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DEPARTAMENT DE FILOLOGIA ANGLESA I DE GERMANÍSTICA

Suicide Discourse: A Linguistic Analysis of Suicide

Markers in Speech

BA dissertation

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Vull agrair a la meva família i la meva parella per ser els meus grans pilars, no tants sols mentre feia aquest treball, sinó que també al llarg del grau i la meva vida. Sense la vostra ajuda i paciència, hauria estat físicament i mentalment impossible estar avui aquí.

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Abstract: Suicide is one of the leading causes of death in the world. Understanding the suicidal mind plays a vital role in suicide detection and prevention, but it is a complex task as multiple individual factors can trigger it. The current dissertation considers previous research to examine the relationship between linguistic features and suicidal behavior. Due to the many linguistic indicators that previous studies focus on, we have selected the most common and characteristic markers for suicide speech, including first-person singular pronouns, negative and positive emotional words, and death expressions. The aim is to account for the aforementioned categories to establish relationships between language use and the psychodynamics of suicide. To do so, we look at previous analyses and draw on collected data to provide a further interpretation than merely listing word choices and patterns. Moreover, we will see how computer-based programs have facilitated the interpretational process due to faster and more precise language categorization. Finally, we will briefly discuss how online suicide speech can be analyzed through this software to detect at-risk individuals on social media, hence adapting detection and prevention strategies to our society. Also, some general conclusions are drawn about analyzing linguistic markers in suicide discourse, and some solutions are proposed to overcome issues prompted by internet restrictions.

Keywords: Suicide prevention, linguistic markers, LIWC, computational linguistics, language use.

1. Introduction

Suicide is one of the most complex and enigmatic causes leading to death. Psychologists specialized in unraveling the mysteries behind suicidal behavior struggle to develop predictive models to detect suicide risk and help suicidal individuals before ending their lives. Even though there have been many advances to detect people needing psychological help, unfortunately, the mental-health system still needs to improve in identifying and providing psychological care to those ideating suicide (Bruffaerts et al. 2011).

Suicide detection and prevention are complicated tasks because the nature of ideation and execution is multifactorial; in other words, it involves several factors like genetics, psychological state, and social context (Levi-Belz, Gvion & Apter 2019; Turecki et al. 2019). Notwithstanding, many affected people often have some mental disorder, especially depression. Clinical analyses of individuals with suicidal proclivities do not shed any light on the grounds of those who were successful at ending their lives. That exhibits the urgency of further research to identify the many unnoticed indicators to create successful prevention strategies.

In the 1970s, Edwin. S. Schneidman, the founding father of suicidology – the psychology branch focused on studying suicidal behavior – proposed that the linguistic analysis of the written materials left by the deceased, such as suicide notes, would be a great source to understanding the mind of the suicidal person (Schneidman 1973). As Tausczik & Pennebaker (2010) note, "the words we use in daily life reflect what we are paying attention to, what we are thinking about, what we are trying to avoid, how we are feeling, and how we are organizing and analyzing our worlds" (Tausczik & Pennebaker, 2010, p. 30).

Modern suicidologists have observed that suicide letters are not long enough to determine the psychodynamics of the author's mind (Barnes, Lawal-Solarin & Lester 2007). Accordingly, they suggested that larger samples, like suicide diaries, would be necessary to provide extensive data to identify sufficient linguistic patterns to reveal the inner workings of the suicidal mind (Lester 2010).

To streamline the work of investigators, together with the development of new technologies, new methods to decipher personal writings have been integrated into research. Computational Linguistics (CL) and machine learning (ML) strategies have been positively applied to suicide prevention. ML computer algorithms can identify and predict patterns, assess them, and even evaluate linguistic choices that may expose covert states of mind and thoughts. For instance, suicide risk can be identified by explicit expressions (e.g., *I wish I was dead*) and more subtle or implicit words (e.g., not using future tenses).

The transition from traditional to computed language analysis of suicide texts started in the late 1960s with Schneidman (1969). Nevertheless, early programs were very rudimentary and required human judges to determine the psychological cues behind the words. It was not until 2001 that Pennebaker, Francis, and Booth developed the Linguistic Inquiry and Word Count (LIWC, pronounced like *Luke*) computer program. LIWC tracks the different linguistic patterns of a whole text and relates them with the thought processes, emotional states, intentions, and motivations of an individual. This ML program has been vital for multiple psychodynamic studies, especially suicide prevention research.

Very relevant to our study, Lester (2004) conducted a multidisciplinary analysis of the yearlong diary of a 21-year-old woman who committed suicide, which later he

edited into a single book titled *Katie's Diary: Unlocking the Mystery of Suicide*. It contains eight articles that strive to comprehend what led this young woman to attempt against her life by analyzing it through psychoanalytic, linguistic, sociological, and cognitive models.

The chapter in Lester's 2004 book "What Was She Trying to Say? A Linguistic Analysis of Katie's Diary" is one of the primary sources of the data analyzed in the present dissertation. Stone and Pennebaker (2004), operating LIWC, tracked different trends in the linguistic categories that the young lady used over the last year of her life and related them to the deterioration of her state of mind. The most revealing linguistic tendencies identified by the software were: first, an increase in words reflecting positive emotions by the end of her life; and second, a decrease in personal pronouns and words concerned with negative emotions, death, and social life.

Undoubtedly, the linguistic study of this posthumous diary has served as a precedent for posterior studies on suicide and for the development of new research and preventive strategies able to help persons at risk, such as analyzing language use on social media. Nowadays, people increasingly leave traces of their inner thoughts and intentions on online platforms, which facilitates researchers' job in accessing data. This data provides priceless insight into people's thoughts and feelings, especially considering teenagers and young adults tend to reveal more negative introspections and opinions under anonymity (Ma, Hancock & Naaman 2016). Moreover, it has been demonstrated how users experience self-disclosure while using social networks. Hence, more natural and unconstrained use of language is elicited, allowing linguists and psychologists to conduct language analyses to determine significant mental health indicators.

