PhD thesis

ABSOLUTE PITCH, ABSOLUTE TONALITY AND MUSICAL SOPHISTICATION BETWEEN MUSICIANS PLAYING TRANSPOSING AND NON-TRANSPOSING INSTRUMENTS

Attila Herceg
Supervisor: Pál Szabó MD, CSc

UNIVERSITY OF DEBRECEN
Doctoral School of Human Sciences

2025

1.1. Aims of the thesis, outline of the topic

According to the simplest grouping of musical abilities, we can speak musical abilities in a narrower and in a broader sense (Asztalos, 2021). Musical abilities in a narrower sense refer to abilities directly related to the properties of musical sound (rhythm, volume, pitch, pitch), as well as the ability to recognise and reproduce melodies. Musical abilities in a broader sense refer to the abilities necessary for the reception, interpretation of music, and musical creation (Asztalos, 2021). Absolute pitch (AP) and absolute tonality (AT) can be classified as musical abilities in a narrower sense, while musical sophistication refers to the system of musical abilities in a broader sense.

As an interdisciplinary phenomenon, AP is the subject of research in genetics, neuroscience, musicology and psychology (Herceg & Szabó, 2022). Individuals with AP are able to identify the pitch of an isolated sound (passive AP) or to reproduce the sound (active AP) (Bachem, 1937; Herceg & Szabó, 2022; Herceg & Szabó, 2023; Miyazaki, 2004; Takeuchi & Hulse, 1993;

Weisman, Balkwill, Hoeschele, Moscicki & Sturdy, 2012; Ziv & Radin, 2014).

In tonal music, isolated or complex pitches (chords) are organised around a central pitch or chord – referring to as tonality (Jackendoff & Lerdahl, 2006). Through passive AT, a subject is able to judge whether a piece of music known by the subject is in its original or a different (transposed) tonality, whereas through active AT, a subject is able to sing or to play a piece of music known by the subject in its original tonality (Parncutt & Levitin, 2001).

The concept of musical sophistication first appeared in a study by Ollen (2006). In the interpretation of Müllensiefen, Gingras, Musil and Stewart (2014), musical sophistication summarizes different aspects of musical abilities, experiences and knowledge including explicit and implicit musical skills. The Goldsmiths Musical Sophistication Index (Gold-MSI) developed by Müllensiefen et al. (2014) measures a variety of skills and performances, mostly independent of each other, such as

musical perception, musical traning, memory, creativity, and music listening and music-making habits.

The findings reported on AP, AT and musical sophistication are contradictory. I designed 3 experiments to explore the relationship between playing a transposing instrument and (1) AP, (2) AT, and (3) musical sophistication. In the case of transposing instruments, the pitches written in the musical score and the pitches sounded in reality do not match.

1.2. Methods, measures and samples

All experiments were undertaken online, comparing the groups of subjects playing non-transposing and transposing instruments.

AP was measured with self-developed note-naming tests, 3 in isolated and 1 in complex musical contexts – in the latter subjects heard 2 pitches simultaneously. The AP-test in complex musical context required the identification of the pitch of the higher note.

AT was measured with self-developed test in which musical excerpts of two beats, unknown to the subject were played on different instruments, while the score of the excerpts was displayed. Subjects had to judge whether the tonality of the excerpts and that of their scores were the same or different.

Musical sophistication was measured with the Hungarian version of the Gold-MSI.

The first experiment included 87 participants (47 women and 40 men), with a mean age of 29.78 years (*SD* = 13.21), the youngest subject being 14 and the oldest subject being 83 years old. The second experiment included 71 participants (50 women and 21 men), the mean age of the sample was 35.90 years (*SD* = 13.27), the youngest subject was 15 and the oldest subject was 64 years old. The third experiment included 71 participants (47 women and 24 men), the mean age of the sample was 37.51 years (*SD* = 14.95), the youngest subject was 9 and the oldest subject was 75 years old. In all experiments, the rates of non-transposing instrument players were higher

than that of transposing instrument players (80.5% vs 19.5%, 81.7% vs 18.3%, 85.9% vs 14.1%).

AP-tests were scored using two methods: (1) 1 point for a correct answer and 0 for an incorrect answer, (2) the degree of semitone errors were taken into account. For the latter method, based on the protocol of Athos et al. (2007), 1 point for a correct answer, 0.75 points for one semitone error, 0.5 points for two semitone errors, 0.25 points for three semitone errors, and 0 points for more than three semitone errors were given.

Subjects were divided into three groups based on their scores on the AP-test, following Miyazaki's (2007) protocol: (1) those in the inaccurate group identified less than 70% of the pitches; (2) Those in the intermediate group identified at least 70% but not more than 90% of the pitches; (3) Those in the accurate group identified more than 90% of the pitches.

2. Results of the thesis

In the first and second experiments, subjects playing transposing instruments identified fewer pitches (p = 0.061 [one-tailed] and p = 0.068 [one-tailed]), and scored lower on AP-tests than subjects playing non-transposing instruments (p = 0.002 [one-tailed] and p = 0.058 [one-tailed]). On AP-test in complex musical context, subjects playing transposing instruments identified fewer pitches than subjects playing non-transposing instruments (p = 0.090 [one-tailed]).

