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MMTT Prototypes Usability Testing First-Round Report May 10, 2002

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Executive Summary

During February and March 2002, the first round of usability testing was conducted for three Multimedia Music Theory Teaching (MMTT) lesson prototypes. The purpose of the MMTT initiative is to create authoring tools which music theory faculty can use to create personalized theory exercises, as well as provide music students with a way to practice theory in an interactive environment. More information about this project as well as its umbrella project, Variations2: The IU Digital Music Library, may be found at: <http://dml.indiana.edu/mti/index.html>.

Five students worked through computer-based prototypes of the lessons at the Usability Lab at Indiana University's School of Library and Information Science (SLIS). The purpose of the formative evaluation was to gauge student interest in computer-based theory practice, assess learning potential, and uncover general design usability issues.

Results of the sessions revealed that students were enthusiastic about using these types of tools to practice music theory. Participants enjoyed the musical examples and claimed that both the types and difficulty of questions were appropriate. Aside from some "cosmetic" issues with the interface (e.g. color and layout), the most severe problems occurred when users opened the first prototype and did not know what to do. Although technical glitches prevented testing of some elements (e.g. melodic dictation - Lesson 3), users seemed comfortable with the interactive nature of most tasks. One notable issue was confusion due to the movement of the score in Lesson 2. In addition, some users incorrectly used the Check/Reset answers function and were confused by the red x's which indicate an incorrect answer. Suggestions for improvement of the design with regard to the above issues are offered.

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I. Purpose of the Study

The Multimedia Music Theory Teaching (MMTT) Project aims to:

“...produce software tools and applications to support music teaching, learning, and research. Using these new tools, students will be able to experiment, try alternatives, and work collaboratively with colleagues who have access to the same resources. Faculty with modest computer skills will be able to create lessons efficiently and provide students with highly interactive learning experiences in music.” (from <http://dml.indiana.edu/mti/index.html>)

As such, a formative usability study was conducted on the first iteration of MMTT prototypes in order to:

- evaluate student learning potential in light of a variety of lesson content and presentation formats (i.e. question difficulty, appropriateness of musical examples, ease of completing harmonic analysis, melodic dictation, etc.);
- gauge student interest in using similar computer-based applications to complete music theory exercises; and
- assess the usability of the interfaces in terms of navigation, content layout and design.

MMTT Lessons

Three prototypes were created using Macromedia Director to facilitate a high-fidelity, computer-based testing environment. The sample lessons are intended for use in a) class assignments and b) general music theory practice. Each lesson contains a musical listening example (controllable by a media player) related to the lesson questions. As detailed below, each of the three MMTT lessons is designed to test specific music theory skills through use of various interactive elements.

Lesson 1 introduces the “phrase bubble” concept which appears in later lessons. Users may click on each phrase bubble to hear that specific phrase, or they may select a phrase tab and use the player controls on that tab. Dropdown menus (indicated with a ?) above each phrase bubble allow the user to select and label the phrases, as required for question 1. Each tab contains additional questions that address a wide range of music theory concepts, including harmonic rhythm, rhythmic motive, scale degrees, texture, cadential chords, and motives; users may check or reset answers on the final tab. Questions in Lesson 1 require a range of user interactivity, from multiple choice and dropdown menu selection to dragging and dropping. Since the media player is always available, users may listen to the musical example and repeat phrases as many times as necessary in order to answer the questions.