Notwithstanding, most online texts can be processed using the LIWC program or similar software, which has helped detect suicidal risk and enable prevention. However, more investigation on developing online tools to prevent suicide still needs to be done.

Considering the importance of examining how suicidal individuals express themselves, this study focuses on analyzing suicide markers in speech that may contribute to more effective detection and prevention of suicide. The paper is divided into different sections. Following this introduction (Section 1), Section 2 presents the objectives of this research. Section 3 covers the conceptual framework, presenting the analysis of language use in psychology, the evolution of computer-based language analysis, and how LIWC codes and classifies word choice. Section 4 discusses the methods, explaining the corpora chosen for the study, justifying why we reanalyzed it and providing our interpretations. Next, in Section 5, we discuss the results of the case study conducted by Stone and Pennebaker (2004) to analyze suicide speech by dissecting a suicided young woman's diary through LIWC. Their results are used as our secondary data, selecting what we considered the most important linguistic markers for suicide detection – first-person singular pronouns, emotion words, and death references – and providing our analysis. Then, in Section 6, we discuss how the linguistic analysis of suicide speech through ML software can be transferred to online social networks for suicide prevention. Finally, we draw our conclusions in Section 7, providing an overview of the issues dealt with and some concluding remarks. It is followed by the References and Appendices, which show some of the word categories decoded by LIWC and some excerpts of the 20-year-old woman's diary to illustrate the language markers of Section 5.

2. Objectives

The present dissertation analyzes the relationship of linguistic features with suicidal behavior by considering existing research on the topic. The main article chosen to evaluate suicide discourse is the diary of a 21-year-old suicided woman in which Pennebaker and Stone (2004), in their article "What Was She Trying to Say? A Linguistic Analysis of Katie's Diary", analyze Katie's writings prior to her death by employing the LIWC software. Since their analysis considers many linguistic indicators, such as pronouns, social and familial words, emotional and cognitive expressions, or punctuation, this paper has selected the most common and characteristic markers of suicide speech. Henceforth, first-person personal pronouns, negative and positive emotion expressions, and death words have been displayed and analyzed to reveal the correlations between word choice and psychological meaning in the mind of the suicide. As there are not many previous studies on the topic, since suicides usually do not leave long written materials, the aim is to provide an account of the aforementioned linguistic markers and display how a linguistic analysis by modern ML programs may help in the early detection and prevention of possible cases of suicide. We will briefly discuss how LIWC, or other Computational Linguistic (CL) software, can be applied in social media to detect suicidal risk and, thus, adapt suicide prevention strategies to those in need.

3. Conceptual Framework

Hereunder, we will go over the conceptual framework of the current dissertation. First, we will see how the analysis of language use has been applied to psychology. Second, we will briefly visit how computer-based linguistic programs have been applied and have accelerated the process of psycholinguistic research. Finally, we will consider

one of the most effective programs used in studying language and psychological processes, LIWC.

3.1 Language Use and Psychology

We have different ways to express what we think and feel, but words are the most powerful resource to communicate them. Incredible as it may seem, even the less noticeable aspects of language unveil a lot about us. Accordingly, many psychologists attempt to understand people's behavior through word choice (Tausczik & Pennebaker 2010), which can reveal much more about our thoughts and feelings than the semantic meaning of any utterance. Pennebaker and Stone (2004) contend that "how we say things – our linguistic style – reveals our level of understanding our relationship to the world and others" (Pennebaker & Stone 2004: 56).

During the past decade, research in psychology has begun to incorporate a qualitative study of patients' language, as it opens the door to a better understanding some mental conditions. However, these studies have focused on the relationship between content and context and have neglected analyzing the intrinsic properties of function and content words. As we demonstrate in this thesis, a linguistic analysis looking for language patterns will build a consistent bridge between linguistic style and the psychodynamics of an individual.

3.2 Computer-Based Language Analysis

Psychologists and psychiatrists started recording their patients for short periods during the late 1950s and then transcribed their dialogues so that they could analyze the grammar and content of their sentences. A specialized team evaluated the transcripts to determine

how the phrases reflected different issues related to the diagnosed mental illness, such as anxiety or depression (e.g., Gottschalk et al. 1958; Gottschalk & Gesler 1969).

It was not until the late 1960s that computer-based language analyses were introduced into the world of psychology. Stone et al. (1966) were the first to develop a computerized text analysis program called General Inquirer (GI). The GI and similar elementary programs analyzed a person's psychological state based on quantifying trends in their written speech and, separately, associating those verbal tendencies with the psychological records of the patients. However, these software systems relied excessively on the researchers' manipulation and the specialized judges' criteria to reassess and correlate the linguistic variables to the medical records, an impossible task for these basic programs. That usually happened when there was a non-prototypical use of the language strategies or when these were, *per se*, difficult to detect and evaluate without considering intonation or facial expressions, such as irony or passive-aggressiveness.

In the 1980s, scholars like Pennebaker and Beall (1986) realized that the linguistic analysis of written texts could reveal whether patients' mental health had improved. As in prior studies, investigators read essays to assess them according to structure, coherence, emotional content, and rationality. Nevertheless, there were still limitations, the most important being the slowness of evaluation, the subjectivity when categorizing certain elements, and the influence on the analysts' mood deterioration due to overexposure to negative texts. All the disadvantages above pushed psycholinguistics into creating effective computer-operated text analyzers. Accordingly, Pennebaker, Francis, and Booth (2001) developed the revolutionary Linguistic Inquiry and Word Count (LIWC), a computerized program that counted and grouped psychologically-relevant words and word categories of a given text and compared them with corpora databases.

