

## **Abstract**

In this report, we present the first case of depression showing symptomatic improvement with the auditory training program, Music for the Mind 2, added to a standard treatment regimen. This commercially available program combines advanced psychoacoustic techniques with the improvisational art of Ostad Elahi (1895–1974) to encourage active listening by targeting early auditory information processing (EAIP) pathways. We introduced MFM2 as add-on therapy to standard treatment over a 3-week period and administered the listening regimen (minimum 20 min per day) to a young Caucasian male with a first episode of major depression. We assessed the impact of MFM2 on depressive symptomatology as well as coping mechanisms and mindfulness. The results showed that through targeting EAIP pathways and thus accessing higher-order cognitive functions (e.g., active listening), recovery from depressive symptoms can be accelerated. Further studies are needed to investigate the impact of auditory training, particularly MFM2, on clinical outcomes, brain structure, and function. Through this case report, we introduce an innovative, safe, and effective music medicine that can enhance the lives of people with depression.

Key words: auditory training, active listening, depression, Ostad Elahi

## Introduction

Depression affects several hundred million people worldwide and has prevailed as the third-leading cause of years lived with disabilities [1]. Add-on therapies are emerging as valuable complements to psychopharmacological and psychotherapeutic treatments for depression. Among these, music-based therapies are gaining popularity in the clinical management of patients. Meta-analyses have illustrated the benefits of music therapy and music medicine on depression without always making this important distinction [2]–[4]. Music medicine can be further subdivided by considering interventions targeting early auditory information processing (EAIP) pathways (i.e., tonal processing) such as auditory training (AT) programs. These programs are particularly interesting in light of findings indicating that central auditory processing disorders are present in a range of mental disorders [5], including depression [6]. Yet, there has been a notable dearth of research into the potential effects of AT on depressive symptomatology.

AT is based on the neurological effects of sounds through the delivery of electronically modified music to the brain; specifically sound that has been filtered for various frequencies and amplitudes [7]. By re-educating the hearing mechanism to take in a full spectrum of sound, AT is adopted with the intention to stimulate and improve perception, and to provide a better integration between sensorial systems and neurophysiological responses [8]. Further, by improving EAIP pathways and listening functions as auditory memory, sequencing, and discrimination [9], AT develops higher-order (social) cognitive functions such as active listening, a skill that shares the same conceptual space with mindfulness. Patients with depression show a deficit in social cognitive capacities [10] and it is plausible that the amelioration of cognitive deficits through the development of active listening should assuage depressive symptoms.

In the current report, we present what is, to the best of our knowledge, the first case of depression using an add-on therapy based on an AT program: Music for the Mind 2 (MFM2). This unique music intervention, produced by Advanced Brain Technologies and the Nour Foundation, combines modern psychoacoustic methods (i.e., filtering frequencies, gating) with the improvisational art of Ostad Elahi (1895–1974).

### Clinical Presentation

A 27-year-old, single Caucasian man, living with his parents, studying machine engineering, and working as an intern, presented himself to the psychiatric emergency unit. For the preceding 3-week period he was experiencing anxiety, depressed mood, diminished ability to concentrate, anhedonia, avolition, asocial behavior, insomnia, loss of appetite, and erratic behavior. For the last 8 weeks, he had been feeling mentally drained, living through a time of intense stress at work, as concurrent to his employment, the patient was writing his master's thesis. He felt overwhelmed by the workload, the lack of proper supervision, and was consumed by fear of failure.

On physical examination, the patient had a good appearance overall. He reported being healthy and indicated no history of major illnesses, surgeries, head injuries, or seizures. The patient took no medication, had no allergies, and his laboratory results and basic urinalysis were within the

normal limits. The electrocardiogram, cerebral magnetic resonance imaging (cMRI) and electroencephalography (EEG) were unremarkable. The general medical and neurologic examination revealed no clinical signs and symptoms. The clinical team therefore excluded organic origins (i.e., encephalitis, cerebral mass lesions) from consideration.