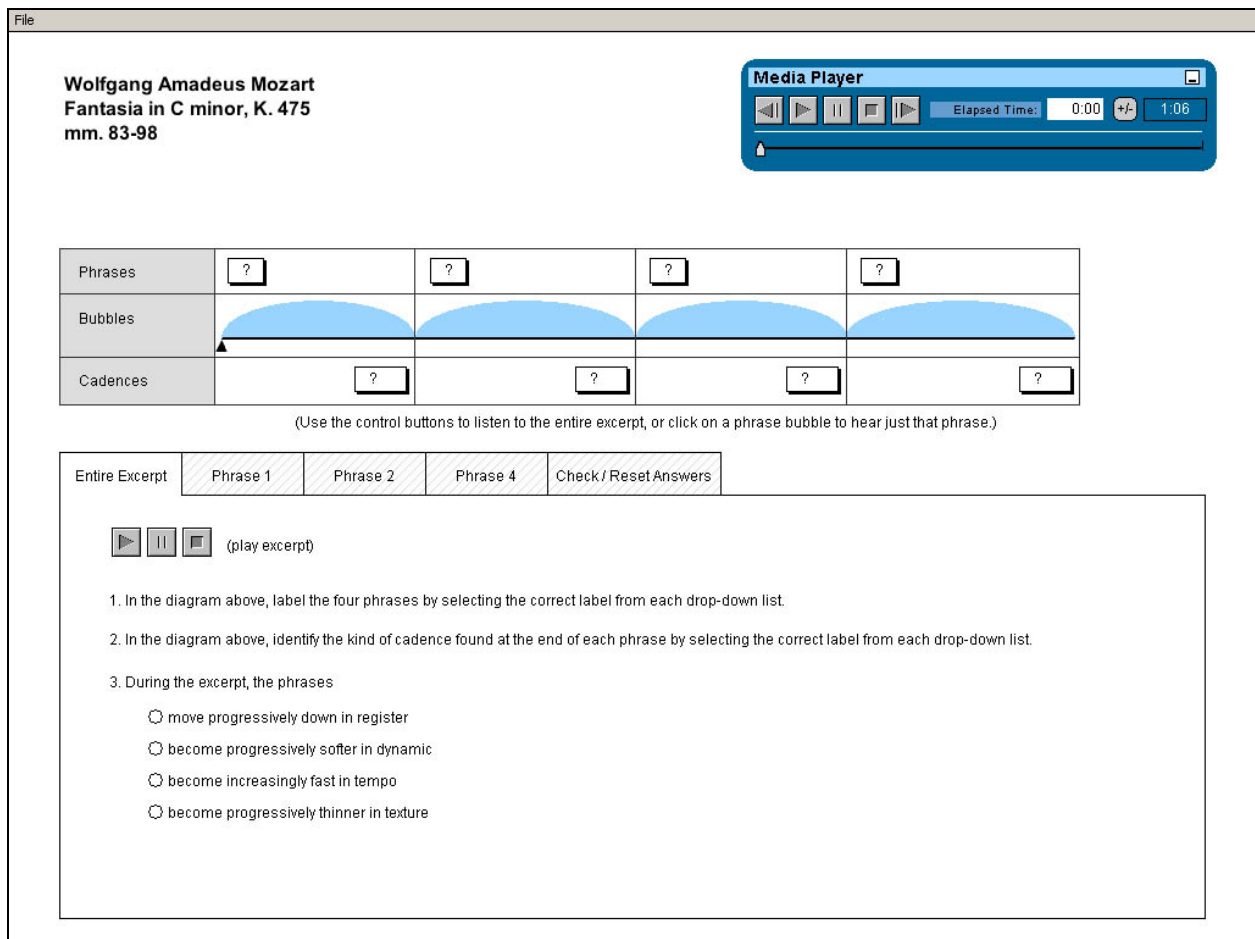


Figure 1 - Lesson 1 Initial Screen

Lesson 2 includes an interactive, movable score that helps users determine the structure of the excerpt while completing a form diagram. The score may be moved using the arrows on the left and right sides or by dragging with the mouse. Users may double click on the score while the excerpt is playing in order to add phrase markers (shown as vertical lines in mm. 8 & 12), or alternatively, may press the space bar to add markers. Once the phrase structure has been determined then phrase labels may be selected from the dropdown menus which appear as the phrase markers are placed. Roman numeral analysis is another element which allows users to interact with the score by typing in chords below the score (e.g. the "V" typed in the box below measure 9). Finally, identification of a non-chord tone is enabled through a drag and drop method in which users place a box labeled NCT over the note in the score that is a non-chord tone. They may then double click on the NCT box to select the type of non-chord tone exemplified by the note (shown in measure 10). In this lesson, users may not "check" their answers; they may only reset or submit them.

The screenshot shows a software interface for music analysis. At the top left, it identifies the piece as "Franz Joseph Haydn Menuet from Divertimento in C, Hob. XVI, I". A "Media Player" window is visible in the top right corner, showing an elapsed time of 0:00 and a total duration of 0:56. The main area contains a musical score with several measures (4, 9, 11, 12, 13, 14) and blue shaded regions above it representing phrase structures. A dropdown menu is open over measure 11, listing options: "?", "a", "a'", "a''", "b", "b'", "c", "c'", and "d". Below the score, there are boxes for Roman numeral analysis, with the letter "v" entered in the first box. At the bottom, there is a "Form diagram" section with tabs for "Roman Numerals", "Non-chord tones", and "Submit Answers". The instructions in this section are:

1. Create a form diagram showing the phrase structure of this piece. Double-click on the score to mark the location of each new phrase. You may reposition the marker by dragging it to the left or right. You may delete a marker by double-clicking on it.
2. Once you have created your form diagram, indicate the phrase form by selecting the correct phrase label from each drop-down list in the "Phrases" row.
3. Which term best describes the form of this piece?
 - simple binary
 - rounded binary
 - balanced binary
 - ternary

Figure 2 - Lesson 2: Illustration of form diagram phrase markers, phrase dropdown menu, roman numeral analysis, and NCT box.

Lesson 3 introduces the Timeliner as an interactive tool to aid the form diagram activity. As illustrated, users set the phrase bubbles as they listen to the excerpt. As in Lesson 1, the phrase and cadence structures are also selected from dropdown menus. Finally, bubble colors are changed to reflect similar and contrasting phrase structures. The Melodic Dictation tab features a Note Palette that enables users to drag and drop notes onto staff lines. Additional theory questions are asked in various formats regarding scale degrees (multiple choice), texture (text box fill in), and orchestration (checkbox choices). As with Lesson 2, users may not “check” their answers; they may only submit or reset them.

The screenshot displays the Lesson 3 interface for Johann Sebastian Bach's "In meines Herzens Grunde". It includes a media player at the top right, a central timeline diagram with four colored bubbles (two purple, one green, one black) and question marks for phrases and cadences, and a timeliner tool at the bottom right. The timeliner tool has a 'Marks' list with values 0.0, 11.8, 23.2, 36.0, and 54.9, and a 'Bubble Color' dropdown menu currently set to 'Black'. Below the timeline, there are instructions for using the tool and a set of tabs for 'Form diagram', 'Melodic Dictation', 'Scale Degrees', 'Texture / Orchestration', and 'Submit Answers'.

Figure 3 - Lesson 3: Illustration of cadence dropdown, Timeliner tool, and bubble colors.

II. Participants

Co-investigator Mark Notess recruited participants (n=5) from two music theory courses at Indiana University (T252, T511). During recruitment, the purpose of the usability test was explained and students who wanted to volunteer wrote their email addresses on a sign-up sheet. An email was then sent to those students who volunteered and a session time was arranged for those who responded that they would like to participate in the particular round of testing.

All participants were music majors and had varying levels of experience with computers, computer-based music theory software and other educational software. A summary of the relevant demographic characteristics of the participants is shown in Table 1.

Table 1 – Participant Demographics Summary

Student #	Gender	Major	Computer Usage (hrs/wk)	Used music theory software? Which ones?	Used other educational software?	PC Experience (1=novice – 5=Expert)
1	F	Choral/general music education	11-20	Y – ET Drill	N	4
2	F	Viola Performance	11-20	Y – Practica Music; Lorenzo Crosby Program	Y	4
3	F	Voice Performance	0-5	Y – ET Drill; Finale; Cake-walk; Passport/music time	Y	2
4	F	Trombone Performance	6-10	Y – ET Drill	N	4
5	M	Trumpet Performance	6-10	N	N	4

III. Method

Upon each student’s arrival at the SLIS usability lab, the facilitator explained briefly the purpose of the usability test and also made sure that participants were comfortable with the set-up of the lab. Participants were then seated at a PC (set to 1024x768 resolution) and provided with a packet of information. First, they read through and signed the Informed Consent form (which also described the testing procedure). Next, they filled out an initial demographic survey (Appendix A, p. 1). When done with that, participants explored the computer-based lessons; each worked through in the same order: Lesson 1, then Lesson 2, then Lesson 3. A shortcut icon for each lesson was already up on the computer desktop so participants simply had to double-click to open each application. All interactions with the lessons were videotaped and observed by the facilitator. Once subjects had explored all three lessons, they completed a final satisfaction questionnaire (Appendix A, p. 2). The facilitator then debriefed the subject in order to ask about noted critical incidents and glean responses to a pre-written list of debriefing questions (Appendix A, p. 3). After debriefing, participants were given a \$10 giftcard as compensation and asked to sign a sheet indicating they had received the giftcard. Finally, the facilitator made a photocopy of the Informed Consent form and gave that to the participant for his/her records. All facilitation was performed by the principal investigator and included acts such as giving assistance when participants got “stuck” or when there was a technical glitch in the prototype, inquiring about critical incidents, and debriefing. Results deemed important were mostly qualitative in nature; a transcription of these data is provided in Appendix B.

IV. Findings and Recommendations

Overall

Overall, test participants made positive comments about the prototypes. They indicated enthusiasm about learning and practicing music theory skills using similar types of computer-based tools. For example, student #1 commented, “I really like this program,” and student #5 said, “Contextual listening is nice,” and “It helped me.”

Satisfaction Questionnaire Results

Consolidated results of the satisfaction questionnaire are shown in Table 2. Individual ratings from 1-7 for each question are indicated by an "X". In some cases, an adjective was circled rather than a number. In this event, the number closest to the word was counted. For example, if "Likely" was circled in question 1., then the respondent's answer was interpreted as a 1 for calculation purposes.

Table 2 - Post-test Satisfaction Ratings

Question	Rating							Mean Score
	1	2	3	4	5	6	7	
1. If this tool were available to you to complete music theory assignments, how likely would you be to use it?	Likely			Unlikely				1.2
	X	X						
	X							
	X							
	X							
2. The prospect of doing frequent assignments using this type of software is:	Exciting			Distressing				2.5 (n=4)
		X	X					
3. Please rate the overall difficulty of the questions in the exercises:	Challenging			Simple				3
		X	X	X				
			X					
			X					
4. Please rate the layout of the screen components:	Tidy			Cluttered				2.8
	X	X	X		X			
5. Figuring out how to use the lessons was:	Easy			Hard				4
		X		X	X			
6. Knowing what to do next as I worked through the lessons was:	Straightforward			Confusing				4.6
	X				X	X		
					X	X		
7. Working through lessons like this as part of regular class assignments would be:	Helpful			Pointless				1.2
	X	X						
	X							
	X							
	X							
8. Compared to completing assignments like this on paper, using the computer is:	Better			Worse				1.8
	X		X					
	X		X					
	X							

The satisfaction ratings suggest that participants would be likely to use a tool like this again, that it would be helpful tool for class assignments, and that using these types of tools would be better than using paper. Ratings of screen design ranged from 1 to 5 and are consistent with some participants' comments that the screen was somewhat cluttered but mostly fine (e.g. "Content is clustered to the center"). Although there were no satisfaction questions that gauged color specifically, results in this area are more apparent in the qualitative comments. For example, the debriefing question concerning what one participant least liked about the tool elicited the response: "Color schemes – there were none. Might be why some

things weren't obvious." As well, participants noted that they would change the "color of tabs," and that, "color is boring – blue & gray."

Lower ratings were garnered in the areas of figuring out how to use the lessons and knowing how to proceed through the lessons. Indeed, participants' comments about these areas indicate that there was difficulty with knowing what exactly to do when confronted with the beginning screen: "Doesn't flow right," "I didn't see the way the tabs moved," and "Definitely useful, but could be a little more guided." Several participants indicated that they would like an introductory screen to orient them, and that some direction within the questions to indicate an order would be helpful. Comments included: "A directions page might be good," "Have all the questions in front of you to begin with," and "Have indicators of total number of questions."

Lesson Completion Times

Participants completed the lessons in varying times, as shown in Table 3. Lesson 1 took the longest time, on average, presumably due to a learning curve, although the difference in time between Lesson 1 and Lesson 2 was fairly negligible. The shorter times in general for Lesson 3 were likely caused by the absence of the Melodic Dictation activity, which was unable to be completed due to prototype problems. The similarity of completion times may indicate that all three lessons have comparable difficulty levels. Participant 3 took an unusually longer time for Lesson 3 due to bugs associated with the bubble activity. Participant 1 had a longer time for Lesson 1 because the lesson had to be restarted two times in an effort to eliminate a program bug. After restarting, the bug was not fixed, but answers were erased, causing the participant to have to redo several questions.

Table 3 – Lesson Completion Times

Student #	Time [mm:ss]		
	Lesson 1	Lesson 2	Lesson 3
1	19:50	16:37	10:58
2	13:22	11:06	08:27
3	14:58	14:08	18:24
4	11:09	14:47	11:57
5	14:09	15:25	12:24
Average Lesson Time:	14:42	14:25	12:26

Interventions and Task Completion

Facilitator interventions generally occurred in order to point out bugs in the prototype and tell participants to simply move on to another tab or lesson if they were having difficulties. For example, in every session, the facilitator had to let participants know that the Melodic Dictation element (Lesson 3) was not working. Also in Lesson 3, during earlier sessions, the Scale Degrees element had font problems, and the facilitator made participants aware of what the correct notation should have been. In session 5, the facilitator had to intervene during Lesson 2 when the participant asked, "Am I supposed to do something with these boxes?" In this case, the student was referring to the second set of boxes for the Roman Numeral analysis, which he had left blank because he had skipped that set. The facilitator made him aware that the boxes were not for the non-chord tone box, but instead for the roman numeral analysis. At this point, the participant realized he had forgotten to do the second set and proceeded to fill in the boxes.

Participants were able to complete most tasks that were not hindered by a prototype bug. Exceptions included participant #2, who in Lesson 1 missed the Phrase 3 cadence and phrase questions due to the fact that there was no Phrase 3 tab in the lesson. Instead of

attempting to complete the incorrect questions, she assumed there was no way to play Phrase 3 and went on to the next lesson. In Lesson 2, participant #3 gave up before completing the second part of the Roman Numeral analysis because she was frustrated that she couldn't type in numbers. During the non-chord tone activity (the next tab), the same participant attempted to place the NCT box inside the text box intended for the Roman Numeral analysis because these boxes were empty. In Lesson 3, the same participant also gave up on changing the bubble color of the last phrase because of a bug that prevented the color from changing.

Which lessons were easiest?

In terms of specific lesson findings, two participants indicated that they found Lesson 1 easiest to complete because "it was most similar to tests" and one commented that Lesson 1 "had a lot of hard questions but it was clear how to complete it." Three participants found Lesson 3 easiest to complete. For one student, this was due to "...more general listening questions, less specific technical questions." One student found Lesson 3 "most fun," because it was "more interactive," she "could tap," and she "had the hang of it by then." A third student liked Lesson 3 because there were more "texture-oriented questions" and the "music excerpt was more appealing".

Which lessons were most difficult?

Three of the five participants claimed that Lesson 2 was most difficult for various reasons, although comments that illustrated the difficulty of Lesson 2 were made by all five participants. When asked why Lesson 2 was most difficult, student #4 said, "because of the score, not difficulty of questions" in accordance with student #5 who least liked "some glitchy things with the score." On the other hand, participant #2 felt it was due to the NCT (non-chord tone) element. Student #3 felt that "phrase markers were kind of tricky" and noted that "arrow and score movement are contradictory" and similarly, student #1 was, "at first, confused that there were 2 markers on the score." This problem area was exemplified in several sessions as users had difficulty deleting incorrect phrase markers and placing the markers while the score jumped. In addition, two participants skipped the second set of Roman Numeral analysis measures and all had trouble inputting the chord notations.

Two of the students claimed that Lesson 1 was the most difficult. In these cases, the reasons cited were confusion with the check answers function. One checked her answers after completion of only the Entire Excerpt tab and then was confused that she had so many questions incorrect. Instead of attempting to complete the incorrect answers on the additional tabs, the student then reset her answers and had to redo the Entire Excerpt tab questions. Yet another student did not understand the function of the x's which indicate an incorrect answer, stating, "Are the red x's in the wrong or right place?". In addition, two participants were confused by the fact that a phrase 3 tab was not available and commented that, "Phrase 3 [is] missing". Usually this occurred because the students attempted to listen to the phrases using the individual phrase players on the tabs rather than clicking the phrase bubbles or moving the media player.

Technical Glitches

Interactions were hampered somewhat by technical glitches in the prototypes themselves. These included problems such as musical fonts (notes, notation) not working correctly, inability to type notation characters (e.g. the '7' in a V⁷ chord) and difficulties with manipulation of the timelines, phrase bubbles, and score elements (e.g. phrase marks and deletion).

Recommendations

Based upon participants' actions and comments, the following issues and recommendations for redesign are offered. Severity of each issue is based on the rating scale below:

High – Issue prevents users from making progress or led to mistakes.

Medium – Issue causes confusion, annoyance, or minor mistakes.

Low – Issue causes minor amounts of confusion, inefficiency, or dissatisfaction.

Bug – System was not working properly.

Table 4 – Issues, Recommendations, and Severity Ratings

Issue	Recommendation(s)	Severity Rating
1. Participants did not know what to do upon seeing the beginning screen in Lesson 1.	<ul style="list-style-type: none"> • Provide an introductory screen or orientation. • Provide a help system or tutorial for first-time users. 	High
2. Participants expressed that there was no "flow" to the lessons – that it was difficult to gauge their progress.	<ul style="list-style-type: none"> • Indicate how many questions are included in the lesson. • Place question # information with the tab titles. • Change tab colors to something other than gray to invite exploration. 	High
3. Users did not know what to do next.	<ul style="list-style-type: none"> • Include directional guides such as arrows or text prompts so that users know to click on the next tab. 	High
4. Score movement in Lesson 2 was overwhelming and caused incorrect phrase marker placement.	<ul style="list-style-type: none"> • Make excerpt short enough so that the entire score can be shown without jumping. • Fix prototype so that clicking, double clicking, and deletion mechanisms are easier. • Have score scroll vertically instead of horizontally. 	High
5. In two sessions, the second set of Roman Numeral analysis (Lesson 2) was skipped entirely.	<ul style="list-style-type: none"> • Divide the Roman Numeral analysis activity into two separate questions. 	High
6. Colors were deemed boring and unhelpful as guides.	<ul style="list-style-type: none"> • Alter tab colors so that users do not think they are "grayed" out and unclickable. • Shadow or border the tabs so that they stand out in a 3-D fashion. 	Medium
7. Check/Reset Answers function was unclear and led to extra time spent redoing questions when correct answers were accidentally reset.	<ul style="list-style-type: none"> • Explain purpose of red x's on Check Answers tab – indicate what exactly the red x is pointing to (e.g. the incorrect answer or the question in general) • Place red x's in a consistent spot (e.g. next to question #) rather than at the place of error. • Include a dialog box that asks, "Are you sure you want to reset your answers?" 	Medium

8. Content is clustered to the center of the screen – not enough space.	<ul style="list-style-type: none"> Separate top of screen phrase, cadence, timeline elements farther from question box. 	Low
9. Users were wary of clicking on "Submit" button in Lessons 2 and 3.	<ul style="list-style-type: none"> Indicate where the Lesson materials/answers will be sent to and have a dialog box ask, "Are you sure want to submit your answers now?" 	Low
10. Exit mechanism not obvious.	<ul style="list-style-type: none"> Change menu name from "File" to "Exit". Eliminate menu option completely – just have an Exit button which prompts a dialog box which asks the user "Are you sure you want to exit this lesson?". 	Low
11. Timeliner bubble color choices caused some confusion due to the large number of choices and the length of the dropdown box.	<ul style="list-style-type: none"> Limit the color choices to 5 or 6. 	Low
12. Melodic dictation in Lesson 3 could not be completed due to font problems.	<ul style="list-style-type: none"> Fix future prototype in this regard and test on usability lab computer to make sure it works before next round of testing 	Bug
13. Numbers could not be typed into the roman numeral analysis boxes in Lesson 2.	<ul style="list-style-type: none"> Fix prototype so that numbers can be typed in. 	Bug

V. Discussion

Overall, the testing went well. The demographic survey and final questionnaire seemed to raise issues relevant to the purposes of this usability test. Qualitative results were of higher importance than quantitative, as we wanted to get a feel for the contexts in which participants would use these types of tools and whether they would be willing to use computer-based tools in place of paper-based tools for music theory learning activities. The prospects for student acceptance of MMTT-based assignments look promising once the learnability and usability issues are addressed.

Two limitations of the present study are worth noting:

- Because of problems in the test environment, not all of the prototyped functionality was tested (e.g., melodic dictation was omitted).
- We had initially planned to run eight testing sessions, but recruiting students was difficult; some students who agreed to be test subjects did not show up for the tests. For future tests we will need to improve our recruiting strategies.

VI. Appendices

APPENDIX A – p. 1

MMTT Prototypes Usability Evaluation

Initial Survey

1. Are you Male / Female? (Circle one)

2. Please describe your major (e.g. composition, voice, piano):

3. Have you ever used computer-based *music theory* software? _____Yes _____No

3a. If your answer to 3. was 'Yes', please list the titles and frequency of use:

Title	Frequency
_____	___ 1 time ___ a few times ___ many times
_____	___ 1 time ___ a few times ___ many times
_____	___ 1 time ___ a few times ___ many times

4. Have you ever used computer-based educational software that is NOT music-related?
_____Yes _____No

4a. If your answer to 4. was 'Yes', please list the titles and frequency of use:

Title	Frequency
_____	___ 1 time ___ a few times ___ many times
_____	___ 1 time ___ a few times ___ many times
_____	___ 1 time ___ a few times ___ many times

5. How many hours per week do you spend using a computer?

- ___ 0-5
- ___ 6-10
- ___ 11-20
- ___ 20 or more

6. Please rate your computer experience on the following systems by circling 1-5 below:

- a. PC: Novice 1 2 3 4 5 Expert
- b. Macintosh: Novice 1 2 3 4 5 Expert

APPENDIX A – p. 2

MMTT Prototypes Usability Evaluation

Final Questionnaire

1. If this tool were available to you to complete music theory assignments, how likely would you be to use it?

Likely 1 2 3 4 5 6 7 Unlikely

2. The prospect of doing frequent assignments using this type of software is:

Exciting 1 2 3 4 5 6 7 Distressing

3. Please rate the overall difficulty of the questions in the exercises:

Challenging 1 2 3 4 5 6 7 Simple

4. Please rate the layout of the screen components:

Tidy 1 2 3 4 5 6 7 Cluttered

5. Figuring out how to use the lessons was:

Easy 1 2 3 4 5 6 7 Hard

6. Knowing what to do next as I worked through the lessons was:

Straightforward 1 2 3 4 5 6 7 Confusing

7. Working through lessons like this as part of regular class assignments would be:

Helpful 1 2 3 4 5 6 7 Pointless

8. Compared to completing assignments like this on paper, using the computer is:

Better 1 2 3 4 5 6 7 Worse

APPENDIX A – p. 3

MMTT Prototypes Usability Evaluation

Debriefing Procedure

During debriefing, the facilitator will be taking notes to record participant's comments concerning the following inquiries:

1. Ask participant to describe his/her overall reaction to the tool.
2. Ask participant to explain observed critical incidents (noted by facilitator during participant's interactions with the tool).
3. Which elements did you find difficult to use?
4. Which elements did you find easiest to use?
5. Which of the 3 lessons did you find easiest to complete? Why?
6. Which of the 3 lessons did you find most difficult to complete? Why?
7. What did you like best about this tool?
8. What did you like least about this tool?
9. What would you change about this tool?

APPENDIX B – Summary of Qualitative Data

These data are organized into two sections. The first details verbal comments made by participants as they explored the lessons as well as facilitator observations of participant actions. The second section is a summary of participants' responses to the debriefing questions.

Lesson Comments

Lesson 1	
Student #	Action/Comment
1	<ul style="list-style-type: none"> • Subject counting in head, nodding head, tapping fingers in air • Held left hand out the whole time • "Is that it?" [Didn't know to go to additional tabs]
2	<ul style="list-style-type: none"> • "Oh, okay, 'In the diagram above'...What am I supposed to do here?" • Clicked phrase tabs in order to hear that particular phrase (instead of phrase bubbles). • "I don't see a phrase 3."
3	<ul style="list-style-type: none"> • Checked answers to the "Entire Excerpt" tab only, then was confounded by wrong answers on Phrase 1, etc.... • "Oh, I see what I'm supposed to do here." • Humming, snapping fingers • "Ah, this is like a theory class! Ah!" • "I don't understand it. Oh, okay, I see" [in reference to question 4] • "What are those red x's for?" [after checking answers] • Clicked phrase bubbles to hear each individual phrase.
4	<ul style="list-style-type: none"> • Spent time observing screen and layout, clicked on dropdowns • Did Entire Excerpt tab and then checked answers (like U3). Then clicked Phrase 1 tab - "Oh, I see", But not before she had reset answers.
5	<ul style="list-style-type: none"> • Leaning in, looking, observing the screen • Listened to whole excerpt before starting • Checked dropdowns • Moved through questions in sequence • Noticed the tabs right away • Used phrase tabs to listen to individual phrases (instead of clicking timeline bubbles): "No Phrase 3 box?" • "Some of these questions are hard! I need a keyboard here to figure this out."
Lesson 2	
Student #	Action/Comment
1	<ul style="list-style-type: none"> • Did not drag score - always used arrows

