The sense of nonsense. Syllable choice in spontaneous nonsense-text

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THE SENSE OF NONSENSE. SYLLABLE CHOICE IN SPONTANEOUS NONSENSE-TEXT SINGING

Johan Sundberg & Lars Frydén

Abstract

When informally singing memorized instrumental or vocal themes, we tend to invent nonsense texts, e.g., duda duda dudaa or... dibidi bambi dudi. It can be hypothesized that the choice of syllables in such nonsense texts is not completely random. Rather, certain principles reflecting aspects of musical structure are likely to guide this choice.

A group of eleven members of a professional orchestra sang six melodical excerpts and their choice of syllables was analyzed. With regard to the phonetic properties the choice showed coherence in certain musical situations. For example, a change of syllable was frequently made at structural boundaries while repetition of syllable was often used for all notes constituting a short motif.

Later, one of the same musicians used typical signs, such as dots, dashes, slurs, etc., to mark how these same excerpts should be performed according to his view. This material suggested that the meaning of, e.g., a nasal consonant plus a [p] was an accent, whereas a voiced stop consonant, such as [d] plus vowel, frequently corresponded to a legato. We also compared these performance suggestions with those predicted by our system of performance rules.

INTRODUCTION

Probably, the most common type of music performance is when we sing tunes using a nonsense text, like Tidelipom, to quote Winnie the Pooh. This type of making music seems interesting. Musicians sometimes use it when they want to demonstrate how a theme should be performed. Even great conductors sometimes use this method when instructing the orchestra. Let us imagine an example. A conductor demonstrates how the "Waltz of the Flowers" from Pjotr Tschaikovski’s "Nut Cracker Suite" should be played. Perhaps he would sing the following text:

Are these syllables meaningless? One way of finding a quick answer is to simply change the order of the syllables above.

Is that instruction equivalent to the one we just heard? Probably not. Thus, Jooopi and Tiidam do not seem to be equivalent. This implies that, within this framework,

There must be a meaning of nonsense!

What is this meaning, then? Given the fact that musicians sometimes use this kind of singing to show how a theme should be played, it is clear that the syllable choice...
must be dependent on and hence in one way or the other reflect aspects of music performance.

It is not likely that the choice of syllables carries the entire information on performance. The way in which the syllables are pronounced must be another important factor. However, this investigation will concentrate only on the phonetic aspects.

Although there seems to be reasons to assume that the choice of syllables in nonsense-text singing is a worthwhile phenomenon for a scientific analysis, no attempt seems to have been ventured in the past. There is not even a term for the phenomenon. Therefore, it is necessary to select a term. We propose the term syllabling for this phenomenon, that people invent nonsense texts while singing themes, melodies, etc. The purpose of the present investigation was to find out what information is communicated by the syllable choice in syllabling.

Three experiments were carried out. The goal of the first experiment was to get an overview of the phenomenon: how similar are different musicians' syllablings of the same melody, and what are the phonetic characteristics of the syllables used in different musical contexts? The second experiment examined in detail the syllabling of a highly experienced musician and compared it with his articulation markings. The third experiment compared this musician's syllabling with the performance produced by a computer program producing performances of input note files.

EXPERIMENT I

In this experiment we asked eleven professional musicians to perform syllabling of six music excerpts. The excerpts, shown in Fig. 1, represented different musical styles, from an organ fuge theme by J.S. Bach to chamber music and popular tunes, like Santa Lucia.

Of the subjects, two were top-level music students, both bowed instrument players, 19 and 24 years old and with more than 14 years of experience. The nine remaining subjects were members of a professional Stockholm symphonic orchestra, age 30-55 years. Seven played bowed instruments and two played wind instruments, and all of them had at least 29 years of experience of playing.

The subjects were given six sheets of paper. On each, one excerpt was given in normal music notation. Most of the excerpts were well-known to most of the subjects. In cases where this did not apply, the subjects were asked to familiarize themselves with the excerpt until they felt they knew how it should be played.

