Chapter Four

Results

The results of the investigation will be reported in the following sequence: (1) Summary Statistics Relating to Session Sound Activity, (2) Variations in Participant Interaction with IMMI Audio Components, (3) Sound Activity Profiles, (4) Reconciliation of Audio and Video Records, (5) Analysis of Follow-up Interview Responses, (6) Participant Perceptions of Session Sound Activity, (7) Prior Computing Experience and Participant Sound Activity, (8) Participants’ Reactions to the Selected IMMI Programs. A summary of findings arising from results reported in this chapter is provided in Chapter Five within a contextual restatement of the research questions.

Summary Statistics Relating to Session Sound Activity


The duration of each study session was approximately twenty minutes (1200 seconds). Some very small variations in individual session times resulted in an average duration of 1199 seconds for MDQ sessions, while the average length of MMI sessions was 1193 seconds. Summary statistics relating to the occurrence of the audio components of Music, Voice, and Silence during the study sessions are presented in Table 4.1. The results indicate that on average, MDQ participants spent 28 percent (337.05 seconds) of their session time with Music playing, while Music occupied an average of 34 percent (404.81 seconds) of MMI session time. Voice occurred for an average of 13 percent (158.45 seconds) of MDQ session time, while in MMI sessions, an average of less than
one percent (3.06 seconds) of the session was spent with Voice sounding. MDQ participants spent an average of 58 percent (702.60 seconds) of session time in Silence, while in MMI sessions, Silence occurred for an average of 65 percent (784.71 seconds) of the session time.

Table 4.1 Summary Statistics - Occurrence of Audio Components in Study Sessions

<table>
<thead>
<tr>
<th>Audio Component</th>
<th>Mozart Dissonant Quartet</th>
<th></th>
<th></th>
<th>Microsoft Musical Instruments</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M *</td>
<td>SD *</td>
<td>%</td>
<td>M *</td>
<td>SD *</td>
<td>%</td>
</tr>
<tr>
<td>Music</td>
<td>337.05</td>
<td>127.65</td>
<td>28</td>
<td>404.81</td>
<td>134.30</td>
<td>34</td>
</tr>
<tr>
<td>Voice</td>
<td>158.45</td>
<td>197.23</td>
<td>13</td>
<td>3.06</td>
<td>2.79</td>
<td>1</td>
</tr>
<tr>
<td>Silence</td>
<td>702.60</td>
<td>182.53</td>
<td>58</td>
<td>784.71</td>
<td>135.17</td>
<td>65</td>
</tr>
</tbody>
</table>

Note. * = in Seconds, % = Percentage of Session Time

The number of Music, Voice, and Silence Events that occurred in each study session was determined through the identification and classification of the discrete audio segments using Sound Designer analysis. Following classification, the frequency of occurrence of Audio Events in each category was determined by the researcher using Sound Designer records which itemised every Audio Event that had occurred during the study sessions. Summary statistics relating to the number of Audio Events that occurred in the study sessions are presented in Table 4.2.

Table 4.2 Number of Audio Events per Session

<table>
<thead>
<tr>
<th>Type of Audio Event</th>
<th>Mozart Dissonant Quartet</th>
<th></th>
<th></th>
<th>Microsoft Musical Instruments</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M *</td>
<td>SD*</td>
<td></td>
<td>M*</td>
<td>SD*</td>
<td></td>
</tr>
<tr>
<td>Music Events</td>
<td>33.70</td>
<td>13.13</td>
<td></td>
<td>69.10</td>
<td>39.91</td>
<td></td>
</tr>
<tr>
<td>Voice Events</td>
<td>10.65</td>
<td>8.32</td>
<td></td>
<td>5.45</td>
<td>4.47</td>
<td></td>
</tr>
<tr>
<td>Silence Events</td>
<td>45.50</td>
<td>17.61</td>
<td></td>
<td>76.25</td>
<td>38.99</td>
<td></td>
</tr>
</tbody>
</table>
As Table 4.2 shows, the average number of Music Events in MDQ sessions was 33.70, while MMI participants activated an average of 69.10 Music Events. The average number of Voice Events in the MDQ sessions was 10.65, while MMI participants activated an average of 5.45 Voice Events. The average number of discrete periods of Silence in MDQ sessions was 45.50, while MMI participants had an average of 76.25 Silence Events.

The mean duration of individual Audio Events in each category was determined by dividing the average amount of time that an audio component had occurred during the sessions by the average number of occurrences of that component. As Table 4.3 shows, MDQ Music Events lasted for an average of 10.85 seconds, while Music Events in MMI sessions lasted for an average of 6.62 seconds. Voice Events in MDQ sessions continued for an average of 39.49 seconds, while MMI Voice Events lasted an average of less that one second. The average duration of a Silence Event in the MDQ sessions was 18.55 seconds, while Silence Events in MMI sessions lasted for an average of 13.05 seconds.

Table 4.3  Average Duration of Individual Audio Events

<table>
<thead>
<tr>
<th>Type of Audio Event</th>
<th>Mozart Dissonant Quartet</th>
<th>Microsoft Musical Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M *</td>
<td>SD*</td>
</tr>
<tr>
<td>Music Event</td>
<td>10.85</td>
<td>5.70</td>
</tr>
<tr>
<td>Voice Event</td>
<td>39.49</td>
<td>100.39</td>
</tr>
<tr>
<td>Silence Event</td>
<td>18.55</td>
<td>10.70</td>
</tr>
</tbody>
</table>

Note.  * = in Seconds
Variations in Participant Interaction with IMMI Audio Components

The Standard Deviation figures shown previously in Tables 4.1 and 4.2 indicate that variability in the extent of participant interaction with IMMI audio components was high. To further illustrate the observed variations, differences in participants’ use of Music are shown below in Figure 4.1, which depicts the percentage of session time that individual MDQ participants spent with Music playing.

As Figure 4.1 shows, the lowest occurrence of Music in the MDQ sessions was registered by Subject 16, who spent just five percent of the session time with Music playing. Subject 6, who spent 48 percent of the session time with Music playing had the highest occurrence of Music in the MDQ sessions.

A high level of variability in the occurrence of Music was also found in the MMI sessions. For example, as Figure 4.2 shows, while Subject 14 spent 58 percent of the session time with Music playing, Subject 9 spent just 15 percent of the session time with Music sounding.
The average duration of the Music Events that occurred in the study sessions also varied widely. For instance, Figure 4.3 shows that while Music Events in Subject 6's MDQ session were an average of more than thirty seconds in duration, Music Events in Subject 1's session had an average duration of just six seconds.
Likewise, wide variations were observed in the average duration of the Music Events that occurred in MMI sessions. As Figure 4.4 shows, the average length of the Music Events in Subject 14’s MMI session was 11 seconds, while Music Events in Subject 6 and Subject 8’s sessions lasted for an average of just three seconds.

![Figure 4.4 Average Duration of MMI Music Events](image)

Since the incidence of Voice was universally low in MMI sessions, typically less than one percent of session time, the occurrence of the two remaining audio components, namely Music and Silence, forms an almost inverse relationship in MMI sessions. As shown below in Figure 4.5, the percentage of session time that MMI participants spent in Silence varied widely. For example, Subject 9 registered the highest amount of Silence in an MMI session by spending 85 percent of session time in Silence. In contrast, Subject 14 passed 42 percent of the session time in Silence, which was less than half the Silence that occurred in Subject 9’s session. While there were substantial variations in the extent of the occurrence of Silence in MMI sessions, 40 percent of the study cohort spent 70 percent or more of their MMI session time in Silence.
In MDQ sessions, Voice played a more prominent role than it did in MMI sessions. Accordingly, the relationship between the occurrence of Music and Silence in MDQ sessions was frequently influenced by the occurrence of Voice. As Figure 4.6 shows,
Subject 16 registered 75 percent of session time with Voice sounding, an amount that was far higher than for any other MDQ participant. The high level of Voice occurrence in Subject 16’s session provides a plausible explanation for the low occurrence of Music in that session which was noted previously in Figure 4.1. The occurrence of Voice in other MDQ sessions was less extensive than that of Subject 16. Figure 4.6 also shows that while Subject 1 and Subject 17 each spent 27 percent of the session time with Voice sounding, the majority of MDQ participants registered Voice occurrence of less than 10 percent of session time.

The occurrence of Silence in MDQ sessions is depicted in Figure 4.7. Subject 4, who spent 88 percent of the session in Silence, registered the highest amount of Silence in an MDQ session. Subject 16, who spent just 20 percent of session time in Silence, recorded the lowest occurrence of Silence in an MDQ session.

As previously noted however, Subject 16’s session featured a high amount of Voice and thus, the relatively low level of Silence in this case does not represent a high level of
occurrence of Music. The results shown in Figure 4.7 also indicate that 25 percent of MDQ participants spent 70 percent or more of their session time in Silence.

Table 4.4 provides a summary of extremes in the amount of session time where Music, Voice, and Silence occurred. The results indicate that the occurrence of Music in MDQ sessions ranged from a minimum of five percent of session time to a maximum of 48 percent of the session time. In MMI sessions, the percentage of session time spent with Music playing ranged from 15 percent to 58 percent of the session time. The occurrence of Voice in MDQ sessions ranged from two percent of session time to 76 percent of session time, while the occurrence of Voice in MMI sessions remained universally low at less than one percent of session time. The occurrence of Silence in MDQ sessions varied between 20 percent of session time and 88 percent of session time. Similar variations in the occurrence of Silence were present in MMI sessions where one participant spent 42 percent of the time in Silence, while another passed 85 percent of session time in Silence.

Table 4.4 - Comparison of Extremes in Audio Component Occurrence

<table>
<thead>
<tr>
<th>Audio Component</th>
<th>Mozart Dissonant Quartet</th>
<th>Microsoft Musical Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High %</td>
<td>Low %</td>
</tr>
<tr>
<td>Music</td>
<td>48</td>
<td>5</td>
</tr>
<tr>
<td>Voice</td>
<td>76</td>
<td>2</td>
</tr>
<tr>
<td>Silence</td>
<td>88</td>
<td>20</td>
</tr>
</tbody>
</table>

*Note. % = Percentage of Session Time*

Figure 4.8 shows the number of Music Events that occurred in each MDQ session. There was a marked diversity in the frequency at which MDQ participants activated Music Examples. For example, Subject 14 activated 56 Music examples during the session, while Subject 16 activated just six Music examples.

