Published in final edited form as:

J Nerv Ment Dis. 2018 December ; 206(12): 968–970. doi:10.1097/NMD.0000000000000911.

How music impacts visual attention training in schizophrenia: A pilot study

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Abstract

Music has been demonstrated to improve cognitive test performance in neuropsychiatric populations. However, the impact of music on cognitive training effects, and the importance of music preference, has yet to be studied. This is an essential oversight since many cognitive training programs play music in the background. We sought to determine if participant-preferred or random music would increase the efficacy of computer-based attention training (AT). Forty-eight patients with schizophrenia were randomly assigned to two weeks of either: (a) AT with participants' choice of background music, (b) AT with random background music, (c) AT without music, or (d) a no training or music control—watching videos without AT or music. All groups except the no training/no music control group demonstrated improvement in reaction time and response accuracy after training, with those participating in AT with their choice of music exhibiting greater gains than either of the other two AT groups. These findings suggest that complimenting AT with music, and allowing participants to choose the music, may increase the efficacy of AT.

Keywords

Cognitive training; schizophrenia; music therapy

Introduction

Previous research has shown that playing background music (herein referred to as music therapy) provides a wide variety of benefits to non-psychiatric populations. In healthy controls, music therapy has been shown to improve reaction time on tests of attention (Chraif et al. 2013; Robb, 2003; Turner et al. 1996; Lesiuk 2010). Music therapy has also been demonstrated to reduce stress and improve mood and working memory in individuals with medical disorders (Tumuluri et al. 2017).

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In individuals with psychological disorders, music therapy has also been shown to have beneficial effects. Music therapy has been widely used to improve mood and alleviate anxiety and other psychiatric symptoms in patients with neuropsychiatric conditions such as dementia and schizophrenia (SCZ) (Bruer et al., 2007; Chang et al., 2015). In people with SCZ, listening to music playing in the background has been shown to improve performance on tests of attention (Tseng et al., 2015). There is also some data to suggest that in people with SCZ, popular music might have greater benefits than non-popular music. For example, in a 2015 study of adults with psychosis, Shih and colleagues found that the group that listened to popular music, which was generally preferred over classical music, performed better on an attention test than the group that listened to classical music.

For people with SCZ, a condition characterized by significant cognitive impairments (Ahmed et al., 2018; Smith et al., 2014; Ventura et al., 2015), background music has become a common supplement to cognitive training interventions, which are behavioral treatments aimed at remediating impairments in attention, memory, and executive function. To date, however, there have been no studies examining whether background music enhances the efficacy of cognitive training in this population, nor whether background music enhances performance on cognitive tasks. There is also no research examining whether the reported superior benefit of popular music is due to it being preferred by the participant or to some other factors inherent to this type of music. These gaps in the literature are important to address, since random music is played in the background during many cognitive training programs, and since clinicians and researchers alike are striving to tailor cognitive training interventions to maximize their beneficial effects.

Given the above, we conducted a study investigating whether a participant-chosen genre or random genre of supplemental background music would increase the magnitude of cognitive improvement following computer-based visual attention training (AT), a type of cognitive training focused on improving the ability to stay focused and react quickly to visual stimuli. We hypothesized that compared to a group undergoing AT without supplemental music, adults with SCZ who listen to any music while doing AT would demonstrate greater improvements from the AT, as indicated by faster reaction times and greater response accuracy post-training. We further hypothesized that improvements demonstrated by individuals who were allowed to choose the genre of the supplemental music that played while working on AT would be greater than the improvements demonstrated by individuals for whom a random genre of music was selected.

Methods

Participants

Participants were 48 outpatients diagnosed with schizophrenia or schizoaffective disorder, aged 18–55, recruited from the intensive outpatient Schizophrenia Rehabilitation Program at The Institute of Living in Hartford, CT. Data was collected from August 2016 to August 2017. Prior to enrollment in the study, participants had to be psychiatrically stable for at least 30 days on their psychotropic medication. Diagnosis of schizophrenia or schizoaffective disorder was confirmed by the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-IV; First et al., 1997). Any participants with significant auditory/

visual impairment, lack of fluency in English or medical illnesses known to impair brain function (other than schizophrenia), were excluded. Participants who met criteria for current substance abuse/dependence were also excluded, as were those who had active substance abuse within the 30 days prior to joining the study.

Procedures

Following baseline assessment, participants were randomly assigned to one of four groups: (a) Music choice during attention training (MC+AT), (b) Music random during attention training (MR+AT), (c) No music during attention training (NM+AT), and (d) a no music and no attention training control. Participants in the music choice (MC+AT) group were given the choice of genre (not artist or song) of music playing in the background while working on AT. Participants in the music random (MR+AT) group listened to a randomly selected music genre during AT. Participants in the no music (NM+AT) group did not listen to any music while working on AT, and participants in the no music/no AT control group watched videos on YouTube for the same duration as the AT training period. Each music genre (pop, rock and roll, jazz, folk, new age, blues, classical, country, reggae and techno) had a song preselected that would be played for all participants listening to that genre. All preselected songs had no lyrics.