The subjects also received a written instruction: "Dear subject. How would you like to play this example? Demonstrate how you would like it played. Feel free to try several times until you feel satisfied." By this scarce instruction we hoped to have the subjects feel comfortable. Most subjects found the task reasonably easy, probably because they often use this method for communicating interpretational details to colleagues. In addition, some personal information was collected on a separate sheet of paper containing questions about age, instrument played, and how long they had been playing it. Many subjects enjoyed the experiment. One of the student subjects, however, was disturbed by an insufficient acquaintance with singing after notes.

Analysis

The subjects' syllabbling was recorded on a cassette tape recorder. The tape recordings were then transcribed to phonetic symbols. Because of a technical problem, the results from Excerpt No. 4 was not analyzed in this experiment.
Fig. 1. Music examples used in the tests.
Table I shows which syllables were used by these eleven musicians in terms of the occurrence of the 15 most common syllables used in excerpts Nos. 1, 5, and 6, a material of a total of 1026 syllables. These excerpts represented different types of melodies: No. 1 was a folk tune in legato cantabile, No. 5 a somewhat more rhythmically marked popular tune, while No. 6 was a rhythmically energetic, Baroque fugue theme. The total number of syllables that occurred in this material was 65.

As can be seen in Table I, the syllable choice did not show a very great variety. The syllable [da] is the outstanding winner, almost three times as common as [di], which, in turn, is more than twice as frequent as [ta]. Interestingly, the syllable [tral] which has been used to coin the Swedish term for syllabling ("tralla") does not occur one single time in the entire material, and the syllable [la] is rare but represented. It is also noteworthy that the only final consonant occurring in the material is [m]. This means that all syllables used in syllabling end either on a vowel or an [m].

<table>
<thead>
<tr>
<th>SYLLABLE</th>
<th>OCCURRENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>[da]</td>
<td>34%</td>
</tr>
<tr>
<td>[di]</td>
<td>13%</td>
</tr>
<tr>
<td>[ta]</td>
<td>6%</td>
</tr>
<tr>
<td>[dam]</td>
<td>4%</td>
</tr>
<tr>
<td>[ba]</td>
<td>3%</td>
</tr>
<tr>
<td>[du]</td>
<td>3%</td>
</tr>
<tr>
<td>[za]</td>
<td>3%</td>
</tr>
<tr>
<td>[la]</td>
<td>3%</td>
</tr>
<tr>
<td>[do]</td>
<td>2%</td>
</tr>
<tr>
<td>[na]</td>
<td>2%</td>
</tr>
<tr>
<td>[do]</td>
<td>2%</td>
</tr>
<tr>
<td>[do]</td>
<td>2%</td>
</tr>
<tr>
<td>[bam]</td>
<td>2%</td>
</tr>
<tr>
<td>[dy]</td>
<td>2%</td>
</tr>
<tr>
<td>[duu]</td>
<td>1%</td>
</tr>
</tbody>
</table>

Table I. Occurrence of the 15 most common of the 65 syllables that the eleven subjects used in Excerpts Nos. 1, 5, and 6. The total number of syllables counted was 1026.

The subjects differed considerably with regard to the number of syllables they used. As the focus of this study was the choice of syllables, it did not seem worthwhile to include in the analysis instances of syllabling that mainly repeated the same syllables. Therefore, for each excerpt and subject, the number of syllable repetitions were counted.

Fig. 2. Syllables, transcribed to phonetic symbols, used by the eleven subjects for the various tones in syllabling Excerpt No. 1, Santa Lucia. The numbers shown to the left represent subject number and those to the right the total number of syllable repetitions between adjacent tones.
Fig. 3. Occurrence of various phenomena in eight musicians' syllabing of Excerpt No. 2, the theme of the first Kyrie from J.S. Bach's b-minor Mass: repetitions of syllable from one tone to the next, syllable with final nasal consonant, with diphthong, with initial vowel, with initial voiced stop consonant, and with initial unvoiced stop consonant.
Figure 2 shows the result for Excerpt No. 1, the *Santa Lucia*. The responses have been arranged as a matrix, where each subject is represented by a line, and each tone by a column. The tuba player (subject No. 8) can be recognized by his stubborn repeating the syllable [ta] throughout. All such cases when a tone was sung on the same syllable as the preceding tone have been marked with a minus sign. The total number of minus signs per subject is given in the last column. It can be seen that the number of repetitions in this excerpt varied between a minimum of two and a maximum of 22 which corresponded to the highest possible.

