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MUSIC IN A SERIAL REPETITION TASK: IS THERE PERSEVERATIVE BEHAVIOR?

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SUMMARY

Background:

This paper revisits some of the processes that contribute to the study of perseveration. In particular it investigates whether the perseverative last step in an addition task (Brugger & Gardner, 1994) occurs in normal subjects with or without a systematic musical education. The classic mathematical addition task, which requires the repetitive change of the position of digits in a calculation (1000+40+1000+30+1000+20+1000+10) was applied to music, but with an exception in the change allowed in the last move.

Material/ Methods:

The sample consisted of 40 healthy college students from northern Greece (19 men, 21 women, 18 to 27 years of age). Two music tasks were used. The first consisted of 7 measures of descending, morphologically similar note patterns, and the subjects were asked to anticipate the eighth measure. The second required the prediction of the sixth measure of a more complex, ascending and descending five-measure pattern.

Results:

For the majority of subjects and for all three tasks, regardless of the degree of creativity allowed by the instructions, there was a strong, incorrect imitative continuation of the way that subjects had previously responded to the tasks, i.e. an inappropriate maintenance of the pattern.

Conclusions:

Music has no specific response similar to the perseverative last step in the addition task, but the lack of a unique correct response does not prevent further study of this phenomenon.

Key words: mathematics, addition task, creativity

INTRODUCTION

In music, regardless of the historical period or the artistic style (baroque, classic or contemporary minimalist), rhythmical and tonic repetitive patterns seem to be dominant in the morphology of all compositions, to such an extent that it forms the impression that perseveration is inherent in the procedure of composing. Characteristic examples of this are the Beethoven's 5th symphony, Pachelbel's Canon in D and Gigue in D, and many of Bach's compositions. Explicit perseveration, as in the case of Ravel's *Boléro*, has been described in the literature as being the result of severe psychopathology in the composer (Amaducci, Grassi & Boller, 2002; Blakeslee, 2008). These articles may be viewed, however, as purely speculative; their results suggest that frontotemporal dementia could be diagnosed in this composer, without strong scientific evidence or proof. As noted above, recurrent patterns exist in many famous musical compositions whose composers are considered to have been neurologically intact at the time of composition. The obsessive insistence of a simple rhythmical pattern consisting of two bars that are repeated throughout the piece might represent a form of musical perseveration (Cybulska, 1997) that is not so much the by-product of the composer's possible mental illness at the time of composition of *Boléro*, as perhaps a fundamental element of human musical thought.

Perseveration is mainly described in behavioral neurology as one of the most striking features in patients with dementia, especially fronto-temporal lobar atrophy (Bayles, Tomoeda & Kaszniak, 1985; Neary, Snowden, Northern & Goulding, 1988; Sandson & Albert, 1987).

The APA *Dictionary of Psychology* (VandenBos, 2007) defines the term "perseveration" in neuropsychology as the inappropriate repetition of behavior that is often associated with damage to the frontal lobe of the brain. But another definition adds that this difficulty can be experienced by normal subjects as well (e.g., workers under extreme task demands), and thus it can be observed as an everyday inability to interrupt a task or to shift from one strategy or procedure to another (VandenBos, 2007).

One study that attempted to investigate perseveration in healthy students used a simple addition task that demanded a repetitive change of the position of digits in the calculation (Gardner, 1971). In the calculation process, the last step had to be different, but the majority of the normal participants (approximately 70%) failed to make the adjustment (Brugger & Gardner, 1994).

This interesting finding has been replicated with a college student population recruited from several institutions (Proios & Brugger, 2004). In this study some participants were examined with the original uncolored (black-and-white) version of the addition task, while others received a colored version (coloring the thousands) that would make the correct answer easier. Contrary to the authors' expectations, the majority of subjects failed to produce the correct response in both conditions, and particularly in the second condition.

The goal of the present experiment is to expand on the study of this phenomenon in healthy young musicians and non-musicians using both the original “5000” task and two newly composed musical tasks. The aim is not only to compare perseveration in music to perseveration in the previously studied mathematic addition task, but also to document the high frequency of perseverative responses in different tasks and under different instructions.