On review of all psychiatric findings, given the significant impairment of occupational and social functioning, the patient was diagnosed with a first episode major depressive disorder (MDD) without psychotic symptoms according to the ICD:10 criteria (F32.2 in the ICD-10: International statistical classification of diseases and related health problems) [11].

The patient received standard clinical care consisting of weekly 30-min appointments with a resident psychiatrist, low-intensity physical exercise (e.g., Tai Chi), and group therapies, which included social competence training, milieu therapeutic interventions (e.g., joint cooking, social indoor and outdoor activities) and psychoeducational groups focusing on the general psychopathology and etiology of depression based on cognitive behavioral therapy. Regarding pharmacological treatments, the patient was initially prescribed an antidepressant mainly due to insomnia. An attempt with mirtazapine 7.5 mg succeeded, attributable to its sedative side effect. The patient was medicated for a total of 12 days in this dosage, as he was at first reluctant to increase his medication to the therapeutic dosage of 15 mg mirtazapine per day. Nevertheless, he was open to non-pharmacological treatments and thus, following informed consent, voluntarily accepted to participate in a 3-week AT program (MFM2). On Day 11 of the music intervention, the patient agreed to increase mirtazapine to 15 mg per day, and the dosage remained unchanged until the end of the intervention period. He did not report any side effects regarding the increased dosage of mirtazapine.

### **Music for the Mind 2**

The MFM2 program was initially developed through the digital restoration of Elahi's recordings. According to the dedicated MFM2 website, restoration was achieved "without compromising the tonal integrity of Elahi's tanbur" [12] by accurately filtering aberrant audio waveforms. In addition, resonance was added to the original recordings to create the effect that the music is being heard in a medium-sized concert hall. This effect decreases with the progression of the recordings to increase the intimacy of Ostad Elahi's music [12].

The categorization of the music into four distinct mind-body states (Contemplation, Relaxation, Well-being, and Energy) was accomplished by means of a small clinical study ( $N = 30$ ) conducted in New York and using individuals who were familiar with Elahi's music. For instance, "Contemplation" enables the listener to delve into self-reflection and metacognition, whereas "Relaxation" is intended to help the listener unwind and let go of a stressful day. The tracks then underwent psychoacoustic modifications by filtering sound frequencies most favorable to the physiological purpose of each of the four categories. For instance, tracks on the "Well-Being" disc remain unfiltered, tracks on the "Energy" disc use a high-pass filter that removes lower frequencies [12].

High-quality recordings of nature soundscapes were added at the opening and closing of the sections. This feature was blended in to calm and soothe the listener and to present an added sonic dimension [12]. Each mind-body state has three associated tracks of 18–22 min duration.

Finally, the music was processed by use of Dolby Headphone® technology to deliver a surround-sound experience [12]. MFM2 is commercially available from various websites (as a CD set) as well as via streaming services (e.g., Spotify) for devices running iOS and Android operating systems.

### **The Music of Ostad Elahi**

Ostad Elahi was born in 1895 in West Iran and was an influential thinker, jurist, and musician. He worked in government service for almost 30 years and his last tenure was as Chief Judge of the Criminal Court of Appeals. Music occupied a prominent place in his life and at the tender age of 9 years he was considered an unsurpassed master of the tanbur<sup>1</sup>, an ancient Kurdish lute reserved for devotional purposes. Ostad Elahi introduced profound technical and structural modifications to this instrument, notably adding a third string, innovating new playing techniques, extending its repertoire, and reviving an ancient musical tradition by elevating it to a learned art form. It was only after his retirement that his musical reputation began to spread<sup>2</sup>. Interestingly, Ostad Elahi never performed in public and considered music above all as a means of reflection and contemplation. What has remained from his music are nonprofessional recordings by his family, sometimes taped without his knowledge. These recordings amount to some 40 hours and several of the recordings have been remastered and published [13].