In the second experiment, subjects playing non-transposing instruments identified more pitches on the AP-test in isolated than in complex musical context ($p < 0.001$ [one-tailed]), whereas no difference was found for subjects playing transposing instruments (p = 0.133 [one-tailed]).

On the AT-test of the second experiment, subjects playing non-tranposing instruments overperformed subjects playing transposing instruments (p = 0.001 [one-tailed]).

Subjects playing transposing instruments achieved higher scores on the Perceptual Abilities (p = 0.030 [one-tailed]), Emotions (p = 0.018 [one-tailed]), Active Engagement (p = 0.092 [one-tailed]), Musical Training (p = 0.056 [one-tailed]) and Singing Abilities (p = 0.063 [one-tailed]) subscale of the Gold-MSI than subjects playing non-transposing instruments. There was no significant difference on the General Sophistication subscale.

3. Conclusion

The results show that subjects playong transposing instruments performed worse on the AP and AT tests than subjects playing non-transposing intruments, which could be explained by several reasons. Since, in the case of transposing instruments, pitches written in the score and pitches actually sounded are not the same, it is unclear what association is made between pitches heard and the names of the pitches during instrumental training. There are three possible ways: (1) the pitch as written in the score and the associated sound name, (2) the pitch as heard in real life and the associated sound name, or (3) the pitch as

heard in real life and the sound name associated with the pitch as written in the score.

The first case can lead to so-called instrument-specific AP. Individuals with instrument-specific AH can more accurately identify pitches playing on a familiar instrument (Reymore & Hansen, 2020), but this ability is not beneficial for the development of either true AP or AT. Individuals with instrument-specific AP are unlikely to identify nearly any pitch correctly, but if semitone errors are examined, it can be found that the deviations are always the same and identical, and that the degree of semitone error is equal to the difference between the pitch of the transposing instrument and the pitch written in the score.

The second case may lead to the development of genuine AP, but this is not what music education methods in Western music culture typically aim to achieve. The third case is not beneficial to the development of AP at all, since transposing instruments are typically made in several different tunings – e.g. clarinet in B-flat, clarinet in A, clarinet in E-flat. This means that the deviation between

the pitches written in the score and the actual pitches of the different instruments is also variable: 2 semitones for clarinet in B-flat, 3 semitones for clarinet in A and for clarinet in E-flat, in addition, the actual pitches of clarinet in B-flat and clarinet in A are lower than the pitches written in the score, while the actual pitches of clarinet in E-flat are higher than the pitches written in the score (Arnóth, 2017). If a clarinet player performs on several instruments, the association between the pitches written in the score and the actual pitches cannot develop due to the constant variability.

Subjects playing transposing instruments scored worse than subjects playing non-transposing instruments not only on the AP-tests but also on the AT-tests. AT requires that individuals with the ability can identify at least the central pitch of a melody. However, this also requires that they can use this central pitch as a reference pitch to determine whether or not the central pitch of two melodies is the same. It can be assumed that passive AT requires a type of AP that goes beyond the level of pseudo- or quasi-AH. Individuals with pseudo- and quasi-AP are

typically able to identify with certainty one pitch, which they use as a reference for identifying other pitches, but comparing the tonality of two melodies requires a different strategy: the ability to identify only one pitch is not sufficient.

Subjects playing transposing instruments achieved higher scores on the Gold-MSI than subjects playing non-transposing instruments except for the General Sophistication subscale. To understand the differences on the Gold-MSI between subjects playing transposing and subjects playing non-transposing instruments, further background variables need to be explored. For example: within the Musical Training subscale, subjects playing transposing instruments practised more on their main instrument and participated in more musical events on average than subjects playing non-transposing instruments. However, intensive instrumental practice in itself is not a sufficient condition for the acquisition of AP, since if there is a discrepancy between the pitch of the instrument and the pitch written (named) in the score, this does not facilitate the development of AP. The question is

whether subjects playing transposing instruments play their instruments for longer than subjects playing non-transposing instrument – earlier onset of instrumental training may explain this difference. So, in addition to practice, it is crucial to become aware of how to name pitches - an explicit process that requires extra effort from subjects playing transposing instruments.

It is emphasized that experiments were designed to measure only passive AP and passive AT, and that the participants were typically musicians with formal musical training who played instruments, mostly professionally. Due to the limitations and the contradictory results of the studies, further investigations are needed.

References

Arnóth, Z. (2017). *A klarinét hangja a zenekarban*. [DLA doktori értekezés, Pécsi Tudományegyetem Művészeti Kar Doktori Iskola, Pécs]. https://pea.lib.pte.hu/handle/pea/17542

Asztalos, A. (2021). *Az ének-zene tantárgyat tanító pedagógusok nézetei*. Budapest: Akadémiai Kiadó. ISBN 978-963-4547-46-4

Athos, E. A., Levinson, B., Kistler, A., