

# Computer Notation-based Music Composition and the Delayed Introduction of Musical Expression Markings

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## ABSTRACT

The present study concerns itself with the manner in which composers create a musical score via the use of music notation software. Several composers took part in a study during which they completed three tasks: one composition and two arrangements/orchestrations. Of particular interest for this study was the order in which composers enter musical notes and other musical expression markings that provide information for the live performance of the music. Also of interest was whether or not these expression markings are entered simultaneously with the entry of the musical notes, or whether they are added later once all note entry is complete, and whether or not the use of MIDI playback facilities influences these decisions. This study analysed the results for two participants, who were at different levels of experience in both composition and in the use of notation software. The analysis suggests that composers begin by entering the pitches and durations of notes before expression markings are added. The more experienced participant added expression markings almost simultaneously with the entry of notes during a composition component of the test, but not during the two arrangement tasks. The less-experienced participant tended to omit musical expression markings during all three tasks.

## Keywords

Music, Composition, Computer, Interface, Notation, Software.

## INTRODUCTION

An increasing number of composers, both students and professionals, are using music notation software to create their scores, in preference to the more traditional method of using pen (or pencil) and manuscript paper. As many professional music publishers now make extensive use of the notation software that is also readily available to the general public, one of the main reasons composers make use of music notation software is for its apparent ability to allow them to produce professional-looking music scores relatively quickly and easily. Another feature of notation software is its ability to provide a MIDI 'playback' of the notated scores, making use of

computer sound cards that produce synthesized or sampled sounds of actual instruments. This enables a composer to immediately hear a version of their notated score as they work on it. In light of this feature, many composers have begun to use music notation software in both creative ways (composing directly at the computer keyboard) as well as in purely functional ways (producing professional-looking scores).

The present study concerns itself with the manner in which composers create a musical score via the use of notation software and how the use of such software may be influencing decision-making processes, or even the actual creative process. For this study, of particular interest is the order of events: that is, the order in which composers enter musical notes and the corresponding musical expression markings that provide information for the live performance of the notated music. Also of interest is whether or not these musical expression markings are entered simultaneously with the entry of the musical notes (as usually happens in pen and manuscript composition mode), or whether they are added later, once all note entry is complete. Musical expression markings are those that provide information about the way in which a musical note, or group of notes, or a musical phrase, should be performed; generally any musical performance instruction that goes beyond pitch or duration indications. For the purposes of this paper, expression markings will mean those used to indicate dynamics, note articulation, or phrase and slur markings.

While there is little or no statistical data to support the idea, the author believes that many students of composition are tending to use notation software in less than efficient ways. One such observation concerns the lack of sufficient musical expression markings being included on many notation-based scores produced by student composers. This speculation is based on personal observations made during the teaching of composition at the university level over a period of five years and on anecdotal evidence received from other teachers of composition. This paper intends to investigate this speculation.

Referring to Edwin Gordon's (1997) use of the term "audiation", meaning "to think in sound", it is the author's contention that more experienced composers audiate when composing: they know the sounds they want to hear and how to notate them, and thus they enter the musical notes and the musical expression markings onto their scores at around the same time. In the author's experience, this is the case for the more traditional pen and paper method of writing musical scores. When notation software is used to create the scores, however, the order of entry of the musical notes and the expression markings can vary considerably. Note entry, in the notation software mode, is one action, but in order to add expression markings the user has to stop entering notes and access different menus and other notation tools to complete the action (unless they are aware of any keyboard shortcuts that may be available). Thus, the two activities can sometimes be considered as quite separate, and may be carried out at different times. The question then arises whether or not the composer is thinking of these musical expression markings as the notes are being entered, and stores these details in long term memory or an episodic buffer (Baddeley, 2000), or whether they are considered quite separate to note entry and as such are not being perceived as part of the creative process. For more experienced composers, who audiate effectively and who have experience with the use of the notation software, it is quite likely that they are aware of the required musical expression markings at the time of note entry, and are aware that these markings must be added at some point. However, because they are effectively using the episodic buffer, they can delay the entry of these details to some extent. Less-experienced composers, on the other hand, who may not audiate as effectively and may not be adequately familiar with the use of the software, may decide to concentrate on note entry alone, as one separate action, before entering or even considering the addition of any expression markings.

A previous study (Peterson and Schubert, 2007) showed evidence that supported these ideas of more efficient cognitive organization and the capacity to audiate for mature age composers. A group of composers were set the task of arranging/orchestrating two short pieces for a given instrumentation (four parts), and composing one short original work within a limited time period. One group of participants used a computer and music notation software, and a control group used pen and paper for the same tasks. The analysis showed that only 50% of participants in the notation software-based condition included most types of musical expression markings

(dynamic markings, phrasing and/or slur markings, note articulations and so forth) beyond pitch and duration – compared with a control group of pen and paper compositions for which 85% included expression markings. For the computer-based composition condition, in particular, the amount of musical expression detail that was included was both varied and often not comprehensive throughout the entire score. The study demonstrated that even established composers are often not using the minimum, or necessary, level of tools for music communication when using music notation technology. This aspect of the study has important ramifications for the role of the computer and notation software in music composition, and the implications for how we should teach composition using such technology. To address these problems, we need ways of analysing not just what composers are doing, but when they do what they do.

Of further interest is the use of the notation software's MIDI playback facilities. All types of expression markings, when added to a notation software-based score, will feature as part of the MIDI playback – one can hear all these details being approximated by the software. For experienced composers, who audiate effectively, MIDI playback may be used merely to check the music (for pitch and rhythmic accuracy) and to listen for the overall effectiveness of the musical sound: that is, the use of MIDI playback does not alter the experienced composer's perception, or audiation, of the music. For less-experienced composers, there may be a tendency to listen to MIDI playback quite early in the process, often after only the musical notes have been entered, and this may mean that they begin to focus only on aspects of pitch and duration, and not necessarily on musical expression markings. Therefore if the less-experienced composers are not audiating effectively, they will use MIDI playback quite extensively, and also quite early in the process of creating their musical score. Their sound world will become that of the MIDI generated sounds. Evidence of the shift to the externalised MIDI sound playing world would be provided by early and frequent use of MIDI playback during the composition process. An experienced composer might not necessarily be expected to use playback as often, nor as soon, as the less experienced composer but, if they do, it might be expected that the musical expression marks have been included in the score at the time of accessing the MIDI playback.

Given these propositions, the author speculates two hypotheses: (1) experienced composers will add expression markings earlier in notation-

software based composition tasks than less experienced composers, and (2) experienced composers will use MIDI playback later (if at all) than less experienced composers.

### METHOD

Two case studies are reported in this paper in which the participants were given three composition or music arranging tasks to be completed in a time period of three hours. The prescribed set of tasks were: an arrangement of a short section of a Bach Chorale prelude, an arrangement of a one-page piano piece, and one original composition; all written for the same four-part instrumentation. All tasks were completed using music notation software during sessions held in the Empirical Musicology Lab in Music and Music Education at the University of New South Wales. All participants were selected according to their familiarity with the use of either the *Finale* or the *Sibelius* notation software programs, both of which are recognized as being the industry standard (see Peterson & Schubert, 2007, for further details).

In order to establish the level of experience of the two participants (henceforth referred to as Participant A and Participant B) used in the present study, each participant answered several questions in a survey. Both Participant A and Participant B reported that, at the time of the research session, they had been using notation software for about five years. It emerged after the study that Participant A was considerably less experienced at using notation software than Participant B. For example, Participant A referred quite frequently to the on-line user's manual, while Participant B did not. Similarly, both participants reported that they had been composing music for over twenty years. Participant A, however, was completing a Master of Music Degree (in composition), while Participant B was in the process of completing a doctoral degree in composition at the time of the study. For these reasons, Participant B was, for the purposes of this study, considered as having a higher level of both compositional experience and experience in the use of the notation software compared to Participant A.

A 'screen snapshot' software program was running in the computer desktop background, taking a picture of the computer screen every five seconds during the session – providing twelve snapshots for each minute of the duration of the session. Thus a detailed record of the participant's actions, including the key strokes and the use of menus during the three-hour session was produced. The researcher can then scroll through

the screen snapshots enabling close examination of the order of entry of musical materials.

### RESULTS

The screen snapshot results demonstrate that the first thing a composer enters when they begin a score is the pitches and rhythmic values of the notes of the music for each individual instrument contained within the musical arrangement or composition. Further, it takes several measures of note entry before the first expression markings, are entered; though no entry of expression marks or musical details was also sometimes encountered.