2	<ul style="list-style-type: none"> • Used finger to trace text on screen while reading • Double clicked on media player buttons • Tapping mouse • Used cursor to help read text • Confusion about Check/Submit buttons [since it wasn't actually going anywhere] • Multiple phrase mark lines [double click did not erase them] • Missed the 2nd set of roman numerals in question
3	<ul style="list-style-type: none"> • Read the directions first, then went through all tabs to check content. • Much grimacing here, during first playback of Haydn, as score was moving around. • Used arrows to move score at first, then later moved it by dragging. • Double clicking wasn't working for deleting phrase lines so she hit "Delete" on the keyboard. • "How am I supposed to get the 7 in there? Whatever. I give up." [Roman Numerals tab] • Did not complete phrases at top • "It won't tell me. Do I get to know?" [Re: checking answers] • "Oh, this is worse than a theory class, oh."
4	<ul style="list-style-type: none"> • Spent time observing the screen, options • Moved score with arrows at first then later by dragging. • Clicked wrong button to "Play" on media player • Surprise when clicking on Timeline bubble caused excerpt to play. • Can't type in a 7 in the Roman Numerals tab • "I don't know how to make a diminished symbol." • Double clicking of phrase marks was not working well
5	<ul style="list-style-type: none"> • Looking, observing the score • Clicking on the score - using arrows to move it • Clicking on bottom arrow • Tried to double click to add phrase line and score jumped right as he did it, so phrase line went in completely the wrong place. • "7 can't be typed in...no number can." • Missed the 2nd set of Roman Numeral analysis: "Oh, I didn't read the directions."

Lesson 3	
Student #	Action/Comment
1	<ul style="list-style-type: none"> • Scale degrees notation "B & f are funny" [this was b/c fonts were not showing up properly]
2	<ul style="list-style-type: none"> • Finger on screen to read directions • Used space bar to set phrase lines • Double clicking on media player • Moved forward in music by dragging arrow • Remarked that scale tab had funny characters [again, an issue with prototype fonts] • Held head while listening for orchestration

3	<ul style="list-style-type: none"> • Read directions out loud first and also went through all tabs. • "Well, this is fun." [bubble colors] • Moved arrow underneath Timeline bubbles to start music in different phrase places • Hand on forehead – listening for phrases • Selected bubble on Timeline then last bubble disappeared [something in prototype] • Thinks a measure number is missing at the end of the excerpt • Used Clear to start over again • Scale Degrees – lots of humming
4	<ul style="list-style-type: none"> • Groaned upon first observation of screen • Checked watch • Read directions then went through tabs to read all questions before beginning • Started with questions 8 & 9 [Texture tab] • Used Timeliner to set marks (not space bar) • Tried to delete marks with Timeliner button • Lots of fidgeting, closing eyes
5	<ul style="list-style-type: none"> • Worked through fairly sequentially • Moved bottom arrow to place on Timeliner he wanted to start playing, rather than just clicking on the bubbles (same as Lesson 1)

Debriefing Question Responses

1. Ask participant to describe his/her overall reaction to the tool.

Student #	Responses
1	<ul style="list-style-type: none"> • "I Really like this program. It's really great." • Score excerpts especially useful • Could go back in the music, which was nice • The directions were unclear • Questions at a good level
2	<ul style="list-style-type: none"> • No introduction at the beginning • Phrase 3 missing • "Doesn't flow right." • Mentioned Practica Musica tabs • Level of difficulty of questions was okay
3	<ul style="list-style-type: none"> • "It started nice but I ended up frustrated."
4	<ul style="list-style-type: none"> • "It took a little while to get used to it." • To be more effective: give a tonality, count off tempo • Phrase markers were kind of tricky • Color made it difficult to distinguish tabs • Written analysis – some symbols missing
5	<ul style="list-style-type: none"> • Helpful but stressful. • "Having a keyboard handy would be useful, but at test time you don't have a keyboard." • "It helped me." • "A directions page might be good." • "Contextual listening is nice." • "Have all the questions in front of you to begin with."

2. Ask participant to explain observed critical incidents (noted by facilitator during participant's interactions with the tool).

Student #	Responses
1	<ul style="list-style-type: none"> • Tabs – didn't see the way the tabs were laid out – maybe my personal stupidity. • Might be easier with a numbering system on the tabs.
2	<ul style="list-style-type: none"> • Using finger to read from screen - Anticipated misreading the question. • More focused on specifics of score than timeline – "score would move when I was trying to mark" • Space bar seemed obvious – keyboard input is easier, less energy...mouse is ambiguous.
3	<ul style="list-style-type: none"> • First exercise [Lesson] was most straightforward but "Need an introduction". • "Put a 'continue on' indicator" • Are the red x's in the wrong or right place? • Score moved too much; perhaps score should move vertically rather than horizontally. • Should be a toolbar for dragging • Where's the help? • Hit backspace to delete phrase lines.
4	<ul style="list-style-type: none"> • Why reading so much? – to get oriented. • Trial & error to figure out what to do • Started with questions 8 & 9 because they were easier and could do in conjunction with listening.
5	<ul style="list-style-type: none"> • Why did he move sequentially? - "Tabs were shaded so I noticed them...seemed like other computer applications."

