Title: Temporal expectancy and timbre

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Results available: Estimated 2018

Background and Aims

Dynamic Attending Theory suggests that our attention is guided by events that occur regularly in time, such as a simple rhythm of musical beats. The regular (i.e. rhythmic) timing of sounds lets listeners predict when each sound occurs. This is because attention forms a cyclical pattern while listening to the sequence of beats, where it peaks at the occurrence of each beat. This is known as temporal expectancy. The cyclical pattern of attention should theoretically correspond with performance on a task based on the sequence of sounds. These tasks usually involve some judgement on the features of one of the sounds, where attention must focus on a given sound. In this way, performance should peak when attention also peaks (i.e. at the point of time where a sound is expected to occur). Performance in tasks should therefore decrease during times that are further away from the expected point of time. Observing this relationship offers evidence for Dynamic Attending Theory. Research has tried to expand this evidence by extending the types of tasks to where performance benefits via temporal expectancy exist.

So far temporal expectancy has proven beneficial to performing time-judgement tasks within sequences of sounds. Performance on tasks based on other properties of musical notes that can be investigated are pitch, timbre and loudness. Along with time, these four properties form the musical dimensions of a note, and each can be changed without affecting the other. Pitch regards the frequency of sound, commonly perceived as “high” or “low”. The pitch-judgement tasks that have been used in research have offered contradictory results. Some studies could demonstrate effects of temporal expectancy while others could not. Often, these tasks involved comparing the pitch of the final tone of a sequence with the first tone.

Because of the uncertainty of pitch tasks, the next step is to look at tasks based on the remaining musical properties. Loudness of sounds is a straightforward dimension, and is commonly perceived as “soft” or “loud”. Timbre is a more complex dimension, regarding the tonal “quality” of sounds. It can most simply be described as the difference found between sounds of different instruments. For example, a note played on piano sounds significantly different to the same note played on a guitar.

The present study aimed to provide more evidence for Dynamic Attending Theory. This was done by examining performance on loudness-judgements and timbre-judgements of the final sound in a sequence. To provide evidence for Dynamic Attending Theory, performance on the task would be best at when the final sound occurred in line with the rhythm as expected. However if the final sound was manipulated to occur at unexpected points of time, performance would decline.

Method

Participants of the study listened to a series of 10 tone sequences. They were instructed to compare the final tone with the first tone of each sequence. For the timbre task listeners would indicate whether the timbre of the final tone was “the same” or “different” to the timbre of the first. In the loudness task, listeners would indicate if the final tone was “louder” or “softer” than the first.

The time gaps between each of the first 9 tones were always equal (500 milliseconds). The occurrence of the final tone was made to occur on time, earlier or later than expected in relation to the simple rhythm provided by the first 9 tones. These provided the expectancy conditions, where performance would theoretically peak at the “on time” condition and systematically fall at earlier and later conditions.

Musical experience of participants was also assessed to examine differences this may have on performance and potential effects of temporal expectancy.

Results

The final sample size was 52 participants in the timbre experiment and 24 participants in the loudness experiment.
In summary there appeared to be no desired effect of temporal expectancy in loudness or timbre judgements. That is, performance did not peak for “on time” conditions nor did it systematically fall when the final tone was manipulated to occur earlier or later than expected. For the most part, performance patterns were seemingly random and often with very little changes across the expectancy conditions. The musical experience of participants also did not offer any significant changes in these patterns, and in fact had no apparent relationship with determining performance on the task.

The present study did offer secondary findings irrelevant to temporal expectancy. Specifically, performance on loudness judgements steadily improved when the difference in loudness between the first and final tones of sequences became larger. This falls in line with other studies that demonstrate performance increasing with larger differences in loudness. This is logical since larger differences in loudness would be easier to perceive than smaller ones. Additionally, performance was slightly improved in conditions when the final tone was louder than the first tone rather than softer. This has implications on the effects certain degrees of difficulty may have in loudness tasks, which could be used in future research.

Conclusion

Because this study failed to demonstrate effects of temporal expectancy, it falls in accordance with the previous studies that also failed to display effects. The common factor between these studies may be

the task itself. Therefore combining these findings together offers the implication that the specific task design used in these experiments is incapable of providing evidence for Dynamic Attending Theory, whether it be through pitch, timbre or loudness judgement tasks.

Furthermore there are still numerous studies that display evidence for Dynamic Attending Theory, mainly in time-judgement tasks. There is still much more opportunity for Dynamic Attending Theory research in musical sounds, especially in seeking evidence for tasks other than time-judgements.

Therefore, if one wishes to provide evidence for Dynamic Attending Theory through use of musical properties other than time, they should avoid using a design such as the ones used in this study where listeners must compare the last tone of a sequence with the first tone.