The music of Ostad Elahi is exceptionally well suited to the creation of an AT program, as it inherently promotes active listening. First and foremost, all recorded pieces are improvisations that infuse the music with a free quality and the combination of repetition, inspirational creativity, and freedom in playing allows for unusual harmonic and rhythmic structures causing the listener to be highly attentive. Thus, Elahi's art continuously incites the listener to discover new "twists and turns" that prevent habituation, keep the brain alert, and encourage active listening [12].

The music is rich in high-frequency sounds that invite deeper listening and promote increased awareness and motivation. In fact, a spectral analysis revealed a dense range of high frequencies unlike any other instrument, enabling the musician to play with the highest tonal quality [14]. Elahi's fingering and striking technique gives the auditory illusion of simultaneous dissonance and consonance, creating polyphonic effects that again contribute to an active listening experience. Moreover, because of the percussive nature of the instrument, it generates random intense sounds and perceptual sound contrast so that no additional gating was required [12]. In summary, Elahi's music provides a strong foundation for creating a prodigious AT program (usually the preserve of classical music, such as Mozart concertos).

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<sup>1</sup> Tanbur is a generic term used to designate a class of lutes with necks longer than their bodies. It has been used, almost exclusively, for devotional purposes by the Ahle-Haq community since the 15th century.

<sup>2</sup> From August 5th, 2014, to January 11th, 2015, *The Sacred Lute: The Art of Ostad Elahi* was the first American exhibition to explore the life and music of Ostad Elahi at the Metropolitan Museum of Art in New York. As from March 2018, the tanbur of Ostad Elahi has been exhibited within Gallery 684 in a showcase titled "Famous Musicians," dedicated to some of the most influential musicians of the 20th century. One of the reasons this particular tanbur is significant is that most of the remaining recordings were played using this instrument. Finally, Gallery 681 houses a striking showcase dedicated to four of Elahi's prized instruments (<https://ostadelahi.com/life/exhibitions/the-sacred-lute-the-art-of-ostad-elahi/>).

## Methods

As MFM2 has been suitably designed in terms of track selection, sequencing, and neuro-acoustic techniques to encourage active listening, the purpose of the present intervention was to investigate its influence when administered as music medicine on depressive symptoms over a 3-week intervention period. The primary outcomes were the 21-item Hamilton Rating Scale for Depression (HAM-D-2) [15] and Beck's Depression Inventory (BDI-II) [16] and improvements were expected in both sets of scores. As secondary outcomes, we considered improvements in coping behaviors and mindfulness. Instructions, explanations, and assessments were administered by the first author.

Assessments were executed before and after the music intervention. The severity of depressive symptoms was assessed using HAM-D-21 as a clinician-rated assessment and BDI-II as a self-report assessment. Further, the Brief COPE questionnaire [17] was used, as a self-report measure of different coping behaviors and cognitions in response to stressful situations. On the Brief COPE, "Avoidant Coping" is generally considered less effective in the management of stress and "Approach Coping" is associated with proactive behaviors in the face of adversity.

Mindfulness was assessed using the Cognitive and Affective Mindfulness Scale-Revised (CAMS-R). This is a 12-item measure designed to capture a broad conceptualization of mindfulness with language that is not specific to any particular type of meditation training [18]. The higher the score, the more mindful the examined patient is deemed to be.

Before administration of the intervention, the patient was provided with minimal information regarding the AT program. He was told that, while listening to the music, he should avoid engaging in taxing or concurrent cognitive tasks such as driving, watching television, and reading. Finally, the patient was told not to listen to any music other than MFM2 during the intervention period.

