Overview on Cognitive Abnormalities in Post-Traumatic Stress Disorder

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Abstract

Post-Traumatic Stress Disorder (PTSD) is a disorder of memory and the people suffering from it relive their trauma in the form of involuntary recollection. Prominent cognitive abnormalities have motivated many researchers do the research to elucidate the mediating mechanisms that produce PTSD symptoms. In this paper, we focused our research on PTSD and proceeded by implementing Artificial Intelligence to predict the disorder accurately. Dataset is created and AI based deep learning prediction algorithm is applied that gives exact outcomes as achieved on doing manual data analysis. So, using AI algorithm, it is found that an effective diagnosis of PTSD is possible through recognition of voice quality or tone of person's voice.

Introduction

PTSD (post-traumatic stress disorder) is an anxiety disorder that develops in some people who have experienced a shocking, scary, or dangerous event. Artificial Intelligence could be used to detect PTSD. PTSD can occur in all people, of any ethnicity, nationality, or culture, and at any age. New York University researchers' AI Program trained using 'random forests' that is a statistical machine learning technique that allows an AI to develop the ability to classify people based on earlier examples.

Symptoms of PTSD:

The symptoms might start within one month of a traumatic event and sometimes may not be realized until years. PTSD symptoms are generally grouped into four types: intrusive memories, avoidance, negative changes in thinking and mood, and changes in physical and emotional reactions.

1. **Intrusive Memories:** It may include repeated, distressing memories, upsetting dreams, nightmares, or flashbacks of the traumatic event. Sometimes people feel they are re-living the traumatic experience.

2. **Avoidance:** Avoiding reminders of the traumatic event may include avoiding people, places, activities, objects, and situations that may trigger distressing memories. People may try to avoid remembering or thinking about the traumatic event.

3. **Negative Changes in Thinking and Mood:** Hopelessness about the future, negative thoughts about oneself or others, ongoing fear, horror, anger, guilt, or shame, much less interest in activities previously enjoyed, feeling detached from others, or being unable to experience positive emotions, lack of interest in favorite activities.

4. **Changes in Physical and Emotional Reactions:** Being irritable and having angry outbursts, having problems concentrating or sleeping, guilt or shame.

Causes:

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There is also a genetic factor that is involved in PTSD. For example, having a parent with a mental health problem is thought to increase the chances of developing PTSD. Types of events that can lead to PTSD include:

1. serious accidents
2. physical or sexual assault, torture
3. abuse, including childhood or domestic abuse
4. exposure to traumatic events at work, including remote exposure
5. serious health problems, such as being admitted to intensive care
6. childbirth experiences, such as losing a baby
7. war and conflict

Why does PTSD develop?

1. **Survival Mechanism:** One suggestion is that the symptoms of PTSD are the outcome of an instinctive mechanism intended to help you live on further traumatic experiences. For example, many people with PTSD experience the flashbacks that may force them to think about the events in detail so they become better prepared if it happens again. These responses may be intended to help you survive.

2. **High adrenaline levels:** Studies have shown that people with PTSD have abnormal levels of stress hormones. When we are in danger, our body produces stress hormones like adrenaline that trigger a reaction in the body. This reaction is known as the "fight or flight" reaction. It helps to deaden the senses and dull pain. People with PTSD have been found to continue to produce high amounts of stress hormones even when there's no danger.

3. **Changes in the brain:** For people with PTSD, parts of the brain involved in emotional processing appear different in brain scans. One part of the brain responsible for memory and emotions is known as the hippocampus. The hippocampus appears smaller in size and changes in this part of the brain may be related to fear and anxiety, memory problems, and flashbacks. The malfunctioning hippocampus may prevent flashbacks and nightmares from being properly processed.

Treatment:

PTSD is one of the most challenging disorders to diagnose but professional help is very effective to treat PTSD. PTSD can be successfully treated many years after the traumatic event or events occurred, which means it's never too late to seek help.

➤ **Assessment:** Before having treatment for PTSD, a detailed assessment of the symptoms will be carried out. This may be carried out by a GP or specialist. You can refer yourself for the assessment to a psychological therapy service. There are many mental health specialists to treat PTSD, such as a psychological therapist, psychologist, community psychiatric nurse, or psychiatrist.

➤ **Active Monitoring:** If you have mild symptoms of PTSD, or you've had symptoms for less than 4 weeks, an approach called active monitoring may be recommended. Active monitoring involves carefully monitoring the symptoms to see whether the patient gets to improve or get worse.

➤ **Psychological Therapies:** A combination of psychological therapy and medicine may be recommended if you have severe or persistent PTSD. A GP can refer you to NHS psychological therapies service (IAPT) or, in some cases, a specialist clinic. Following are the psychological therapies used to treat people with PTSD.

• **Cognitive Behavioral Therapy (CBT):** It is a type of therapy that aims to help you manage problems by changing how you think and act. Trauma- focused CBT uses a range of psychological techniques to help you come to terms with the traumatic event. During the process, your therapist can help you gain control of your fear and distress by reviewing with you any conclusions you have drawn about your experience.