AT consisted of Choice Visual Reaction tasks, as provided by the NeuropsychOnline Choice Visual Reaction Module. Patients were instructed to focus on the center of a colored circle in the middle of the screen, and pay attention to a colored border on the outside edge of the screen; periodically, a colored square would appear somewhere on the screen, and the patients were instructed to click the computer mouse if and only if the colored square was the same color as the outside border. Each AT session was 15 minutes, and occurred twice a week for two weeks, totaling 60 minutes of AT over four sessions.

Measures

Assessments were conducted prior to the AT training (or control period), and immediately thereafter. Attention was assessed using the Continuous Performance Test-Identical Pairs (CPT-IP; Cornblatt et al., 1988). Proximal AT training outcome measures were quantified by performance on the Choice Visual Reaction Task on NeuropsychOnline (Bracy, 1995), which recorded reaction time (ms) and response accuracy (number of errors). Baseline and post performances were measured as the average reaction time and errors from the first three trials on the Choice Visual Reaction Task where no music was played. All participants were assessed at baseline and post-treatment, including the no music/no AT control who were post-tested 2 weeks after their baseline.

Data Analysis

The distribution of scores for each variable in each group was inspected for normality and compared to relevant comparison groups for homogeneity of variance. When these conditions were not met, we also ran non-parametric tests, but since in no instances did the results of parametric measures differ from those of non-parametric tests, the results from parametric tests for all measure are reported. To ensure that the four experimental groups

were similar on baseline demographic and clinical variables, we compared these baseline variables across the four groups via one-way analyses of variance (ANOVA).

To assess the impact of music on AT, we computed the change in scores from pre- to post-training for each participant on the CPT-IP, as well as the Choice Visual Reaction task measuring reaction time and number of errors. We then entered these change scores into three one-way ANOVAs, one for CPT-IP, another for reaction time, and one for errors, with experimental condition as the between-subjects variable. When significant effects were evident in ANOVA, Tukey's HSD test was conducted for pairwise comparisons. All statistical tests were two-tailed and alpha was set at .05.

Results

Demographic information and clinical characteristics of each group are summarized in Table 1. There were no significant group differences in demographic or clinical characteristics, including attentional ability at baseline. There were also no significant group differences in baseline reaction time or number of errors. All participants randomized to AT completed all four of the relatively brief training sessions.

As shown in Figure 1, while all three AT groups improved reaction time ($p's < .037$) from pre to post with the no music/no AT control group showing a trend toward improvement ($p = .058$), the one-way ANOVA for change in average reaction time revealed a group by time interaction ($F[2, 42] = 14.09, p < .003$) with music choice+AT producing greater improvement in reaction time relative to the other three conditions. A similar effect was seen in response accuracy (Figure 2). While music random+AT and no music+AT made fewer errors from pre to post than the control group ($p's < .041$), music choice+AT produced a greater reduction in errors relative to the random music and no music AT groups ($F[2, 42] = 6.63-8.14, p < .013$). The no music/no AT control showed no improvement in errors. There was no change in attentional ability on the CPT-IP in any of the groups ($p's > .205$).

Discussion

All groups demonstrated improvement in reaction time and response accuracy after AT, with those participating in AT with a choice of music exhibiting greater gains than the other AT groups. Given that these results were found in the context of no change in cognitive performance in a no treatment control group, these results suggest that visual AT for people with psychosis can be more effective when participants are allowed to choose the genre of music. That is, the benefits of music during AT may be related to participant affinity for the music playing, rather than just the presence of the music in the background.

There are several potential explanations for the observed patterns in our findings. It is possible that when participants listened to music they preferred, it improved their mood and energy level, causing greater improvement during the AT. It is also possible that some participants who were assigned a genre of music found the music a distraction and it interfered with their concentration. There is also a possibility that the ability to choose a genre of music, rather than the actual music itself, empowered participants and motivated them to engage more in their AT. Finally, it is also possible that preferred music may also

help patients to focus on visual stimuli by blocking auditory distractions; the elimination of such distractions could in turn greatly increase their ability to parse visual stimuli, because their auditory attention may be focused on the music, instead of being drawn away by auditory hallucinations or general noises in the testing environment. It is also worthwhile to note that random music playing in the background did not offer any advantages compared to when no music was played, thus suggesting that playing random music may not add anything meaningful to a cognitive training program.