Table 1 summarises the amount of time that elapsed before the first appearance of particular types of musical detail, other than note entry, over the duration of the three tasks attempted during the study. In general, it can be observed that the more experienced composer (Participant B) added expression markings earlier than the less experienced composer (Participant A).

Table 1. First expression mark appearance time for two participants taking part in the study

<p><b>Participant A:</b> Medium-level of experience, using <i>Finale</i> software.</p> <p><u>Bach Chorale</u> (arrangement):</p> <ul style="list-style-type: none"> <li>• 66 minutes to complete task.</li> <li>• first note articulations at 57.6 minutes into task;</li> <li>• No phrasing or slur markings added.</li> <li>• No dynamic markings added.</li> </ul> <p><u>Piano Work</u> (arrangement):</p> <ul style="list-style-type: none"> <li>• 97.5 minutes to complete task.</li> <li>• first phrasing or slur markings at 76 minutes;</li> <li>• first dynamic marking at 82.5 minutes;</li> <li>• first note articulations at 82.8 minutes.</li> </ul> <p><u>Original Composition:</u></p> <ul style="list-style-type: none"> <li>• 27 minutes to complete task.</li> <li>• No phrasing or slur markings added.</li> <li>• No dynamic markings added.</li> <li>• No note articulations added.</li> </ul>
<p><b>Participant B:</b> Medium to high level of experience, using <i>Finale</i> software.</p> <p><u>Bach Choral</u> (arrangement):</p> <ul style="list-style-type: none"> <li>• 53.4 minutes to complete task.</li> <li>• first note articulations at 43.9 minutes into task;</li> <li>• No dynamic markings added;</li> <li>• No phrasing or slur markings added.</li> </ul> <p><u>Piano work</u> (arrangement):</p> <ul style="list-style-type: none"> <li>• 74.3 minutes to complete task.</li> <li>• No phrasing or slur markings added.</li> </ul>

- No dynamic markings added.
- No note articulations added.

Original Composition:

- 46.6 minutes to complete task.
- first dynamic marking at 5.6 minutes into task;
- first note articulations at 6.1 minutes;
- first phrasing or slur markings at 6.5 minutes.

Table 2 shows the times when the MIDI playback features were accessed by Participant A.

Table 2: Time of MIDI playback during each task for Participant A:

Bach Chorale (arrangement):

- 66 minutes to complete task.
- first MIDI playback at 7.5 into task;
- subsequent playback at 9 minutes, 52 minutes, and 64.8 minutes.

Piano Work (arrangement):

- 97.5 minutes to complete task.
- accesses MIDI Instrument List at 46 minutes into task, but no evidence of playback;
- first MIDI playback at 96 minutes;
- subsequent playback at 96.5 minutes.

Original Composition:

- 27 minutes to complete task.
- first MIDI playback at 9.8 minutes;
- subsequent playback at 11.3 minutes and 14.25 minutes.

Participant A also spent about 20 minutes accessing the on-line manual during the Bach task, and 8.9 minutes during the Piano arrangement task; but not during the composition task.

Participant B did not access the MIDI playback features or the on-line manual during any of the three tasks.

### DISCUSSION

It is worth noting that the more experienced composer, and the more experienced user of the software, completed the given tasks in a faster time. Participant B completed the Bach and Piano arrangement tasks in a shorter time than Participant A, thus allowing Participant B more time for work on the original composition.

The results support hypotheses that, if the less-experienced composers are not audiating effectively, they will use MIDI playback quite extensively, and also quite early in the process of creating their musical score, and that musical expression markings will be added much later in the process than would be the case for the more

experienced composers. During the Bach arrangement and composition tasks, Participant A made use of the MIDI playback facilities quite early in the process and, in the case of the Bach arrangement, again towards the end of the process in what might be assumed to be a check of the overall sound of the arrangement. The only musical expression markings that are added consist of the fermatas (pause markings) at the ends of phrases that are replicated from the original chorale prelude score, and are added quite late in the process.