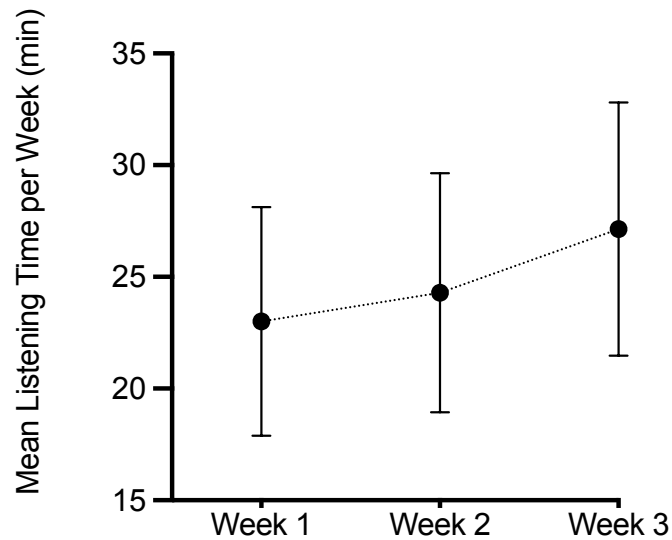
The patient was instructed to listen to the category "Well-being" in the morning within 30 min of waking up, and "Relaxation" in the evenings within 30 min of going to bed. As each category contains three tracks, the patient started with Track 1 on Day 1 and switched to the next track for the following day until he returned to Track 1 on Day 4. The minimum listening dosage per day per category was 10 min (total of 20 min per day). The patient was requested to use his own headphones and for listening volume to be kept at a moderate level (6/7 out of 10). To ensure regular application of MFM2, we asked the patient to maintain a daily record of listening duration and the time of day at which MFM2 was used.

## Results

During the 3-week intervention period (i.e., 21 consecutive days), the patient listened to MFM2, on average ( $M$ ) of 24.8 min per day ( $SD = 5.40$  min). The average time listened per week increased steadily from Week 1 (23.00 min,  $SD = 5.13$  min) to Week 3 (27.14 min,  $SD = 5.67$  min; Figure 1). The patient reported that there were no adverse events associated with listening to MFM2.

**Figure 1**

*Average Music for the Mind 2 (MFM2) Listening Time Per Week*

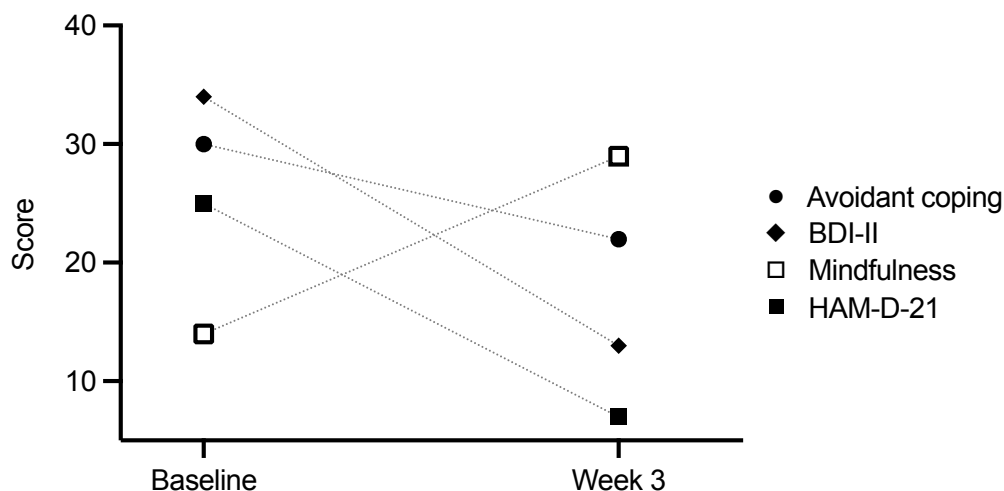


*Note.* Average time listened to MFM2 is shown using black dots. Error bars represent standard errors.

