learning to overcome through technology itself. This dynamic state shows that trust for self-driving cars among the public is not necessarily static but is instead dependent on experience accrued through shared knowledge and corporate action. The discussion surrounding safety at self-driving cars is not just approval or complaint but rather consists of emotional expressions to come to terms between wonder to what is happening and fear at the same time. This clearly shows that for self-driving cars to gain approval from the public is dependent not only on advancements but also on corporate efforts to deal with all emotional expressions for genuine acceptance of new technology.

5. Conclusion

This work adds to the knowledge of how the general public's emotional responses and key concerns relate to accident cases involving self-driving cars, especially those associated with Tesla's Autopilot features. This work also contains some limitations. First of all, while discussing popularity and comment ratio for all YouTube auto accident videos selected for analysis in this work, we needed to consider those cases where very few comments appeared to demonstrate strong emotional expressions against or for any particular statement or concerns being raised by viewers or critics. This makes it somewhat difficult to gain diverse insights into sentiment analysis to reach concrete conclusions.

There is also limited scientific and academic writing on this particular subject matter, making it rather tough to form solid ground to test theories for conclusions to reach informed insights.

In addition to data limitations, several broader challenges existed while applying the methodology to this study. The analysis only relied on data from YouTube, which may lack universality considering its rich contextuality but is only one expression of online public opinion at its best. People who participate actively may have different opinions from others who do not comment but constitute the majority of others. Additionally, few accident cases were analyzed for this study to gain insight into how opinions change overtime or with increasing technology advancements.

A further limitation is that while text analysis software such as MDCOR and SENA is highly efficient and objective, it may lack cultural nuances or sarcasm. It is recommended for future studies to conduct cross-platform analysis (e.g., analysis of posts on Twitter or Reddit) or carry out analysis in several languages for added representativeness. Despite these limitations, there are several theoretical and practical implications from this study for both business and regulators/educators. For business actors, knowledge of public opinions can point to more emotional communication strategies for business to reduce negative emotions among the public. By addressing their fears and highlighting shared responsibility between humans and machines, business actors can reduce negative emotions among the public and gain their acceptance instead. For regulators/educators, this study implies that they have to pay closer attention to addressing emotional and moral aspects of opinions among the public on their own efforts at cognitive co-construction for successful

implementation of risk management strategies for any technology development. Looking to the future and advancements associated with autonomous vehicle development, emotional and moral aspects of opinions on this technology will continue to shift for business actors to monitor and learn from for acceptance of its development by the public.

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Chenyu Wang, and Jiayi He contributed equally to this work and should be considered co-first authors.

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