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Melodic Error Detection of Adult Amateur Musicians

The purpose of this study was to examine the effect of listening condition, age, and years of performing experience on the melodic error detection process and accuracy of adult amateur musicians. Participants (N = 33) engaged in a series of six short melodies, where each participant played three melodies and listened to three melodies. The investigator provided each participant a 10-second time period to examine each of the four-measure melodies, and then each participant was asked to identify any perceived errors they may have heard while either listening to the melodies or playing the melodies. The most salient result from this study was that participants demonstrated a high overall success rate in error detection tasks regardless of age, years of performance experience, or order of listening condition. Participants attributed a portion of their success to their familiarity of the tunes selected; however, despite the condition, participants had a more difficult time identifying melodic errors in unfamiliar melodies.

Keywords: adult amateur musicians, melodic error detection, lifelong learning, New Horizons

Introduction

Research in the area of adult amateur musicianship has steadily risen over the years as senior adults have become more involved in music-related activities. While this area of research has garnered more attention, the primary focus has been on enhancing the quality of life (Coffman, 2008, 2009; Coleman, 2000; Rohwer & Coffman, 2006; Schellenberg, 2005), the improved mental, physical, and social benefits of playing an instrument, (Bittman et al., 2005; Coffman, 2002; Coffman & Adamek, 1999; Dabback, 2008; Ernst & Emmons, 1992), and the general attitudes of participating in music as an adult (Rohwer, 2013; Rohwer et al., 2013).

As a direct result of the increase in musical activity, efforts have been made to accommodate the rapidly growing adult amateur population's desire to learn music, and examining this phenomenon has become more approachable. Com-

munity instrumental ensembles geared toward meeting the needs of senior adults have emerged in recent years. Perhaps the most significant of these is the New Horizons International Music Association, which has served as a catalyst and a model for the creation of nearly 200 ensembles that focus on making music with senior adults (Ernst & Emmons, 1992). For some, the lifelong dream of learning an instrument is realized. For others, an extended hiatus from playing an instrument concludes and they are in search of a re-entry point to the music-making process. In either case, adults have opportunities afforded to them to be part of an organization that promotes lifelong learning in a relaxed, stress-free environment. Perhaps more importantly, it removes the stereotype that "If you didn't learn how to play an instrument as a child, it's too late" (Ernst & Emmons, 1992, p. 30).

As more adults begin to participate in music-making activities, it is important to understand the nature of the adult music learner (Coffman, 2009; Coffman & Levy, 1997; Rohwer, 2005). Coffman (2009) recognized that the majority of the extant literature centered on adult music learners is often geared toward "the characteristics of the participants, their motivations and, sometimes, their perceived benefits, rather than how they learn or how they are taught" (p. 230). This realization is an important step in understanding the adult learner and how they process music. By understanding how adult amateurs process music, the likelihood of creating meaningful musical experiences should increase. Adults bring with them myriad life experiences, psychological experiences, and a wide array of emotions that exceed far beyond that of a young student. Many adults also bring with them high expectations. As Gibbons (1985) suggested, adults often insist on learning new skills and express dissatisfaction when their participation in music activities does not lead to perceived achievement.

The body of research for adult amateur music involvement continues to grow, and one starting point for understanding how adult amateurs process music may be error detection. The ability to detect errors is crucial in aiding in the development of the independent musician. Much of the extant literature concerning the error detection process is geared toward students enrolled in teacher education programs (Bowen, 2003; Brand & Burnsed, 1981; Byo, 1993, 1997; Crowe, 1996; Deal, 1985; DeCarbo, 1982; Forsythe & Woods, 1983; Lane, 2006; Larson, 1977; Ramsey, 1979; Sheldon, 1998; Sidnell, 1971; Stuart, 1979), however, it is an equally essential skill in the development of adult amateur musicians (Talbert & Edelman, 2018). Kratus (2019) calls for a return to amateurism in music education, and while citing Regelski (2007), he notes musical independence is perhaps the most important aspect for the amateur musician. One of the primary reasons adult musicians want to learn to play an instrument is to possess the ability to play

a tune independently and know whether or not it sounds correct. If these musicians can work to develop the skills to become independent, and not rely on directors or private instructors to point out errors, they can become more self-sufficient and be involved in more meaningful musical experiences.