3.3 Linguistic Inquiry and Word Count (LIWC)

LIWC counts the words in a text file and classifies them according to linguistic properties (e.g., word class), psychological functions (e.g., positive and negative emotions), relativity (e.g., time and space), and individual concerns (e.g., work, religion or social interaction).

The LIWC software has a processing and a dictionary component. Tausczik and Pennebaker (2010) explain: "The processing feature is the program itself, which opens a series of text files (...) and then goes through each file word by word. Each word (...) is compared with the dictionary file." (Tausczik & Pennebaker 2010, 27). For instance, imagine that we encounter a sentence like *She was sad*. The software would first select the word *she* and look for it in its internal dictionary. It would code *she* as a feminine third-person singular pronoun. LIWC would proceed in the same manner with the rest of the words, and, afterward, it would calculate and list the frequency rates of each category in the novel.

Unfortunately, measuring words psychometrics is not straightforward since some extralinguistic elements are not considered (e.g., context, non-verbal reactions, and intonation). Nevertheless, a vast list of language markers, along with their individual and psychological correspondences, can be captured through the LIWC software. In this way, detailed computerized linguistic analysis has enabled the creation of linguistic profiles from the correlations between the 80 categories that the program considers and their mental implications. Appendix A contains a summary table with some LIWC categories, psychodynamic correlations between word categories, psychological implications, and examples.

All the previous subjects constitute the basis of this paper's analysis of suicide markers in speech. Consequently, the notions that we are going to for our study are language use as a feasible variable to study mental conditions; linguistic analysis as a required tool to understand the mind and behavior of the mentally ill; and the use of linguistic ML software to speed the process of language examination and psychological and psychiatric treatment, being LIWC the most widespread program.

4. Methodology

The present dissertation draws on the data collected by Stone and Pennebaker (2004) about the linguistic markers in the diary of Katie, a 20-year-old young woman who killed herself. The authors embrace a qualitative approach to the young woman's diary; that is, by collecting, analyzing, and interpreting data to understand how she perceived and constructed her reality. Accordingly, they consider the main linguistic features that present fundamental characteristics of a depressed and suicidal individual with the assistance of LIWC software, focusing on detecting suicidal speech markers and patterns that may help us in the early detection of suicide.

Despite being a unique study, as many experts just concentrate on the overall meaning of suicidal texts, we found Stone and Pennebaker's (2004) analysis too general and focused on statistical data. That is why we used their results as a secondary source to take the analysis further and delve into the psychodynamics of a suicided individual across time by selecting the most determinant markers in our opinion: first-person singular pronouns, positive and negative emotion words, and death references. Moreover, we relate them to different cognitive and behavioral processes that the investigators overlooked.

Then, we later discuss how LIWC and other CL programs can be implemented as a qualitative approach to online suicidal posts, as the internet revolution has led to a still increasing number of social media users expressing how they feel via social-networking websites. Moreover, we suggest some solutions overcome ethical issues that ML software may encounter when operating to analyze online texts.

5. A Case Study of Suicide Speech through LIWC

In this section, we will visit and assess Stone and Pennebaker's (2004) linguistic approach to suicide speech by analyzing Katie's diary through LIWC. We first display Katie's profile to understand better the relationship between her speech and cognitive and behavioral conduct. We will then see how the researchers conducted their study and their results. Finally, we will consider more in-depth than the authors their findings and give a possible explanation of the correlations between the use of the selected suicide linguistic markers – first-person singular pronouns, positive and negative emotional expressions, and death references – and Katie's psychodynamics.

5.1 Katie's Profile

Suicide often materializes when several stressors converge, creating a sense of overwhelming despair. Even though depression is the most common mental disorder, there are many other risk factors, such as adverse familial, social, and romantic experiences and physical or psychological conditions. However, it is crucial to underline that there are no universal explanations as individual factors will always prevail. In this vein, providing a brief profile of Katie will contribute to a better understanding of her situation and guide us in a better interpretation of the linguistic markers that might have helped detect her mental deterioration and, consequently, prevent her death.

Katie's parents were first-generation German-Hungarian emigrants established in the United States. Her father was an alcoholic who physically and verbally abused his wife and daughters. Moreover, he repeatedly sexually abused Katie during her childhood. Soon after her parents divorced, her father died of natural circumstances. Not long afterward, her mother was institutionalized in a psychiatric hospital for schizophrenia, and the state authorities placed Katie and her sister in different foster homes. Unsurprisingly, Katie developed an eating disorder (ED) right after being removed from her family. Due to her severe anorexia nervosa (AN) and major depressive disorder (MDD), she needed to be hospitalized several times, but there are no records of suicide attempts.

We learn in the diary that she had a toxic relationship with her boyfriend. He had an affair with his prior girlfriend, which emotionally destabilized Katie. Consequently, her academic results were affected. Also, she started having financial problems without any expectations to find a job to pay the rent or her education.

On her death, Katie's boyfriend went to her college dormitory and found her hung in her bathroom. There were no suicide notes, but a five-volume diary was found while collecting Katie's belongings. Lester (2004) and several colleagues from different research areas analyzed that diary in detail. Their results were published in *Katie's Diary: Unlocking the Mystery of Suicide* (2004). The aforementioned study by Stone and Pennebaker (2004) is among the different approaches to the text.

5.2 Katie's Diary & LIWC

So that LIWC software could process Katie's entries, these needed to be transcribed into digital text files to be analyzed by LIWC. Before the program coded the diary, the

researchers organized the entries according to season, year, topics, and feelings discussed (see Table 5.1. below):

Table 5.1. Katie's Diary Entries by Season, Year, Topics, and Feelings*

Season	Year	Topics	Feelings
Summer	1	Childhood	Extreme torment Despair
Fall		Break up with boyfriend	Anger Self-abuse
Winter	2	Family	Strong Control
Spring		Self-isolation	Lack of control Self-hatred
Summer		Loss	Severe pain Despair

*This table has been elaborated based on Stone and Pennebaker's (2004) division of Katie's entries in her diary.

Among the categories examined by LIWC, we will consider what we believe are the most revealing patterns, starting with using pronouns, which are the quintessential linguistic markers of depression and suicidality. After many years of research on depressive and suicidal speech, experts have found that first-person singular pronouns reveal how preoccupied suicidal people are with themselves. By trying to disclose the causality of this relationship, they concluded that when people are soaked into depression, their use of these sorts of pronouns increases along with excessive self-focus (Henken 1967; Salovey 1992; Wood, Saltzberg & Goldsamt 1990). Moreover, they inferred that the high incidence of pronouns in first-person singular confirmed that the over-fixation of the self of depressive and suicidal individuals is related to a generalized social detachment (Stirman and Pennebaker 2001). Henceforth, understanding how Katie referred to herself is crucial to comprehending her distress and alienation.

Secondly, positive and negative emotional words must be considered. Rude, Gortner, and Pennebaker (2002) had already proposed that depressed individuals use more negative emotional terms. With the analysis of Katie's entries, the researchers sought to corroborate this claim. However, later we will see that this was not the case because the closer she was to committing suicide, the more positive the emotions expressed were (e.g., "My spirit and inner soul are growing back rapidly").

Finally, as stated before, there is no single cause of suicide since we all have experiences and perceptions entirely different from others'. Therefore, individual factors are highly relevant when talking about suicide. For instance, in Katie's case, her ED prompted the presence of words related to food and physical appearance in her diary due to her struggles with her body and weight (e.g., "Eating (low fat), less and healthy"). However, we will focus on death references (e.g., "It kills me") among the critical individual factors. Stone and Pennebaker (2004) also viewed their importance and carefully scrutinized with LIWC the significant patterns.

The authors used the corpora collected from a previous study as their control group. In that investigation, depressed college students wrote about their traumatic childhood experiences to analyze their mental improvement across time (Rude, Gortner & Pennebaker 2002). Thus, Katie's speech could be compared to those of her generation and with similar conditions by calculating "the mean value (...) for each category (...) to determine whether Katie's language was statistically unusual" (Stone & Pennebaker 2004, 62). However, let us note that none of the young adults in the control group had suicidal tendencies but were only diagnosed with an MDD. Therefore, it would be expected that Katie's results were higher because, as a consequence of her severe depressive symptoms, she killed herself.

The mean scores¹ of the linguistic markers computed by LIWC and which were previously mentioned as the primary concern of this dissertation are presented in Table 5.2.:

Table 5.2. Mean Scores of the Selected Linguistic Categories for the Control Group and Katie*

Linguistic category	Control group	Katie
1 st -person singular pronouns	10.83	12.23
Positive emotion words	2.76	3.21
Negative emotion words	1.68	3.8
Death words	0.14	0.2
Number of texts	764	152

*This table is an adaptation of Stone and Pennebaker's (2004) results.

As we can see, a selection of 152 entries from Katie's diary was compared to the essays collected by Rude, Gortner, and Pennebaker (2002). Notice that the means do not differ much. As expected, the control group obtained, in general, lower values than Katie – a difference of 1.4 in the use of first-person singular pronouns and 2.12 in negative emotions. Although the control group's mean score is lower than Katie's, the values for death references only vary to 0.06. Even more unexpectedly, Katie's presence of positive emotions is higher than the control group's, differing by 0.45.

The following sections will comment on these results. However, since some of the author's judgments seemed insufficient for us, we proposed our analysis of Katie's speech and related it to her psychodynamics.

¹ The *mean score*, or *average*, of a data set is the sum of all values divided by the total number of values. For instance, if we needed to calculate the mean of 3, 5, and 6. We would sum up these numbers and then divide them by three. The resulting number, 4.67, would be the mean score

5.2.1. First-Person Singular Pronouns

Since the 1970s, several researchers have been focused on demonstrating the correlation between pronouns and mental health. They have concluded that people deeply induced by sad emotions increase self-focus and, consequently, the use of first-person pronouns (Henken 1967). As explained in section 5.2., first-person singular pronouns indicate psychological distress and social detachment (Salovey 1992; Wood, Saltzberg & Goldsamt 1990). Some instances of such a relationship would be utterances like "I hate myself" or "I don't have anyone who loves me."

More recent studies like Campbell and Pennebaker's (2003) investigated how people with traumatic experiences referred to them. They could observe that those participants who mainly used first-person singular pronouns showed less psychological improvement than those who showed a variety of perspectives through a broad range of personal pronouns.

Due to the importance given to first-person singular pronouns in psychological and linguistic research, Stone and Pennebaker (2004) considered their appearance in Katie's speech and the possible relationships with her mental health. They related their results to those previous research and concluded that Katie's pronoun use denoted an intense preoccupation with herself and her past, which was an obvious indicator that she had not overcome her past traumas.

The authors detected that during Summer 1, when Katie used *I*, *me*, or *my*, she used more present tense verbs and negative emotion words (Stone & Pennebaker 2004: 64). Fall 1 and Winter 2 also displayed the exact correlation. In our opinion, this linguistic pattern suggests that Katie explored her feelings in the present, which may conclude that past adverse experiences were so deeply entrenched that she had not overcome them.

In Spring 2, "the more [Katie] used first-person pronouns (...), the less she used language referring to other people," in addition to past tense. (Stone & Pennebaker 2004: 64). We propose that pattern may indicate a turning inward on herself, social withdrawal, and an excessive focus on past traumas. All in all that indicates a severe decline in her mental state.

During the last month of her life, there was a change in verbal tense, that is, in Summer 2: "the more Katie referred to herself, the less she used future tense verbs" (Stone & Pennebaker 2004: 64). What was ignored by the researchers is that positive emotions were highly present during the whole season, not only during the last month of Katie's life. Therefore, we can deduce that the increment of future verbs is related to the augment of references regarding positive emotions. That may reveal, on the one hand, that Katie did not have any plans because she had been devising her death for months and thought about it optimistically since she saw it as the end of her suffering.

To better understand the correlations between first-person pronouns and the other linguistic categories, we have created Table 5.3. Also, some excerpts illustrating Katie's use of first-person singular personal pronouns can be found in Appendix B.

Table 5.3. Correlations between first-person singular pronouns with other word categories across time.

Season	Year	1 st -person singular pronouns	Other word categories
Summer	1	✓	Present tense Negative emotions
Fall		✓	
Winter	2	✓	Past tense No social interaction
Spring		✓	
Summer		✓	No future tense Positive emotions

Earlier studies had claimed first-person singular pronouns were linked to depression and suicide, and Stone and Pennebaker (2004) could corroborate it with their

results. Moreover, as illustrated and later explained in Table 5.2., the frequency of these sorts of pronouns was higher in Katie's writing than in the control group, obtaining a mean score of 12.23 and 10.83, respectively. We suggest that she had been experiencing a more extended period of self-focusing, eventually detrimental to her mental state. That was clear evidence that pronoun choice may have accentuated her suicidal thoughts and behavior and is an excellent start to understanding suicidal discourse.

5.2.2. Positive and Negative Emotion Words

Depression has always been associated with elevated negative emotions' elevated presence and intensity (Wood et al. 1990; Watson & Kendall 1989). Nonetheless, no such pattern was detected in comparing depressed college students (Rude, Gortner, & Pennebaker 2002) and Katie. As Table 5.2. illustrates, against all odds, positive emotion words (e.g., *like*, *love*, or *kind*) are more frequent than negative emotion words (e.g., *angry*, *hate*, or *tired*). Moreover, Katie's writing displays even more positive feelings than the control group. Some extracts have been selected in Appendix C to exemplify Katie's tendency to write about positive emotions.

This pattern is fascinating because the stereotypical proclivity for depression and suicide is negative emotional expression. Here, however, we see that not only depressed and suicidal individuals seem to express more positive sensations in their daily speech, but also suicide language appears to have more positive connotations than depressed vocabulary. A feasible explanation we find is that, while personal written records of the depressed or suicide reveal the relationship between emotions and language, they may not fully address their connection with the linguistic patterns of depression or suicide. However, we believe that together with other word categories, they can unveil some

cognitive and emotional processes. For instance, if we go back to our interpretation of Katie's last summer and the use of pronouns, we will remember that, as illustrated in Table 5.3., we concluded that the combination of first-person singular pronouns and the lack of future tense verbs were linked to the expression of positive feelings. That occurred by the end of Katie's life, so we suggested that this relationship could have stemmed from prior suicide planning and the firm conviction that death would bring freedom and mental and emotional relief.

By contrast, other studies like Stirman and Pennebaker's (2003), in which they compared word choice in the poems of suicidal poets with their stylistically-similar, non-suicidal counterparts, support the long-established assumption that depressive and suicidal speech is based on negative emotions. In such analysis, the researchers could confirm that not only did the use of the first-person singular pronoun *I* indicate a higher suicide risk among poets with MDD but negative feelings were highly mentioned in their poetry.

Overall, we believe that the linguistic results of Katie's diary and Stirman and Pennebaker's (2003) study suggest that suicidal distress may be challenging to detect since qualitative differences exist among the very diverse cases of suicides. Nevertheless, what is undeniable is that emotional terms may not necessarily determine suicidality markers.

5.2.3. Death References

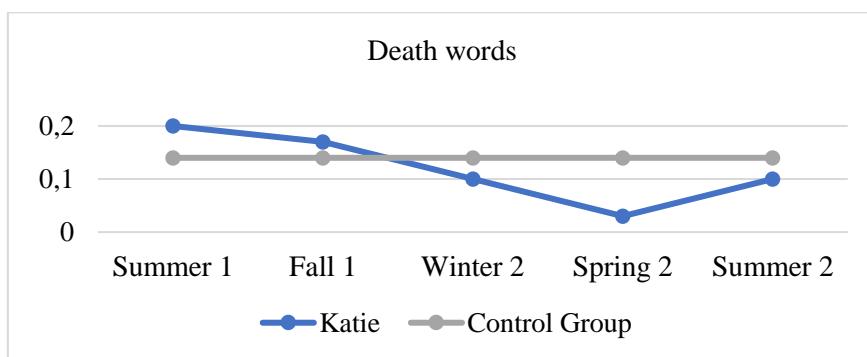
Among the broad category of individual factors, Katie used eating words (e.g., *eat, fat, skinny*, and so on). This kind of language had an undeniable basis in her ED. Hence, it is not surprising for it to be frequent in her worst depressive episodes. Even

though this subcategory is important in Katie's profile, we will focus on death expression as it could be applied to every linguistic analysis of suicide speech, and it also seems much more necessary for us regarding suicide prevention.

Despite the higher use of death-related words, LIWC detected that, in contrast to the control group, in which the appearance of this category was regular, it was more irregular in Katie's discourse. When analyzing the results, Stone and Pennebaker (2004) noted that "despite the intuitive assumption that death words would increase as an individual becomes despairing enough to contemplate and commit suicide, this pattern was not evident in Katie's diary" (Stone and Pennebaker 2004: 74).

We created Figure 5.1. to illustrate the variation of death expressions across time in Katie's diary. Instead of seeing an upward curve from Summer 1 to the summer of her suicide, we can observe that the highest rate of death words happened to be during Summer 1. By contrast, LIWC obtained the lowest rate for the spring prior to the summer of her death.

Figure 5.1. Variation of Death References Across Time in Katie's Diary.



It is worth saying that Stone and Pennebaker (2004) detected that, regardless of the lowest frequencies of death references during the months before her death, the words are more somber and personal than in any other period (see the excerpts in Appendix C). Besides, during the period she talked the most about death, she referred to the anxiety

evoked by her past and troubled childhood. Similarly, another correlation was found between death and religious terms in Fall 1 and Winter 2. Nonetheless, it is not sufficient to merely point out the quantitative values of these language markers without providing a hypothesis of this behavior, as the authors did, since it does not contribute to developing or improving other research on this area. In our view, and following the initial observation of the researchers, despite the low rates of death expressions, Katie's speech was darker, more intimate, and anxious. Sometimes, individuals with suicidal thoughts do not straightforwardly mention them, and there might be other indicators, such as the bleak quality of their speech or behavior. Additionally, considering there was an increase in the references to her troubled childhood and adolescence, it is undeniable that Katie had not overcome her past trauma and that there was no psychological amelioration. Likewise, she started to mention God, especially in her last entries, and, as the Christian she was, it may denote that, somehow, she was asking for divine help or forgiveness for the upcoming event, considered a sin in the Christian community.

6. A Discussion on Applying ML software for Online Suicide Prevention

Most research examining the relationship between language and suicidal psychodynamics has changed its focus to the internet, as social media publications comprise a vast, varied data source. Many researchers turn to LIWC, or other ML computer programs, to analyze the linguistic features on online profiles of suicidal people and how these are linked to the core message of their posts and their cognitive-emotional processes. For instance, Li et al. (2014) used LIWC to explore the blog posts of a teenager who attempted against his life. They reached the same conclusions as Pennebaker and Stone (2004) – the correlation between suicide risk and high use of first-person singular

pronouns. Similarly, Coppersmith et al. (2015) examined via LIWC several tweets from individuals who had attempted suicide. The findings coincide with Katie's results and other computer-based studies: as the day of the death draws near, there is an increment of positive emotions. As explained in sections 5.2.1. and 5.2.2., Katie's entries during her last months incorporated first-person singular pronouns and no future tense verbs, which were combined with an increase in the expression of positive emotions. We proposed that this correlation could have derived from preceding suicide ideation and the belief that death would bring mental and emotional comfort.

Researchers have found that individuals who completed or planned their suicide usually use the online world to express themselves more unrestrictedly due to its anonymity. Thanks to a computer-based linguistic analysis, the data produced has been listed and codified as common phrases used by suicidal individuals (e.g., "I feel empty"; "If I'm living like this, I'd rather be dead"; I can't do it anymore," and so on). Most importantly to the previous section, ML programs have enabled the analysis of word categories and patterns (e.g., Sierra et al. 2021). Studies like this confirm that social media results match those of suicide letters or diaries, which implies that the word choice of internet users can predict the psychodynamics of the suicide mind and, thus, it is relevant for detecting and preventing suicide. However, more investigation needs to be done on the subject, as it is a relatively new subject of research and, consequently, there are few studies on it.

A significant limitation we encounter concerns ethics. Despite being very promising, analyzing online suicidal content may be controversial due to consent and privacy issues. Most studies on CL methods to detect mental health conditions rely on public content. Notwithstanding, most users do not contemplate that their posts could be

used for research and even published and seen by someone outside their community. Undeniably, that would be a violation of privacy. Since data needs to be shared with the scientific community to develop a predictive model and ensure generalizations, we strongly advised researchers to adhere to a consent form, mainly because suicidal data contains susceptible content. Accordingly, participants may not feel comfortable sharing that information, so assuring confidentiality and anonymity is vital. Furthermore, they should also be allowed to withdraw whenever they want.

Despite the plight of privacy and sharing data to progress in CL research of suicide prevention, some basic guidelines have been published by public organizations from time to time. However, it is still necessary a better-designed protocol.

7. Conclusion

The main objective of this paper was to demonstrate that identifying linguistic markers can help us predict any suicidal behavior to intervene on time. Previously, scholars have focused on analyzing suicidal individuals regarding clinical records or the connotations of their speech. Regardless of the many mentions of death, a desire to commit suicide, and pain, sometimes exclusively content-based analysis can be misleading. Nevertheless, suppose we concentrate on the linguistic patterns of suicide discourse. In that case, we might notice suspicious trends that may be determinative for detecting unhealthy mental development. Thus, a linguistic analysis of the speech of suicide becomes an essential tool for prevention. Furthermore, we could say that combining content and language analysis would foster a broader insight into the suicidal mind.

Undoubtedly, new CL programs are transforming language analysis. Software like LIWC is faster than human judges in analyzing texts and can also determine the psychological connotations of the words. Unfortunately, these ML programs have not been welcomed in the scientific community since their creation in the 1970s. Although many researchers employ them, many are still reluctant to operate new technologies to conduct their research and question their efficiency.

Stone and Pennebaker's (2004) study case allowed us to observe the precision of LIWC in the inquiry of the linguistic use of suicide discourse. Since their analysis was too broad in terms of word patterns and psychological processes examined, we selected the linguistic markers we considered the most revealing regarding suicide speech: first-person singular pronouns, positive and negative emotions words, and death-related phrases.

The authors provided an excellent quantitative analysis of the different linguistic categories present in the specific case of suicide they analyzed but failed to provide sufficient explanations for those results. Thus, we reinterpreted the data and explained further the possible correlations between words and the psyche. We corroborated that, according to previous studies (Henken 1967; Salovey 1992; Wood, Saltzberg & Goldsamt 1990), Katie's case demonstrates that first-person singular pronouns are deeply interconnected with mental health improvement. We could see that the more she used them, the less she mentally improved.

We also concluded that more research on emotional word patterns should be conducted since, contrary to all expectations, negative emotions do not necessarily behave as markers of depression or suicide. In this case, negative feelings were less present than positive ones. Nevertheless, we proposed that, especially during the last

months of her life, Katie expressed more positive sensations due to the possible planning of her suicide and foreseeing the end of her suffering.

Ultimately, we observed how the tendency to use death-related words provides an understanding of the evolution of the afflicted's mental state. In a very unexpected manner, death references tend not to be as frequent as expected in suicidal speech, as we could see in Katie's scores of these words. However, we noticed an overall obscure tone in her writing by the end of Katie's life. Despite not directly mentioning her willingness to die, we proposed that other indicators like the overall feeling she conveyed through the darker and ambiguous words suggested her mental state was critical.

Promising as it may be the use of online data, there are few investigations on the relationship between language and suicide on profiles of suicidal individuals. Undeniably, CL technology can improve the capacity to comprehend and detect suicide ideation. ML computer programs provide precise predictions by tracking daily social media content in real-time. Nonetheless, this useful analytic software should be cautiously operated as ethical infractions, such as violating someone's privacy, may be committed. However, we suggested using consent forms for the families of the deceased or individuals with suicidal tendencies to solve this issue. In such a manner, they will feel comfortable enough to share data due to anonymity and the opportunity to withdraw from the investigation at any point.

We are optimistic that future multidisciplinary research will apply ML programs to their studies, which will positively impact the way of perceiving, detecting, and treating suicide nowadays. Further, we hope that the lack or insufficiency of ML tools in languages other than English will be overcome.

Last but not least, it is essential to stress that written data must be carefully interpreted as they do not provide an ultimate explanation of the suicidal mind. Let us bear in mind that each case is unique and, as such, there is no one-to-one relationship between word choice and psychological and behavioral processes for all suicidals. Dying in such a manner involves several external factors, and only externalized thoughts are not enough to determine or explain suicide. Accordingly, we recommend an interdisciplinary approach, combining language use analysis with psychological, clinical, and behavioral methods. Nonetheless, that does not mean that some generalizations can be drawn, such as those we have proposed about first-person singular pronouns, positive and negative feelings expressions, or death mentions. Indeed, linguistically analyzing suicide speech would allow mental health professionals to improve their treatments by knowing how suicidal individuals express their feelings unrestrictedly in their daily lives and not like what probably happens during their therapeutic sessions.

To conclude, let us remember that listening is key to suicide prevention. This study demonstrates that people may not always openly mention death or suicide. Notwithstanding, at the early stages of suicide ideation, they may share their distress with their significant others by expressing hopelessness, feeling like a burden, estrangement, obsession with the past, solitude, and inability to cope with life. Thus, let us encourage the readers not to wait until someone asks for help; let us listen to the covert thoughts and cries for help behind words.

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Appendix A

A summary table relating LIWC word categories to psychological correlates with examples (based on Tausczik and Pennebaker, 2010)

Main Categories	Subcategory	Psychological meaning	Examples
Grammatical categories	1 st -person singular pronouns	Honesty, personal, depression, emotional	<i>I, me, mine</i>
	1 st -person plural pronouns	Detachment, socially connected to group	<i>We, us, our</i>
	3 rd -person singular pronouns	Social interests, social support	<i>She, her, him</i>
	3 rd -person plural pronouns	Social interests, out-group awareness	<i>They, their, they</i>
	Articles	Concretion, interest	<i>a/an, the</i>
	Past tense	Focus on the past	<i>used, ran, had</i>
	Present tense	Living in the here and now	<i>Is, has, learn</i>
	Future tense	Future expectations, goal oriented	<i>Will, gonna, shall</i>
	Prepositions	Education, concern with precision	<i>with, above, under</i>
	Negations	Inhibition	<i>No, not, never</i>
	Swear words	Informal, aggressivity	<i>Damn, fuck, sucks</i>
Psychological processes	Affective processes	Emotionality	<i>Happy, cry, feel</i>
	Positive emotion	Optimism, happiness	<i>Love, kind, sweet</i>
	Negative emotion	Negativism, unhappiness	<i>Hurt, overwhelmed, devastated</i>
	Anxiety	Concern, feeling of losing control	<i>Worried, nervous, terrified</i>
	Anger	Instability, rejection, loss	<i>Hate, kill, annoyed</i>
	Sadness	Loss, depression, unhappiness	<i>Crying, grief, sad</i>
	Cognitive processes (Certainty, tentative, discrepancy, etc.)	Social skills, emotional stability, honesty	<i>Know, always, but</i>

	Perceptual processes	Attention, preoccupation	<i>Observing, heard, feeling, view, saw, seen, listen, hearing, feels, touch</i>
	Biological processes (body, health, ingestion, etc.)	Self-awareness, self-knowledge	<i>Hands, flu, relax</i>
	Relativity (motion, space, time)	Observer, distinction between the internal and external	<i>Go, down, finish,</i>
	Work	Discipline, collective, commitment	<i>Job, majors, Xerox</i>
Personal concerns	Leisure	Self-care, social interests	<i>Cook, chat, movie</i>
	Home	Peace, joy, comfort, protection	<i>Apartment, kitchen, family</i>
	Money	Success, education, social class	<i>Audit, cash, owe</i>
	Religion	Education, spiritual beliefs, collective	<i>Altar, church, mosque</i>
	Death	Anxiety, negative emotions, mental health issues	<i>Bury, coffin, kill</i>
	Assent	Agreement, passivity	<i>Agree, OK, yes</i>
Spoken categories	Non-fluencies, fillers	Informal, unprepared speech	<i>Er, hm, um</i>

Appendix B

Excerpts of Katie's diary illustrating the use of first-person singular personal pronouns found in the transcription of her diary in Lester's *Katie's Diary: Unlocking the Mystery of Suicide* (2004)

August 22nd (Summer 1)

I refuse to eat anymore. I refuse to take care of myself anymore. I'm sick of it – all of the fucking heaviness on my heart. I'm FUCKING SICK OF ALL OF IT. I WANT TO GO AWAY! I WANT TO EVERYBODY TO GO AWAY. I WANT TO BE LEFT ALONE. I DON'T WANT TO BE TOUCHED – NOT my body, nor my heart! It hurts. It always hurts. It's not different this time. I feel like I'm being shut out for who I am. I'm so sick OF MY WRITING IN THIS JOURNAL. I HATE IT. I SOUND SO DAMN PATHETIC! I HATE MYSELF. I WANT TO DIE! WHAT I DO ISN'T GOOD ENOUGH!!!

November 28th (Fall 1)

It killed me how much I hurt Mark. I want so badly to make him happy and make it up to him. Maybe we got the kinks out. Maybe it's better now. All I know. I hate to argue. I hate it (...). I never want to hurt him again. I will do much better now than I did before. I'll relax and work on being me. I have had a difficult time with my food. I struggle with wanting to be thin, but I know what's really important in life. If I become a strict vegetarian, I'll be OK. I'll lose weight easily. Like my mom did. I don't want to eat barely any fat. I know I'm obsessing today – understandable. A lot of things are going on inside of me. I'm different from my family. I know a lot more, I think. I think I can make it – somewhere good in life.

February 8th (Winter 2)

I love Mark. He told me that he feels trapped. How could I tell him that I was reading his diary? I feel so awful. I had to know what his intentions were with me. I can't believe I told him all about Chris. I hope he never talks about it again.

I feel awful that I hurt him yesterday. So, I made myself eat an incredible amount. I wonder if I spoiled his birthday. I didn't mean to if I did. It's all so awful. I wish he would come here soon so I could make love to him. I do anything and everything for him because he truly deserves it. He has put up with so much crap from me.

Appendix C

Excerpts of Katie's diary illustrating the use of positive emotions found in the transcription of her diary in Lester's *Katie's Diary: Unlocking the Mystery of Suicide* (2004).

June 2nd (Summer 2)

But there has to be something out there that is right and able to be believed in. It actually feels nice to write (...). People used to tell me I was always wrong (foster parents). They were all so abusive to me. I kept fighting back spiritually, but my heart crumbled, and slowly it's been going up. I have to believe that my spirit and inner person are growing back rapidly. I need to focus and do things to nurture this growth process. The world has most definitely gotten to me to the core – raw one. I know I was naive in ways before, but I am wiser now. That is very important to see right now. However, I've seen and learned everything, and the hope for today is that I have the ability to change my behavior and self and life the things I don't like. That is the hope I believe in, that I do have control over my fate now as a fully grown adult versus my circumstance as a child and nothing of hopeless, absolutely nothing. Many things, bad and good, have been bridges toward individual freedom and goodness, or rather a place that is much nicer to live in. I refuse to speak badly of another but promise to be honest in my perceptions of them (objective). I promise to do what is right, speak my mind, surpass all insecurities, and try to strengthen the friendships I have and myself.

Objective, realistic thinking is not bad at all, reaching for better things is not bad at all and doing what I feel is right in the face of life's circumstances with intuition makes someone truly beautiful and strong (...). "Nothing in life is that hard." That carefree statement makes me feel better in times of my life when I care to make great improvements and changes. I need to make pebbles of boulders, and thinking this way helps do just that (...). Today I realized many people, including myself, always want to do things differently or make a change. They might say something that is supposed to change them or think alone. However, the point is that no one makes a plan that makes things more attainable at all, and that is what I'm trying to do. Now I have a grasp on my feeling about myself, and my life is going up (...). Be happy, laugh, and be free, Katie. I give you permission; to be a distinct individual; don't mesh and just live, and do what you can to do what is right and smart.

Appendix D

Excerpts of Katie's diary illustrating the use of death references and their correlation to strong negative emotions, her past, and religiosity found in the transcription of her diary in Lester's Katie's Diary: Unlocking the Mystery of Suicide (2004).

May 30th (Spring 2)

I can't stand myself and my life anymore. The very things I believe in are starting to disappear. I'm really hurting, but I can't talk about it because there is nothing left to talk about (...).

I've just freaked out because I don't have any control whatsoever in my life at all. It's absolutely terrifying. I have to just say for the record that I'm not going to try to kill myself by doing this – only perhaps the old Katie, so a new isolated individual could rise up and emerge (...). I want all this to melt away – all of it. I will not end up in the hospital again. Maybe I will be listened to now – taken more seriously (...).

I need to have the courage to face myself and take some action (...). I need to make myself free – free – that is what I want to be. I want to make all the people I've hurt free of my tormented parts. Just like Mrs. W said, I have to isolate myself from my past. I have to say goodbye for good – to Michael and the past pains and let the good feelings thrive in my soul.

June 15th (Summer 2)

It kills me inside – not a friend in the world. I feel no connection with anyone, and it scares me so much. The world seems so cold, dark, and scary. No matter what Mrs. W says, I'm alone, alone, and left to myself (...). I want to kill myself. Bullet through my heart – the only way I'll ever stop caring about people (...). I did try reaching out again for the last time. People are so mean and selfish. I want to kill myself on my birthday. I have to.

June 20th (Summer 2)

Please, dear God, let things pick up in my life beautifully. I want to feel whole inside instead of being severed into hundreds of little pieces from my own and others' actions. It's all so much, but it's controllable, and I'm the one in charge. No one else is. I'm just going to let that go (stupid comment) (...).

Please let me come out on top of everything, and let it put me on sure ground, so I won't fall and won't lose anything at all (...). Now focused. Please help me through this and next week especially; things are so hard right now.