• **Eye Movement Desensitization and Reprocessing (EMDR):** EMDR is a psychological treatment that's been found to reduce the symptoms of PTSD. It involves recalling the traumatic incident in detail while making eye movements, usually by following the movement of your therapist's finger. It may help you change the negative way that you think about a traumatic experience.

➢ **Medicine:** Antidepressants such as paroxetine, sertraline, mirtazapine, amitriptyline or phenelzine, are used to treat PTSD in adults. Amitriptyline or phenelzine is to be used under the supervision of a mental health specialist only. Antidepressants can also be prescribed for reducing any associated symptoms of depression and anxiety and help with sleeping problems. Before prescribing medicine, your doctor should inform you about possible side affects you may have while taking it.

➢ **Children and Young People:** Trauma-focused CBT is usually recommended for children and young people with PTSD. This involves a course of 6 to12 sessions that have been adapted to suit the child's age, circumstances, and level of development. Treatment includes consulting with the child's family. Children who do not respond to trauma-focused CBT may be offered EMDR.

Methods:

1. Chatbot could be used for the PTSD risk assessment by getting access to the patient datasets and we can apply Linear Classifiers in NLP (Natural Language processing) for the risk assessment. Chatbot is a system that can converse and interact with human users using spoken, written, and visual language.

2. A Voice analysis program could be used to understand human speech and to detect PTSD signifiers and emotions. The audio could be used to teach artificial intelligence which vocal changes. The indicators of PTSD are a slower, more uninteresting, or toneless voice, shorter tonal range with less utterance. AI could be used to detect the minute changes in the voice like the tension of the throat muscles, whether the tongue touches the lips.

3. The Convolutional Neural Networks (CNN) could be used to learn the characteristic of depression from speech. It could be used to extract features from a spectrogram to classify the audio spectrogram into two classes depressed and non-depressed.

Phenomenological and Meta-Cognitive Findings

Among persons in pain of PTSD, their memory has been expressed in several ways, and phenomenological research has provided facts that how to represent memory of trauma [4]. For example, a person might be experienced continuously an unwanted thoughts about the incident and they might think such things in their mind 'Why do this thing happened to me?' and may experience memories of trauma [5]. One study seen that breaking up of memories representative taken part with outline, seeing sudden come-backs of the past incidents causing reaction that went before was the most fear point of view of the trauma and not having serious point of view of the experience per Se [6]. It seems flashbacks giving warning signals that predicted were the worst part of the event. For example, one person still living of a head-on collision stated sudden come-backs of the past of the headlights of the on-coming vehicle, not of the smashing noise itself. Flashbacks are more likely to have to do with certain of the senses modalities than others. Flashbacks are most common that went after in several times followed in frequency by bodily/kinaesthetic, auditory, olfactory, and gustatory [5].

Intrusive cognition about the trauma can be put forward in language, and includes story, descriptions of the trauma itself and meta-cognitive option of the value is of one's acute PTSD symptoms. Although the senses experiences are especially like an actor in a play features of PTSD and as compared to the intrusive thoughts of the trauma, they are less frequent. A study of assault victims indicated that people with PTSD symptoms, their memories of the trauma are more disorganised and the size of disorganisation says what will take place in the future with coming after PTSD pathology [7]. People in pain or troubled with PTSD symptoms did not give signs of disorganisation when giving detailed accounts of a non-traumatic, control event meeting regularly from the time of trauma. The memory of trauma did not make into one control events in the early work on disorganised story, and disorganisation itself appeared to be a thing of limited by verbal ability [8].

Meta-cognitive option of value of one's acute PTSD symptoms says what will take place in the future, whether one will undergo growth does not get well from PTSD [9, 10]. For example, if sudden come-backs of the past are took as having a certain cause as

give news of coming psychosis, or if it had seen greater or worse than it is surprise reactions and nightmares are causing fear give as a signs of personal weakness. People who suffered from trauma are at high point danger for coming short to get back from the serious effects of trauma exposure. Although risk factor researches that make observations representative identify variables, pre-trauma, those predict the symptoms of PTSD. The meta-cognitive appraisals of first symptoms predict the recovery of PTSD that Ehlers and her colleagues indicated.

Brewin [11] has suggested that trauma memories are in a dual-representation system: a verbally accessible one, a situational accessible one. The former accessed voluntarily, and mediates breaking up cognition about the trauma, in view of the fact that the latter mediates of the senses reliving of the trauma itself and triggered automatically by Cues have thoughts of the past of those present during the experience (e.g. Ehler's 'warning stimuli').

Intrusive Cognition and the Emotional Stroop Effect

Intrusive cognition and the strong feelings stroop effect studies have on condition that Evidence in harmony with complaints about getting breaking up, not wanted ideas about the trauma. People with PTSD to trauma-exposed people without the disorder, take time to name the colors of words related to trauma(e.g. firefight) than to name the colors of negative words (e.g. disgustingly dirty), and positive words (e.g. friendship), and neutral words (e.g. concrete) [12]. People with PTSD attempts to give attention to color of words, the senses of words of trauma go where not desired, capturing attention, and slow speaking of the color naming.