The results for each excerpt and each of the eleven subjects are shown in Table II. There are clear differences between the excerpts, as shown by the bottom line. Repetitions were much more frequent in Excerpt No. 1, the cantabile tune *Santa Lucia* than in Excerpt No. 6, the energetic fuge theme. This may depend on the different characters of the excerpts. For example, it is likely that an example containing a great number of short notes tends to reduce the number of repetitions; it would be articulatorily more convenient to alternate between two syllables than to repeat the same syllable in sequences of short tones (dagadagadam rather than dadadadadam).

<table>
<thead>
<tr>
<th>EXCERPT NO.</th>
<th>SUBJECT NO.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Sum</th>
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<td>15</td>
<td>14</td>
<td>23</td>
<td>11</td>
<td>11</td>
<td>9</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>11</td>
<td>8</td>
<td>10</td>
<td>9</td>
<td>17</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>12</td>
<td>4</td>
<td>10</td>
<td>3</td>
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<td>2</td>
<td>2</td>
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<td>1</td>
<td>33</td>
<td></td>
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<tr>
<td>5</td>
<td>15</td>
<td>24*</td>
<td>44*</td>
<td>41*</td>
<td>23</td>
<td>23</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>22*</td>
<td>15</td>
<td>27</td>
<td>24</td>
<td>16</td>
<td>4</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>22*</td>
<td>15</td>
<td>25</td>
<td>8</td>
<td>11</td>
<td>7</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>20*</td>
<td>22*</td>
<td>49*</td>
<td>36*</td>
<td>5</td>
<td>24</td>
<td>156</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>19</td>
<td>16</td>
<td>23</td>
<td>27</td>
<td>7</td>
<td>28</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>19*</td>
<td>31*</td>
<td>28</td>
<td>19</td>
<td>47*</td>
<td>145</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>10</td>
<td>4</td>
<td>25</td>
<td>27</td>
<td>10</td>
<td>5</td>
<td>81</td>
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</table>

<table>
<thead>
<tr>
<th>TOTAL NO. OF REPETITIONS</th>
<th>145</th>
<th>154</th>
<th>269</th>
<th>237</th>
<th>117</th>
<th>172</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL NO. OF TONES</td>
<td>23</td>
<td>32</td>
<td>57</td>
<td>56</td>
<td>32</td>
<td>51</td>
</tr>
<tr>
<td>REPEAT %</td>
<td>57</td>
<td>44</td>
<td>43</td>
<td>38</td>
<td>33</td>
<td>31</td>
</tr>
</tbody>
</table>

Table II. Number of cases where the subject used the same syllable for two adjacent tones. The rightmost column shows the subject’s total number of syllable repetitions. The Repeat % shows the total occurrence of syllable repetitions for that excerpt.

Both inter- and intraindividual variations were considerable. For example, the bass tuba player subject (No. 8) tended to repeat syllables in all excerpts except in Excerpt No. 5, which was a well-known popular song. Presumably, acquaintance with the excerpt was a significant factor; when the same subject syllabled a familiar theme, a more varied syllable choice often emerged. Subjects 3 and 4 repeated syllables comparatively rarely. All cases, where the syllabling consisted mostly of repetitions, were excluded from further analysis. These cases have been marked by asterisks in the Table.
The subjects seemed to adhere to certain phonetic principles. For example, front vowels seemed to be used somewhat more commonly for high notes than for low notes, and vowels with a high first formant frequency was particularly frequent on stressed beats. However, the most interesting principle appeared to be the phonetic representation of boundaries between tone groups. Therefore, the analysis was concentrated to this phenomenon.