Temperley (2007) examined music perception and cognition through a probabilistic approach and devoted one section of his book to exploring perceptual processes such as error detection and pitch identification. Concerning error detection, Temperley wrote, "It seems uncontroversial that most human listeners have some ability to detect errors – "wrong notes" – even in an unfamiliar melody. However, the idea of error detection proves to be quite complex and encompasses a variety of different phenomena" (p. 74). Based on this example, it would seem logical to conclude performers of any age have the ability to detect errors; however, it is important to differentiate between the skill sets of adolescent and adult amateur musicians. Adolescents have skills that are constantly developing and they are capable of detecting errors at a relatively young age and with very little formal training (Wehrum et al., 2011). Although adults have the ability to detect errors, there is the possibility of a dramatic change in hearing ability occurring once an individual reaches age 60 (Divenyi et al., 2005; Hull, 1995). The natural aging process tends to reveal a decline in hearing, thus making it more difficult to hear potential errors. Divenyi et al. also suggested that hearing aids are useful for improving speech understanding, but not equally as effective in improving the ability to hear music. This fact must be taken into consideration when working with the adult music learner.

Thornton (2008) evaluated the abilities of novice musicians to detect melodic errors in familiar melodies under two separate listening conditions. Participants in the study were fifth- and sixth-grade woodwind students with one or two years of playing experience. The first condition, listening-only, evaluated students' ability to detect performance errors while listening to a recording. The second condition, the listening-playing condition, evaluated the students' ability to detect performance errors while they performed a short melody on their instrument. Results indicated that no differences were observed between listening conditions and the grade experience variable, however, the researcher did not conduct statistical tests in this study due to the extreme imbalance between instrument groups. Overall, the students were successful in hearing and locating the performance error, regardless of listening condition. These findings suggested that students with minimal music training have the ability to detect performance errors in melodies in which they identified as familiar.

Additionally, researchers have often focused on how young, amateur instrumentalists process music (Delzell, 1989; Deutsch, 1971; Geringer, 1983; Gud-

mundsdottir, 1999; Thornton, 2004, 2008). Although a number of parallels may be drawn from young musicians to adult amateur musicians, there is still a need to examine and better understand how adult amateur musicians process music. The purpose of this study was to examine the effects of listening condition, age, and years of performance experience on the melodic error detection ability of adult amateur musicians. The following questions guided the research:

1. Are there differences in error detection with regard to listening and playing conditions?
2. What are the relationships between age and years of performance experience on error detection ability?
3. How did participants perceive their success on the error detection tasks?

Method

Participants

Participants in the study (N = 33; 15 women and 18 men) were members of a New Horizons Band, a program that provides active music learning opportunities for adult amateur musicians. Participants' ages ranged from 45 to 81 (M = 64.2, SD = 8.6) and participants' years of performance experience ranged from six months to 30 years (M = 6.4, SD = 6.3). For the purpose of this study, years of experience was defined as the self-reported number of years the participant has played their instrument. The participants' instrument distribution was as follows: flute (n = 5), oboe (n = 1), clarinet (n = 6), alto saxophone (n = 6), tenor saxophone (n = 2), trumpet (n = 7), horn (n = 1), trombone (n = 1), euphonium (n = 2), tuba (n = 1), and mallet percussion (n = 1).

Melodies

The melodies used in the study are noted in Table 1. Of the six different melodies used in this research design, I adapted four from Thornton's study (2008). Previous research by Killian (1996) identified those four as melodies familiar to elementary students. In addition, I selected two melodies from the Music Learning Research (MLR) Instrumental Score Reading Program manual (Froseth & Grunow, 1979). I selected *Melody Five* (*Excerpt from Hymn*, arr. J.O. Froseth) and *Melody Six* (*Excerpt from Sonatina* by M. Clementi, arr. Charles D. Yates) because they were more melodically and rhythmically complex than the four melodies adapted from Thornton's study (2008). *Melody Five* and *Melody Six* were familiar melodies with the titles removed.