With few inconsistencies [13], studies have repeated the effect of those people with PTSD in response to various pains (e.g. serious accidents, physical torture, and war) [14]. In novel application of pattern, Buckley et al. [15] had actors that attempt to imitate the conditions of PTSD people. The actors demonstrated the slowing down overall color-naming rather than slowing down trauma words color-naming. The authors brings to an end of the emotional stroop that emotional stroop might help in distinguish the real PTSD patients from those who pretend ill from PTSD. Discussed/Distressed about

people who replicated PTSD to get monetary compensation seemed increasing [16]. One exceptionally troublesome study showed that 59 out of 100 male introducing with Vietnam-related PTSD decades later had no confirmation of displaying trauma in their personnel files, and few of them have not served in Vietnam at all [17]. Until now almost everyone had experienced the PTSD detection from evaluating to clinicians.

Neural Mechanisms of the Emotional Stroop Effect

The neural mechanisms that moderate emotional Stroop effect in PTSD have explained by practical studies. In Positron Emission Tomography (PET) study, Bremner et al. [18] established that female with physical torture has related PTSD, comparative to sufferer without PTSD. The anterior cingulate previous activation revealed less during the emotional Stroop task and it did not vary in the middle of the groups when a standard Stroop task conducted, therefore suggested that to process the trauma-related information there has been activation shortage.

Moreover, applying functional Magnetic Resonance Imaging (fMRI), Shin et al. [19] found that Vietnam veterans with war-related PTSD has displayed reduced in rostral anterior cingulate activation when showed to trauma words in the emotional counting Stroop. The participants perspective shows accommodate through 4 copies of a word that differs in emotional behavior (e.g. firefight, firefight, firefight) and press a key correlated to correct number (e.g. [3]). The participant will be slow down in counting the number of copies of word on the screen as the emotional meaning of the word catches attention.

Emotional Stroop research discovers support a pathophysiology model of PTSD that the abnormalities in medial prefrontal cortex (PFC) and amygdala have shown [20-22]. The medial prefrontal cortex consists of anterior cingulate cortex (ACC), subcallosal cortex, and medial frontal gyrus. The PFC downward projections decrease the amygdala activation; a complete medial PFC is necessary for putting out conditioned fear [23]. Unwanted, worry or pain memories of the trauma, followed by strengthened physiologic arousal, are compatible

with either hyper-responsive amygdala or hypoactive medial PFC or both [24].

Evidence of prefrontal abnormalities

In the latest fMRI research, Shin and her colleagues gave more confirmation in support of this model [25]. Shin and her colleagues established that the participants of PTSD showed strengthened amygdala responses (Figure 1a) and decreased medial prefrontal cortex responses to the images of happy and fearful facial expressions (Figure 1b). In fact, in the PTSD group, both signal changes in amygdala and symptoms intensity were negatively related with signal changes in the medial prefrontal cortex (Figure 1c). Shin et al.'s research on inflated (excessive) amygdala responses to scared faces linked with earlier work displaying that briefly introduced and reversed masked scared faces give rise to strengthened amygdala responses in the PTSD participants [22]. While being exposed to trauma related pictures [26], sounds [27], traumatic imagery scripts [28], the patients with PTSD indicate declined in medial prefrontal or anterior cingulate activation (Figure 2).

Shin et al. [24] highlighted that the researchers discovered decreased medial PFC activation in people with PTSD and smaller ACC volumes in people with PTSD related to trauma-exposed persons without having disorder [29-31]. As well, these researches also showed that the smaller the ACC volume, the worse the seriousness of PTSD symptoms [30, 31]. In one study [30], suggesting that smaller ACC volume represents either a previous vulnerability cause or a 'scar' from PTSD disorder than a correspond of the illness itself.

Implementation:

Clinicians have observed that people with PTSD display the changes in their voice quality such as more slower, more uninteresting voice and toneless voice. Artificial Intelligence helps in diagnosing PTSD by analyzing the voices. Using AI technology, we have used the voice analysis software to detect PTSD. The audio recordings have been feed into the software. It has total 40,526 voice-based features that has captured in the recordings. The algorithm has used 18 voice features to identify the disorder and the algorithm used in this software searched repeatedly the features until it found the 18 factors of PTSD.

The factors of PTSD include slower, more uninteresting, or toneless voice, shorter tonal range with less utterance. It distinguishes between the voices of those people with PTSD or without PTSD. The program has correctly identified people with PTSD.

Conclusion:

PTSD is a complex highly disabling and suffering disorder where the past is always present in people. People have intense, disturbing thoughts and feelings related to their experience that last long after the traumatic event has ended. Treatment should be given to cure the disorder and to improve the mental health of people.

Artificial Intelligence also plays a vital role in making better of the mental health of people. AI has made it possible to diagnose PTSD and help to treat the patient and improve their mental health. People have to go to the psychiatrist for the treatment and now AI has made it easier for people to detect and treat PTSD at home without going to the clinic.

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