The occurrences of six different types of phonemes were determined: syllable change, final nasal consonant, final diphongue, initial consonant, voiced and voiceless stops. The occurrence of all these phenomena were counted using the tone boundary as the reference.

Figure 3 shows the result for Excerpt No. 2, the theme of the first Kyrie from J.S. Bach's "b-minor Mass". Certain regularities can be observed. Syllable changes were more common at the wide leaps in bars 2 and 3 than at the interleaved minor second intervals. Also, few subjects changed syllable between the first and the second eighth note in bar 4 while all subjects but one changed syllable between the first and the second quarter notes in bar 5.

The occurrence of final nasals also showed some regularity. They never occurred on short notes in this excerpt, and only on some of the quarter notes. Three of the subjects used final nasal on the first quarter note in bar 5 which terminates a subphrase. This suggests that final nasals are used for terminations of tone groups.

Further support for this assumption could be found in other excerpts. Figure 4 presents an example from Excerpt No. 3, a string quartet by J. Haydn. Here, final nasals were observed on none of the half notes and none of the sixteenth notes but on most of the quarter notes. However, there is one quartenote that forms an exception, viz., the first one in bar 5. This note is an appoggiatura, i.e., a non-chord note appearing in stressed position and being followed by the chord note one scale tone step lower. Intuitively, it seems self-evident that the two tones constituting an appoggiatura tone belong strongly together, i.e., there should be no boundary between such tones. Apparently, an open syllable followed by a voice stop was used for signalling continuity.

Summarizing, traces can be discerned of certain principles that guide musicians' choice of syllables in syllabling. Some kind of regularity seemed to exist for the occurrence of final nasal consonants and for syllable changes in our material. This supports the idea that the choice of syllables in syllabling is systematic rather than random.

EXPERIMENT II

The question raised in this experiment was: "What is the musical meaning of the various phonetic characteristics of the syllables used in syllabling?"

To find the answer to this question, a translation is needed from syllabling to a well-known code for music performance. Such a code is the articulation marks used by musicians: dot, dash, slur, comma, accent, etc. The experiment was to have one of our subjects from Experiment I show by means of such articulation marks what seemed, according to his judgement, to be the appropriate performance of the same melodies.

As the subjects in Experiment I differed considerably in their responses to the syllabling task, some type of subject selection seemed indicated. The concert master was a particularly experienced subject. Also, he was one of the subjects who most fre-
sequently changed syllable from one note to the other. Therefore, he could be assumed to make a particularly careful choice of syllables so his syllabling should rather precisely reflect his ideas about how the excerpts would be performed. Moreover, as Concert Master, he was experienced with the task of describing performance characteristics by means of articulation marks. For these reasons we selected this subject for this experiment and gave him the music of the same six excerpts as in Experiment I, asking him to write articulation marks.

**Results**

Figure 5 shows his syllabling together with his articulatory markings for Excerpt No. 3, a string quartet by Haydn. Certain regularities can be observed. Dots frequently corresponded to syllables with a final nasal consonant and the boundary between slurred eighth notes by a voiced stop consonant. For the three cases of dotted eighth note plus sixteenth note, which were all marked with a slur plus dot on the second note, a final nasal was used for the first note and a voiceless stop for the beginning of the second.

![CONCERT MASTER’S ARTICULATION MARKS AND SYLLABLING](image)

**Fig. 5. The Concert Master’s syllabling and performance marks for Excerpt No. 3.**

Table III summarizes these and other observations made on the entire material. Some principles were followed in all cases. A slur was associated with a final vowel on the first note and an initial voiced consonant on the second; the vowel was mostly a back vowel. Thus, a typical representation was [tada]. If the second note had a dot, there was mostly a final nasal on the first note and an initial voiceless consonant on the second, e.g., [dampa]. A dot often corresponded to a final nasal, e.g., [pam], while both dashes and dotted dashes were mostly realized by open syllables, e.g., [da]. Appoggiaturas were realized by a final vowel on the first note and a voiceless stop in the beginning of the second, e.g., [dida]. For notes with accents, finally, a back vowel often preceded by a nasal or a final front vowel was mostly used, e.g., [dimpa].
1. SLUR
   Final back vowel on first 18/22; (82%)
   Final vowel on first 22/22; (100%)
   Final back vowel on second 18/22; (82%)
   Initial voiced stop on second 22/22; (100%)

