

Review article:
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THE ZEN PROGRAM FROM WIDEX

A new tool for relaxation, concentration and attention diversion for hearing aid users

Abstract

Increased levels of stress are more frequent in the hearing-impaired population than in normal-hearing people. Because of the high frequency of stress in the hearing-impaired population and the ability of music to reduce stress, Widex has included a feature in the high end mind440 hearing aid which allows users to listen to a choice of different music styles.

Generally researchers agree that music can affect the ability to perform specific tasks by masking unwanted and disturbing noise. The positive emotional and psychological effects of music are also well documented in the literature, with most researchers agreeing that music can reduce stress and make people feel more relaxed, comfortable and less anxious. However, the music must be simple, instrumental, non-repetitive and without lyrics to produce these effects. Inspired by this knowledge, Widex has developed the Zen™ program – a harmonic sound program based on fractal technology offering a choice of soothing tones and chimes.

Two studies have examined the Zen styles' potential for enhancing relaxation and concentration in hearing-impaired listeners. The results suggest that the Zen styles may be helpful to a large portion of the hearing-impaired population.

Music or broadband noise may also be used in combination with counselling to manage tinnitus. A broadband noise has therefore been included in the Zen program as an additional tool for tinnitus management in combination with counselling.

Stress-related consequences of hearing loss

Studies have shown that hearing loss very often has a negative impact on a person's physical and emotional well-being (e.g., Dalton et al., 2003; Fellingner et al. 2007). Reactions vary from person to person, but many hearing-impaired people experience some social, psychological and physical challenges as a result of their hearing loss. Social consequences of hearing loss may for instance involve avoiding certain people or situations. Psychological consequences may include embarrassment, problems concentrating, anxiety, low self-esteem and insecurity. Negative physical consequences may include tiredness or exhaustion, headache, muscle tension, sleeping problems, and increased stress levels, to mention just a few.

The increased stress levels resulting from extra energy spent on listening by people with hearing loss have inspired Widex to develop a new feature for relaxation and concentration. The feature, which is included in the mind440 hearing aid, exploits the potential of music to enhance relaxation and concentration in humans.

The effect of music on the ability to relax

If we take a look at how music has been used for relaxation purposes throughout history, we find that music's ability to affect people in a relaxing manner has been known for thousands of years.

In several classical cultures, music has played an important role in the treatment of illnesses. We know that ancient Greeks used music to heal, and in Arab culture, stringed instrument music, combined with the sound of water from fountains, was an essential part of the environment in hospitals and therapeutic centres (Mornhinweg, 1992; Musica Humana, 2007).

In modern medical science, where focus has been on accuracy and measurability, this knowledge has been practically forgotten, and it is therefore a relatively new initiative that hospitals and researchers in various parts of the world have started doing tests with music to document music's effect on human beings. Especially the psychological effects of music have been widely studied, with several positive outcomes. Studies have shown that relaxing music has the ability to affect the unconscious part of our system, reducing breathing rate, heart rhythm, chronic stress and blood pressure. Some of these studies have even shown that the effect of music on the ability to relax is higher than the effect of complete silence (e.g., Khalifa et al., 2003; Scheufele, 2000).

There is now general agreement among researchers that music has the ability to affect people psychologically, making them feel more at ease, more relaxed and less anxious (e.g., Hanser, 1985; Staum, 2000). Some studies conducted at hospitals have also shown that the use of music decreased the amount of stress patients experienced when hospitalised and the amount of pain-killing medicine needed (Musica Humana, 2007).

THE ABILITY OF MUSIC TO IMPROVE CONCENTRATION

Music's ability to improve concentration has also been an object of study. One area of focus has been the effect of background noise on the performance in different cognitive tasks. Not unexpectedly, noise has turned out to be a source of stress and negatively affect concentration and productivity (Furnham & Strbac, 2002). This finding has been especially interesting for companies with open-plan offices, as the biggest advantage of this setup – i.e. the possibility of free communication – has also turned out to be the biggest disadvantage. Several initiatives have been introduced to overcome this problem and enhance productivity and the ability to concentrate in such environments, including rearrange-

ment of furniture, white noise masking and the use of background music (Loewen & Sudfeld, 1992; Furnham & Strbac 2002; Banbury & Berry, 1998; 2005).