Figure 4.8  MDQ – Number of Music Events Per Session
Figure 4.9 shows variations in the number of Music Events that occurred in each MMI session, which suggest that individual participants approached the activation of MMI Music examples in markedly different ways. For instance, Subject 8 activated 174 discrete Music Events, while Subject 3 activated 31 Music Events.
The number of Voice Events detected in the study sessions was low in comparison to the number of Music Events that occurred. Nonetheless, as Figure 4.10 shows, there were substantial variations in the number of Voice Events that occurred in the MDQ sessions. For example, Subject 2 and Subject 6 did not activate the Voice option, while 33 Voice Events occurred during Subject 1’s MDQ session and Subject 11 activated 25 Voice Events in his MDQ session.

Figure 4.10  MDQ – Number of Voice Events per Session

The graph shown below in Figure 4.11 indicates that despite the relatively small number of Voice Events that occurred in MMI sessions, there was a considerable amount of variation in the extent of participant activation of MMI Voice examples. For instance, while Subjects 3, 6, 7, 16, and 17 did not activate the Voice option, Subject 5 activated 16 Voice Events.
The number of Silence Events that occurred during each MDQ session is depicted in Figure 4.12. Subjects 1, 11, 13, and 14 each had more than 60 Silence Events, while Subject 16 registered only eight Silence Events during his MDQ session.
Figure 4.13 shows the substantial variation that existed in the occurrence of Silence Events during MMI sessions. For example, Subject 8 had 179 Silence Events, while Subject 3 registered only 32 Silence Events during the MMI session.

Table 4.5 shows a summary of extremes in the frequency of participant activation of Audio Events during the study sessions. In MDQ sessions, the highest number of Music Events was 56, and the lowest number of Music Events was six. The number of Voice Events in MDQ sessions varied from a maximum of 33 to a minimum of one. The number of Silence Events in MDQ sessions ranged from a maximum of 73 to a minimum of eight. The maximum number of Music Events that occurred during an MMI session was 174, while the minimum was 31. While one MMI participant activated 16 Voice Events, several other participant did not activate the Voice option in MMI. The highest number of Silence Events in the MMI sessions was 179, while the lowest number of Silence Events was 32.
Table 4.5 Comparison of Extremes in Participant Activation of Audio Events

<table>
<thead>
<tr>
<th>Audio Component</th>
<th>Mozart Dissonant Quartet</th>
<th>Microsoft Musical Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Highest #</td>
<td>Lowest #</td>
</tr>
<tr>
<td>Music</td>
<td>56</td>
<td>6</td>
</tr>
<tr>
<td>Voice</td>
<td>33</td>
<td>1</td>
</tr>
<tr>
<td>Silence</td>
<td>73</td>
<td>8</td>
</tr>
</tbody>
</table>

Note. # = Number of Audio Events per Session

As the provision of Music examples differs markedly between the two IMMI programs under investigation, comparisons of the extent of participant interaction with Music examples in MDQ and MMI sessions need to be undertaken with those differences in mind. Figure 4.14 shows a scattergram comparison of the amount of Music that occurred in the MMI and MDQ sessions.

Figure 4.14 Comparison of the Occurrence of Music in MDQ and MMI Sessions
As the scattergram shows, the amount of Music that occurred in the MMI sessions of Subject 2 and Subject 11 was similar to the amount of Music that occurred in their MDQ sessions. Conversely, the amount of Music that occurred during Subject 16’s MMI session was far greater than the occurrence of Music in his MDQ session. There was also a considerable difference between the amount of Music that occurred in the MMI sessions of Subjects 1, 4, and 8 compared to the amount of Music that occurred in their MDQ sessions. When considered overall, Figure 4.14 shows that eleven subjects registered higher amounts of Music in their MMI session, while nine participants recorded higher amounts of Music in their MDQ session.

The results presented thus far highlight variations in the extent of participant interaction with IMMI audio components during the study sessions. While some participants activated a relatively large number of Music examples and spent a substantial amount of their session time with Music playing, participant interaction with IMMI Music examples was frequently sparse, and the occurrence of Silence was extensive in many study sessions. The Sound Activity Profiles that follow extend the results of the present statistical analysis of session audio activity and integrate them with Sound Designer graphs, which elucidate further the variability that was present in participant interactions with IMMI audio components.

**Sound Activity Profiles**

To characterise participant interactions with IMMI audio components more accurately, a Sound Activity Profile (SAP) was developed for selected study sessions. A prominent feature of each SAP is a Sound Designer graph of sound activity that provides a visual basis upon which to interpret and compare participants’ session sound use. The graphs are accompanied by a table that lists the following details relating to the session:
1. The category of audio component: Music, Voice, or Silence.

2. The amount of the session time where Music, Voice, and Silence occurred.

3. The percentage of the session time where Music, Voice, and Silence occurred.


5. The frequency of occurrence of Music, Voice, and Silence Events.


The discussion of the SAPs is presented in three sections that correspond to the three audio components which are fundamental to the present investigation, namely, Music, Voice, and Silence. The study sessions depicted in the SAPs were selected on the basis of results from the initial statistical analysis of session sound activity. In an attempt to illustrate the variability in session sound usage, participants whose SAPs demonstrate extremes in the range of values for the occurrence of each of the three audio components were chosen for detailed examination. A complete set of Sound Designer graphs which show audio activity in each of the study sessions can be found in Appendixes F and G. It is important to emphasise that the Sound Designer graphs shown in the SAPs provide an overview of all session sound activity, that is, Music and Voice Events are not isolated graphically.
The Occurrence of Music in MDQ Sessions

The summary statistics of session sound activity shown previously in Table 4.1 indicate that the group mean for the amount of Music in MDQ sessions was 337.05 seconds (28 percent of session time). On average, MDQ Music Events lasted for ten seconds.

As Figure 4.15 shows, Music occurred for 574 seconds during Subject 6's MDQ session. Thus, Music accounts for 48 percent of Subject 6's session time, which was the highest amount of Music to occur in any MDQ session. Eighteen Music Events, which had an average duration of 32 seconds, were detected during the session.

Figure 4.15  Subject 6 - Mozart Dissonant Quartet  SAP

<table>
<thead>
<tr>
<th>Audio Component</th>
<th>Amount of Session Time (Seconds)</th>
<th>Percentage of Session Time (%)</th>
<th>Percentage Difference from Group Mean (%)</th>
<th>Number of Events for this Session</th>
<th>Average Length of Audio Events (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music</td>
<td>574</td>
<td>48</td>
<td>+14</td>
<td>18</td>
<td>32</td>
</tr>
<tr>
<td>Voice</td>
<td>112</td>
<td>9</td>
<td>+8</td>
<td>1</td>
<td>112</td>
</tr>
<tr>
<td>Silence</td>
<td>513</td>
<td>43</td>
<td>-22</td>
<td>20</td>
<td>26</td>
</tr>
</tbody>
</table>

Figure 4.16 shows that Subject 4 spent 86 seconds (seven percent) of the MDQ session time with Music playing. Ten Music Events were recorded during Subject 4's session and, on average, these Music Events lasted for nine seconds.
Variations in the occurrence of Music used during MDQ sessions can be illustrated further by a comparison of the SAPs of Subject 6 and Subject 4. Scrutiny of the graph of Subject 6's MDQ sound usage indicates that audio activity in the session was concentrated in three episodes. The most well defined of these is the period from approximately 14 minutes until the end of the session in which sound activity is almost constant. The graph of Subject 4's sound activity reveals a session characterised by long periods of Silence which were punctuated by short, isolated segments of sound. Silence dominates the session in which the limited sound activity is sporadic.

The results indicate that Subject 6 encountered almost seven times (6.67) more Music than Subject 4. The number of Music Events in Subject 6's session was 80 percent higher than the number in Subject 4's session. On average, Music Events in Subjects 6's session were three and a half times (3.55) longer than those in Subject 4's session.
The Occurrence of Music in MMI Sessions

As reported previously in Table 4.1, the average amount of Music that occurred in MMI sessions was 404.81 seconds (34 percent of the session time), while the average length of MMI Music Events was 6.62 seconds. Analysis of the MMI audio activity indicates that Subject 14 recorded the highest amount of session time with Music playing. The table in Figure 4.17 shows that Music use in Subject 14’s session was measured at 686 seconds (57 percent of session time) which is 23 percent above the group average. There were 60 Music Events during Subject 14’s MMI session and on average, those Music Events lasted for 11 seconds, which is almost twice the group mean.

Figure 4.17  Subject 14 - Microsoft Musical Instruments  SAP

<table>
<thead>
<tr>
<th>Audio Component</th>
<th>Amount of Session Time (Seconds)</th>
<th>Percentage of Session Time (%)</th>
<th>Percentage Difference from Group Mean (%)</th>
<th>Number of Audio Events</th>
<th>Average Length of Audio Events (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music</td>
<td>686</td>
<td>57</td>
<td>+23</td>
<td>60</td>
<td>11</td>
</tr>
<tr>
<td>Voice</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Silence</td>
<td>503</td>
<td>42</td>
<td>-23</td>
<td>65</td>
<td>8</td>
</tr>
</tbody>
</table>

Subject 9 registered the lowest occurrence of Music of all the MMI sessions. As Figure 4.18 shows, 182 seconds of Music occurred during the session which amounts to 15
percent of the session time, 19 percent below the group average. Forty-one Music Events occurred during Subject 9’s session which had an average length of four seconds.