2. SLUR WITH DOT ON SECOND NOTE
   Final nasal on first 6/8; (75%)
   Initial voiceless stop on second 8/8; (100%)

3. DOT
   Final nasal 27/40; (68%)

4. DASH
   Final vowel 39/47; (83%)

5. DOTTED DASH
   Final vowel 23/33; (70%)

6. APPOGGIATURA
   Final vowel on first 14/14; (100%)
   Initial voiced stop on second 14/14; (100%)

7. ACCENT
   Back vowel 22/24; (92%)
   Final nasal on preceding note 9/13; (69%)
   Final front vowel on preceding note 7/13; (54%)

Table III. Concert Master's syllabing and articulation marks. Occurrences are given as the ratio between number of observations and total number of cases and also, within parentheses, as percentages.

Experiment I showed a certain coherence in the choice of syllables in our musician subjects' syllabing of the six music excerpts. Experiment II revealed the musical significance of some of the phonetic characteristics. This seems to imply that the coherence in the responses collected in Experiment I were signs of a certain agreement in musical interpretation among the musicians. The main conclusion, however, is that there seems to be a clear correspondence between syllabling and articulation markings, i.e., the performance of the piece.

EXPERIMENT III

In a research project in Stockholm, we have used an analysis-by-synthesis procedure to investigate the principles underlying music performance (Sundberg, Friberg, & Frydén, 1991). The research has resulted in a generative set of rules that produce musical performances of input note files (Friberg, 1991). The aim of Experiment III was to find out if there was any agreement between the predictions of musical articulation produced by this system and that produced by a syllabing musician subject.

Our generative performance grammar produces a number of performance details, such as adding or subtracting duration from tones, increasing or decreasing amplitude, inserting micropauses between tones, and modifying fine tuning and vibrato depth. Most of these details are hard to measure in syllabing. However, an aspect that could be compared was micropauses. Such micropauses could be assumed to
occur in situations where the musician used some phonemes that produced a similar kind of amplitude modulation.

The performance rule system inserts micropauses in three cases: at the end of subphrases, at tone repetitions, and in melodic leaps. Subphrase marks are added to the input notation by hand, according to the experimenter’s judgement, so that a comparison of rule-generated and syllabled performances is unrevealing in these cases. Hence, we refrained from including subphrase markers in the comparison.

The eleven subjects in Experiment I exhibited a rather varied response to the task, as mentioned. For instance, many subjects changed syllable comparatively rarely. Two subjects changed syllables particularly frequently. One of these subjects was the Concert Master who was the subject in Experiment II. This experiment suggested that he produced a careful syllabling. For example, his syllabling showed a nice agreement with his articulatory marks. Therefore, it seemed worthwhile to compare his syllabling with the performances produced by the performance program.

<table>
<thead>
<tr>
<th>EXCERPT NUMBER</th>
<th>NUMBER OF CASES</th>
<th>NUMBER OF AGREEMENTS</th>
<th>AGREEMENT PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23</td>
<td>13</td>
<td>56% (56%)</td>
</tr>
<tr>
<td>2</td>
<td>32</td>
<td>20</td>
<td>63% (65%)</td>
</tr>
<tr>
<td>3</td>
<td>57</td>
<td>43</td>
<td>75% (82%)</td>
</tr>
<tr>
<td>4</td>
<td>45</td>
<td>30</td>
<td>67% (78%)</td>
</tr>
<tr>
<td>5</td>
<td>33</td>
<td>19</td>
<td>58% (58%)</td>
</tr>
<tr>
<td>6</td>
<td>51</td>
<td>40</td>
<td>78% (98%)</td>
</tr>
</tbody>
</table>