Important musical components - relaxation

Despite the fact that it is individual whether a piece of music is relaxing or not, there are some musical components that seem to be decisive. One of these is the basic rhythm - a fast basic rhythm seems to result in a faster heart rhythm and pulse rate, and a slow basic rhythm in a slower heart rhythm and pulse rate. Besides that, there are indications that volume and intensity may have the same effect, i.e., a higher volume generally results in a faster heart rhythm. Not all studies have found this to be the case, however. The discrepancies may be due to a personality factor. Studies have shown that extroverts prefer and are able to handle larger amounts of auditory stimuli than introverts and prefer a higher volume level than introverts (Daoussis & McKelvie, 1986).

The same fundamental considerations that apply to heart rhythm seem to apply to breathing rate. A slow musical rhythm seems to produce calmness and relaxation, while a faster rhythm may result in stress and anxiety. Furthermore, the breathing pattern seems to be directly influenced by the emotional content of the music, so that pieces of music evoking strong feelings and emotions may lead to large variations in the respiratory pattern (Myskja, 1999).

Important musical components - concentration

The effect of background music on the performance of different tasks has been the subject of many studies. Type of music is a factor that seems to be relevant in relation to music's ability to facilitate concentration in a noisy environment. The literature reports that soothing music, rock music and classical music are all types of music that in some way can influence a person's ability to concentrate on a specific task. Researchers have tried to determine whether the complexity of music is a possible factor. For example, Kiger (1989) concluded that scores on a reading comprehension test were higher under conditions with low-information music than with silence or high-information music (Kiger, 1989, cited in Furnham & Strbac, 2002).

Another factor that seems to be of importance if music is to facilitate concentration is level of arousal and personality. Some studies have shown that using preferred music as background sound will enhance task performance. With this starting point, several researchers have investigated the influence of background music on different personality types' ability to concentrate. Several arrived at the same result, namely that listening to background music with low information load will often enhance concentration on a task, although the way mu-

sic will influence the listener differs with personality and preference for type of music. More specifically, background music can be distracting for introverts as their optimal arousal level is quickly exceeded, whereas it is stimulating for extroverts (Daoussis & McKelvie, 1986; Furnham & Bradley, 1997; Furnham & Strbac, 2002).

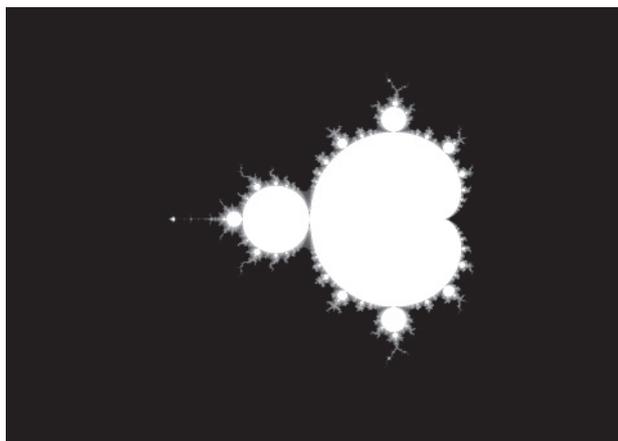
Reviewing the literature it does seem that music has the potential of facilitating concentration when presented in the right way to the listener. Many studies have shown that if the music is relaxing, it will produce results in the area of concentration and task performance. To facilitate concentration it seems that the information load of the music should be low. Furthermore, being able to adjust the volume and individualise the music to meet the listener's individual preferences appear to be important factors too.

THE WIDEX ZEN™ PROGRAM

In the Widex Zen™ program, we have tried to accommodate as many of the above-mentioned factors as possible.

Concentration seems to improve if the information load of the music is low. Moreover, the listeners should ideally be able to adjust the volume and individualise the music to meet their own musical preferences too.

