



# Reaching the mind through Zen music; Case studies

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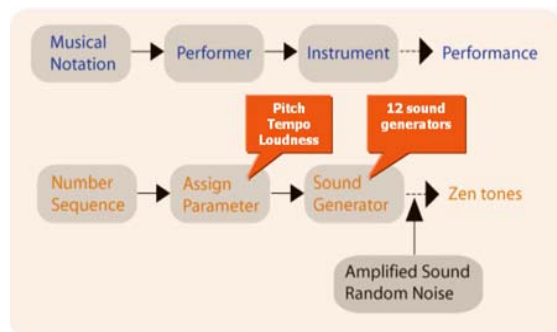


## INTRODUCTION

### Background

Stress may be the number one health problem in the United States (AIS online). Hearing impaired individuals are no exception. Indeed, they may experience even greater stress as a consequence of communication difficulties. While the use of hearing aids can address communication stress there may be more that hearing aids can do to improve on quality of life. A survey conducted by *The New York Times* in 2000 showed that 64% of the general population listened to music to relax and 8% participated in meditation or yoga classes. Accompanying the practice of relaxation techniques is the inclusion of calm, soothing music. The ability of music to relax listeners is one of its great appeals. By providing hearing impaired patients with tools to enhance their musical/relaxation experiences professionals can enhance the quality of care provided to patients. In the current study participants were fit with hearing aids which generated music using fractal algorithms. Experiences of individuals' trials are reported here in order to evaluate the effectiveness of applying Zen music to everyday life.

Figure 1: Sequence of events leading to live music (blue) and Zen tones (orange).



### Creation of fractal tones

To produce the music the fractal generator produces a numerical output. The numbers in the output represent various parameters including pitch, intensity level, and duration between tones. The numerical sequence is delivered to a sound generator in the hearing aid to interpret which parameters are to be met in the output. Twelve sound generators are present in the hearing aid to speed up this process (Figure 1). Zen music played at a normal tempo will activate four generators. Faster tempos will activate more sound generators (Table 1). When the hearing aid microphones are requested to be 'on' the amplified sound is mixed with the musical tones from the sound generator.

Table 1: Parameters of the four fractal music styles evaluated by participants.

Music styles	Tonality		Dynamics		Tempo		Pitch
	Major	Minor	Restricted	Broad	Slow to moderate	Moderate to fast	Reverberant high frequencies
Aqua	Major	Minor	Restricted	Broad	Slow to moderate	Moderate to fast	Reverberant high frequencies
Coral	Major	Minor	Restricted	Broad	Slow to moderate	Moderate to fast	Reverberant high frequencies
Lavender	Major	Minor	Restricted	Broad	Slow to moderate	Moderate to fast	Reverberant high frequencies
Green	Major	Minor	Restricted	Broad	Slow to moderate	Moderate to fast	Reverberant high frequencies

## METHODS

### Study hearing aids

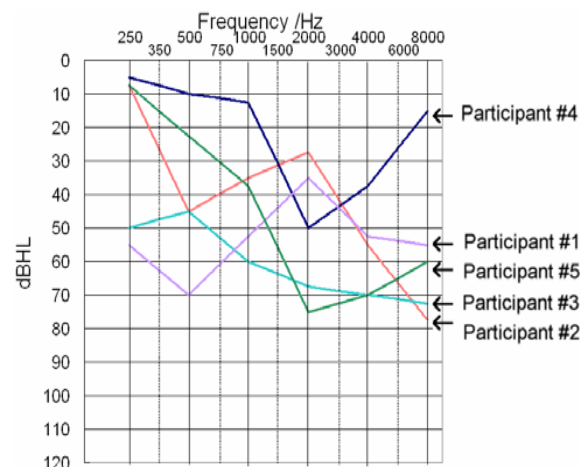
- mind440 hearing aid in a micro-size (M4-m) behind-the-ear (BTE) model
- 15-channel wide dynamic range compression
  - Compression threshold as low as 0 dB HL
  - 15-channel fully adaptive directional microphone
  - Speech intelligibility index (SII) based noise reduction
  - Active feedback cancellation
    - These features were activated during take-home trials.
- Contains the Zen listening program options

### Case study participants

Five participants ages 52 to 80 yrs are included in this report (Table 2).

- Varying degrees of hearing losses
- 3 were experienced hearing aid wearers

Figure 2: Audiograms of each of the five participants.