Prior to the intervention, the patient's scores on HAM-D-21 and BDI-II indicated an episode of severe depression. The patient exhibited a steady decline in depressive symptoms within the 3-week intervention period. The HAM-D-21 score decreased by 72% showing total remission, whereas the BDI-II score fell by 61.8 %, indicating a residual mild depressive symptomatology post-intervention (see Figure 2).

**Figure 2**

*Changes in Depressive Symptoms, Avoidant Coping, and Mindfulness Scores Over 3 weeks*



*Note.* Changes from baseline to Week 3 in depressive symptoms were measured with the 21-item Hamilton Rating Scale for Depression (HAM-D-21) and Beck's Depression Inventory (BDI-II); avoidant coping was measured with the Brief COPE questionnaire and for mindfulness scores the Cognitive and Affective Mindfulness Scale–Revised (CAMS-R) was used.

Regarding coping strategies, the patient maintained his approach coping strategies while letting go of avoidant coping mechanisms. Compared to baseline, the patient relied more frequently on the practice of positive reframing (+150%) to regulate his inner emotional states and refrained from use of alcohol (-67%) and self-blame (-50%). Thus, we observed a decrease of 26.7% in his application of avoidant coping.

With reference to mindfulness, we asked the patient to complete the scale using a retrospective frame. After first assessing his current state of “mindfulness” (i.e., post-intervention), he then retrospectively assessed his state prior to the intervention. It was apparent that there was a 107% improvement over the intervention period (see Figure 2).

On Day 21 of the intervention, the patient was discharged from the outpatient unit. He was looking forward to returning to work and writing-up his master's thesis. The patient insisted upon continuing with the AT program for a further 3-weeks under modified conditions (e.g., without a minimum listening time per day). The associated outcomes, although encouraging, are not a focus of the present analysis.

## Discussion

The present case study centers on an AT intervention for a 27-year-old master's student who had been hospitalized following a first episode of major depression. He was subjected to an AT program (MFM2) over a 3-week period, targeting EAIP pathways to improve active listening. These improvements were expected to be illustrated by an amelioration of depressive symptoms

and other secondary parameters, such as mindfulness and coping mechanisms. During the intervention period, the patient improved considerably upon his initial clinical condition in terms of overall depressive symptoms. He also enhanced his mindfulness skills and employed avoidant coping strategies far less.

Our findings are in line with those of previous studies demonstrating an amelioration of depressive symptoms when clinically depressed patients are administered music medicine [19], [20]. Regarding the effects of AT, most studies investigated the Tomatis Method and mainly explored its effects in children and adolescents with auditory processing disorders [9]. Studies applying the Tomatis Method to psychological disorders remain inconclusive [21]. To our knowledge, this is the first study reporting on the effects of an AT program (MFM2) on depressive symptoms. Findings suggest that AT may reduce depression by promoting mindfulness.

The patient indicated an improvement on the Mindfulness Scale, supporting the hypothesis that active listening, as trained by MFM2, might enhance facets of mindfulness (i.e., being attentive inwardly to the here and now without rejection, judgement, or attachment) through music (i.e., “music-guided” mindfulness). According to Gearhart and Bodie [22], active listening consists of cognitive, affective, and behavioral processes, that may partially mediate aspects of mindfulness (e.g., executive attention and executive monitoring). Also mindfulness-based therapies have been studied extensively over the last two decades and many reports have shown positive effects on depression [23].

One facet of mindfulness, executive attention, is best trained when maintaining the focus of attention on (or returning our attention to) a point of concentration, while disregarding distractions [24]. Even while listening attentively to MFM2, the mind spontaneously wanders off (i.e., memories, thoughts about the future). The inherent qualities of Elahi’s music and the applied sound modulations capture the listener’s attention and alert the brain, thus facilitating the process of re-attending to the object of concentration more swiftly and effortlessly. In everyday social interactions, especially when burdened with a mental disease such as depression, a sufficient degree of attention regulation is necessary to stay engaged in conversations and to interact with others, as opposed to drifting into reverie.