MATERIAL AND METHOD

Twenty non-musicians (9 women, 11 men; mean age= 21.20 years, SD= 2.72) and twenty undergraduate music students from northern Greece (12 women, 8 men; mean age= 21.95 years, SD= 2.48; mean years of music education= 12.15) participated voluntarily in the study. No subjects had current or past neurological or psychiatric disorders. The subjects were informed of the procedure for the experiment, which was similar to the initial procedure of Brugger and Gardner (1994). All subjects were tested in three tasks in a counterbalanced order in a classroom setting. Thus, for one third of the participants the first task was a replication of Brugger and Gardner’s addition task. The participants were asked to write down their responses to an addition task with Arabic numbers (1000+40+1000+30+1000+20+1000+10) presented one number at a time by a computer projector at a rate of two seconds per number. After that, the participants were tested in the second task. They saw in the same way a seven-measure music score that consisted of the following descending sequences of eighth-notes (see Fig. 1): E-D-F-E (first measure), D-C-E-D (second measure), C-B-D-C (third measure), B-A-C-B (fourth measure), A-G-B-A (fifth measure), G-F-A-G (sixth measure), F-E-G-F (seventh measure). Half of the subjects were asked simply to add the eighth measure, while the others were asked to add the eighth measure creatively. Finally, another more complex music task was given in the same visual manner, containing the following measures: C-F-D-B (first measure), B-E-C-E (second measure), A-D-B-G (third measure), G-C-A-C (fourth measure), F-B-G-E (fifth measure). Again, half of the subjects were asked simply to fill in the



Fig. 1. Simple music test 1



Fig. 2. More complex music test 2

sixth measure, while the others were asked to fill in the sixth measure creatively. For all three tasks there was no specified time limit for responses.

RESULTS

The results for the mathematic task replicated the previous findings of Brugger and Gardner (1994) and Proios and Brugger (2004). 85% of the subjects produced an incorrect answer. The predominant incorrect answer was 5000 (65%) and the mean speed for musicians and non-musicians was similar (all participants answered immediately, within a few seconds after the presentation of the slides). The answers for the eighth measure of the visually administered music task indicated a similar strong tendency towards inappropriate maintenance of behavior. The majority of the participants (38 of 40 participants) gave E-D-F-E as the only correct future continuation of the previous measures, even when the instructions gave them clearly the opportunity to give an alternative, creative response. Also, the majority of the participants, and especially the participants with music education, responded rapidly and without any hesitation in their answers.

The same thing happened for the second music task. The majority of the participants (34 of 40 participants) gave E-A-F-A as their response. Paradoxically, in this case it is clear that participants did not “take the easy way out,” as can possibly be claimed for the first music task, because of the difficulty for the non-musicians to read the notes (especially for the second task) and calculate the tone interval. The pattern consisted this time of two measures, which included tonal ascending fourths and twice descending thirds (first measure) in eighth-notes, and ascending fourths and descending third followed by ascending third (second measure). Thus the subjects had to keep in mind and group mentally

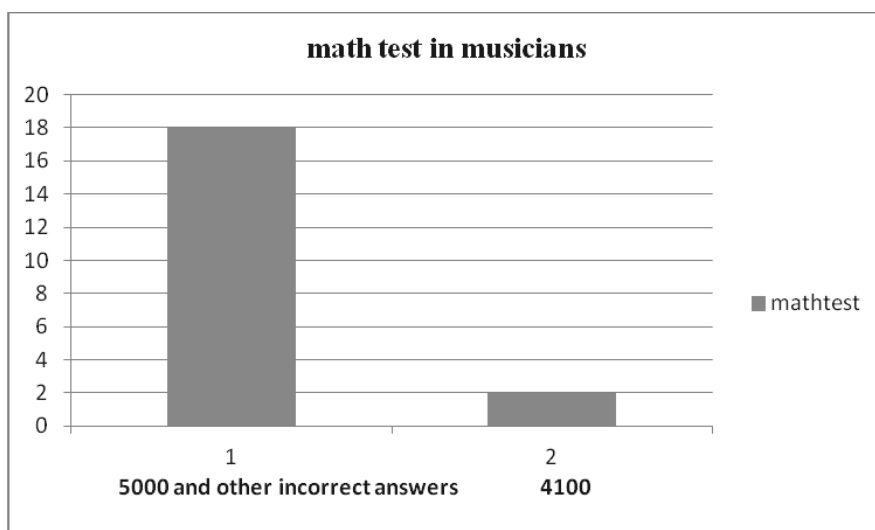


Fig. 3. The results of the math test in musicians

the first two measures, and after that apply the rule in order to give the sixth measure, a procedure that certainly has great cognitive demands and which was not necessary when creative responses were allowed and more specifically asked for. In this task the participants with music education responded with a rapidity similar to the previous task, but the majority of the non-musicians needed approximately three minutes for giving their final responses in written form.