### Procedures

- Study hearing aids were worn for 6 months
- Each participant initially listened each of the four default Zen styles
  - Preferred Zen style and parameters were determined individually (Table 3)
    - Participants were able to switch styles at any point during the study
  - Two Zen listening programs were provided for take-home use (in addition to the primary adaptive listening program)
    - Zen with HA microphones (Zen + mic)
    - Zen without HA microphones (Zen only)
  - Participants were asked to log the use of the Zen programs including notes on the situation and effectiveness (Table 4).
  - Participants were asked to partake in a 15-30 minute relaxation exercise each day while focusing on the Zen music (Table 5).
    - Each person logged the date, program used, length of relaxation session, and outcome.
  - Periodic visits to the lab were conducted in which participants responded to questions about relaxation and overall experience (Table 6).

## RESULTS

Table 2: Participant profiles.

Participant	Experienced HA wearer?	Profile	
		Occupation	Considerations
1	Yes	Retired	Multiple sclerosis (MS)
2	HA research	Educator	Attention Deficit Hyperactivity Disorder (ADHD)
3	No	Sales	-
4	No	School administration	Experienced knee surgery during the study
5	Yes	Educator	Experienced a surge in arthritis during the study

Table 3: Zen styles and parameters selected for take-home trials by each participant.

Participant	Zen style	Pitch	Tempo	Volume
1	Green	Medium-Low	Medium	7
1 (mid study)	Coral	Medium-High	Medium	8
2	Aqua	Low	Fast	12
3	Aqua	Medium-Low	Slow	10
4	Aqua	Low	Slow	13
5	Green	High	Fast	5

Table 4: List of situations in which participants found Zen to successfully and unsuccessfully manage stress.

Participant	Situations	
	Zen was helpful	Zen was not helpful
1	Driving/riding in the car Lunch with friends Reading the newspaper Sewing Watching T.V.	In a restaurant Noisy open area Shopping
2	Completing tasks	N/A (Only used Zen programs)
3	Driving between home and work General daily stress On the computer Reading the newspaper Sleep Sitting in the car	Noisy open area Watching T.V. Work break/Lunch
4	Chores Completing tasks (like creating a schedule) Driving in traffic or construction Expressway driving Sleep Waiting for an appointment Work related anxiety	Conversing on the phone Talking in a group Watching T.V.
5	Doctor's appointment Serving as a reader at worship Sleep Spending time with in-laws	Talking in a group

## RESULTS (cont.)

Table 5: Responses to questions pertaining to the application of Zen for relaxation at each visit.

Participant	Which is the most relaxing Zen?			How long did each relaxation exercise last (min)?			How would you describe your mood after relaxation exercises?		
	1 month and 6 hrs	3 months and 6 hrs	6 months and 6 hrs	1 month and 6 hrs	3 months and 6 hrs	6 months and 6 hrs	1 month and 6 hrs	3 months and 6 hrs	6 months and 6 hrs
1	Zen only	Zen only	Zen + Mic	15	15	15	Indifferent	Somewhat relaxed	Somewhat relaxed, ready to contend with the rest of the day
2	Zen only	-	-	20	-	-	I was contented and felt more peaceful.	-	-
3	Zen + Mic	Zen + Mic	Zen + Mic	20	15	20	Maybe a little less stressed or more relaxed	Ready to go to sleep or back to activities; rejuvenated	Same as before, no change of mood
4	Zen only	Zen + Mic	Zen + Mic	15	15	15	Neutral	Neutral, okay	Neutral
5	Zen + Mic	Zen + Mic	Zen + Mic	30	30	15	Relaxed	Depressed on what I was going to do next, and it was done.	Sort of relaxed, sleepy, lazy

Table 6: Comments on Zen experiences from each participant.

Participant	Zen comments and experiences
1	1. Often used the Zen alone as a more pleasant mute option in noisy environments 2. Found the Zen to be helpful when reading the paper in the morning and has made this part of the daily ritual
2	1. Zen sounds were reportedly soothing and reduced anxiety 2. Contributed to relaxation and improved concentration
3	1. Found that using the Zen in a noisy work environment only adds to the noise and distractions 2. Uses the Zen at the end of the day when preparing for bed and finds this to be relaxing and helpful
4	1. Effectiveness of the Zen for relaxation appeared to vary
5	1. Mixed experiences with Zen and gave the general impression that it was "fine," neither good nor bad 2. Found Zen to aid with sleep when woken in the middle of the night for unusual reasons (CO2 alarm, pain, etc.)

## DISCUSSION

Zen music programs were reported to be effectively relaxing for many situations including work stress, household chores, distraction from pain, minor emergency situations, and inability to fall enough to fall asleep. Of the five participants in the study three were consistently happy with the relaxing qualities of the Zen music from the hearing aids. In general, the reaction to Zen appeared to vary between individuals.

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