For relaxation to be obtained, the basic rhythm should probably be relatively slow, and elements evoking strong emotions in the listener should be avoided. Adjustable volume is also important to accommodate the many individual preferences, and the listener should be given a choice of different styles. Besides that, it seems essential that the music is rather predictable without sudden changes.



A fractal is a shape that can be split into parts, each of which is (to a large extent) a reduced-size copy of the whole.

In the Widex Zen™ program, the music is based on fractal technology, which ensures that the music is predictable without repeating itself. The user has a choice of

“musical tones” called Zen styles, and it is possible to further individualise these by adjusting tempo and pitch of the styles. The music consists of sequences of tones with no lyrics to avoid strong emotions in the listener.

The volume can be adjusted in Compass or by using the volume control on the hearing aid. Furthermore the Zen™ program includes a setting where the microphone sound is deactivated and only the Zen tones are played. To make sure that the Zen tones are audible at all times the Zen™ program takes the individual hearing loss and the background noise into consideration when generating the fractal music.

STUDIES EVALUATING THE ZEN STYLES' POTENTIAL FOR FACILITATING RELAXATION AND CONCENTRATION IN HEARING AID USERS

The efficacy of the Zen tones in helping hearing aid users concentrate and relax has been evaluated in several studies.

In a clinical field trial conducted by Widex' Applied Research Team, 32 subjects with varying degrees of hearing loss (Clinical field trial #33-07. Data on file), ranging from mild to profound, tested three Zen styles (Aqua, Coral and Lavender) for an average of 18 days. The subjects reported their overall impression of the Zen styles using a 0 to 10 point scale with 0 being “very bad” and 10 being “very good”.

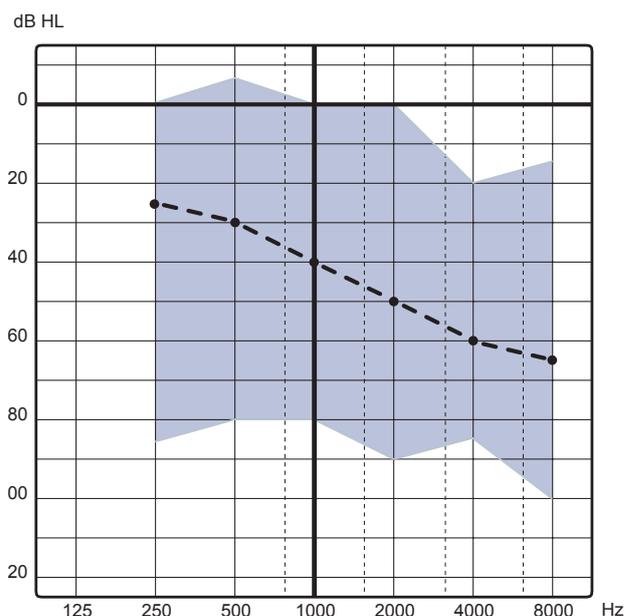


Figure 1. Average audiogram of the 32 subjects that participated in the clinical field trial conducted by Widex' Applied Research Team (black dotted line). The shaded area indicates the minimum and maximum hearing threshold levels for the subjects.

As many as 85% of the subjects scored the Zen styles in the middle of the scale or upwards. 44% rated them as either “good” or “very good”. Only 15.5% rated them as “bad” or “very bad”. These results suggest that the Zen styles may be used for relaxation by a large portion of the hearing-impaired population.

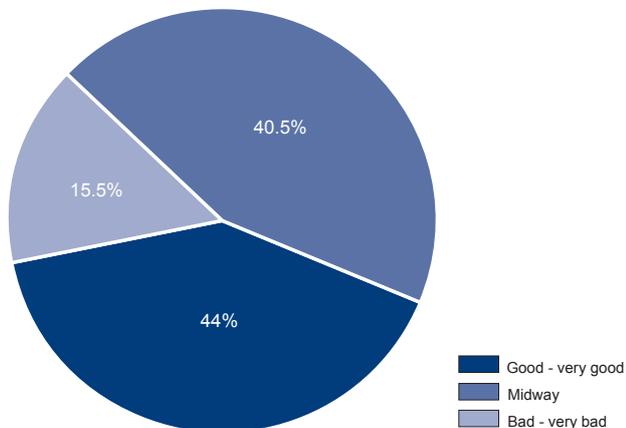


Figure 2. Overall evaluation of three Zen styles by 32 subjects.