Another facet of mindfulness, executive monitoring (i.e., meta-awareness) might also be trained and in turn positively influence metacognition (i.e., thinking about one’s own thinking). Indeed models providing insight into the relationship between metacognition and mindfulness, indicate that mindfulness is related to the “highest level” of metacognition [25]. Also, that both depend upon a shift in perspective, wherein subjective inner perceptions become objectifiable [26] and mental processes gain clarity [27]; hence becoming identifiable and expressible. When compared to a social situation where attention is required to interact meaningfully, a sufficient degree of executive monitoring is indispensable to become mindful of inner emotions, thoughts, and dialogues. This is necessary to avoid drifting off into rumination, self-blame, or other cognitive biases.

Consequently, one might argue that active listening promotes mindfulness, which in turn mediates metacognition resulting in improvements in one’s quality of thinking. As a matter of



fact, cognitive restructuring (i.e., disputation, reattribution) is a crucial psychotherapeutic technique used to identify and question cognitive distortions in depressive patients (cf. Beck's 1970 cognitive triad). This applies particularly to the improvements demonstrated by the patient in practicing positive reframing and circumventing self-blame [28].

For any piece of music, the composer, composition, instrumentation, and cumulative implicit as well as explicit effects should be taken into consideration. The qualities of Ostad Elahi's art were gathered by During (2003) and expounded in his seminal book *The Spirit of Sounds*. Regarding its potential tangible effects, During concluded from eyewitness testimonies of auditors that this music, while always directed toward a spiritual goal, also exerted secondary somatic and psychological effects [14]. However, further studies are required to verify these qualities and to examine the validity of such first-hand accounts.

Lastly, this case report also demonstrates the feasibility and acceptability of MFM2, given that the patient increased his average daily listening time week by week. Additionally, the fact that the patient insisted upon continuing the program for a further 3 weeks underscores his belief that the AT bore meaningful benefits. The present findings hint at the need for further studies to examine the nature of patients' motivation to continue with this music medicine.

### **Limitations**

While the findings of this case study are promising, several limitations warrant mention. First, due to the very nature of a case report, findings cannot be applied to the general population. Second, not all effects can be attributed to MFM2. Especially the effectiveness of therapeutic milieu interventions in a day-clinic setting must be considered. However, the patient stated that the most potent agent was the therapeutic relationship, although standard patient/therapist sessions were limited to 30 min per week. As in other studies of this nature, there is a possibility of a Hawthorne effect [29]. Third, symptom relief may be partly attributable to the sedative effects of mirtazapine and, by extension, its amelioration of disruptive sleep patterns. Nevertheless, depressive symptom relief is unlikely to be solely explained by the administration of mirtazapine. It could be argued that early relief of insomnia might have improved overall functioning. While recognizing this potentially confounding variable, we reiterate that MFM2 is an add-on therapy to standard treatment and not a replacement. We highlight the need for future research to determine the effects of MFM2 on a broader range of mental health outcomes, and compare it with other types of music with reference to potential mental health benefits [30].

### **Conclusions**

While the development of severe depression is a multifactorial process, the causal determinant in this specific case was both academic (writing a master's thesis) and professional (work overload) in nature. Yet, within a brief period the patient was able to improve to such a degree that he was able to return to his workplace. Such a return would leave him facing the many challenges that had initially led him on the path to the emergency unit.

Based on the present findings, we conclude that listening to MFM2 may expedite recovery from depressive symptoms. The combination of modern psychoacoustic techniques with the music of Ostad Elahi enables a form of "music-guided" mindfulness that aids discernible

neuropsychological functions (i.e., active listening, metacognition). Such functions can ameliorate debilitating symptoms through the implementation of approach coping mechanisms.

Further studies to test the applicability and potential clinical benefits associated with MFM2 (and other AT programs) are now needed. With this case report, our intention was to introduce an original and accessible add-on auditory stimulation program that can enhance the lives of individuals who are experiencing depressive symptoms.

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