Figure 4.18  Subject 9 - *Microsoft Musical Instruments*  SAP

<table>
<thead>
<tr>
<th>Audio Component</th>
<th>Amount of Session Time (Seconds)</th>
<th>Percentage of Session Time (%)</th>
<th>Percentage Difference from Group Mean (%)</th>
<th>Number of Events for this Session</th>
<th>Average Length of Audio Events (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music</td>
<td>182</td>
<td>15</td>
<td>-19</td>
<td>41</td>
<td>4</td>
</tr>
<tr>
<td>Voice</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Silence</td>
<td>1010</td>
<td>84</td>
<td>+19</td>
<td>50</td>
<td>20</td>
</tr>
</tbody>
</table>

Scrutiny of the graph of Subject 14’s MMI sound use indicates that this session was characterised by multiple periods of sound activity which were punctuated by relatively short periods of Silence. Sound activity is relatively evenly distributed throughout Subject 14’s session. However, the graph of Subject 9’s MMI audio activity depicts a session characterised by relatively long periods of Silence interspersed with shorter periods of sound. Audio activity occurs intermittently throughout the session with a notable absence of sound in the last few minutes of the session.

Variations in the occurrence of Music during MMI sessions are evident in a comparison of the SAPs of Subject 14 and Subject 9. Subject 14’s session contained almost four
times as much Music as Subject 9’s. The number of Music Events in Subject 14’s session was 46 percent higher than the number recorded in Subject 9’s session. On average, Subject 14’s Music Events were almost three times longer than Subject 9’s.

The Occurrence of Voice in MDQ Sessions

Analysis of session sound activity shows that, on average, participants encountered 158.45 seconds of Voice during MDQ sessions, which amounts to 13 percent of the session time. The average length of a Voice Event was 14.87 seconds. During her MDQ session, Subject 16 used 908 seconds of Voice. This amounts to 75 percent of the session time and is 62 percent above the average. As the results in Figure 4.19 indicate, two Voice Events occurred during Subject 16’s session.

Figure 4.19  Subject 16 - Mozart Dissonant Quartet  SAP

<table>
<thead>
<tr>
<th>Audio Component</th>
<th>Amount of Session Time (Seconds)</th>
<th>Percentage of Session Time (%)</th>
<th>Percentage Difference from Group Mean (%)</th>
<th>Number of Events for this Session</th>
<th>Average Length of Audio Events (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music</td>
<td>56</td>
<td>5</td>
<td>-23</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Voice</td>
<td>908</td>
<td>75</td>
<td>+62</td>
<td>2</td>
<td>454</td>
</tr>
<tr>
<td>Silence</td>
<td>237</td>
<td>20</td>
<td>-38</td>
<td>8</td>
<td>30</td>
</tr>
</tbody>
</table>

Legend: The horizontal axis = session time, the vertical axis = sound measured in decibels
The 908 seconds of Voice encountered by Subject 16 were delivered in two segments, resulting in an average Voice Event length of 454 seconds. As Subject 16 allowed the narration to play unimpeded for relatively long periods of time, the uncharacteristically large amount of time spent with Voice playing during Subject 16’s session was far greater than in any other MDQ session.

In comparison to the relatively long Voice Events in Subject 16’s session, the use of Voice for Subject 2 was confined to a single Voice Event that lasted for 24 seconds or two percent of the session time. Figure 4.20 shows that Subject 2’s session was characterised by relatively long periods of Silence with low occurrence of Voice and relatively moderate use of Music examples.

**Figure 4.20 Subject 2 - Mozart Dissonant Quartet SAP**

<table>
<thead>
<tr>
<th>Audio Component</th>
<th>Amount of Session Time (Seconds)</th>
<th>Percentage of Session Time (%)</th>
<th>Percentage Difference from Group Mean (%)</th>
<th>Number of Events for this Session</th>
<th>Average Length of Audio Events (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music</td>
<td>306</td>
<td>25</td>
<td>-3</td>
<td>36</td>
<td>9</td>
</tr>
<tr>
<td>Voice</td>
<td>24</td>
<td>2</td>
<td>-11</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
<td>Silence</td>
<td>878</td>
<td>73</td>
<td>+18</td>
<td>38</td>
<td>23</td>
</tr>
</tbody>
</table>

Inspection of the graph of Subject 16's MDQ session reveals consistent sound activity for much of the session. During the period from approximately minute one after the start
of the session until the seventeenth minute there is constant sound activity. The graph of Subject 2's session depicts sound activity of a more sporadic nature. The session is characterised by relatively brief segments of sound interspersed with longer periods of Silence.

The results presented in Figures 4.19 and 4.20 highlight substantial variations in the use of Voice in sessions with the MDQ program. For example, Subject 16 used 38 times more Voice than Subject 2. While Subject 16's use of Voice was 62 percent above the group mean, Subject 2's Voice use was 11 percent below the group mean. As the number of Voice Events was very low for both participants, comparisons between participants based on the average duration of Voice Events need to be interpreted with caution. Nonetheless, the relatively large amount of Voice used by Subject 16 resulted in an average length for the two Voice Events that was 19 times (18.91) higher than the length of the single voice event recorded during Subject 2's session.

**The Occurrence of Voice in MMI Sessions**

Statistical analysis of session sound activity indicates that the average occurrence of Voice in the MMI sessions was 3.06 seconds (less than one percent of session time). The average length of individual Voice Events was less than one second. As the table in Figure 4.21 shows, Voice occurred for 10 seconds in Subject 5's session, which amounts to less than one percent of the total session time. The table also shows that Subject 5 activated a total of 16 Voice Events which was the highest Voice usage of any MMI participant. While Subject 5's use of Voice was the higher than other MMI participants, the amount of Voice that occurred in the session was very small in comparison to the occurrence of Music. Therefore, the widespread audio activity depicted in the graph in Figure 4.21 essentially represents the occurrence of Music, which accounted for 46 percent of Subject 5's MMI session time.
The graph in Figure 4.22 depicts the audio activity in Subject 7’s MMI session. As the accompanying table shows, Subject 7 did not activate any Voice events and sound activity in the session was confined to the use of Music examples, which accounted for 23 percent of the session time. The absence of Voice Events in Subject 7’s session is representative of the Voice usage of a further 20 percent of MMI participants who did not activate the Voice option during their sessions.
Overall, the occurrence of the Voice component during MMI sessions was very low in comparison to the occurrence of Voice in MDQ sessions. It is important to reiterate, however, that the limited availability of Voice in the MMI program is likely to have had a marked influence on these results. While many MMI participants did avail themselves of the opportunity to hear some of the names of musical instruments pronounced, the brevity of those Voice excerpts and the lack of any other form of narration in the program, is likely to have contributed substantially to the low occurrence of Voice in MMI sessions.

The Occurrence of Silence in MDQ Sessions

Summary statistics of sound activity during MDQ sessions indicate that the average amount of Silence during session was 702.60 seconds (58 percent of session time). The average length of a segment of Silence was 15.44 seconds. The table in Figure 4.23
shows that during his MDQ session, Subject 4 registered 1057 seconds of Silence. This amounts to 88 percent of the session time, which is 30 percent above the group mean. The number of Silence Events during this session was 19 and the average length of a period of Silence was 56 seconds.

Conversely, the data reported in Figure 4.24 indicates that Subject 16 recorded 237 seconds of Silence during the MDQ session. This amounts to 20 percent of the session time which is 38 percent lower than the group average. There were eight Silence Events during Subject 16’s session and on average, a period of Silence lasted for 30 seconds.
The graphs in Figures 4.23 and 4.24 demonstrate the differences in the occurrence of Silence during these MDQ sessions. Subject 4's session is characterised by relatively long periods of Silence and short segments of Music and Voice. Sound activity is limited and Silence is the dominant feature of Subject 4's session. Conversely, the graph of Subject 16's MDQ session depicts a lengthy encounter with narration and relatively limited occurrence of Silence.

Further analysis indicates that more than four times (4.45) the amount of Silence occurred in Subject 4’s MDQ session than occurred in Subject 16's. Subject 4 had more than twice (2.37) as many Silence Events as Subject 16, and the average length of the Silence Events in Subject 4's session was almost twice (1.89) the average length of the Silence Events in Subject 16's MDQ session.
The Occurrence of Silence in MMI Sessions

The summary statistics presented in Table 4.1 indicated that the average amount of Silence in MMI sessions was 784.71 seconds (65 percent of the session time). The average length of a Silence Event was 10.29 seconds. Figure 4.25 shows that while using MMI, Subject 9 recorded 1010 seconds of Silence. This amounts to 84 percent of the session time, which is 19 percent above the group mean. As the accompanying table indicates, the number of Silence Events recorded during the session was 50. The average length of a period of Silence during Subject 9’s session was 20 seconds.

![Subject 9 - Microsoft Musical Instruments SAP](image)

Legend: The horizontal axis = session time, the vertical axis = sound measured in decibels

<table>
<thead>
<tr>
<th>Audio Component</th>
<th>Amount of Session Time (Seconds)</th>
<th>Percentage of Session Time (%)</th>
<th>Percentage Difference from Group Mean (%)</th>
<th>Number of Events for this Session</th>
<th>Average Length of Audio Events (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music</td>
<td>182</td>
<td>15</td>
<td>-19</td>
<td>41</td>
<td>4</td>
</tr>
<tr>
<td>Voice</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Silence</td>
<td>1010</td>
<td>84</td>
<td>+19</td>
<td>50</td>
<td>20</td>
</tr>
</tbody>
</table>

As the table in Figure 4.26 shows, Subject 14’s Silence was measured at 503 seconds or 42 percent of the session time, which is 23 percent below the group average. The number of Silences recorded during Subject 14’s session was 65, and on average, these periods of Silence lasted for eight seconds.
Variations in the occurrence of Silence during the MMI sessions can be further illustrated by a comparison of results obtained for Subject 9 and Subject 14. Figures 4.25 and 4.26 illustrate the differences between the sessions. Subject 9’s session is characterised by relatively short Music Events, which are on average four seconds in length, and longer periods of Silence, which last on average for 20 seconds. Subject 14’s graph reveals consistent sound activity throughout the session interspersed with relatively short periods of Silence. Subject 9 had twice (2.00) as much Silence during the session as Subject 14. The number of Silence Events in Subject 9’s session was 23 percent lower than that of Subject 14. On average, Silences in Subjects 9’s session were two and a half (2.50) times longer than the periods of Silence in Subject 14’s session.

The SAPs demonstrate substantial variations in the manner in which participants used Music, Voice, and Silence in the study sessions. The occurrence of Music ranged from a low of 5 percent of session time for one MDQ participant, to a high of 57 percent of
session time for one MMI participant. The occurrence of Voice was similarly diverse with subjects using small amounts in MMI sessions (typically less than one percent of session time), while Voice occurrence ranged to a high of 75 percent of session time in one MDQ session. The occurrence of Silence varied from a low of 42 percent of session time in one MMI session to more than double that in one MDQ session, where 88 percent of the session time was spent in Silence.

The results presented in the SAPs confirm that lengthy periods of Silence occurred in many study sessions. On average, 58 percent of an MDQ session was delivered in Silence, while an average of 65 percent of the time was spent in Silence during the MMI sessions. More striking is the discovery that some study participants spent as much as 88 percent of the session time in Silence. In view of these results, further investigation was undertaken with the aim of identifying reasons for the conspicuous occurrence of Silence in many study sessions. In an attempt to determine what was happening during the periods of Silence, two additional procedures were conducted. Firstly, an examination of videotape records of the sessions was undertaken in which the visual aspects of each session recording were reconciled with its audio components. Through this investigation of the visual component of each session recording, the researcher was able to determine the extent of participant interruption of Music examples and to consider whether interruption to Music examples could in part explain the Silences often found in the sessions. Secondly, follow-up interviews were conducted with selected subjects in an attempt to identify and explain behaviours and cognitive processes which may have influenced participant session sound activity. The results of these additional procedures are discussed in the following sections of this chapter.

Reconciliation of Audio and Video Records

With the aim of corroborating and expanding upon the results presented in the SAPs, the video component of each session recording was examined in an attempt to reconcile
visual documentation of participant activation and interruption of Audio Events with the corresponding audio recording. The analysis was conducted by the researcher using a Likert-scale evaluation instrument (shown in Appendix H) that was developed for the present study. A description of the analysis procedure and the methods that were used to establish its reliability have been provided in Chapter Three. In the graphs that follow, a score of 1 on the Likert scale corresponds to "Very Infrequently", while a score of 5 corresponds to "Very Frequently".

Participant Interaction with MDQ Music Examples

As Figure 4.27 indicates, 75 percent of participants activated MDQ Music examples either "Frequently" or "Very Frequently". However, the extent of participant activation of Music examples varied widely, as Subjects 4 and 16 activated MDQ Music examples "Very Infrequently".

Figure 4.27  MDQ – Level of Participant Activation of Music Examples

![Graph showing participant activation levels](image)

Note: M = 4.00, SD = 1.26
As Figure 4.28 shows, the generally high levels of activation of Music examples in MDQ sessions did not always translate into lengthy periods of Music listening. For example, while Subjects 4, 8, 15, 16, 19, and 20 interrupted Music examples "Very Infrequently", others, such as Subjects 1, 5, 9, and 18, often interrupted the Music examples they had selected.

Figure 4.28  MDQ – Level of Participant Interruption of Music Examples

Note. M = 2.40  SD = 1.23

Another measure of participant interaction with MDQ Music examples was an assessment of the extent to which participant activated individual Music examples more than once during the sessions. While the majority of MDQ participants did not often re-activate individual Music examples, the variability that was present in participant interaction with MDQ Music examples is evident in the behaviour of some participants who listened to Music examples several times. The graph in Figure 4.29. illustrates the extent of participant re-activation of individual Music examples.
Where multiple Music examples appeared on one screen, MDQ participant behaviour likewise varied considerably. As Figure 4.30 indicates, participants such as Subjects 1, 8, 13, 14, 15, 19, and 20, adopted a methodical approach by activating each Music example.
example on the screen before moving to a new screen. Others participants, such as Subjects 4, 6, and 16 tended to ignore multiple Music examples and frequently moved on without listening to them.

Participant Interaction with MMI Music Examples

As the graph in Figure 4.31 shows, the reconciliation of visual and aural components of the session recordings suggests that participant activation of Music examples during MMI sessions was high.

Figure 4.31   MMI – Level of Participant Activation of Music Examples

Note. M = 4.45, SD = .69

Ninety percent of participants activated Music examples either "Frequently" or "Very Frequently" and the Mean level of activation, when assessed on a five-point Likert scale, was 4.45 with a Standard Deviation of .69.

While the level of participant activation of Music examples was high for most MMI participants, a high level of activation did not necessarily translate into lengthy periods of Music listening. As the graph in Figure 4.32 indicates, some participants exhibited a high
level of interruption of Music examples during MMI sessions. For example, Subjects 3, 9, and 12 interrupted Music examples "Very Frequently". However, variability in the level of interruption of Music examples was high as Subjects 6, 14, 16, 17, and 20 demonstrated a very low level of interruption of Music examples.

Figure 4.32  MMI – Level of Participant Interruption of Music Examples

Note. M = 3.00  SD = 1.41

An assessment of the tendency of MMI participants to activate individual Music examples more than once during a session was also conducted. Participants rarely re-activated MMI Music examples, but as the graph in Figure 4.33 indicates, variability in the use of Music examples is reflected in the behaviour of Subjects 4 and 18 who demonstrated a much higher level of re-activation of individual Music examples than other participants.
Individualistic sound use behaviour is confirmed by the high level of variability in the level of participant activation of Music examples when multiple examples were made available on one program screen. The graph in Figure 4.34 shows that some subjects,
for example, Subjects 1, 6, and 8, had a tendency to methodically activate each Music example on a screen before moving to the next activity. However, many other users (for example Subjects, 3, 4, 7, 9, 11, 16, 17, and 18), when offered multiple Music examples on one screen, rarely chose to activate all these examples before moving to the next screen.

Reconciliation of the visual components of the study session recordings with the corresponding audio components indicates that while activation of Music examples was often high, participants frequently interrupted the Music examples they had selected. The high level of interruption of Music examples appears to have led to a decrease in the time that some participants spent on detailed Music listening. However, there was a high level of variability in the manner in which participants interacted with the Music examples and some subjects rarely interrupted the Music examples they had selected. A few participants were methodical in their approach, and listened to all the Music examples that were offered on each screen before proceeding to the next activity. Most participants chose not to listen to individual Music examples more than once.

**Analysis of Follow-up Interview Responses**

The analysis of session sound activity indicates that there were substantial differences between participants in the extent of their interaction with the IMMI audio components. In order to identify reasons for the observed variations, a series of follow-up interviews with selected participants was undertaken. The principal goal of these interviews was to ask subjects to identify and explain attitudes, behaviours, and cognitive processes which may have influenced their use of the audio components of Music, Voice, and Silence. Based on summary statistics and the results presented in the SAPs, four subjects were selected for further investigation. Two participants whose session sound activity represented extremes in the range of scores for use of the three audio components were selected for interview. A further two subjects whose sound use was near the group mean
for the use of the audio components were also selected. Details of the procedures adopted in the selection of follow-up interview participants and the subsequent analysis of responses have been provided in Chapter Three.

The follow-up interview responses were transcribed from audiotape and analysed using a computerised "keyword" searching technique. Common themes that were identified during the analysis have been used to develop a framework for presentation of the results. The responses will now be reported in respect to each of the identified themes which are Silence, Control of Sound, Quality of Sound, Simultaneous Presentation of Information in Differing Sensory Modalities, Instructional Advantages of IMMI, Sound Design, and Sound Use and Session Goals. Each section features a summary table which provides representative quotes that have been selected from responses to the interview questions and an overview of responses to the follow-up interviews finalises the discussion. Complete transcripts of the follow-up interviews are shown in Appendix J.

Silence
Subjects were asked: "Can you describe what you were doing during the periods of silence?". The most frequently cited responses were those relating to the issues of familiarisation, navigation, and time for decision making. Subjects often stated that the periods of Silence were a product of their need to familiarise themselves with the IMMI programs. Typical of comments was: "The silence was more just searching around the screen to see where I could go and trying to get familiar with the program really, seeing what options I had. That was about all. Feeling my way through it". Another subject observed : "Silence gives me the opportunity to look at everything and explore things, try something, comprehend something. Just to give you a chance to familiarise yourself, basically feel your way around".

The familiarisation process that subjects described involved gaining an overview of the program structure and content, and learning how to operate the user interface in order to
navigate successfully through the material presented in the program. Most subjects noted
that this familiarisation process was particularly important in the early stages of the
session. When accounting for periods of Silence later in their session, participants often
mentioned that Silence provided time for decision making as they contemplated their next
move. Silence also provided participants with an opportunity to concentrate on the
material presented on the screen, such as text and graphics, and gave them time to absorb
that information. Typical of comments was: "Silence... I guess I like that

Table 4.6   Silence - Representative Responses

<table>
<thead>
<tr>
<th>Comments prompted by Microsoft Musical Instruments</th>
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</thead>
<tbody>
<tr>
<td>Silence gives me the opportunity to look at everything and explore things, try something, comprehend something. Just to give you a chance to familiarise yourself, basically feel your way around. It's like a kid with a new toy, you have no idea of what the rules are and how far it can go and things like that. So it's important for things like that...for thinking.</td>
</tr>
<tr>
<td>At the start I guess I didn't listen too much just because I was trying to find my way into the program, and I wasn't really experienced...</td>
</tr>
<tr>
<td>If there was no sound playing and I was trying to work out what section I wanted to go in, then I might take a bit more time with that. If I knew the program well, there wouldn't be very much time where I wouldn't hear any sound. That's why I feel as though in both programs I had more time than I think of as being ideal with no sound playing, because I didn't know the programs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comments prompted by Mozart Dissonant Quartet</th>
</tr>
</thead>
<tbody>
<tr>
<td>I think I probably wasted a lot of time exploring... I mean you need to get to know the program, but I think once I knew the program more, I would have been better off spending more time on actually listening to specific sections when I got to them... but with your very first session, that's probably going to be the case with most people because you're looking around and just seeing what's available, sort of investigating it a bit more.</td>
</tr>
<tr>
<td>Yea, I'd have to rate silence quite highly because it allows me to concentrate on where I want to go with it. Part of the time was just spent reading. But most of it, especially in the early stages was just trying to find my legs... I think I spent a lot of time trying to figure out how to find a basic list of things I can choose from or how to get a listening example going, how to move from screen to screen, so it's just trying to get familiar with the CD-ROM.</td>
</tr>
<tr>
<td>I was just looking at the content, I think trying to familiarise myself with all the stuff that was there, you know. Knowing where things were, knowing that you could always go to the Contents (Menu). Because it's a new program I had to get my bearings. There was nothing wrong with the silence, I mean you can't have music going all the time.</td>
</tr>
<tr>
<td>The silence was more just searching around the screen to see where I could go and trying to get familiar with the program really, seeing what options I had. That was about all. Feeling my way through it.</td>
</tr>
</tbody>
</table>

because I can then think through what I'm trying to do, so when I'm not listening to
musical examples it allows me to concentrate on the actual visual stuff on the screen,
whether it's words or pictures". Subjects clearly valued being able to take the time to
consider their next move. A summary of responses relating to participants’ explanations about the occurrence of Silence during the sessions is presented in Table 4.6.