While all three categories of musical expression markings are represented in the score of the piano arrangement, they are added only during the final twenty minutes of the nearly one hundred minutes taken to complete the task and are not numerous. MIDI playback was not, however, accessed until towards the very end of the task. This may have been due to the fact that the piano piece being arranged/orchestrated was a non-tonal work, and perhaps the participant was not interested in checking pitch or durations during the task, and only decided to access the MIDI playback at the end as a brief check of the overall sound of the arrangement.

As most time was spent on the completion of the first two tasks during the session, only twenty-seven minutes remained for the writing of the original composition. Therefore it might be assumed that time constraints may have prevented musical expression markings from being added to the composition task. There may well have been an intention to add musical expression markings later, as the hypothesis contends, but the session time expired before this could be achieved. MIDI playback was accessed on three occasions early in the composition process, further supporting the hypothesis that less experienced composers use the playback facility early in the composition process and rely on the playback rather than their own audiation of their composition material, and leaving the addition of expression markings until much later in the process.

Participant B did not use MIDI playback at all during the completion of the three tasks. The results for the Bach arrangement are similar to those of Participant A: there are a minimal number of note articulations added to the score but no dynamic markings, or phrasing or slur markings. The reasons for both participants adding low levels of expression markings to this score may be partially explained by the fact that the original Bach score also contained no dynamic or phrase markings, and hence neither participant made any attempt to add these types of details to their arrangements. The total lack of musical

expression markings added to the piano arrangement score completed by Participant B is, however, rather more significant. Given the subsequent appearance of all three categories of musical expression markings at quite an early stage during the writing of the original composition suggests that Participant B demonstrated a lack of engagement with both of the music-arranging tasks. It would appear that Participant B may have deemed these arrangement tasks to be somehow less-creative (and, therefore, perhaps less personally-involving) musical endeavours than the act of composition, and thus did not bother to add the requisite performance details. During the composition process, however, musical expression markings are added almost simultaneously with note entry, adding support to the hypothesis that experienced composers view these expression markings as both an important and necessary part of the creative process.

### CONCLUSION

The current study adds support to the views presented in the Peterson & Schubert (2007) study but also provides impetus for further study to be undertaken. The current study is preliminary one and is currently in the process of being broadened so that more participant's results can be analysed. In this way a more comprehensive understanding of the actions of composers and their use of notation software may be examined.

It seems, though, that for more experienced composers the addition of musical expression markings at a point almost simultaneous to the act of entering the pitches and durations of musical notes would appear to be an integral part of the creative process, and supports the view that experienced composers audiate in an efficient way, not relying on MIDI playback to provide clues to the interpretation of the music. The less-experienced composer in this study did not add very many expression markings in any of the tasks, including the original composition, and concentrated primarily on note entry, while making liberal use of the MIDI playback facilities. While the lack of musical detail included in the scores of Participant A may be partly attributed to the restricted time constraints of the study, it should be noted that such time constraints are a common restriction for professional composers who must meet composition commission deadlines. It would seem that, under the pressure of a short time frame, less-experienced composers might be not be able to store enough information (musical details) in their episodic buffer, and concentrate instead on providing a score consisting of pitches and durations, leaving the

addition of expression markings until much later in the process.

Less-experienced composers are sometimes introduced to the basic aspects of notation software, usually how to enter the pitches and durations of notes, and then left to find their own way of dealing with other notational problems, primarily through the use of the on-line manual. The act of entering pitches and durations of notes is, then, often seen as being quite separate to the act of accessing menus and other software tools in order to add musical expression markings. The results obtained from the current analysis might, therefore, be useful when approaching the act of teaching of composition via the use of music notation software. Less-experienced users of the notation software might be given much more intensive training in the use of the software so that the disjunct between the acts of entering notes and of entering performance details is reduced and, subsequently, the creative process is enhanced. The order of input of musical performance details, in particular, might become a feature of a teaching method and thus provide students with the means whereby they consider all aspects of the music, including expression markings, and their effects on the performance of the music by live musicians (as opposed to the MIDI playback conditions) simultaneously with the entry of musical notes. This would make the computer music notation-based condition more analogous with the hand-written condition.

On another level, music notation software companies might find this data of some use for future developments of their programs so that the entry of music and musical details becomes more intuitive for the composer and becomes a more integral part of both the functional process, creating a professional-looking score, and the creative, purely compositional, process.

### REFERENCES

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