Table IV. Number and percentages of instances where the Concert Master’s syllabling and the performance program’s indications were in agreement with respect to micropauses. The figures represent the number of cases when a final nasal or an unvoiced stop occurred in the syllabling in positions where the performance program indicated a micropause, and the number of cases, where a voice stop preceded by a vowel occurred in the syllabling in positions, where the performance program did not indicate any micropause. Percentages within parentheses refer to the agreement observed when micropause predictions on short notes were disregarded.

Table IV summarizes this comparison. It can be seen that in a majority of cases, the Concert Master used a final nasal in those cases where the performance program produced a micropause. In most cases of disagreement (80%), the program predicted a micropause that did no correspond to a final nasal in the syllabling.

In Experiment I, it was observed that final nasal was not used for short tones. If this principle were introduced in the performance rules, the cases of agreement increased considerably in Excerpts Nos. 4 and 6, as can be seen from the percentages within parenthesis in Table IV. This suggests that almost all occurrences of final nasal and final vowel was determined by two principles: except for short tones, syllables with final nasals were used for tones initiating melodic leaps or tone repetitions, while final vowels were used for scale tone steps.

A final nasal may not be the only possible way to represent a micropause. Another alternative would be an unvoiced stop consonant, because such a phoneme will produce a brief micropause before the tone onset, as illustrated in Fig. 6. An analysis revealed that the Concert Master used voiceless stops in 66 cases and in 52 of these, or 79% of the cases, the stop was preceded by a final nasal. Thus, mostly the
voiceless stop seemed to serve the purpose of merely enhancing the final nasal. In the 14 remaining cases, where a voiceless stop occurred without a preceding nasal, seven cases occurred in positions where the performance rules produced micropauses. Thus, in positions where the performance rules indicated a micropause, the Concert Master inserted either a voiceless stop or a final nasal that was often followed by a voiceless stop.

Fig. 6. Time spectrograms of the nonsense words indicated. While phonation is uninterrupted in the left case, the unvoiced stop consonant [p] introduces a silent interval.

The subjects appeared to use a voiceless stop consonant to mark boundaries in 59 cases out of 66, or 89%, and in seven cases for other reasons. Conversely, the performance program suggested a total of 114 micropauses, of these 51 corresponded to final nasal and seven to voiceless stops, while 56 lacked any phonetic representation in the Concert Master’s syllabling. Thus, had final nasal and voiceless stop been the only way of representing a micropause in syllabling, the performance program produced more micropauses than the concert master. However, it is likely that micropauses can also be efficiently represented in other ways, e.g., by timing, prosodic modulation, etc.

DISCUSSION AND CONCLUSIONS

What are the principles used in choosing syllables in syllabling? These experiments have contributed to the answer of that question.

First, what phonemes are used, and why? Table I listed the most commonly used syllables. In this ensemble of syllables, several phonemes were missing. For example, there was not one single sample of the voiceless fricatives [f], [s], and [h]. There may be different reasons for this; it may be relevant that they all lack pitch and consume much air.

Articulatory convenience may be another reason to prefer certain phonemes in certain contexts. A clear case is the principle that final nasal was avoided on short tones; probably, there is not enough time in short notes for producing an initial consonant, a vowel, and a final [m]. Another example was the principle to change syllables between adjacent notes in sequences of short notes.

Articulatory convenience may be the reason why the consonants [g] and [k] were rare. These sounds are both produced by the back of the tongue dorsum, which is a comparatively slow articulator (Kuehn & Moll, 1976). On the other hand, [g] was used in quick passages but then only in alternation with a [d] such as in [daga]. This alternation appears to compensate for the slow tongue dorsum. Another case where
articulatory convenience restricted the choice may be the tremulated version of the consonant [r], which was missing entirely in the material. Instead, its more neutralized cousin, the voiced [z], was used. It seemed essential that the syllabling has an overall relaxed character as opposed to a articulatorily hyperactive character.