The difference between the addition task and the music tasks was the absence of a clearly right or wrong response in the latter case, which makes it impossible to claim a one-to-one correspondence between these musical tasks and the ad-

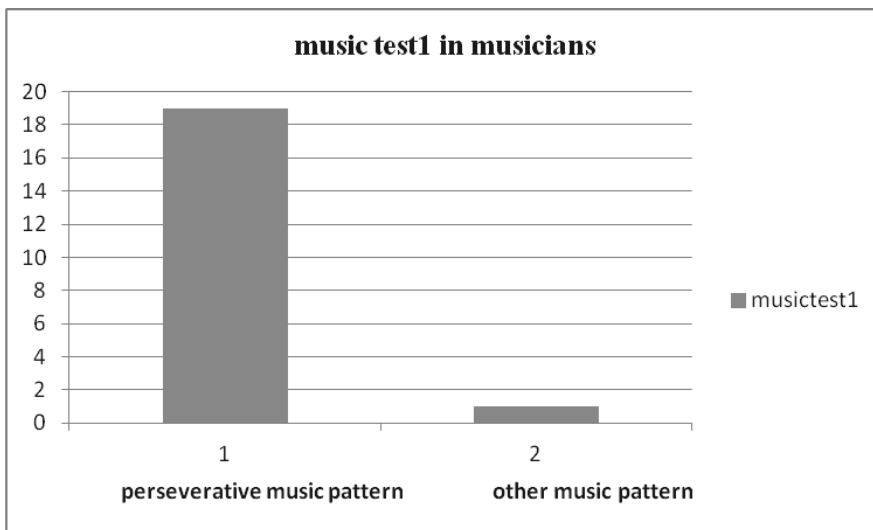


Fig. 4. The results of music test 1 in musicians

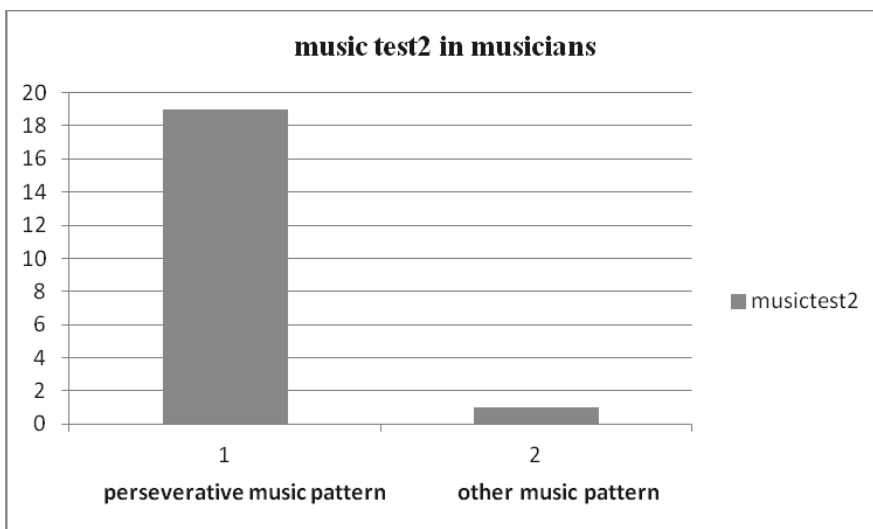


Fig. 5. The results of music test 2 in musicians

dition task. It is interesting, however, that only two subjects mentioned an alternative possible solution for the eighth measure task (music task 1) and that the majority mimetically continued the previously seen rhythmic pattern (four eighth-notes in a measure) and tonal change (each first note of each measure descending one note from the previous measure's first note and following the same musical pattern). The same happened also in the second music task, for which only six participants (from among those asked to give a creative ending) gave different, rather than imitative responses.