Control Of Sound

Most interviewees made reference to the issue of sound control when conversing about their study sessions. The option of being able to turn sound on and off was cited as being highly desirable: "I thought it was good that you could turn the music on and off as you pleased. I turned the sound on and off throughout". Subjects reacted very cautiously to the possibility of the use of "compulsory" sound excerpts (when this was suggested by the interviewer). Most subjects emphasised the need for user control. However one participant expressed a preference for the availability of "continual sound effects" with the option of being able to turn sound on and off.

When using the MDQ program, another subject found that a lack of control of the Music examples was frustrating. Sounds which played "automatically" were particularly undesirable and the participant noted that "all of a sudden it started playing, I hadn't actually clicked on it so it would play, I hadn't realised that that's what it would do". In comparing the two programs, the same subject observed: "I found the Dissonant Quartet program very frustrating because it wasn't clear to me how to get in and out of each screen and how to move to a musical example that I wanted to listen to. Whereas on Microsoft Musical Instruments, I just found it very obvious: it was a sound example and it had a picture of a gramophone".

Subjects often stopped the playback of the musical and narrative excerpts before they were completed. The most frequently cited reason for curtailing the playback of sound excerpts was the desire to explore other aspects of the program in the time available. Typical of comments was: "I stopped the playback of musical examples because I wanted to see what else the program had to offer". Subjects acknowledged that their
awareness of session time constraints led to them turn Music examples off. One participant was uncertain whether or not she had allowed any of the Music examples in her MMI session to play in their entirety.

Table 4.7  Control of Sound - Representative Responses

<table>
<thead>
<tr>
<th>Comments prompted by Microsoft Musical Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>If I had been reading the actual text while the music was playing I probably would have let the examples run longer. I don't know if I even let any of them run the full length. I think I turned them off and on as I was going.</td>
</tr>
<tr>
<td>I think having compulsory musical examples would frustrate me a little bit cause I wouldn't have the control over it. So, say if you were using it over a series of times, if you went to look up an instrument purely for factual information and you'd already looked and listened, there would be no need for you to hear the sound again. If it automatically came up and started playing it at me I'd find that frustrating because that's not what I wanted to use it for in that situation.</td>
</tr>
<tr>
<td>I stopped the playback of musical examples for a variety of reasons... wasn't interested, didn't want to hear any more, now I know what it sounds like, let's find something else.</td>
</tr>
<tr>
<td>I left the music on because I enjoy listening to it. But people could have the option if they didn't like the sound to have just read without any sound.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comments prompted by Mozart Dissonant Quartet</th>
</tr>
</thead>
<tbody>
<tr>
<td>The musical examples got on my nerves more than anything because I couldn't control them. All of a sudden it started playing, I hadn't actually clicked on it so it would play, I hadn't realised that that's what it would do. Even when I went to the Game, it constantly played stuff at me which I didn't really want. Lack of control with the sound frustrated me.</td>
</tr>
<tr>
<td>I stopped the musical examples because I wanted to start looking for more things. I don't think you could investigate while the music was playing.</td>
</tr>
<tr>
<td>I think when you are in a section you should have continual sound effects. That could be something that could be optional though. I mean you could have sound on or off. I would prefer it if music was more available. And the same with narration. If the sound was running more constantly, or that option was more frequent, that would be preferable.</td>
</tr>
<tr>
<td>I stopped the playback of musical examples because I wanted to see what else the program had to offer. It had nothing to do with the quality of sound or the examples because they were good. It was just more of a time thing for me, I just wanted to find more out about the program.</td>
</tr>
</tbody>
</table>

Orientation and navigation within the program also had an effect on some participants' use of the Music examples. One subject valued being able to retrace her steps in order to hear a Music example again: "I was realising you could do certain things, moving on and then thinking I want to hear a bit more, and moving back". Another subject found that retracing his steps was more of a challenge: "It doesn't surprise me that I had little snippets of sound because what I felt happened was that I'd find an excerpt and play a bit
of it, and then I couldn't work out how to get back to it for quite a while, which was why there were long gaps. A summary of responses relating to the Control of Sound is presented in Table 4.7

Quality of Sound
As reported in the analysis of The IMMI Programs in Chapter Three, there are important differences in the sound quality between the two programs. The MDQ program delivers sound of Compact Disc quality, whereas MMI sound is of a substantially lower fidelity.

As might be anticipated of subjects who are trained musicians, each of the interviewees made remarks relating to the quality of sound delivered during the study sessions. Most subjects agreed that the sound quality of both programs was high. It is interesting to note, however, that participants did not always perceive the superior sound quality of the MDQ program. One subject reported that the quality of sound delivered by the MMI program was better than that of the MDQ program. Another participant, who noted that his previous computer experience did not include sound, expressed general reservations about the quality of sound delivered by computers. He reported that in the MMI session he listened to "find out how they tried to simulate a tuba sound". When expressing a preference for Compact Disc recordings he observed: "I find that sound on computers is so obviously to me synthetic", but later acknowledged the possibility of an "in-built bias towards computers". Another subject held similar suspicions about computer-delivered sound and noted that she listened to examples to see what the sound quality was like as "computers sometimes create a false sort of sound". Conversely, another participant was "very impressed" with the sound quality noting that "the system sounded just like a stereo would".
Both of the subjects who expressed reservations about the quality of computer delivered sound asked the interviewer how the sound examples were "produced". Further questioning revealed that there were some misconceptions about how the sound was delivered. In particular, one subject was convinced that sounds were "simulated" on computer and were thus "at very best a rough guide". When asked to describe what he meant by "simulated" sound, the subject described, in some detail, the process of digital sampling which he said he believed to be the way computers delivered sound. A summary of representative responses relating to the Quality of Sound in the IMMI programs is presented in Table 4.8

Table 4.8  Quality of Sound - Representative Responses

<table>
<thead>
<tr>
<th>Comments prompted by Microsoft Musical Instruments</th>
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</thead>
<tbody>
<tr>
<td>The sound quality was really good. I think it was really good how you could see the instrument by itself and hear it within an ensemble.</td>
</tr>
<tr>
<td>I don't think I really listened to the tuba to find out what the tuba sounded like, more just to find out how they tried to simulate a tuba sound and what sort of pattern of music they played. I guess my idea is that the simulated sounds on computers are only, at best, a very rough guide. I don't listen to it to find out what the instrument really sounds like.</td>
</tr>
<tr>
<td>I think the sound quality is excellent, but then again, I can't really judge on the overseas instruments cause I wouldn't know what they'd sound like anyway. But the instruments that I was looking at like the French Horn, they're pretty good.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comments prompted by Mozart Dissonant Quartet</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was generally very impressed with the sound quality and even with the narration ... the recordings, as I've said were a good quality, the system sounded just like a stereo would, so that's a good sign.</td>
</tr>
<tr>
<td>I started off listening to the examples just to see what quality of sound the instruments had, to see if it was accurate. Computers sometimes create a very false sort of sound. I found that the sound quality was OK, it wasn't too tinny sounding, it sounded pretty accurate. Can I ask how the sound was produced?</td>
</tr>
<tr>
<td>The more I think about it, the more I find that sound on computers is so obviously to me synthetic, like it's not acoustic. So that's just something about the sound that I don't like. I'm not sure if it's things like dynamics. I never sense a lot of expression when I hear sounds on a computer.</td>
</tr>
<tr>
<td>If I listen to a CD playing - I'll probably get egg on my face because this is probably recorded by a String Quartet. It's probably just an in-built bias towards computers, maybe, I'm not sure. I tend to sense the expression a lot more when I'm listening on a CD or something. Is this recorded on a CD?</td>
</tr>
</tbody>
</table>

Simultaneous Presentation of Information in Differing Sensory Modalities

Subject reactions to the simultaneous presentation of information in differing sensory modalities such as graphics, music examples, narration, and on-screen text emerged as a
prominent theme in the analysis of interview responses. Participants varied considerably in their attitudes towards the simultaneous presentation of aural and visual media components. Regardless of their preferences for the separate or combined presentation of Music examples, narration, and on-screen text, participants emphasised the importance of user control and choice in the selection of presentation modality. Individual preferences were typified by the comments of one subject who found that narration "frustrates and distracts". He observed that "I guess anything that it would like to say to me I would prefer to just read myself". This subject noted that he worked best when there was "no other noise going on" and that "if narration was going I would have been partially oblivious to it". Another participant chose to focus on Music examples instead of "listening to narration or reading text". The desire for user control was likewise indicated by the participant who observed: "Some people like to be read to, and some like to read".

Support for the narration of on-screen text was provided by a subject who followed the text on the screen as it was narrated and observed that "it kept you focused a bit more than if you were just skimming through it". One user noted that she could "take in a lot more from hearing than from straight reading", while another found the narration annoying because she would "rather work at her own pace, without the voice". She observed that "you don't need somebody reading it out to you when you can read it yourself".