Table 1
Melodies Used in Error Detection Exercise

Melody Number	Title
Melody One	*Twinkle, Twinkle, Little Star*
Melody Two	*Old MacDonald Had a Farm*
Melody Three	*Happy Birthday*
Melody Four	*This Old Man*
Melody Five	*Melody Five* – adapted from MLR
Melody Six	Melody Six – adapted from MLR

In order to ensure a similar level of familiarity for these melodies with participants in this study, I distributed a questionnaire with a Likert-type scale to all participants. The questionnaire included titles to 25 well-known children's tunes, including some of the same tunes used by Killian (1996), and scoring was based on a 3-point Likert-type scale (*1 = Not Familiar, 2 = Somewhat Familiar,* and *3 = Very Familiar*). Each participant was asked to circle the number from one through three which most closely corresponded to their level of familiarity with each tune. I scored the responses to measure the participants' familiarity and results indicated that 98% of participants were *Somewhat Familiar* or *Very Familiar* with the melodies used in the study that I adapted from Thornton (2008).

I used the same tonalities when possible (C, D, F, and G), but also included B$^{\flat}$, E$^{\flat}$ and A, transposing when necessary to meet the instrumentation needs. I made these changes to facilitate range and to accommodate a wider range of instruments. To help control for rhythm as a confounding variable, the rhythmic values used in the melodies consisted of only half notes, quarter notes, and eighth notes. I formatted the printed music for each of the six melodies to include a key signature but no printed accidentals.

Procedure

I created an error detection form for each participant to use when completing the task. The form included the title, written notation of each tune (four measures), and a place for the participants to circle if they thought the tune was presented correctly, incorrectly, or if they were unsure. Additionally, if the participant marked that the melody was presented incorrectly, they were to identify, to the best of their ability, which note(s) were incorrect. Each participant used the following process to complete the error detection tasks:

1. I provided each participant 10 seconds to scan the title and printed music notation of a four-measure melody. Following the 10-second scanning period, the participant listened to a recorded performance of the melody using computer-generated instrument sounds that closely aligned to their primary instrument. After listening to the melody, I asked the participant to identify any perceived melodic errors they may have heard. The participant responded using an investigator-designed error detection form.
2. I provided each participant 10 seconds to scan the title and printed music notation of a second four-measure melody. Following the 10-second scanning period, the participant performed the second melody on their primary instrument. After the performance, I asked the participant to identify any perceived errors they may have heard using the error detection form.
3. This process continued, alternating listening and playing conditions until the participant completed a total of six melodies, three melodies listened to and three melodies played.

Error Detection

Of the six melodies used, I presented three with pre-determined melodic errors and three without errors. All errors were placed one step away from the correct pitch. In the melodies presented with an error, I only placed one pitch error in the excerpt, no rhythmic errors. I placed errors in the recordings for the listening condition; there were no errors on the printed music for the listening condition. Each participant earned three points for correctly identifying the melody as correct or incorrect, two points for pinpointing the location of the error, and one point for identifying incorrectly performed pitches as correct.

I also had to determine the location of the melodic error for *Melody Six* because that melody had not been previously used in Thornton's earlier study (2008). *Melody Six* was a listening condition for each participant because it potentially had a higher level of performance difficulty (e.g. octave leap). For this melody, the original notation had two repeated pitches; I raised one of these repeated pitches up one whole step so the notation differed from the recording. The melodic errors for the melodies presented incorrectly affected the fourth and sixth scale degrees. For the listening condition, I recorded and played back the melodies at a tempo of 112 beats per minute, the average tempo the participants performed the melodies in Thornton's original study (2008).