The syllable choice seemed to depend to some extent on the instrument that the musician was usually playing. For example, the only tuba player was the only subject who used the syllable [taː] almost entirely. It is possible that the articulation in tuba playing is less varied than in other instruments, because of the slow tone onset that typically characterizes bass instruments. Also, wind-instrument players often use syllable articulation movements to achieve the proper control of the airflow, and syllables are frequently used in teaching wind-instrument playing. This can be expected to produce effects in these musicians' syllabling.

Let us now consider the musically relevant principles underlying the choice of syllables in syllabling. It seems that the musicians made a musical use of the phonetic characteristics of the phonemes. For example, Experiment III revealed that [m] was often used to represent micropauses which were represented by dots in the Concert Master's articulation marks. This is logical, as this consonant produces a decrease of loudness. The frequent occurrence of a voiceless stop consonant, like [p] after an [m], increases the effect as voicing ceases during such a stop, see Fig. 6. By preferring back vowels on accented notes, an acoustically induced increase of loudness is achieved; a high first formant produces a higher loudness than a low first formant. The very frequent use of initial voiced stop consonants, mainly [d], would serve the musical purpose that it produces a clear demarkation and, hence, gives the new tone a precise onset which obviously is essential to the timing of tones.

In this study, we have examined a rather limited material only and the analysis has also been focused on the syllable choice only. This poses the question to what extent these results are generalizable. We observed that the instrument of the musician may influence his/her syllable choice. We also observed that some musicians produced a rather stereotype syllabling containing a great number of repetitions of syllables, while others made a very varied and apparently careful choice. Clearly, musicians with different mother tongues can be expected to pronounce the same phonemes differently. On the other hand, as musicians seemed to make a musical use of the phonetic characteristics of the phonemes, it seems likely that the results have a general validity.

It could be mentioned that a very efficient test of the generalizability is now available. In future, we can implement the tentative rules for the syllable choice in syllabling that emerged from this investigation into a generative syllabling program. In such a program, the input is a music file and the output is synthesized syllabling, whereby the singing will be performed by our singing synthesizer MUSSE DIG (Sundberg, 1989).

It is sometimes assumed that music performance shows such a great variability, that it is almost pointless to even attempt a scientific analysis of it. This investigation does not support that assumption. We noted similarities in the syllable choice made by different musicians. We have also seen that the syllable choice is often musically meaningful. This suggests that the similarity in syllabling reflects similarities in the musicians' ideas as to how these music excerpts should be performed.

In our performance research we have found several reasons to believe that the deviations that musicians make from the score's nominal description are musically
meaningful, and therefore, we call them meaningful rather than expressive de-
viations (Sundberg, 1991). The meaning of the deviations, we have seen all imply that
the musician helps the listener in the cognitive task of realizing the structure of the
piece. For example, one type of rules helps the listener to realize how the tones are
grouped, and another type of rules helps the listener to categorize the tones cor-
rectly. In this study, we have seen that this marking of grouping occurs also in syl-
labling. By changing the syllable or by inserting a final nasal, perhaps followed by a
voiceless stop, notes belonging to different groups are separated. Conversely, by
avoiding final nasals and voiceless stops, tones belonging together, such as pairs of
slurred notes and in appoggiatura notes, are tied together acoustically. It is interest-
ing that the marking of groups occurs, although the syllabling person is often the
only listener.

This investigation was limited in many respects. We studied only the choice of
syllables in syllabling. It is possible that a continued examination of our material
may reveal more regularities. For instance, front vowels seemed particularly fre-
quent at high pitches. The pronunciation of the syllables is very likely to be musi-
cally revealing. Furthermore, there are other types of syllabling that may be worth-
while to analyze, such as skat singing and the vocabling that occurs in folk music in
many cultures. Still, even with this limited and preliminary investigation, interesting
results were found. This suggests that syllabling should be a worthwhile topic for
future research.

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