Listening to music in the background was not the favoured option of one subject who preferred "concentrating on it and following a score". However, another user favoured having music playing in the background because "you just get a better feel as the music was playing". She noted that it was possible to "continue on with what you're doing, if that was reading text, or looking at an instrument or artwork". Another participant reported that she could "read text and contemplate her next move while listening to the
musical examples”. Learning simultaneously from information delivered in more than one modality was preferred by a participant who noted that "you're absorbing from what you're watching as well as what you're hearing". Another user suggested that music helped her to recall images and remember the whole scene: "Pretty much when I remember the music the whole picture comes back”. A summary of responses relating to the simultaneous presentation of information in differing sensory modalities is presented in Table 4.9.

Table 4.9 Simultaneous Presentation of Information - Representative Responses

<table>
<thead>
<tr>
<th>Comments prompted by Microsoft Musical Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>I'd prefer having the choice, 'Do you want it read, do you want to read it yourself, or do you want both?'.</td>
</tr>
<tr>
<td>With Microsoft Musical Instruments, I focused on musical examples instead of listening to narration or reading the text.</td>
</tr>
<tr>
<td>I'm probably not reading the text, I'm probably thinking well let's have a listen and see what the differences are between the various orchestra configurations.</td>
</tr>
<tr>
<td>I've never worked very well with lots of noise going on. I've never studied with radios on, so if I wanted to listen to something I'd press the musical example. Otherwise I was quite happy to sit there and read and look at the images and think about that. I think I work best when there's no other noise going on.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comments prompted by Mozart Dissonant Quartet</th>
</tr>
</thead>
<tbody>
<tr>
<td>The narration is good because it's giving you information which you can either listen to or read, which is good cause that's two senses. The person has a choice of which they like.</td>
</tr>
<tr>
<td>From a learning point of view, I take in a lot more from hearing than I do from straight reading. I think I can read things and not take any of it in. So the more narrative stuff there is the better. The same with the music examples, because you're absorbing from what you're watching as well as what you're hearing.</td>
</tr>
<tr>
<td>I was actually reading ahead of the voice. The voice annoyed me a bit. I'd rather work at my own pace, without the voice. I just internalise it better if I'm reading it myself. I think you can work at your own pace anyway, you don't need somebody reading it out to you when you can read it yourself.</td>
</tr>
<tr>
<td>I liked narration with the on-screen text. Others may find that distracting if they wanted to move on faster, but I like listening to it. It was interesting having the text read to you. You were following the words, so it kept you focused a bit more than if you were just skimming through it.</td>
</tr>
<tr>
<td>I find it very hard to listen to art music as a background. The only way I can listen to it is by really concentrating on it and following a score. I find that for me it's worth more than just background music.</td>
</tr>
</tbody>
</table>

The Instructional Advantages of IMMI

Each of the subjects who were interviewed made reference to the advantages of using interactive multimedia for instructional purposes. The provision of information in
combined auditory and visual modalities was viewed very favourably. Subjects valued being able to "see, listen, read about, see where it [the musical instrument] comes from and find out how its name is pronounced". One participant was particularly pleased to be able to listen to the pronunciation of the names of the musical instruments: "I think I listened to a couple of them more than once actually, just to try and really understand what had been said".

Other subjects were impressed with the easy access to appropriate music examples, noting that "you can't get that just teaching in a normal setting". Typical of comments endorsing the use of music examples in the programs was: "I still love the idea of having something that you can listen to". Subjects agreed that: "The musical examples are really important. If you're examining or analysing a specific piece you have to listen to it. You can't just do it by reading".

Access to information about a wide variety of instruments was another issue that was raised. The MMI program was praised for providing access to a wide range of "most unusual instruments that people may not have heard of". One subject observed: "We've got instruments of the world, you want to listen to what it sounds like. I mean I could show you any picture of an instrument and you'd say 'Oh that's lovely dear, but what does it sound like?' You need to hear it".

One subject hinted at a need for moving images (video) in the programs: "I was trying to visualise from pictures, how the instrument would be played". For this participant, sounds and still images didn't provide sufficient information to be able to understand how some instruments might be played. A summary of responses which relate to the Instructional Advantages of IMMI is presented in Table 4.10

Table 4.10 Instructional Advantages of IMMI - Representative Responses
<table>
<thead>
<tr>
<th>Comments prompted by <strong>Microsoft Musical Instruments</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>I found this excellent about the musical instruments program: that it's got the most unusual of instruments that people may not have even heard of, or may not even be in a music dictionary. It's important to listen to instruments that you may not have even heard of before. That you can actually see, listen, read about, see where it comes from and find out how it's pronounced.</td>
</tr>
<tr>
<td>I was surprised by the variety of sounds. There were ensemble sounds and there were individual instrument sounds and I think if you're actually trying to find out about an instrument, but through practical situations you wouldn't have access to or you would never be likely to hear in your life, I guess it would give you some kind of an idea. But I'd be keen to temper that by saying that it's definitely not the real thing, that's my attitude towards it.</td>
</tr>
<tr>
<td>I still love the idea of having something that you can listen to.</td>
</tr>
<tr>
<td>I was trying to visualise from the pictures, how the instrument would be played, because although you've got the picture and you've got the sound, you don't really have that information on how it's played.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Comments prompted by <strong>Mozart Dissonant Quartet</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The musical examples are really important. If you're examining or analysing a specific piece you have to listen to it. You can't just do it by reading. So I think that's really important.</td>
</tr>
<tr>
<td>The program obviously provides plenty of listening examples. I think overall it's good because it covers the field of listening and musicology, providing examples along the way. You read something about Sonata Form then it will describe it, you can't get that if you're just teaching in a normal setting.</td>
</tr>
</tbody>
</table>

**Sound Design**

The responses to the interview questions which related to the design of sound in the MMI programs indicate a positive reaction from the users. Typical of comments was: "Yes, most screens that you went to had some sort of musical example which was good, and they were good examples at that. The actual musical content was good". One subject observed that in the MDQ program, "the narrator went at a good speed, it wasn't too fast, he had a friendly voice". Another subject, however, found that the narrator's accent was unpleasant.

Access to the sound examples was also generally found to be acceptable: "I think that the little sound icons are really easy to follow". However one user found navigation in the MDQ program particularly difficult, reporting that "with the Dissonant Quartet program I found it a lot harder to understand how to do things. I couldn't see the wood for the trees ... I just felt like I was stuck in a maze of tiny little screens and I didn't know how to get to the overall view". This participant expressed a high degree of frustration with the
MDQ user interface as he maintained that it caused confusion which inhibited interaction with the program.

Evaluation of the program designers' choice of music examples was an important goal for some subjects. One participant remarked: "Here I think I might have been trying to gauge how the musical example fitted in with my understanding of what a pop band would sound like". Subjects tended to gravitate toward instruments with which they were familiar (often an instrument they knew how to play) in order to provide a criterion for evaluation. Participants found that the Music examples in both programs were well chosen and representative of the appropriate style. Typical of remarks was: "I thought it was excellent the way the music was presented in more than one style... so that was good because you saw the instruments being used in different contexts". In relation to his Microsoft Musical Instruments session one subject confided: "Even though the musical examples didn't personally interest me, I think that they would be the most important thing about that CD-ROM, so I spent quite a lot of time listening to things".

There was some criticism of the brevity of the music examples provided in the MMI program, but subjects nonetheless valued the stylistic variety of the music excerpts presented in that program. Also valued was the MDQ program designer's choice to allow for the isolation of specific instrumental parts for individual attention: "I was quite impressed by how they divided each part up so you could actually listen to and discriminate between instruments, like how it had the violin and cello and viola, and it gave examples of each, rather than putting on a tape and not being able to discriminate between the parts". A summary of responses relating to Sound Design is presented in Table 4.11

Table 4.11  Sound Design - Representative Responses
Comments prompted by Microsoft Musical Instruments
Here I think I might have been trying to gauge how the musical example fitted in with my understanding of what a pop band would sound like. Yea, to see if the sort of sound they come up with for a 'Soft Rock’ band or a 'Pop’ band was what I would have thought in my own mind, had someone asked me.

The musical examples were long enough. They were good choices because they did show the best of either instrument or orchestra or what ever. It was up to the person's choice whether they wanted to listen to it or not. Some instruments you listen to out of curiosity, to know what it sounds like. Some of course you already know what they sound like.

Comments prompted by Mozart Dissonant Quartet
In the Musical Instruments program, the fact that I was able to go where I wanted to so quickly I think shows that I found it really obvious and clear about what the options were. It was very different with the Dissonant Quartet program. I found it a lot harder to understand how to do things. I couldn't see the wood for the trees. With Microsoft Musical Instruments I could always go to the big screen where you had the picture of the world and you kind of knew the big picture. Whereas on the Dissonant Quartet, I just felt like I was stuck in a maze of tiny little screens and I didn't know how to get to the overall view.

From what I can remember I was quite impressed by how they divided each part up so you could actually listen to and discriminate between instruments, like how it had the violin and cello and viola, and it gave examples of each, rather than putting on a tape and not being able to discriminate between the parts.

It was easy enough to find musical examples, I mean it always told you to 'Press Here'.

Sound Use and Session Goals
Before each of the IMMI sessions began, subjects we instructed to "explore" the program. They were informed that following the session, they would be asked to complete a questionnaire about their experiences during the session. No further instructions were given in relation to session goals.

Analysis of responses to the interview questions suggests that subjects most often approached their session from an investigative or exploratory perspective. Typical of comments was: "I didn't have a specific task I was trying to complete. I was just investigating. That was my plan, just to investigate with the time frame that I had".

Subjects observed that their approach may have been quite different if they had had a specific goal for the session. One user noted: "If I was going through and researching a problem properly I don't know that I would have done so much flicking around things. And the same with the musical examples, I probably would have just played them once, heard it throughout and moved on". The same subject later observed: "If I had, for example, been setting an assignment or something for a music class on a topic, I would
have just sat down and listened through it and sort of paid more attention and got through the whole thing. I don't think that it was boring, I just wanted to move on and see what else was there”.

Most interviewees said that they would have preferred to spend more time listening to Music examples. One subject observed that "whatever time I spent listening to musical examples was probably nowhere near as much as I wanted to spend listening to musical examples”. As an explanation for the limited amount of music listening during the session another subject ventured: "I think it happened more out of being lost at times and thinking I had limited (session) time”.

Musical preferences were acknowledged by one participant as having a significant bearing on her session listening: "So I mean they (the Music examples) were interesting but I thought 'oh no, no’… I remember looking at the bagpipes, I hate bagpipes, and I thought 'oh no, no, see you later!'" Another subject observed: "I can't see myself using a program like that to find out what the instruments sound like. Once I've experimented with different types of ensembles or instruments I would have pretty much exhausted the basic range of sounds that it could produce and so my interest in that was no longer. I was quite happy just to look at things and see the images and see the type of information they gave". A summary of responses relating to Sound Use and Session Goals is presented in Table 4.12.

Table 4.12  Sound Use and Session Goals - Representative Responses
I enjoyed listening, for no particular reason. And again, that's probably because of the way I was approaching the whole program, I was just fiddling around and seeing what I could find. If I was going through and researching a problem properly I don't know that I would have done as much flicking around things. And the same with the musical examples, I probably would have just played them once, heard it throughout, and moved on.

I'm a bit surprised that there's not as much sound in my Microsoft Musical Instruments session as I thought there might be. So I think I probably misjudged the time it took me to get through screens and find out how it worked. I think towards the end of the session, because I was going in to listen to a sound more just to find out how computers could do it, the interest in listening to things decreased. So I was more interested in reading and looking up stuff.

The amount of time I used the music would have been based on whether I wanted to hear them or not. I know that when I played the instrument in Asia, the flute, when I played that... OK, thanks, see you later! [Laughs] I wasn't interested... [in the sound].

I stopped the playback of narration, even though it was interesting, because I guess it wasn't an area I was going to research for a particular reason on the day, so I just moved on to see what else was there. If I had for example been setting an assignment or something for a music class on the topic, I would have just sat down and listened through it and paid more attention and got through the whole thing.

Interviewees frequently attributed the silences that occurred in their study sessions to a need for time to orientate themselves to the program structure and make decisions about how they would navigate through the program. Some interviewees attributed their interruption of Music examples to a desire to proceed with the session and to survey the contents of the program as thoroughly as possible in the time available. All interviewees reported an interest in the audio quality of the IMMI programs, but some were dubious about the capacity of computers to deliver high quality sound. These concerns about computer audio quality led at least one interviewee to minimise his music listening as he was convinced that computer sounds were "synthetic" and therefore of very limited appeal. Conversely, other interviewees found the sound quality was "really good" and praised the comprehensive provision of Music examples. There was agreement amongst interviewees about the need for user control of sound. While some interviewees preferred to listen to Music or narration as they engaged with the visual components of the
programs, other subjects favoured reading the text themselves. Most interviewees indicated that they would have preferred to listen to more Music during their sessions.

**Participant Perceptions of Session Sound Activity**

The four study participants that had been selected for follow-up interviews were asked to estimate the percentage of their session time during which Music, Voice, and Silence had occurred. The aim was to compare participants’ perceptions of their session sound activity with the results obtained from the Sound Designer analysis.

**MMI - Comparison of Perceived and Actual Session Sound Activity**

Interviewee estimates of the occurrence of the three audio components during the study sessions were frequently inaccurate. Figure 4.35 provides a comparison of the Perceived and Actual use of Music during the MMI sessions of the interviewees.

![Figure 4.35](image)

**Figure 4.35**  MMI - Perceived versus Actual Occurrence of Music
Figure 4.35 shows that all of the interviewees overestimated the amount of MMI session time that they had spent with Music playing. Participant overestimation of MMI Music occurrence was often substantial. For example, Subject 2's perceived Music usage was 2.60 times higher than the actual amount of time she had spent with Music playing.

Perceptions about the occurrence of Voice during MMI sessions were likewise frequently higher than the actual amount of Voice that occurred. Figure 4.36 portrays the disparity between interviewee perceptions and the actual amount of Voice that occurred during MMI sessions. For example, Subject 2 estimated that Voice had occurred for 10 percent of the session time when the analysis of session sound activity showed that Voice was present for less than one percent of the session time. While neither Subject 7 nor Subject 16 used Voice during their MMI session, Subject 16 nonetheless believed that Voice had occurred for 5 percent of the session time.

Figure 4.36   MMI - Perceived versus Actual Occurrence of Voice

As Figure 4.37 indicates, interviewee perceptions of the occurrence of Silence in MMI sessions were universally inaccurate. Moreover, interviewee estimates of the amount of
time they had spent in Silence were often substantially lower than the actual amount of Silence measured.

For example, Subject 2’s estimate that 30 percent of session time had been spent in Silence was less than half the 76 percent of session time during which Silence had occurred. Subject 7 was more accurate than the other interviewees in his perception of the occurrence of Silence, as the amount of Silence recorded during his MMI session was only 18 percent more than the estimate he gave. However, the amount of Silence measured in Subject 16’s session was almost one hundred percent higher than her estimate, while the amount of Silence in Subject 18’s session was fifty-seven percent higher than the estimate given.

MDQ - Comparison of Perceived and Actual Session Sound Activity

When considering their sessions with the MDQ program, the inaccuracy of interviewee perceptions of the occurrence of Music were less extreme than their estimates for MMI sessions. As Figure 4.38 indicates, three of the interviewees underestimated their MDQ
Music usage, which contrasts markedly with the universal overestimation of Music use observed in relation to the MMI sessions. Nonetheless, Subject 16 overestimated her MDQ Music usage at 40 percent of session time, while the actual occurrence of Music amounted to five percent of the session time.

Figure 4.38  MDQ - Perceived versus Actual Occurrence of Music

The occurrence of Voice in MDQ sessions was overestimated by two interviewees and underestimated by the other two interviewees, and interviewee estimates of Voice usage were often substantially divergent from the measured occurrence of Voice. As shown in Figure 4.39, Subject 2 estimated Voice usage at 50 percent of session time while her actual usage was two percent of session time. While Subject 7 reported that he had not used the Voice option, Voice had occurred for three percent of his MDQ session time. In Subject 16’s MDQ session, Voice occurred for 75 percent of the session time, although she estimated the occurrence of Voice at 40 percent of session time. Subject 18 was also inaccurate by reporting that 20 percent of session had been spent with Voice sounding, when Voice had occurred for 10 percent of the session time.
The occurrence of Silence in MDQ sessions was likewise not accurately perceived by most interviewees. While Figure 4.40 shows that Subject 16 was correct in estimating...
the occurrence of Silence in her session at 20 percent of the session time, other
interviewees were much less accurate in their perceptions. For example, Subject 2
estimated that 30 percent of her MDQ session time had been spent in Silence. The
analysis of audio activity indicates that Silence occurred for 73 percent of Subject 2’s
MDQ session time, more than twice what the participant had estimated. Subject 7
overestimated the occurrence of Silence at 80 percent of session time, when Silence had
occurred for 64 percent of the session time.

Overview – Interviewee Perceptions of Session Sound Activity
Since the follow-up interviews focused on a very small group of the study participants,
the results of this analysis of interviewees’ perceptions of session sound activity need to
be interpreted with appropriate caution. Nevertheless, some interesting trends emerged
which suggest issues that require further investigation. Most important perhaps is that
the analysis indicates that these IMMI participants frequently, and often to a substantial
degree, overestimated the amount of session time they had spent listening to Music.
Likewise, participants often underestimated the amount of session time they had spent in
Silence.
Prior Computing Experience and Participant Sound Activity

A subsidiary objective of the present investigation was to examine potential relationships between participants’ previous computing experience and their interactions with IMMI audio components. To ascertain the extent of previous computing experience of study participants, a pre-session questionnaire (Questionnaire One shown in Appendix D) which contained 14 items that requested information about the subjects' prior computer usage was administered. All participants (n = 20) reported that they had used a computer previously, however, fifty-five percent had received no formal computer training. Thirty-five percent of subjects had been using computers for less than one year, while twenty-five percent had more than five years computing experience. Fifty percent of participants used a computer, on average, for less than one hour per week, while fifteen percent used a computer for more than five hours a week.

Figure 4.41 shows a comparison of responses when participants were asked to rate their computer skills and their level of confidence in using computers on a five-point Likert scale (1 = Low, 5 = High). Thirty percent of participants rated their computer skills at the lowest level, while none reported having the highest level of computer expertise. Twenty percent of participants rated their computing skills above the Group Mean of 2.00. The results indicate that while there was some variability in the level of computing skills in the group, most participants rated their computing skill as low.

Figure 4.41   Participants’ Computer Skills and Confidence
Figure 4.41 also shows that participant confidence about using computers was often in the middle range, with an average of 2.40 on the Likert scale. Three subjects rated their confidence at the lowest level on the scale, while only one participant (Subject 14) reported having a very high level of confidence about using computers. Participants often reported higher levels of confidence about using computers, but lower levels of computer skill.

A further measure was employed to determine the level of participants' previous computer software usage. Subjects were asked to indicate the extent of their previous use of a variety of computer software such as word processors, music notation programs, and database programs. The Likert scale responses for each item from the twelve sub-scales of software usage have been aggregated to provide an overall indication of the relative level of software usage among participants. The results are summarised in Figure 4.42.
Figure 4.42  Participants’ Previous Computer Software Usage

Note. M = 9.70, SD = 9.16

The results shown in Figure 4.42 confirm substantial variations in the extent of previous software usage of the study cohort. Subject 14, for example, had a software usage aggregate of 34, while Subjects 4, 12, 19, and 20 each had an aggregate of only two.

The types of software that participants had used varied widely. Word processing software was the most frequently reported, with 85 percent of participants previously having used a word processor. The second highest category of software use was that of computer games with 70 percent of participants reporting previous experience of computer games. The use of software in the categories of database programs, desktop publishing, and spreadsheets was very low. Thirty-five percent of participants reported having used computer software in music composition and notation tasks, while ten percent of subjects indicated that they had used music sequencing software such as Cubase (1988). The extent of Internet usage by study participants was very low, with
only one subject noting prior email use, and three subjects reporting "non-email" Internet use. The limited range of computing experience of most study participants was illustrated further by responses which show that 85 percent of subjects had never used a modem. Perhaps of more relevance to the present investigation was that 65 percent of subjects reported that they had not previously used a CD-ROM player.

Another related measure of prior computing experience requested information about the participants' previous use of interactive multimedia programs such as those that are the focus of the current research. As the graph in Figure 4.43 shows, participants' previous usage of interactive multimedia software was very low, with 65 percent of participants reporting no prior experience of interactive multimedia. When questioned specifically about the IMMI programs used in the present investigation, 75 percent of subjects reported that they had not previously used the MMI program, while none reported having previously used the MDQ program.

Figure 4.43  Participants' Previous Interactive Multimedia Software Usage

Note:  M = .90, SD = 1.55
Participants' attitudes towards the use of computers in music instruction may also influence their reactions to, and perceptions of, the IMMI programs under investigation. The pre-session questionnaire surveyed participant attitudes towards the use of computers in music education. Results indicate that 35 percent of subjects considered computers to be important for music learning, but 65 percent of participants were less optimistic about the potential of computers in music instruction. Nonetheless, 55 percent of participants indicated that they would be "Keen" or "Very Keen" to use a personal computer in their music teaching.

Overall, the extent of participants' previous computer usage could be characterised as limited. While most subjects reported being moderately confident about using computers, self-assessment of the level of computer skills was less optimistic. Previous software experience tended to have focused on the use of word processors and computer games, which most subjects had encountered at some time. However, prior use of interactive multimedia software and the Internet was minimal. Participant attitudes towards the use of computers in music education were moderately favourable, but the majority of participants had limited computing experience and no previous experience of IMMI. These results suggest that while most participants were keen to discover more about the use of computers in music instruction, the relatively low levels of previous computer use, and in particular the frequent absence of prior interactive multimedia experience, may affect participant interactions with the principal media components of the IMMI programs that are under investigation in this study. Potential relationships between participants’ prior computing experience and their interactions with Music, Voice, and Silence during the IMMI sessions are explored in the ensuing paragraphs.

To investigate relationships between participants’ previous computer experience and the extent of participant interactions with IMMI audio components, measures of prior computing experience were correlated with the results of the Sound Designer analysis of
session sound activity. While no strong relationships were detected between MDQ
session sound activity and prior computing experience, several of the measures of prior
computing experience showed a moderately strong relationship with the amount of
Music that had occurred during MMI sessions. For example, the overall measure of
participants’ previous computer software usage correlated with the amount of Music in
MMI sessions at the level of $r = .51$. This result indicates that the higher the level of a
participant’s prior computer software usage, the more Music occurred during their MMI
session. A similar positive relationship between subjects’ self-rating of their computer
skills and the amount of Music that occurred during the MMI session was measured at $r
= .44$. Hence, participants who rated their computer skills higher tended to have higher
occurrence of Music in their sessions. Likewise, the relationship between the level of
subject confidence about using computers and the amount of Music occurring during
MMI sessions was found to be moderately strong at the level of $r = .43$. This suggests
that the more confident subjects were about using a personal computer, the more Music
occurred during their session.

As there is an inverse relationship between the occurrence of Music and the occurrence
of Silence in MMI sessions, the amount of Silence that occurred during MMI sessions
showed corresponding negative correlations with the measures of the subjects’ prior
computer experience reported above. These results confirm the positive relationship that
exists between participants prior computer usage and the occurrence of Music in MMI
sessions. The overall measure of previous computer software usage correlated with the
amount of Silence at a level of $r = -.51$. Subjects with a higher level of previous
computer software usage tended to have less Silence in their sessions. MMI participants’
ratings of their personal computer skills correlated negatively with the amount of Silence
in the sessions at the level of $r = -.44$. Higher levels of personal computer skill were
associated with lower amounts of Silence. Participant self-assessment of confidence in
the use of personal computers correlated negatively with the amount of Silence in the
MMI sessions at a level of $r = -0.43$. Participants who were more confident about their computer use tended to have less Silence in their MMI sessions.

The results of the current investigation indicate that there was a moderately positive relationship between the several measures of participants' computing expertise and the extent of their interaction with MMI Music examples. As similar relationships were not found between participants’ prior computing experience and the extent of their interactions with the audio components of the MDQ program, further research will be required to corroborate the results reported here.

**Participants’ Reactions to the Selected IMMI Programs**

A post-session questionnaire (Questionnaire Two shown in Appendix E) was designed to assess participants' reactions to the selected IMMI programs. The questionnaire, which was delivered immediately following each session, included five open-ended questions in which subjects were asked what they felt they had learned during the session and what they thought were the best and worst features of the selected IMMI programs. Participants were also asked to suggest how the IMMI programs could be improved and to summarise their reactions to the programs. A "keyword" searching technique similar to that used in the analysis of the Follow-up Interview responses was applied in the examination of participant responses to these open-ended questions. In view of the principal research objective, which was to analyse sound activity in study sessions, the focus of the keyword search was on participants’ references to sound use during the study sessions. The following summary of responses reflects that emphasis.

Participants obviously valued being able to listen to Music examples during the study sessions. Typical of comments about the IMMI programs was: "I liked being able to hear what the instruments sounded like. It might be interesting to know about an instrument or ensemble, but it's useless if I don't experience their sound". In reference to
the MDQ program one subject noted: "I like how excerpts were played for you - to demonstrate what the text pointed out - for example the tritone". Many MMI users were particularly impressed by the program's capacity to deliver information about lesser known instruments. One participant enthused that "being able to access information and sound examples about not-so-common instruments is great".

Users also valued the IMMI programs' capacity to present information in differing sensory modes. Typical of comments in relation to the MMI sessions was: "It is better than a book because of the combination of sound and sight". MDQ users also approved of the fact that the information was presented in a "variety of learning styles (sic), for example: visual, aural, text and games". However, users were not universal in their approval of multi-modal information presentation. One MMI participant remarked that sometimes "there was too much reading and I just wanted to hear the instruments played". Some MDQ participants wanted more musical notation: "It was a pity that it did not consist of the score. It would have been better to listen to the music with the score in front of me". Another MDQ user agreed and noted that "the music (score) should be visible while listening to the commentary".

Responses indicate that while subjects generally considered the quality of sound to be high in both programs, there were some notable exceptions. The sound quality of MMI examples attracted the most criticism. One discerning participant commented: "I felt the sound quality wasn't the best. In every example there was a hissing sound which you don't expect to hear recorded onto Compact Discs. Some of the instruments sounded as though they had been recorded on synthesiser and not on the original instruments". In spite of widespread approval of the sound quality in the MDQ program, one user nonetheless felt that "the violin sounds were often scratchy and painful to listen to".
Many participants made reference to the benefits of multimedia as an educational tool. One MDQ user reported that "multimedia programs can be very useful and can encourage learning because of the equipment used". Another participant valued "the concise information that is found all at once on a CD. To find all that information one would have to look for information all day in a library". Users were also impressed by the capacity of multimedia to deliver immediate feedback, with one participant suggesting that "the best thing about the program was being able to click on, and immediately compare, sections of the String Quartet. The program provided immediate feedback while the original version was fresh in my mind - a great tool for comparison".

The post-session questionnaire included a further 18 items which required participants to rate their session experience using five-point Likert-type scales. These questions sought to focus participant attention on particular aspects of their multimedia encounter. Initial statistical analysis of responses to these questions involved the calculation of means and mean differences. Further analysis to determine any significant differences was undertaken using the student’s t-test. A summary of the results is shown in Table 4.13.

Table 4.13  Statistical Analysis of Participants’ Reactions to the Sessions

<table>
<thead>
<tr>
<th>Questions and Statements</th>
<th>MMI M</th>
<th>MDQ M</th>
<th>Mean Difference</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. How would you rate the program overall?</td>
<td>4.30</td>
<td>3.75</td>
<td>.55</td>
<td>2.773</td>
<td>.0121*</td>
</tr>
<tr>
<td>7. How would you rate the overall quality of sound?</td>
<td>3.90</td>
<td>4.10</td>
<td>-.20</td>
<td>-.748</td>
<td>.4639</td>
</tr>
<tr>
<td>8. Musical examples were made available at appropriate times.</td>
<td>4.45</td>
<td>3.70</td>
<td>.75</td>
<td>2.162</td>
<td>.0436*</td>
</tr>
<tr>
<td>9. The musical examples were of an adequate length.</td>
<td>3.55</td>
<td>4.10</td>
<td>-.55</td>
<td>-1.718</td>
<td>.1021</td>
</tr>
<tr>
<td>10. It was easy to control the playback of musical examples</td>
<td>4.65</td>
<td>3.90</td>
<td>.75</td>
<td>2.210</td>
<td>.0395*</td>
</tr>
<tr>
<td>11. The musical examples enhanced the information presented on the screen.</td>
<td>4.85</td>
<td>4.05</td>
<td>.80</td>
<td>2.792</td>
<td>.0116*</td>
</tr>
</tbody>
</table>
The results reported in Table 4.13 indicate that overall, participants rated the MMI program higher than the MDQ program. While subjects were not asked to directly compare their experiences with the two MMNI programs, when adjustments are made to account for the polarity of the questions, statistical analysis indicates that subjects rated MMI higher than MDQ on 15 of the 18 measures in the post-session questionnaire. There was a significant difference ($p < .05$) in favour of MMI on six measures, namely, the overall approval rating, the availability of Music examples, the control of playback of Music examples, the Music examples enhanced the information presented on the screen, the desire to use the program again, and willingness to recommend the program to others. There were three measures upon which subjects rated MDQ higher than MMI, namely, the overall quality of sound, the length of the Music examples, and the volume of sound during playback.
sound during the playback of Music examples. However, the differences between programs on these measures were not found to be statistically significant.