Further support for this was found in Kuk & Peeters’ (2008) study. Kuk and Peeters investigated the Zen styles’ potential for helping hearing aid users concentrate and relax. 14 test subjects with mild to moderately severe hearing losses participated in the study. Subjects evaluated four Zen styles (Aqua, Coral, Lavender and Green). The subjects rated each of the Zen styles in terms of how relaxing they perceived it to be, using a 1-5 point scale with 1 being “very relaxing” and 5 being “very tensing”. Afterwards, the pitch and tempo of each subject’s

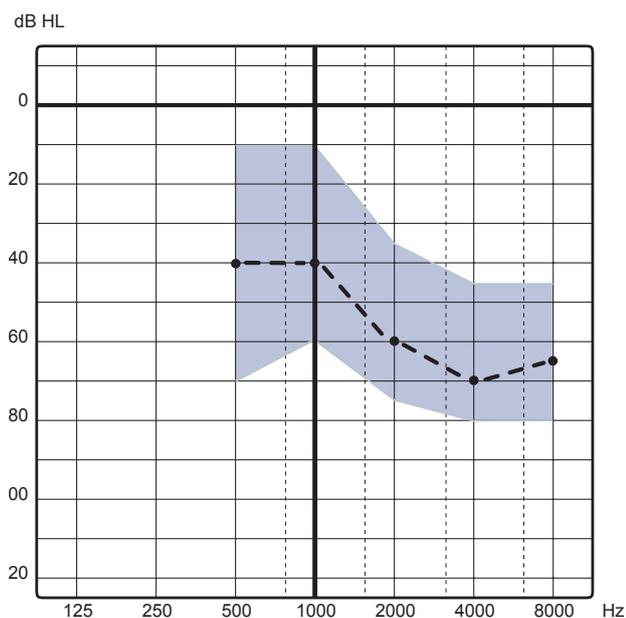


Figure 3. Average audiogram of the 14 subjects that participated in Kuk and Peeters’ (2008) study (black dotted line). The shaded area indicates the minimum and maximum hearing threshold levels for the subjects.

favourite Zen style were fine tuned to match the subject’s individual preferences. The subjects then rated this Zen style in terms of how relaxing they found it once more.

The main results are shown in figure 4 below. The majority of the subjects responded 1 “Very relaxing” or 2 “Somewhat relaxing” for all four Zen styles. This indicates that the Zen styles have the potential to function as a relaxing listening background for a large number of hearing aid users. Moreover, after fine tuning to individual preferences, 12 out of 14 subjects (86%) found their favourite Zen style to be relaxing. This emphasises the importance of being able to adjust the volume and individualise the music to meet one’s own preferences.

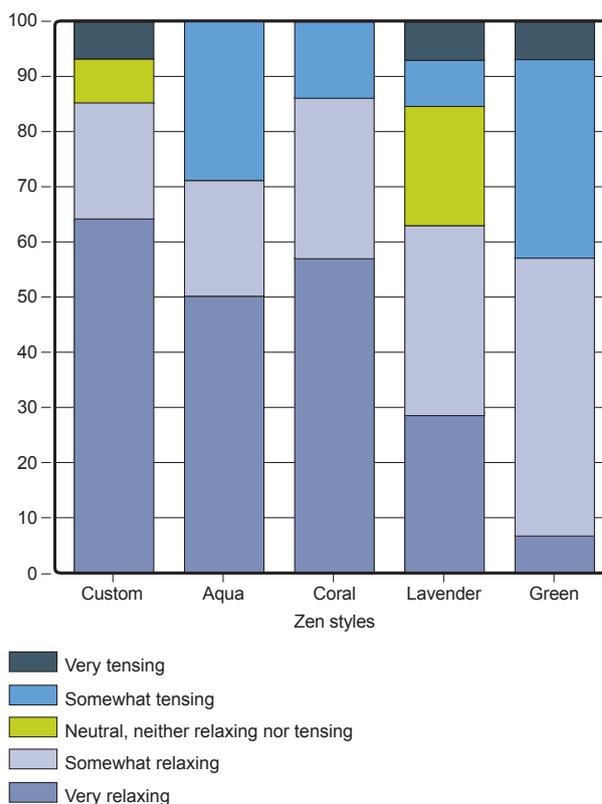


Figure 4. The percentage of subjects who reported a particular rating for the question “Does this music provide a relaxing listening background for you?”

