Middle East Technical University
Informatics Institute

Evaluation Of Emotional Conditions of Patients with Rheumatic Diseases Who Participated in Cognitive Exercise Therapy Approach Through Telerehabilitation with respect to the course of COVID-19 outbreak in Turkey

Advisor Name: Barbaros Yet
(METU)

Student Name: Elif Taştekin
(Cognitive Science)

July 2021

TECHNICAL REPORT
METU/II-TR-2021-

Orta Doğu Teknik Üniversitesi
Enformatik Enstitüsü

Tele rehabilitasyon Yoluyla Bilişsel Egzersiz Terapisi Yaklaşımına Katılan Romatizmalı Hastaların Duygusal Durumlarının Türkiye'de COVID-19 salgınının seyrine göre değerlendirilmesi

Danışman Adı: Barbaros Yet
(ODTÜ)

Öğrenci Adı: Elif Taştekin
(Bilişsel Bilimler)

Temmuz 2021

TEKNİK RAPOR
ODTÜ/II-TR-2021-

REPORT DOCUMENTATION PAGE

1. AGENCY USE ONLY (Internal Use)	2. REPORT DATE 20.07.2021
3. TITLE AND SUBTITLE **Evaluation Of Emotional Conditions of Patients with Rheumatic Diseases Who Participated in Cognitive Exercise Therapy Approach Through Telerehabilitation with respect to the course of COVID-19 outbreak in Turkey**	
4. AUTHOR (S) Elif Taştekin	**5. REPORT NUMBER (Internal Use)** **METU/II-TR-2021-**
6. SPONSORING/ MONITORING AGENCY NAME(S) AND SIGNATURE(S) Cognitive Science Master's Programme, Department of Cognitive Science, Informatics Institute, METU Advisor: Barbaros Yet Signature:	
7. SUPPLEMENTARY NOTES	
8. ABSTRACT (MAXIMUM 200 WORDS) Cognitive Exercise Therapy Approach (CETA) is an innovative exercise method that approaches patients from biological, social, and psychological perspectives. It takes advantage of physical exercises and cognitive therapy in a way to support each other. This study investigates the emotional states of patients with rheumatic diseases who participated in CETA during the Coronavirus outbreak and the quarantine period in 2020 and 2021 in Turkey. CETA has been applied to a group of patients for some time through WhatsApp group text messages. The program includes physical and verbal exercises. The data consists of the personal declarations of the patients on their emotional statuses. In this study, a period from the beginning of the coronavirus outbreak in Turkey, which is March 2020 to July 2021 is examined in accordance to the course of COVID-19 pandemic in Turkey. The most significant determinant of general well-being of the patients is non transparency in the healthcare system.	
9. SUBJECT TERMS Sentiment analysis, rheumatic disease, COVID-19	**10. NUMBER OF PAGES** **31**

Evaluation Of Emotional Conditions of Patients with Rheumatic Diseases Who Participated in Cognitive Exercise Therapy Approach Through Telerehabilitation with respect to the course of COVID-19 outbreak in Turkey

Abstract

Rheumatic diseases are autoimmune and inflammatory diseases that cause the immune system to damage the patient's joints, muscles, bones, and organs. While the severity of the symptoms varies according to the location of the damage and stage of the disease, the common symptoms include pain in joints, fatigue, stiffness in joints, problems in organs such as kidneys, etc. Cognitive Exercise Therapy Approach (CETA) is an innovative exercise method that approaches patients from biological, social, and psychological perspectives. It takes advantage of physical exercises and cognitive therapy in a way to support each other. This study investigates the emotional states of patients with rheumatic diseases who participated in CETA during the Coronavirus outbreak and the quarantine period in 2020 and 2021 in Turkey. CETA has been applied to a group of patients for some time through WhatsApp group text messages. The program includes physical and verbal exercises. In this study, a period from the beginning of the coronavirus outbreak in Turkey, which is March 2020 to July 2021 is examined. The data consists of the personal declarations of the patients on their emotional statuses.

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Chapter 1: Introduction

The aim of this study is to investigate the sentimental statuses of a group of patients who participated to Cognitive Exercise Therapy Approach (CETA) therapy during COVID-19 global pandemic in Turkey, compared to the course of the pandemic. While the severity of the symptoms vary according to the location of the damage and stage of the disease, one of the most common and acute symptoms of the rheumatic diseases is chronic pain. Cognitive Exercise Therapy Approach (CETA) is an innovative interdisciplinary therapy method that approaches patients from biological, social, and psychological perspectives. It takes advantage of physical exercises and cognitive therapy in a way to support each other to develop pain coping mechanisms. by comparing the sentimental statuses of the group to the course of COVID-19 in Turkey, this paper aims to see how the external shocks affect the patients and how resilient are they towards these changes during their therapy.

COVID-19 Pandemic

The COVID-19 pandemic is a worldwide coronavirus outbreak caused by SARS-CoV-2. In December 2019, the virus was initially reported in Wuhan, China. China initiated a countywide lockdown in Wuhan in January 2020, but this failed to control the spread of the virus, which infected people in the other areas of mainland China and subsequently the rest of the world. On January 30, 2020, the

World Health Organization classified the virus as a Public Health Emergency of International Concern, and on March 11, 2020, it was declared a pandemic. It has been continuing to be a pandemic until July 2021, when this report is written.

Rheumatologic Diseases

Rheumatic diseases are among the oldest diseases recognized. They are autoimmune and inflammatory diseases that cause the immune system to damage patients' joints, muscles, bones, and organs. While the severity of the symptoms varies according to the location of the damage and stage of the disease, the common symptoms include pain in joints, fatigue, stiffness in joints, problems in organs such as kidneys, etc.

Most chronic rheumatological disorders require major psychological adaptation as individuals have to learn to come to terms with a painful, disabling condition that is unpredictable in its course (Kostova, Caiata-Zufferey &Schulz, 2014)

"Perceived stress was associated with both pain deterioration and psychological distress. Earlier studies on the COVID-19 pandemic have shown that sources of stress are numerous and include, for example, fear of COVID-19 infection, socioeconomic worries, and traumatic stress responses" (Pagé et al.,2021).

Sentiment Analysis

Sentiment analysis is the study of people's views, feelings, judgments, attitudes, and emotions expressed in casual text form. It is one of the most active research topics in natural language processing. Because of its relevance to society, this study has expanded beyond computer science to social sciences. The rise of

social media platforms and increasing data on personal expressions has increased the potential and importance of sentiment analysis (Liu, 2012).

Cognitive Exercise Therapy Approach (CETA)

CETA is an interdisciplinary treatment method that approaches the patient from biological, psychological, and socio-environmental factors. It aims to help the patient build mind-body information management skills, pain management skills, and mood state knowledge management skills. To build mind-body information management skills, CETA uses function-oriented balance exercises. For pain management skills, CETA uses attention diversion strategies. For mood-state knowledge management skills, it uses authentic movement and dance therapy in individual or group sessions. The method is especially effective because the exercises employed are selected based on the needs of the patient. The group therapy environment helps the patients to regulate their undermined social lives (Ünal, 2017).

In the remainder of this report, Chapter 2 presents the methods used in the analysis that are BERT sentiment analysis and Keyword Spotting technique. Chapter 3 presents the Analysis on data collection and preparation. The discussion on the analysis based on BERT sentiment analysis and keyword spotting is presented in Chapter 4 and finally Chapter 5 presents the conclusions and suggestions for further studies on the topic.

Chapter 2: Methods

Keyword Spotting

Keyword spotting is one of the most straightforward methods to analyze emotional content in text. It is based on classifying the text into effect categories based on some determinant words. The major drawback for this kind of analysis is that observation of a word could be contextual. Alternatively, even more straightforwardly, a word could be following a negative marker such as the word happy in the sentences "I am happy today" and "I am not happy today". However, the Turkish language allows us to point the context more precisely because of the use of suffixes.

Furthermore, in the scope of the data collected, the participants were asked to point out words for how they are feeling and how they want to feel. Because the data consists of simple statements such as "there are miracles in my life", the keywords are generally stripped out of the conversation context. These circumstances make this method a better candidate for this study.

Bidirectional Encoder Representations from Transformers (BERT)

BERT is a bi-directional transformer introduced by Google. It is possible to learn the contextual relationship between words in a text by employing the transformer's encoding mechanism to generate a language model. A transformer contains two distinct processes in its basic form: an encoder that reads the text input and a decoder that generates a prediction output. The previous models were unidirectional, meaning they parse the sentence from left to right while making a prediction. BERT overcomes the unidirectionality limitation of other models by employing a "masked language model" (MLM). The masked language model masks specific tokens from the input randomly to predict the masked word's original vocabulary id based only on its context. Unlike pre-training a left-to-right language model, the MLM objective allows the representation to merge the left and right context, allowing pre-train a deep bidirectional Transformer. (Devlin et al., 2019).

BERT has two pre-trained ready-made models with two different parameter numbers. The medium-scale model consists of 12 layers, 768 hidden dimensions, 12 attention heads, and approximately 110 million parameters. On the other hand, the large-scale model consists of 24 layers, 1024 hidden dimensions, and 16 attention points, with a total of approximately 340 million parameters. Because these massive models take considerable time to train, instead of directly training the models for a specific natural language processing task, an extra layer is added to the pre-trained models, and this layer is trained with labeled data for the intended task. (Acikalın et al., 2020)

For this study, because the data was not labeled, a general-purpose pre-trained model dbmdz/bert-base-turkish-cased for the Turkish language was employed (Hugging Face, 2021).

Chapter 3: Analysis

Data Collection

For this study, the data was collected through the CETA sessions. The sessions were held on WhatsApp messaging service as a group. In the sessions, the patients were asked to do exercise routines, including dance movements, pilates techniques, investigation of the negative emotions, and verbal affirmations to divert their attention to positive emotions. The patients were asked to investigate what they are concerned about when they felt pain during the week, outside of the sessions. Specifically, they were asked to complete the sentence:" this week when I had pain, I stopped what I was doing and asked myself what am I concerned about. The word I come up with was …". Then they are asked to divert their attention to a positive emotion of their choices.

Data Preparation

The textual content in the form of messages sent to the WhatsApp chat group was extracted from the application as a text file. The data was parsed using python programming. A data frame from the data was created containing date, participant, and message columns. The instructors' messages were eliminated to a separate data frame to pick the dates of meetings from. Then the messages that do not contain any relevant information such as greetings, exclamations deleted messages, media notifications, etc. were cleaned. The main data frame

is filtered by the meeting dates to pick the patient’s messages sent to the therapy sessions.

Chapter 4: Discussion

BERT Sentiment Analysis

The session dates are picked, and the data is put in a pre-trained BERT model assigning positive and negative labels with scores between 0 and 1 to all the sentences sent by participants during the session days. The messages that have scored between 0.4 and 0.5 are considered neutral, scoring zero, the negative scores are multiplied with -1, and the positive ones are kept as they are. In order to prevent negative scores from evening out the positive ones, they are separated before the cumulative daily scores are obtained. Figure 1 shows the total normalized negative sentiment scores of the messages sent on the days of sessions by participants.

Because the participation in group sessions was not stable, the scores were normalized by the number of participants.

There is a gap in the data between June 30 2020, and August 30 2020. After that, the instructor changes during September 2020. In the non-normalized graphs, there can be observed reluctance to participate in introspection of negative emotions and positive affirmations. The decline in overall negative reports is not a significant indicator of the mental well-being of patients but an indicator of patient's reluctance to participate in CETA treatment, which points to the importance of continuity of the treatment.

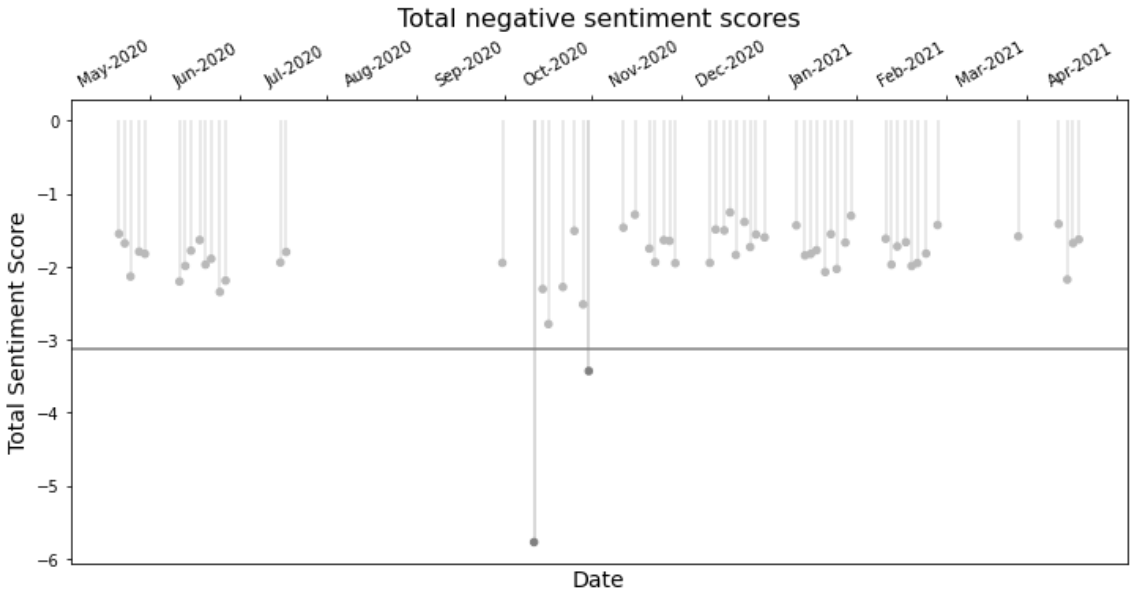

Figure 1, Total negative sentiment scores sent on the days of sessions, normalized by the participation rate.

The red lines on the graphs are p-charts indicating the 0.95 confidence intervals of the cumulative negative score's occurrence in a day. There are two pikes in the chart that vary from the mean exceeding the confidence interval. These correspond to the second and last weeks of October 2020.

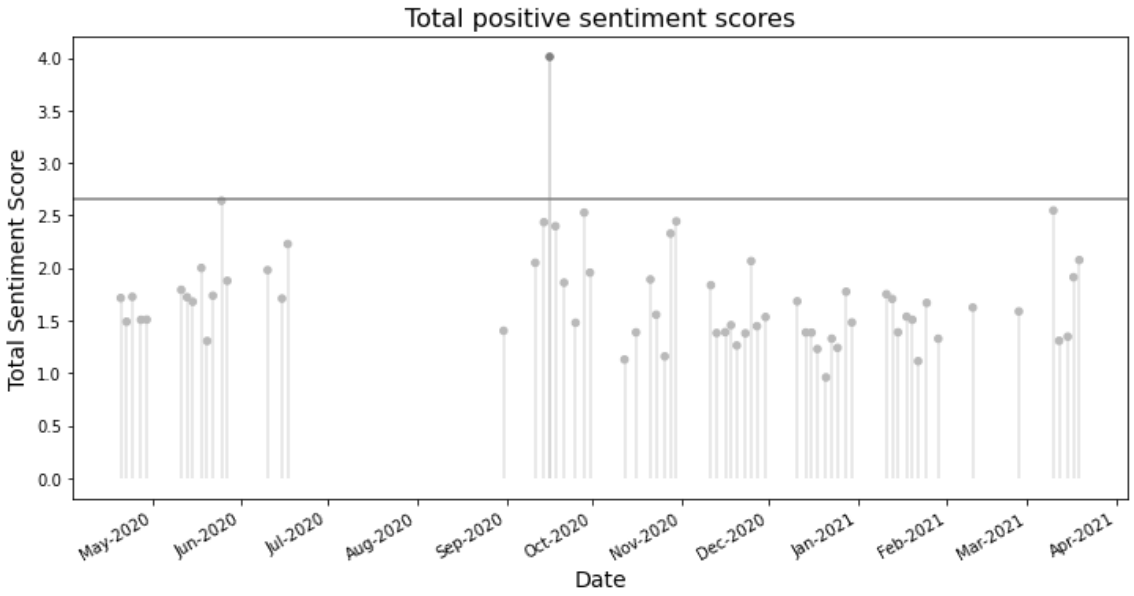

Figure 2, Total positive sentiment scores sent on the days of sessions, normalized by the participation rate.

Similar to figure 1, figure 2 shows the total daily positive sentiment scores normalized by the rate of participation. When participants share their positive keyword of the day, they share how they would rather feel, to distract them from the negative emotions they are in while they are feeling pain. This graph consists of a combination of the sentimental statuses of the patients and their willingness/ableness to distract themselves from these negative sentiments.

There is only one significant rise in the graph, coinciding with the middle of September 2020.

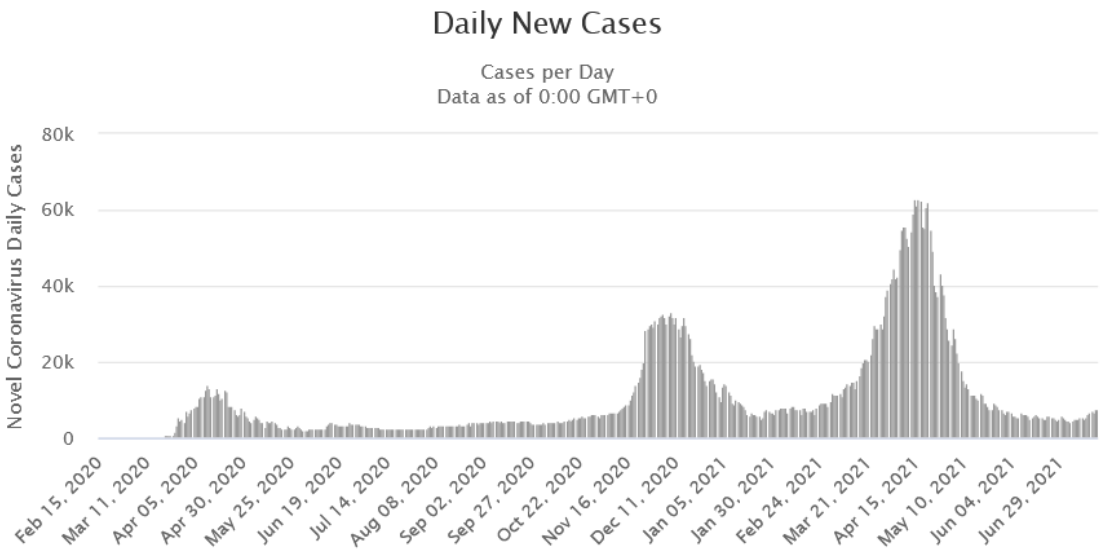

Figure 3, Number of reported covid related cases during the COVID-19 pandemic (worldometers, 2021).

Figure 3 shows the COVID-19 reports in Turkey from the beginning of the pandemic up until July 2021. Grey histograms are the number of cases. The top points of three fast rises in the graph respectively coincide to:

1- April 20 2020

2- December 30 2020

3- April 30 2021

Keyword Spotting Analysis on Time Scale

In this study, the most frequently reported negative and positive words were selected and counted.

Negative Sentiments

Table 1 shows the number of occurrences of the negative indicator keywords in descending order.

Table 1: Negative sentiment frequencies

Sentiment	Frequency
Anxiety	958
Fear	849
Concern	791
Stress	563
Uncertainty	510
Fatigue	435
Sadness	218
Despair	205
Not being able to forgive	175
Unhappiness	171
Being offended	132
Distrust	104
Injustice	100
Hopelessness	99
Uneasiness	55
Touchiness	53
Absent mindedness	52
Fear of future	46
Aggressiveness	44
Cowardice	38
Pessimism	34
Obsessiveness	32

There is a non-linear complex cause and effect cycle between all of these indicators. For example, an increase in stress could cause an increase in pessimism and hopelessness. Moreover, the nature of some keywords is very similar. For instance, concern and fear of the future might both indicate anxiety and stress. The relationship between these keywords is not taken into account in

the scope of this study. Instead, their patterns on the timescale are examined, corresponding to the course of the pandemic. The most frequently reported negative keywords are anxiety, fear, concern, stress, uncertainty, and fatigue.

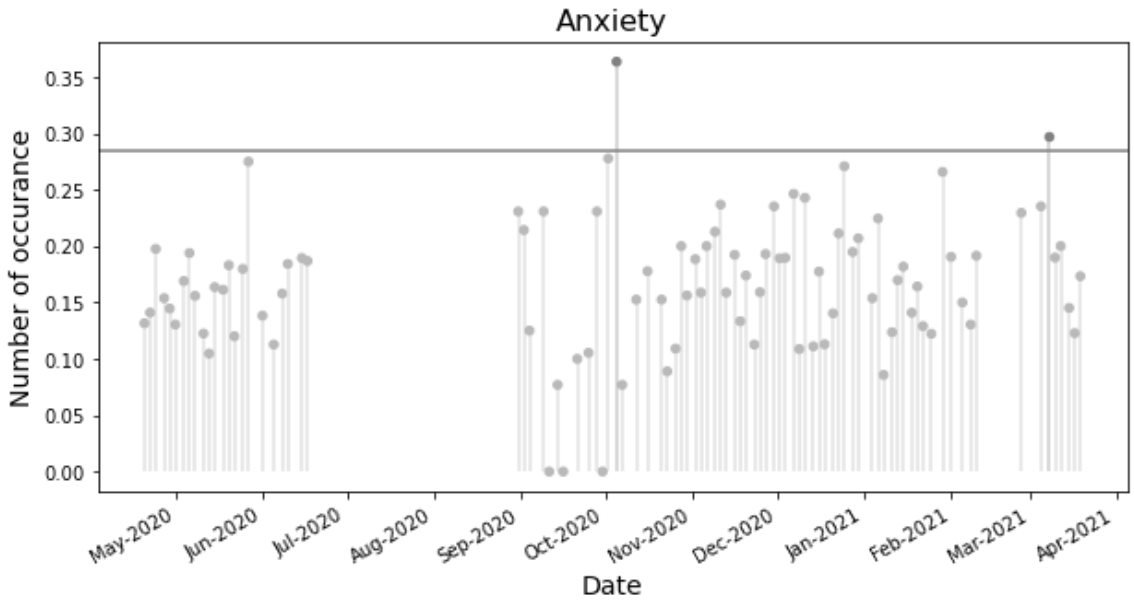

Figure 4, Normalized rate of the keyword "anxiety" through time,

Figure 4 shows the normalized rate of occurrences of the keyword "anxiety". On December 2 2020, Turkey announced a curfew on weekends and weekdays, except working hours on weekdays. This lockdown continued until July 1 2021. During this period, in figure 3, there are 3 apparent significant increases in the number of covid cases. One of them is at the beginning of December and the other, a more serious one, at the end of March 2021.

At the beginning of the pandemic, overall anxiety reports were slightly lower compared to September 2020 and onwards. Two scores exceeded the confidence interval. The first one occurred at the beginning of October 2020, and the second one occurred at the beginning of the second week of March 2021.

Anxiety and depression are major psychological problems that are more likely, as high as about twice, to occur in patients with rheumatologic diseases than in the general population. Because depression and anxiety symptoms, both individually and in combination with other rheumatologic disease symptoms, impact a patient's ability to function, they must be addressed, rather than being dismissed as a normal and unavoidable part of the illness process (Geenen et al., 2012).

CETA aims to address the psychological symptoms to increase mental resilience as well as physical symptoms. Peker and Cengiz report that fear of COVID-19 reduces happiness and increases stress. Therefore, individuals may protect their mental health during the pandemic using psychological coping mechanisms (2021).

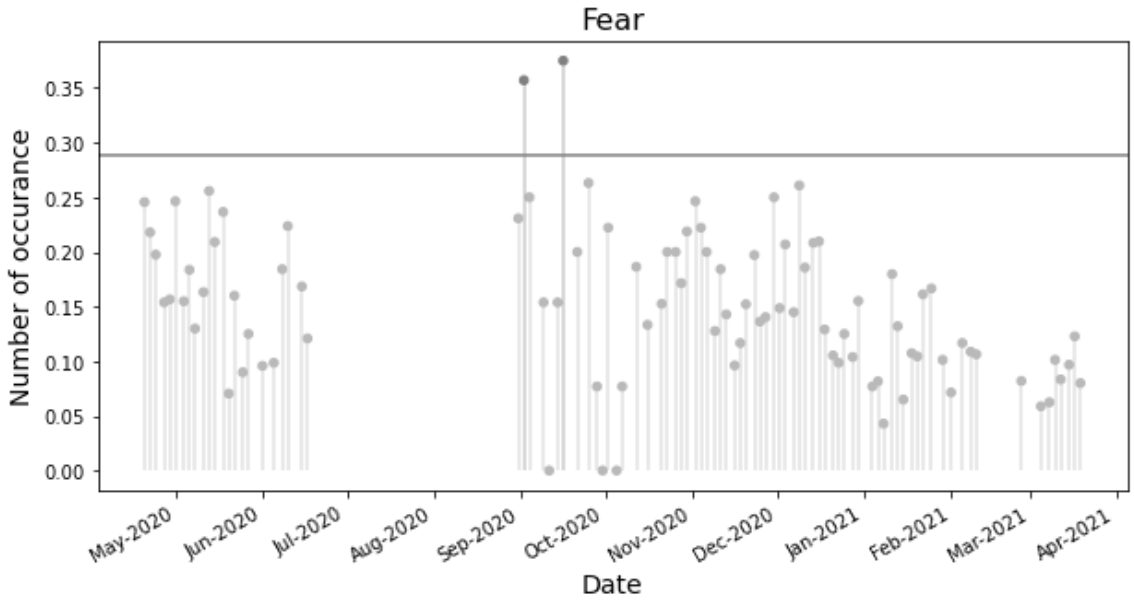

Figure 5, Normalized rate of occurrences of the keyword "fear" through time

Keyword fear, concern, stress, and sadness all can be closely associated with anxiety and depression. Figures 5, 6, and 7 show the normalized rate of keywords

fear, concern and stress. During September 2020, fear and concern keywords rise significantly. Stress also shows a similar pattern, but it is more widely distributed around September and October. Concern and anxiety are very likely to be used interchangeably. It is safe to deduce that general unease in the therapy group increases from September 2020 until mid-December 2020. There is no apparent correlation between the risk of disease and this increase.

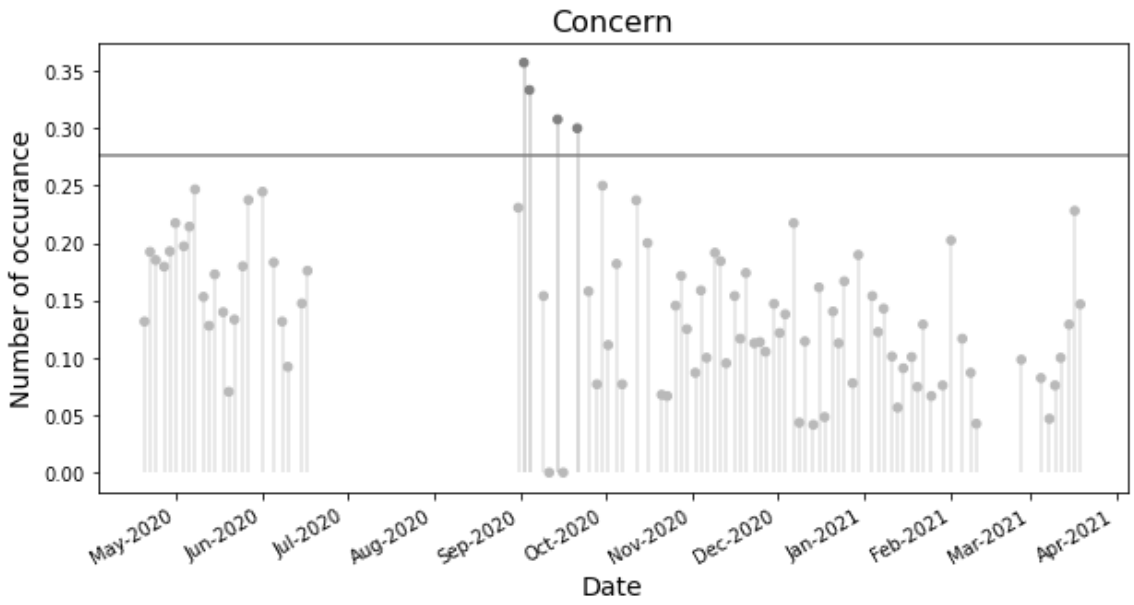

Figure 6, Normalized rate of occurrences of the keyword "concern" through time

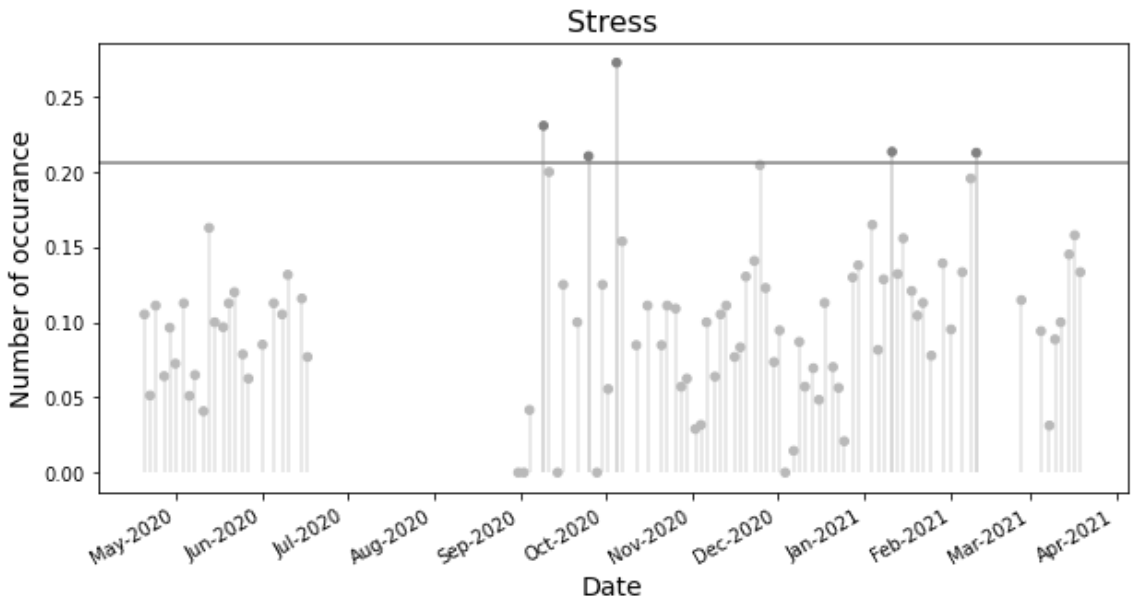

Figure 7, Normalized rate of occurrences of the keyword "stress" through time

Figure 7 shows the normalized rate of occurrences of the keyword “stress”. It shows similar behavior with anxiety, concern and fear around September 2020. There are two other significant scores of the keyword stress. One in the second week of January 2021 and the other in mid-February 2021.

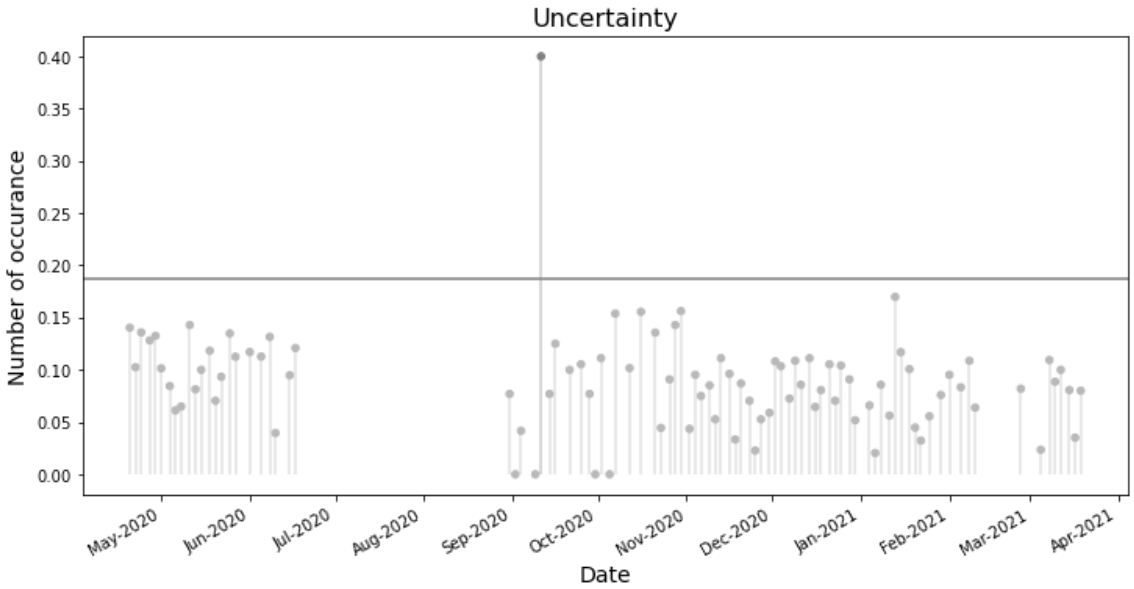

Figure 8, Normalized rate of occurrences of the keyword "uncertainty" through time

Figure 8 shows the normalized rate of occurrences of the keyword "uncertainty". There is one significant rise in uncertainty which corresponds to mid-September 2020.

Uncertainty is not an emotional state but an external determinant factor that became a part of daily life with the emergence of the pandemic. This may be correlated to the overall psychological well-being of the patients. the drastic increase in anxiety, concern, fear, and stress around the same period are very likely to be correlated. Because there is no pandemic vise external factor that changed around that period, this general unease in the group could be related to the absence of the usual instructor for the two months.

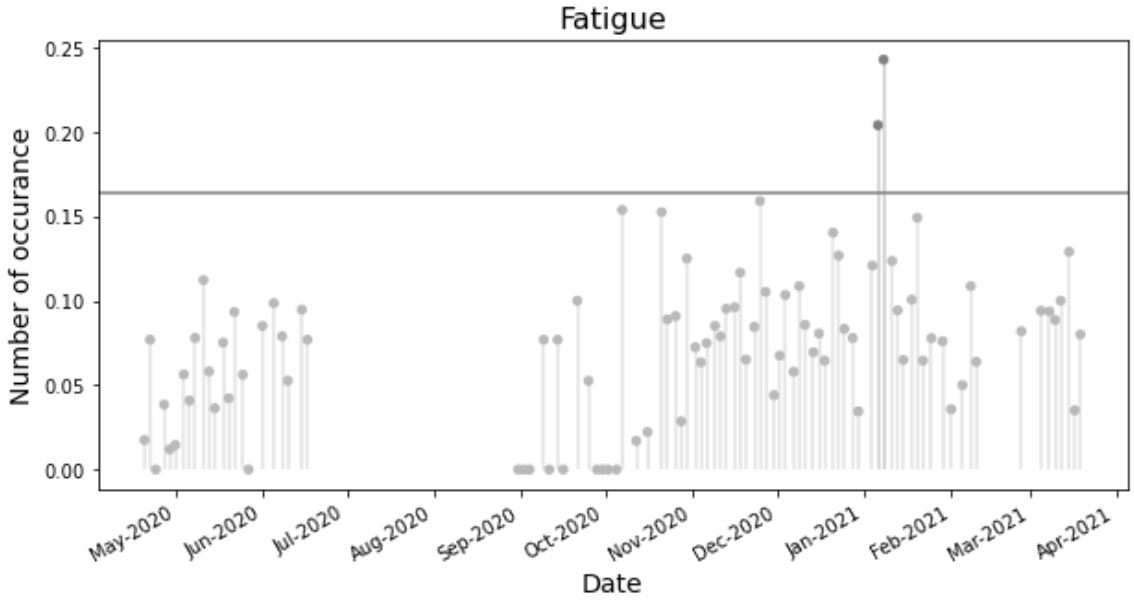

Figure 9, Normalized rate of occurrences of the keyword "fatigue" through time

Figure 9 shows the normalized rate of occurrences of keyword fatigue. Fatigue is a common symptom of rheumatic diseases (Stebbings & Treharne, 2010). Wolfe et al. report that "fatigue has a strong relationship not only with mental health but

also with more broad-based measures of general health status" (1996). This negative health status consecutively affects the general well-being of the patient. Thus, increasing in fatigue may lead to an increase in anxiety, sadness, despair, etc. During the first stages of the pandemic, the word fatigue was not reported significantly high. After October 2020, four scores are very close to the confidence line, and two scores exceeding the line. The two pikes correspond to January 2021, where there was a drastic increase in the covid infections throughout the country.

In figure 7, on January 2021, there is an increase in the score just below the confidence line. It is safe to deduce that the change for the worse in the pandemic course induces stress and fatigue in the group.

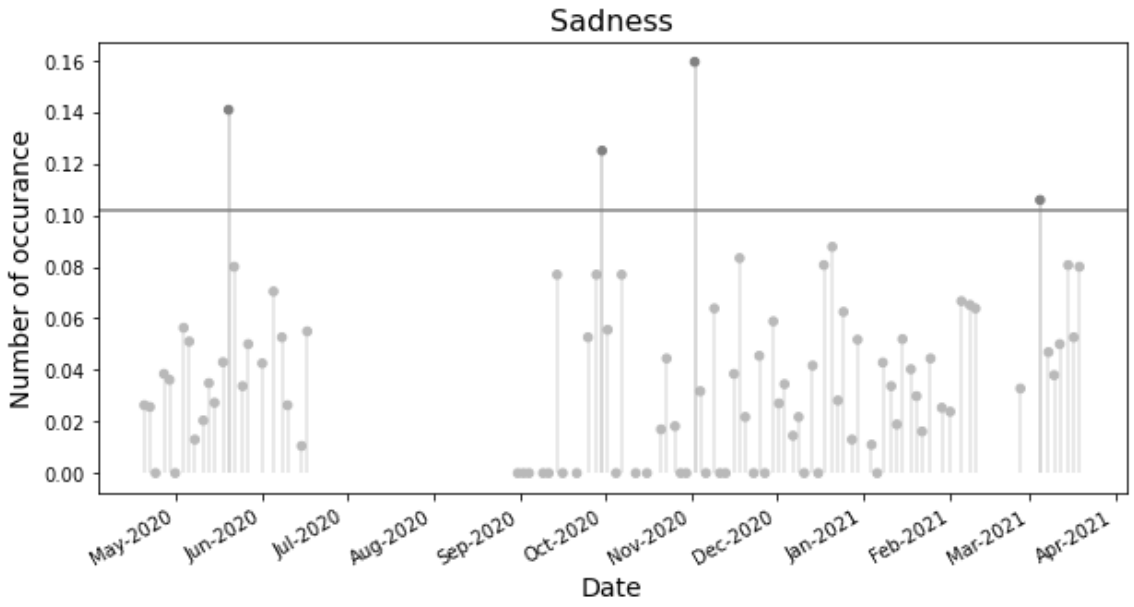

Figure 10, Normalized rate of occurrences of the keyword "sadness" through time

Figure 10 shows the normalized rate of occurrences of the keyword sadness. The pikes correspond to the third week of May 2020, the end of September 2020, the

beginning of November 2020, and the beginning of March 2021. The increases in May 2020, November 2020, and March 2021 correspond to the nationwide increases in covid cases.

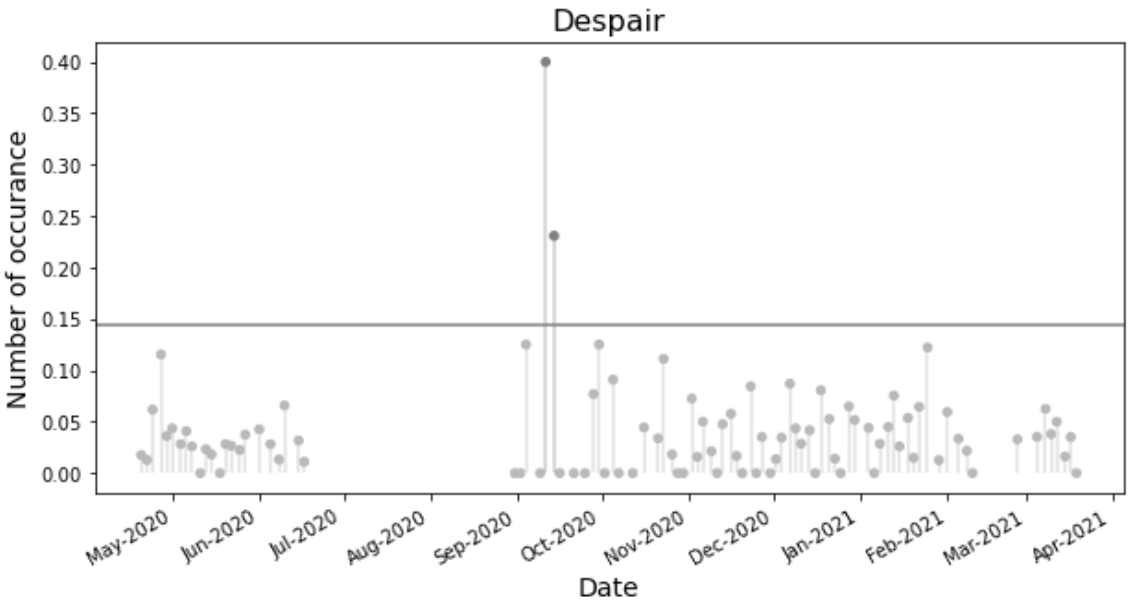

Figure 11, Normalized rate of occurrences of the keyword "despair" through time

Figure 11, Normalized rate of occurrences of the keyword "despair" through time

Figure 11 shows the normalized rate of occurrences of the keyword despair. Even though, in general, patients did not report despair during mid-September 2020, there was a sharp increase in despair. In mid-September 2020, keywords fear, concern, stress and, despair all had dramatic rises. In September 2020, daily new patients were around 1500 (Sağlık Bakanlığı, 2020). Minister of health Fahrettin Koca in an interview for one of the most significant news media sources in the country, stated that it was the second peak of the first wave. The occupancy rate in hospitals was 47%, in intensive care units was 60% in ventilators was 30% (Hakan,2020). On September 30 2020, Koca acknowledged that the official

numbers were not all positive cases but only the symptomatic ones. Around that time, Republican People's Party (CHP) lawmaker Murat Emir claimed that the actual cases were around 30.000 a day (Daventry, 2020). Even though the minister of health did not acknowledge this claim, speculations and the lack of transparency in the healthcare system certainly caused feelings of fear, concern, stress, and despair in the CETA therapy group.

Positive Sentiments

Table 2 shows the number of occurrences of the positive indicator keywords in descending order.

Table 2, Positive sentiment frequencies

Sentiment	Frequency
Miracle	1329
Love	1110
At peace	1054
Hope	815
Happiness	653
Success	415
Joy	355
Worthiness	299
Lucky	270
Abundance	258
Courage	180
Uniqueness	171
Tolerance	112
Special	104
Healthy	87
Forgiving	72
Self-love	69
Full of life	64
Wonderful	56
Beautiful	52
Magnificent	41
Skillful	38

For CETA, patients were asked to stop when they feel pain and ask themselves the negative sentiment behind the pain. After that, they are asked to come up with positive sentiments to replace the negative ones. The keyword spotting analysis shows that patients chose miracle, love, peace, and hope the most.

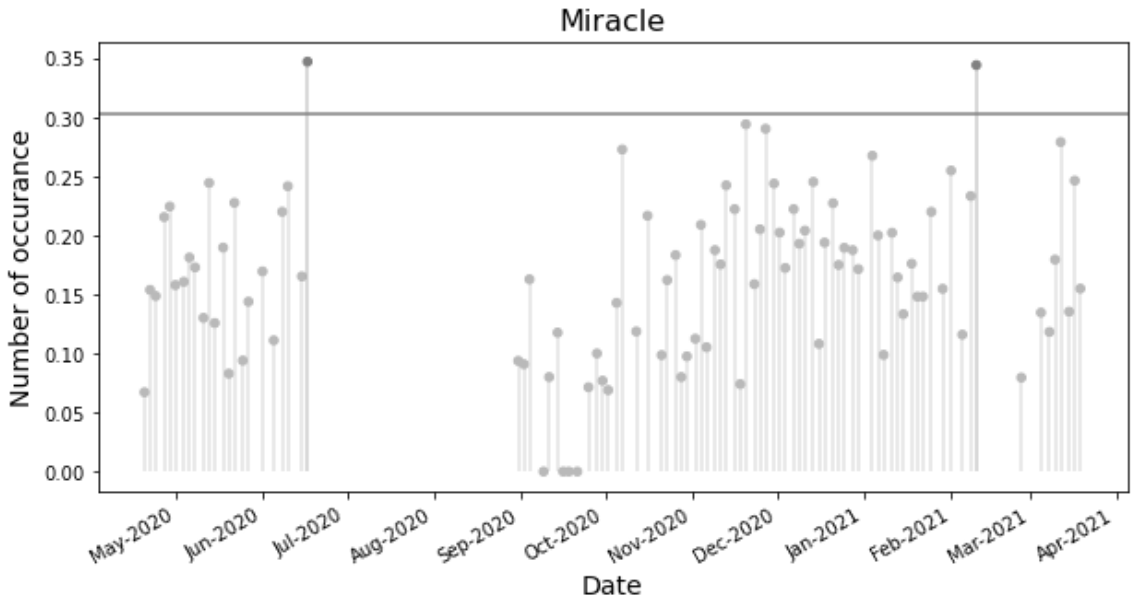

Figure 12, Normalized rate of occurrences of the keyword "miracle" through time

Figure 12, Normalized rate of occurrences of the keyword "miracle" through time

Figure 12 shows the normalized rate of occurrences of the keyword "miracle". The statements are generally in the form of "I am a miracle" or "there are miracles in my life". It is the most frequent attention divergence strategy used by the patients throughout the period under study. Two significant high scores of the keyword correspond to the mid-June 2020 and mid-February 2021.

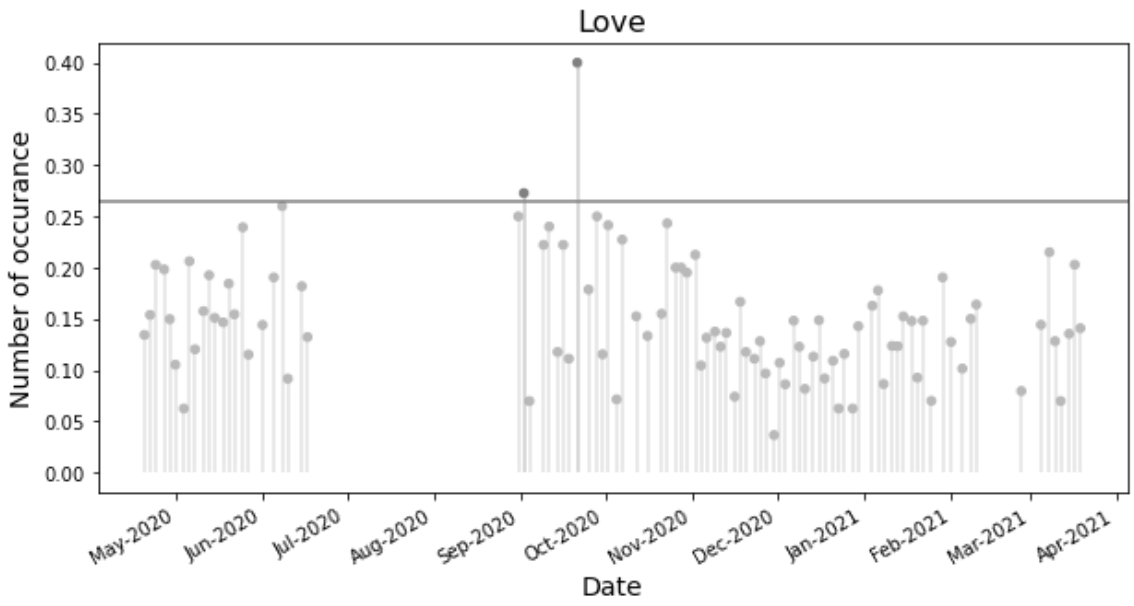

Figure 13, Normalized rate of occurrences of the keyword "love" through time

Figure 13 shows the normalized rate of occurrences of the keyword "love". Love is the second most frequently used word by patients to divert their attention from pain. The scores cross the confidence interval two times. They correspond to the first and third weeks of September.

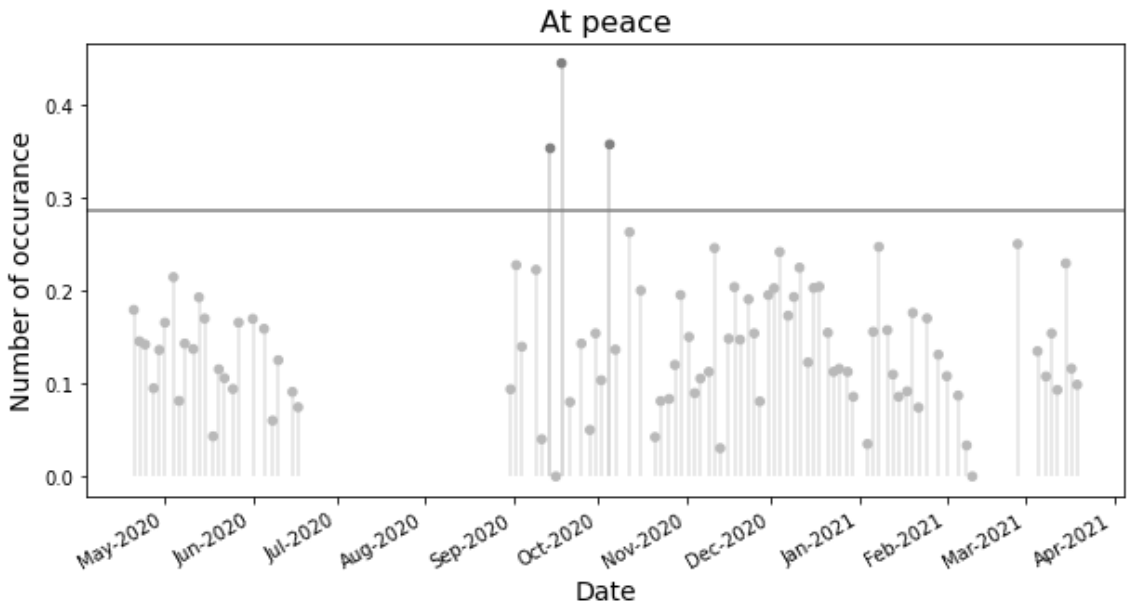

Figure 14, Normalized rate of occurrences of the keyword "at peace" through time

Figure 14 shows the normalized rate of occurrences of the keyword "at peace". The significant increases are during mid-September 2020 and the beginning of October 2020. Apart from that, the general rate of occurrence increased after September 2020 compared to the pandemic's beginning.

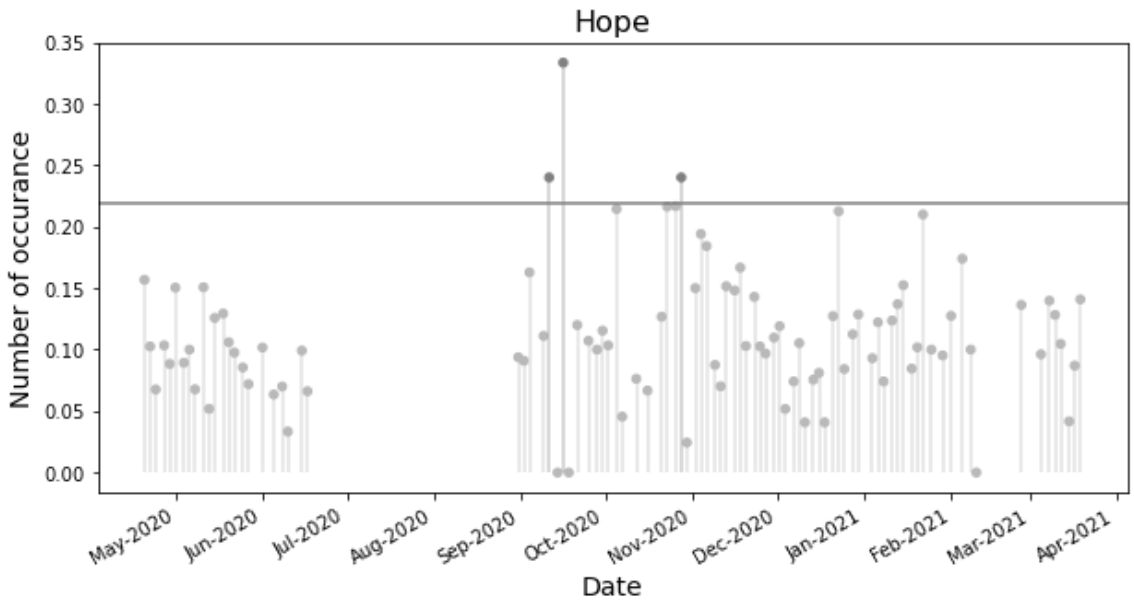

Figure 15, Normalized rate of occurrences of the keyword "hope" through time

Figure 15 shows the normalized rate of occurrences of the keyword "hope". Three significant increases correspond to mid-September 2020 and the end of October 2020. The general pattern of the keyword hope behaves very similarly to the keyword at peace.

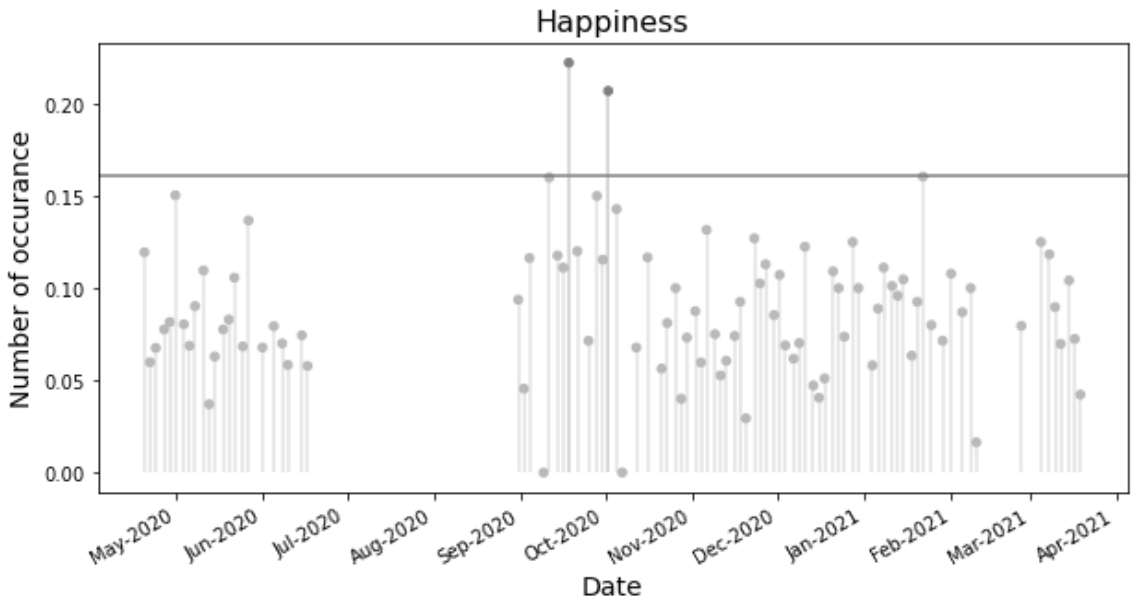

Figure 16, Normalized rate of occurrences of the keyword "happiness" through time

Figure 16 shows the normalized rate of occurrences of the keyword "happiness". Two major pikes are corresponding to the mid-September 2020 and the beginning of October 2020.

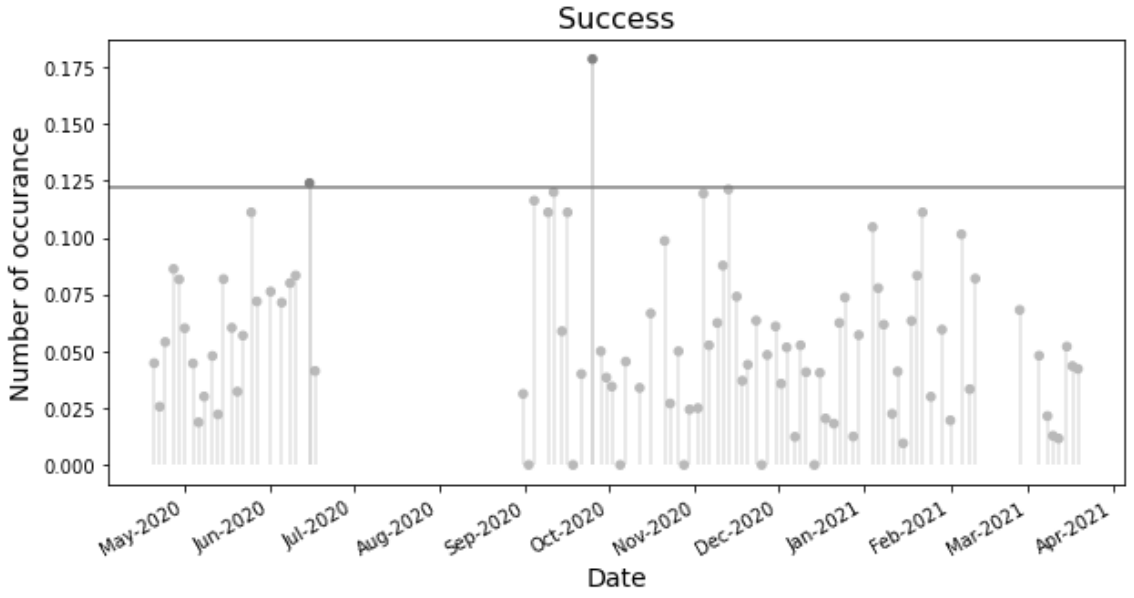

Figure 17, Normalized rate of occurrences of the keyword "success" through time

Figure 17 shows the normalized rate of occurrences of the keyword "success". The two pikes correspond to mid-June 2020 and the end of September 2020.

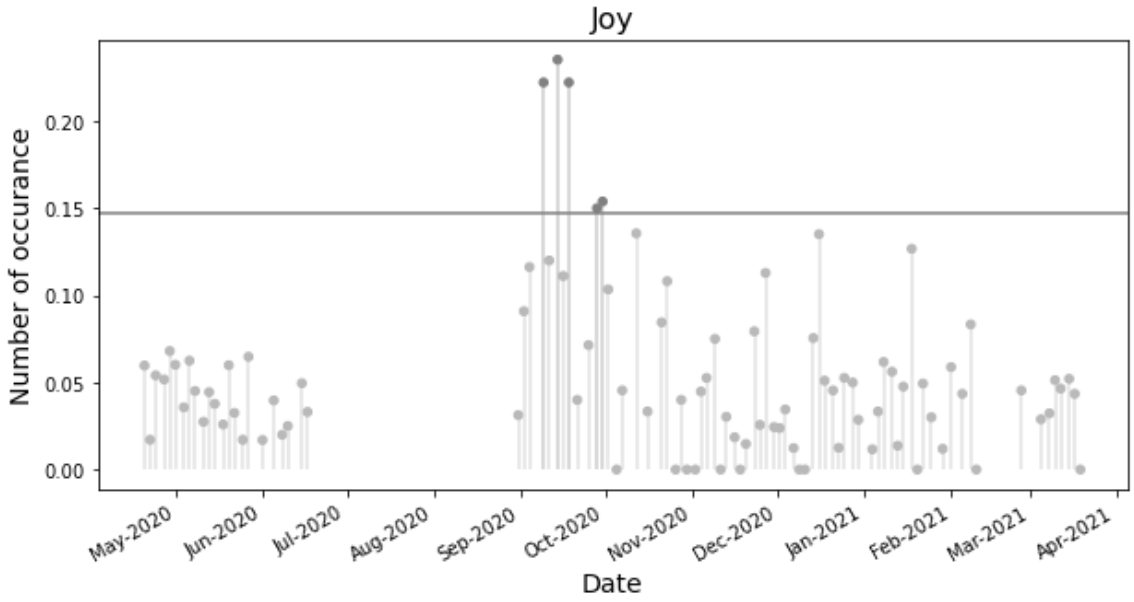

Figure 18, Normalized rate of occurrences of the keyword "joy" through time

Figure 18 shows the normalized rate of occurrences of the keyword "joy". At the beginning of the pandemic, joy was not a keyword that was often used. During September 2020 there are five sharp increases in the rate of occurrence.

Chapter 5: Conclusion

In this study, the data from the CETA therapy group was analyzed in terms of the sentimental statutes of the patients. BERT sentiment analysis showed that the most drastic change in the patients' sentiments was during September 2020. During that time, patients reported feeling fear, concern, stress, uncertainty, and despair the most. According to the reported data, it was not a significant period in terms of the spread of the disease. However, the commentaries in the media and the lack of transparency in the health care system show a correlation with the general unease in the group during that period.

Even though the most critical time so far in the COVID-19 pandemic, according to figure 3 was the period between February 2021 and June 2021, in that period, only stress, sadness, and anxiety keywords were significantly high each one time.

In order to cope with the general unease during September 2020, patients referred to the positive keywords love, at peace, happiness, success, and joy the most. Miracle scored the most frequently used positive affirmation; however, during the time of fear, concern, stress, uncertainty, and despair, patients did not refer to miracle more than they did at other times.

In the future studies, sentiment analysis of the patients can be compared to their physical symptomatic feedbacks. Even though fatigue is one of them, it is the only physical feeling feedback. One of the limitations of this study was that the data only consisted on the sentiment statues of the patients and not the degree of the physical pain they experienced. To see if CETA therapy builds mental and physical resilience against both current and anticipated uncertainty and stress, it is necessary to analyze patients' physical well-being.

Acknowledgements

We are grateful for our collaboration with Prof. Dr. Edibe Ünal.

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