3. Which elements did you find difficult to use?

Student #	Responses
1	<ul style="list-style-type: none"> • Lesson 1: Tabs, drop down lists, notation of f,B [font problem] • Lesson 2: At first, confused there were 2 markers on the score. • Lesson 3: Scale degrees [again, font problem]
2	<ul style="list-style-type: none"> • Clicking tabs to get to questions. Not clear that questions are under tabs. • f, B weird [again, font problem]
3	<ul style="list-style-type: none"> • "Chasing the score was most challenging." • Arrow and score movement are contradictory
4	<ul style="list-style-type: none"> • Lesson 1: Harmonic Rhythm • Lesson 2: Score movement, roman numerals; Don't like the way the score was laid out. • Lesson 3: Worried about how exact the timeliner marks had to be; What is the purpose of changing the color of the bubbles?
5	<ul style="list-style-type: none"> • Bubbles can be confusing, but not too bad. • "Where's an Exit?"

	<ul style="list-style-type: none"> • "Am I done?"
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4. Which elements did you find easiest to use?

Student #	Responses
1	<ul style="list-style-type: none"> • Timeliner tool was easy, fun • Dropdowns • Media player functions (stop, play, pause, etc.)
2	<ul style="list-style-type: none"> • Dropdown menus are neat • Media player helps
3	<ul style="list-style-type: none"> • Bubble and colors was fun
4	<ul style="list-style-type: none"> • Any of the multiple choice questions • Media player was fine
5	<ul style="list-style-type: none"> • Media player because it's familiar • Dragging the bar around

5. Which of the 3 lessons did you find easiest to complete? Why?

Student #	Responses
1	<ul style="list-style-type: none"> • Lesson 3 definitely. More general listening questions, less specific technical questions.
2	<ul style="list-style-type: none"> • Lesson 3 was most fun. More interactive. Could tap. Had the hang of it by then.
3	<ul style="list-style-type: none"> • Lesson 1 b/c it was most similar to tests.
4	<ul style="list-style-type: none"> • Lesson 1 was easiest. Had a lot of hard questions but it was clear how to complete it.
5	<ul style="list-style-type: none"> • Lesson 3 was easiest. More texture-oriented questions; music excerpt was more appealing.

6. Which of the 3 lessons did you find most difficult to complete? Why?

Student #	Responses
1	<ul style="list-style-type: none"> • Lesson 1: Checking answers was weird. • Score example was probably hardest to use b/c had to wait for the score to move.
2	<ul style="list-style-type: none"> • Lesson 2: NCT (non chord tones) element
3	<ul style="list-style-type: none"> • Lesson 1 when I couldn't figure out sequence; • Lesson 2 was most difficult from the beginning (esp. replaying phrases)
4	<ul style="list-style-type: none"> • Lesson 2 because of the score, not difficulty of questions.
5	<ul style="list-style-type: none"> • Lesson 1 because of secondary dominant chords. Also, maybe a learning curve.

7. What did you like best about this tool?

Student #	Responses
1	<ul style="list-style-type: none"> • The music selections, especially in Lesson 3
2	<ul style="list-style-type: none"> • Interactive elements helped: Lesson 3 use of space bar • Seeing score on screen, makes it personal, but not fun.... • "Should capture imagination"
3	<ul style="list-style-type: none"> • Excerpts are real audio, not MIDI. • Having the piece is helpful

4	<ul style="list-style-type: none"> • Another way to practice contextual listening
5	<ul style="list-style-type: none"> • Can do the stuff away from class • A good variety of music • Good recording quality

8. What did you like least about this tool?

Student #	Responses
1	<ul style="list-style-type: none"> • Bugs in the prototype • Definitely useful, but could be a little more guided
2	<ul style="list-style-type: none"> • The flow: "Where do I begin?", "Where do I focus?" • Less clutter would be nice
3	<ul style="list-style-type: none"> • "Color schemes – there were none. Might be why some things weren't obvious."
4	<ul style="list-style-type: none"> • Probably the score in the Haydn
5	<ul style="list-style-type: none"> • The Check Answers thing, but depends on the purpose of the lesson. • Some glitchy things with the score: excerpt wasn't that complicated, so it was okay; phrase lines wouldn't go away.

9. What would you change about this tool?

Student #	Responses
1	<ul style="list-style-type: none"> • Questions could move down [screen layout]. • Content is clustered to the center.
2	<ul style="list-style-type: none"> • Color is boring – blue & gray
3	<ul style="list-style-type: none"> • Would like to know how many questions (e.g. 1-10) • Layout of score vs. questions
4	<ul style="list-style-type: none"> • Color of tabs. • A lot of words are OK, but write, 'read all directions'. • Have indicators of total number of questions.
5	<ul style="list-style-type: none"> • Have an actual beginning screen with directions and samples. • Change Exit mechanism – make it more obvious