11 subjects also participated in a concentration task to determine if the individualised Zen style would enhance concentration. The subjects performed a concentration grid task where they had to eliminate as many numbers as possible starting from 00 and ending with 99 from a 10x10 block with randomised numbers. The concentration task was repeated with the hearing aid microphone only (Zen off) and the hearing aid microphone + Zen (Zen on). The task was carried out in both quiet and in a broadband noise condition. The results showed that significantly more numbers were identified correctly when the Zen style was active than when it was deactivated ($p < 0.01$). This indicates that the Zen styles may

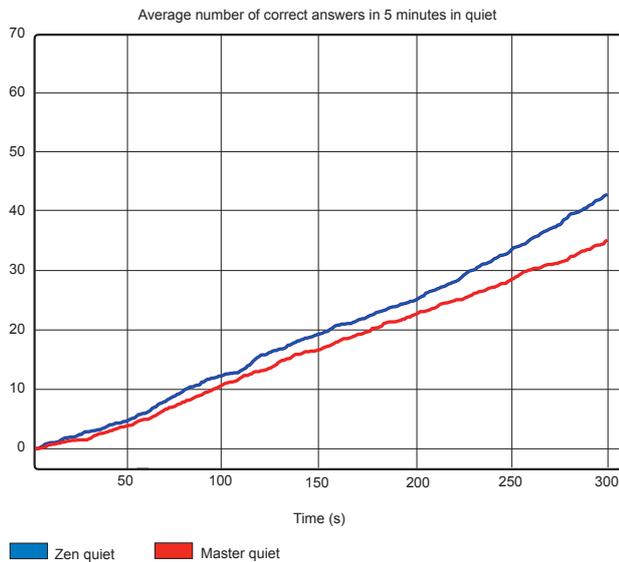


Figure 5. The average number of correctly identified numbers in quiet in the concentration task for the master (red line) and Zen programs (blue line). Adapted from Kuk & Peeters, 2008.

also enhance concentration. The average results in quiet and in noise are shown in the figures below. They are almost identical.

Using music for tinnitus management

A large proportion of people with hearing loss also suffer from tinnitus (Davis & Refaie, 2000). Tinnitus is the perception of sound in the ears or head where no external source is present. It is estimated that 10-15% of the adult population suffer from chronic tinnitus (Hoffman & Reed, 2004). The percentage is estimated to be somewhat higher in hearing-impaired people (Davies & Refaie, 2000).

The impact of tinnitus on a person's life can vary enormously. For some people, tinnitus is only a mild irritation. For others, tinnitus can be downright debilitating, disrupting sleep, family relationships, and their ability to work and concentrate. People with severe tinnitus often have problems sleeping. As a result, they may be irritable and cannot concentrate on anything apart from their tinnitus. They are constantly under stress, perform poorly, and have a low quality of life (McKenna, 2000; Erlandsson, 2000).

The precise mechanisms behind tinnitus are unknown. Presently, therefore, the only option for the majority of people who suffer from tinnitus is to learn certain management techniques which may relieve the stress that their tinnitus creates¹.