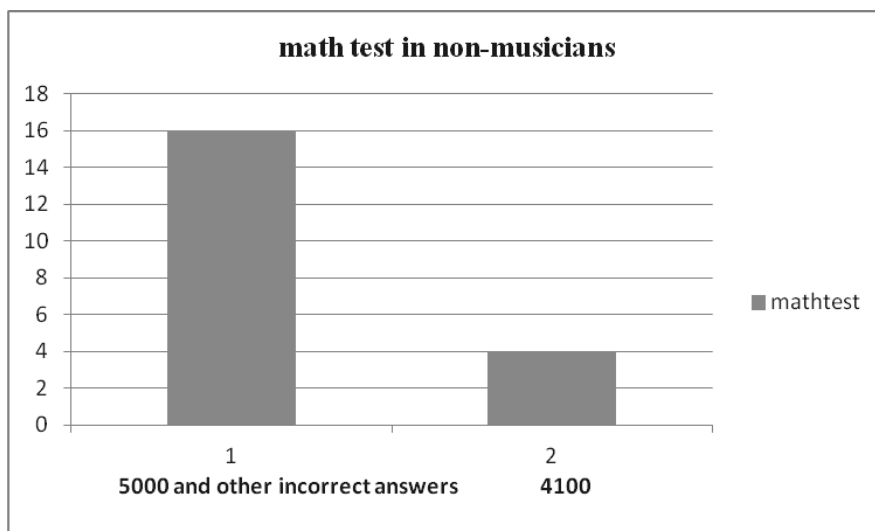


Fig. 6. The results of the math test in non-musicians

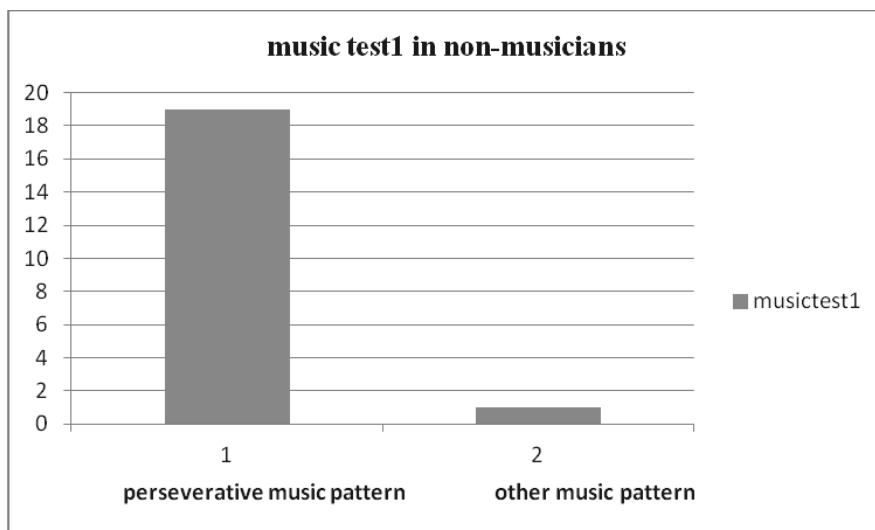


Fig. 7. The results of music test 1 in non-musicians

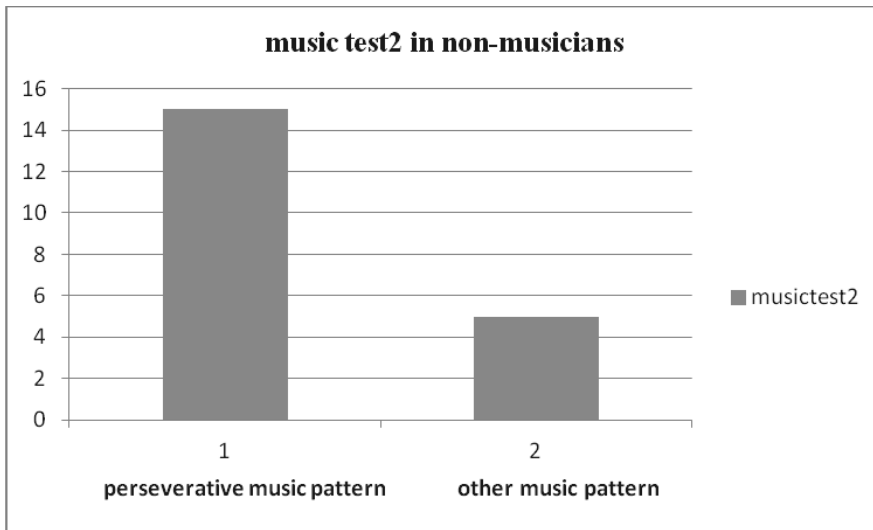


Fig. 8. The results of music test 2 in non-musicians

DISCUSSION

One possible limitation of this study is the fact that we cannot be sure that the participants did not merely take the path of least resistance with their choice of responding imitatively, even when the instructions asked for a creative solution. Of course, this argument might be countered by pointing out the difficulty of obtaining perseverative responses. Also, because of the lack of personal interviews before or after the experiment, a misinterpretation of the word “creatively” might explain this exceptionally perseverative way of thinking. Again, this suggestion thesis does not explain the current findings, because of the clear meaning of “creatively” in the Greek language, using a word that implies the making of qualitatively new things in an inventive way.

Another limitation is the small size of the participant groups and the fact that we cannot categorically claim that the music tasks really examine perseverance, because we cannot eliminate the possibility that previous music knowledge may impose such an answer regardless of the novelty of the tasks (Brown & Pachalska, 2003).

Future research should try to find and examine musical tasks that are strongly associated with the phenomenon in question and try to clarify further music perseverance with acoustic stimuli in larger samples of musicians and non-musicians.

CONCLUSION

It can be argued on the basis of these results that music has no unique response similar to that of the perseverative last step in the addition task, but the lack of a unique correct response does not prevent us from studying this phenomenon.

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