Upon completion of the error detection tasks and the demographic questionnaire, I engaged each participant in a one-on-one interview where participants verbalized their thought process as they reflected on how they completed the error detection exercise. Each participant answered the same three questions:

1. Did you find this task to be easy or difficult? Why?
2. How well do you think you completed this task?
3. Did you find one condition (listening or playing) to be more difficult than the other? Which one? Why?

I provided each participant with a verbatim transcript of their response to check for accuracy. Additionally, I videotaped each interview and used transcripts from these recordings in subsequent data analysis. The responses helped to provide insight into how adult amateur musicians process music through an error detection exercise.

Results

The first question examined whether differences existed in error detection with regards to listening conditions. Results indicated that for the melodies presented correctly, participants' overall mean scores approached the maximum possible points attainable (see Table 2). *Melody Five*, an excerpt from a hymn arranged by Froseth (Froseth & Grunow, 1979) in which participants claimed to be unfamiliar, proved to be the most notable exception, as participants produced the lowest mean scores among the correct melodies in the playing condition. For the melodies presented incorrectly, participants exhibited a wider range of scores, as evidenced by the greater standard deviations

Of the incorrect melodies, *Twinkle, Twinkle, Little Star* had the lowest mean scores in relation to the maximum number of points possible in both the listening and playing conditions. Although that tune was identified as *very familiar* by 100% of the participants, results indicated this was one of the more difficult melodies in which to identify errors. Participants struggled equally in both conditions in identifying the melodic error and pinpointing the location. Slightly more than half of the participants (52%) were unsuccessful in either identifying the melody as incorrect or pinpointing the exact location of the error.

In order to investigate differences between conditions (listening and playing), I conducted a paired sample t test. I found no significant difference between the two conditions, $t(35) = 1.79$, $p > .05$, $d = 0.44$. Conditions (listening or playing) did not affect the error detection score.

Table 2
Mean Error Detection Scores for Each Melody Under Each Condition

Melody	Condition	*M*	*SD*
Correct (No Errors)			
Old Macdonald	Listening	2.82	0.73
	Playing	3.00	0.00
This Old Man	Listening	2.82	0.73
	Playing	3.00	0.00
Melody Five	Playing	1.75	1.18
Incorrect (Errors)			
Twinkle, Twinkle	Listening	3.18	1.94
	Playing	3.19	1.64
Happy Birthday	Listening	4.36	1.32
	Playing	3.88	1.71
Melody Six	Listening	3.00	2.47

Note. The maximum number of points possible for melodies presented correctly was three. The maximum number of points possible for melodies presented incorrectly was five. *Melody Fiv*e was a playing condition for everyone; *Melody Six* was a listening condition for everyone.

The second research question examined the effect of age and years of performance experience on error detection. In order to examine the effect of age and performance experience on error detection, I calculated a repeated measures ANOVA. Neither age ($F(1,12) = 2.28$, $p > .05$) nor performance experience ($F(1,12) = 0.25$, $p > .05$) showed significant main effects.

The final research question concerned the participants' perceptions of the overall difficulty of the task. In general, participants perceived the error detection task to be relatively easy. In most cases, participants' perceptions of their ability to accurately detect melodic errors were correct. One participant, who was 65-years-old with five years of instrumental music experience, replied, "It was moderately easy. The notes and music were understandable and approachable, and nothing was too complicated." This type of response seemed prevalent among the majority of the participants and was directly reflected in their scores.

Discussion and Conclusions

Participants tended to be more accurate in the listening condition than the playing condition. This could be the result of focusing their efforts on one specific task (listening) rather than simultaneous tasks (playing and listening). For those participants who were more accurate in the playing condition, many noted that their success was attributed to their use of an instrument as a reference point. This was especially common with brass players who had to navigate through a number of partials. Muscle memory with the embouchure could be another possible factor

as to why some participants were more accurate in the playing condition. This is consistent with previously explored research on muscle and procedural memory and has been cited to aid in practice habits and performance of passages at faster speeds without compromising technique or sound (Dakon & Dvorak, 2014; Guptill & Zaza, 2010).

I examined the error detection scores for each individual melody in either the playing or the listening condition. The only exception where the overall mean score was lower for the playing condition than for the listening condition was *Happy Birthday*. One possible explanation as to why scores were higher in the listening condition for this melody could be the fact that the time signature for this melody is 3/4. Most beginning instrumentalists often play in a simple duple meter or simple quadruple meter time signature, and then transition to triple meter after a certain level of mastery is attained (Dell, 2010; West, 2015). There is also a leap of a perfect fifth in the melody, which may be difficult for beginning instrumentalists. This melody did, however, produce the highest mean score in relation the maximum number of points possible. This finding is interesting because it seems to contradict previous research. Cuddy (1993) indicated that errors are more easily identified on the first, third, and fifth scale degrees. This particular error affected the sixth scale degree making it logical to conclude that it should have been more difficult to recognize.

The mean scores for *Melody Five* and *Melody Six* were lower for most participants when compared to the other melodies used in the task. This result is likely due to participant's unfamiliarity with those melodies. This is consistent with previous research that indicates both students and adults identify and perform familiar melodies better than unfamiliar (Frewen, 2010; Samson et al., 2012). For many, their response to *Melody Six* on the error detection form appeared to be somewhat of an educated guess. Common responses by participants after hearing this melody included, "Sure, sounds good to me," or "I guess it's right…it went by too quickly for me." Similarly, participants also appeared hesitant after playing *Melody Five*. Some of the most common responses after hearing this melody were, "It sounds familiar…I guess it's right" or "I'm not sure exactly what that melody is. It seems like the last note isn't quite right, but I'm not sure. I'll mark it correct."

The influence of listening condition may be less than the data suggests given the participants' high level of familiarity with four of the melodies used in the study. The results from the Likert-type questionnaire indicated that four of the melodies used in the study were *very familiar* to the majority of the participants. When the participants heard an error in the listening condition, many of them sang back what they knew the melody was supposed to sound like. This process seemed to help them pinpoint the exact location of the error. During the play-

ing condition, there were two common reactions to the perceived melodic errors. Some participants would stop and immediately identify the error when they heard it. Other participants would complete the four-measure melody and then go back and sing and point to what they perceived was incorrect. In either case, neither of the listening conditions seemed to alter their perception of what these familiar tunes were supposed to sound like. The use of the shorter melodies seemed to reduce the chance of memory being a confounding variable. Only two of the participants indicated having an issue remembering where the perceived error was in the melody. In both cases, the participant only mentioned this when talking about the listening condition.

Other influences to consider include elements of the design and implementation of the melodies in this study. I used the four melodies from Thornton's previous research (2008) that were designed for fifth- and sixth-grade woodwind students. Although I altered these melodies when necessary to fit the demands of this study, I followed the same basic outline and implementation process that Thornton described. Due to the relative simplicity of range and rhythm of the melodies, and due to the presentation of each melody at a manageable tempo (112 beats per minute), participants did not appear to be overwhelmed by the task difficulty, especially in regards of the familiar tunes. The participants confirmed these sentiments in the post-task interviews. One participant replied, "It was moderately easy. The notes and the music were understandable and approachable, and nothing was too complicated." This was a common response from the participants.

When examining the results from the other melodies used in the study (*Melody Five* and *Melody Six*), it became evident by the lower scores that the participants were not as comfortable identifying errors in tunes with which they were unfamiliar. These results appear to be consistent with previous research concerning unfamiliar melodies (Frewen, 2010; Samson et al., 2012). Gudmundsdottir (1999) used two familiar tunes and one investigator-generated tune to examine how well students could hear simultaneous melodies. Results from this study indicated that the students were more successful identifying familiar melodies than unfamiliar melodies. The familiarity of melodies appears to be a variable that merits further study in order to measure its impact on error detection accuracy among adult amateur musicians.

Age and years of performance experience did not appear to be major influences on participants' error detection ability. These results appear to be consistent with previous research that supports the idea that age and years of performance experience do not seem to have any relationship on error detection success when

examining single-line scores (Lane, 2006; Waggoner, 2011). Age and years of performance experience may, however, play a factor in error detection scores when examining full scores.

Concerning age in relation to error detection ability, results suggested that as age increased error detection scores decreased slightly. Given that this relationship was not statistically significant, interpretation of this result should only be descriptive in nature. This finding appears to be logical given that a decline in hearing is a trait often associated with the normal aging process (Wingfield et al., 2005). The correlation between listening condition and years of performance experienced produced similar results. Results suggested that as the number of years of performance experience increased, scores in the listening condition decreased. Because the results were not significant, we can assume any correlations were due to chance. Due to the fact that participants' hearing was not tested prior to the study, this is speculative and warrants further attention in future studies.

Similarly, I measured the relationship between age and error detection ability in the playing condition. Results suggested that as age increased, error detection ability in the playing condition decreased slightly, though, as with previous relationships, it was not significant and should only be considered as descriptive findings. These findings seem logical, perhaps due to a decline in participants' technical abilities. For those who have played for an extended period of time, physical ailments such as joint pain and arthritis may contribute in declining technical ability.

When examining the effect between years of performance experience and error detection no main effects were present. Perhaps it is reasonable to conclude, though, that as years of performance experience increase, scores in error detection among the playing condition would also increase. This would seem logical in this study knowing participants who had more experience with instrumental music had to worry less about playing the correct notes and were able to focus more on listening for errors. Conversely, participants less familiar with their instruments more than likely had to focus their attention on listening for errors as well as worrying about playing the correct notes.

When given the opportunity to share their perceptions of the error detection task, participants attributed their success primarily to the familiarity of the tunes. It would appear that adult amateur musicians have a more difficult time identifying melodic errors, in both the listening and playing conditions, with unfamiliar melodies. This is especially important when working to develop independent musicianship skills. For those participants who were relatively new to the music-making process, the most prevalent concern was their lack of aural ability. Adult amateur musicians, especially those that are fairly new to an instrument, are

often self-conscious about their performance because of their perceived inability to develop the technical skills that may have been possible earlier in life (Ernst & Emmons, 1992). As is true in learning any new skill, increased comfort levels tend to become more common with experience (more opportunities to perform) and positive reinforcement. In the case of the participants in the study, each was given the opportunity to perform in weekly concert band settings and chamber ensemble settings, thus creating more experiences and, theoretically, leading to higher comfort levels. These musical experiences, as well as private lessons, provide myriad opportunities to gain performance experience and allows for the adult learner to frequently hear positive reinforcement.

This study examined one way in which adult amateur musicians processed music, including certain influences on their melodic error detection ability. Specific limitations, however, should be noted as they may affect the generalizability of the findings. The small sample size ($N = 33$) and the use of a single New Horizons Band must be considered. Additionally, I did not have participants complete a baseline hearing test prior to the study, which may have altered the results. The likelihood of a ceiling effect must also be considered. The participants in this study were adult amateur musicians with varying levels of performance experience. It is possible that the familiar listening and playing examples were too easy, thus creating an artificially low ceiling and high success rates.

Recommendations for Future Research

A major component in independent musicianship is the ability to function on a basic skill level without the aid of teacher-directed comments. Although many adults enjoy playing melodies that are familiar to them, teachers should work to find the balance between playing familiar melodies as well as introducing them to unfamiliar melodies. This process will aid in increasing their abilities to play unfamiliar music. Future research could take a more thorough examination into the process of how and when sight-reading materials are introduced to adult amateur musicians. Results from the study could be useful in developing a more comprehensive approach to teaching the adult amateur musician. By continuing to analyze the instructional methods used by practitioners who teach adults (Lane, 2019), we can shift our attention on problems that are specific to adult music teaching and learning (Bowles, 2010).

Researchers have provided a solid foundation of materials concerning the adult amateur musician over the past few years, and have thoroughly examined the who, what, when, where, and why of the people that make up this thriving popula-

tion. The important questions now seem to focus more on how adult musicians process music, the cognitive aspect, in an effort to gain more perspective on how to instruct adult amateur musicians in a way that is satisfying to their musical growth.

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