Tinnitus management usually involves a combination of counselling, stress reduction, and/or sound therapy. The sound-based component in tinnitus management can have three objectives: 1) producing a sense of relief from the tinnitus-related stress and tension; 2) passively

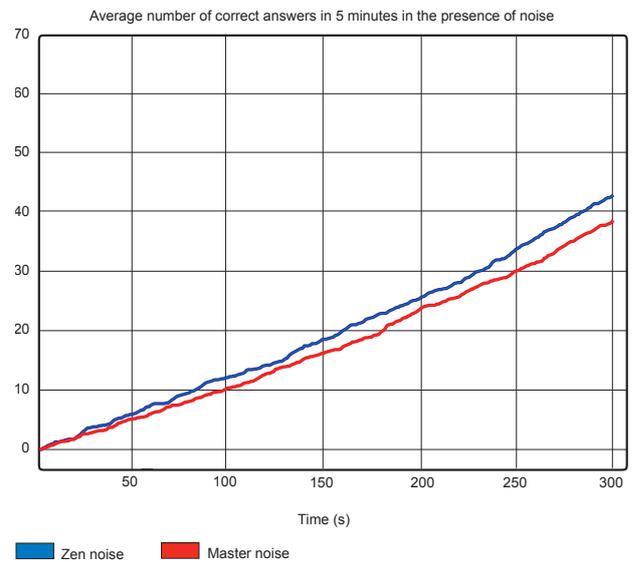


Figure 6. The average number of correctly identified numbers in noise in the concentration task for the master (red line) and Zen programs (blue line). Adapted from Kuk & Peeters, 2008.

diverting attention away from the tinnitus by minimising the contrast between the tinnitus and the surrounding sound environment, and 3) actively diverting attention away from the tinnitus. Each of these three objectives can be achieved by means of music as well as broadband noise (Henry et al., 2008).

Two highly recognised and widely used sound-based methods are Tinnitus Masking and Tinnitus Retraining Therapy (Henry et al., 2008). What these methods have in common is that they involve a shift of attention away from the tinnitus by means of a sound source.

In spite of the term *masking*, Tinnitus Masking is not a method which aims at disguising, or masking the tinnitus. Rather, Tinnitus Masking aims to provide a sense of relief from tinnitus-related tension and stress by means of a soothing stimulus (Vernon & Meikle, 2000). Commonly used stimuli include instrumental music and broadband or filtered noise.

Music and broadband noise are also used in Tinnitus Retraining Therapy. However, unlike Tinnitus Masking, Tinnitus Retraining Therapy does not aim at providing a sense of relief. With Tinnitus Retraining Therapy, focus is on reducing the contrast between the tinnitus and the acoustic environment, so that the tinnitus is less likely to attract attention. Instrumental music with no lyrics and broadband noise are also recommended for this tinnitus management method (Henry et al., 2008).

¹Surgical intervention and medications are also used for tinnitus management. However, as pointed out by Henry et al. (2008: 188), these methods have not proved particularly successful in eliminating tinnitus perception on a large scale.

Tools for sound-based tinnitus management must be flexible to accommodate variations in individual preferences and circumstances. People can respond very differently to the same sound stimuli; a sound which is perceived as pleasant and interesting by one person may be perceived as boring and annoying by another. Moreover, varying circumstances may require different approaches to managing the tinnitus. For example, people who work in a quiet office environment may be troubled by tinnitus during the day, while people who work in a noisy workshop may only be bothered by tinnitus after work (Henry et al., 2008).

To accommodate the large variations in individual preferences and circumstances, a choice of five pre-defined Zen styles, each with its own pitch, tempo and intensity, are available for mind440 hearing aids. The volume, tempo and pitch of the individual Zen styles can be adjusted by the dispenser to optimise it to the individual preferences of the client. Furthermore, a broadband noise is also available in the Zen program as an additional tool for tinnitus management in combination with counselling.

Conclusion

Stress is reportedly more frequent in hearing-impaired people than in the normal-hearing population. Because of the high occurrence of stress in people with hearing loss, Widex has included the Zen program, which permits hearing aid users to listen to a choice of different music styles, in the mind440 hearing aid. Studies have shown that music can reduce stress and enhance concentration. But the music must be simple, instrumental, non-repetitive and without lyrics. The Zen styles from Widex meet all those requirements. Two studies have examined the Zen styles' potential for enhancing relaxation and concentration in hearing-impaired people. The results of both these studies suggest that the Zen styles may be helpful to a large portion of the hearing-impaired population. Instrumental music or broadband noise may also be used in combination with counselling to manage tinnitus. A broadband noise has therefore been included in the Zen program to be used by dispensers in combination with counselling if they wish.

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