This study was limited by a small sample size and a brief attention training period. Most attention training programs for individuals with psychosis consist of training for ten or more hours, while the training period for this study was only one hour in total. Nevertheless, these pilot results are important and suggest that preferred music may enhance the efficacy of cognitive rehabilitation for psychiatric populations. Further research is needed to test the impact of preferred music in a comprehensive attention training program, as well as with other types of cognitive remediation, such as memory training.

Conclusions

This study found that when supplemental music of a genre chosen by the patient was played in the background during visual attention training, patients experienced significantly greater improvements in reaction time and response accuracy than when they underwent the same attention training with a random genre of music playing in the background or no supplemental music.

Acknowledgments

Conflicts of Interest and Source of Funding: Funded in part by a NIMH K23MH086755 to Dr. Choi. No conflicts of interest declared.

References

- Ahmed AO, Strauss GP, Buchanan RW, Kirkpatrick B, & Carpenter WT, 2018 Schizophrenia heterogeneity revisited: Clinical, cognitive, and psychosocial correlates of statistically-derived negative symptoms subgroups. *J Psychiatr Res.* 97, 8–15. [PubMed: 29156414]
- Bracy O, 1995 PSS CogRehab, Version 95. Indianapolis, IN: Psychological Software Services, Inc.
- Bruer R, Spitznagel E, Cloninger C, 2007 The temporal limits of cognitive change from music therapy in elderly persons with dementia or dementia-like cognitive impairment: a randomized controlled trial. *J Music Ther.* 44(4), 308–328. [PubMed: 17997623]
- Chang Y, Chu H, Yang C, Tsai J, Chung M, Liao Y, ... & Chou K, 2015 The efficacy of music therapy for people with dementia: a meta-analysis of randomised controlled trials. *J Clin Nurs.* 24(23–24), 3425–3440. [PubMed: 26299594]
- Chraif M, Mitrofan L, Golu F, & Gâtej E, 2014 The influence of relaxation music on abstract visual short term memory retrieval task at young students at psychology [sic]. *Procedia Soc Behav Sci.* 127, 852–857.
- First MB, Spitzer RL, Gibbon MWJB, & Williams JB, 1995 Structured clinical interview for DSM-IV axis I disorders. New York: New York State Psychiatric Institute.
- Lesiuk T, 2010 The effect of preferred music on mood and performance in a high-cognitive demand occupation. *J Music Ther.* 47(2), 137–154. [PubMed: 21141770]
- Shih Y, Chen C, Chiang H, & Liu C, 2015 Influence of background music on work attention in clients with chronic schizophrenia. *Work.* 51(1), 153–158. [PubMed: 24594536]

- Smith MJ, Schroeder MP, Abram SV, Goldman MB, Parrish TB, Wang X, & Csernansky JG, 2014 Alterations in brain activation during cognitive empathy are related to social functioning in schizophrenia. *Schizophr. Bull* 41(1), 211–222. [PubMed: 24583906]
- Tseng P, Chen Y, Lin P, Tu K, Wang H, Cheng Y, & Wu C, 2016 Significant treatment effect of adjunct music therapy to standardize treatment on the positive, negative, and mood symptoms of schizophrenic patients: a meta-analysis. *BMC Psychiatry*. 16(16).
- Tumuluri I, Hegde S, & Nagendra H, 2017 Effectiveness of music therapy on focused attention, working memory and stress in type 2 diabetes: an exploratory study. *Int J Yoga*. 10(3), 167–170. [PubMed: 29422748]
- Turner M, Fernandez J, & Nelson K, 1996 The effect of music amplitude on the reaction to unexpected visual events. *J Gen Psychol*. 123(1), 51–62. [PubMed: 8901210]
- Ventura J, Subotnik KL, Gitlin MJ, Gretchen-Doorly D, Ered A, Villa KF, & Nuechterlein KH, 2015 Negative symptoms and functioning during the first year after a recent onset of schizophrenia and 8 years later. *Schizophr. Res* 161(2–3), 407–413. [PubMed: 25499044]

Figure 1. Average reaction time (ms) and number of errors in visual attention training between the four groups.

Figure 2.
Average number of errors in visual attention training between the four groups.

Table 1.

Demographic and clinical characteristics of the four groups.

	Music Choice + AT n=12	Music Random + AT n=14	No Music + AT n=12	No Music No AT n=10	(p value)
Age	32.14 (5.70)	33.98 (5.33)	31.26 (7.07)	32.72 (6.43)	.15
Education (yrs)	12.92 (3.87)	13.30 (2.83)	12.47 (2.33)	12.55 (3.19)	.39
Male %	58	57	54	60	.29
Duration of Illness (yrs)	9.50 (5.72)	8.98 (6.18)	9.26 (7.38)	8.88 (7.94)	.21
Attention (CPT-IP) d'	9.27 (3.10)	8.98 (2.87)	8.85 (3.52)	9.05 (2.16)	.28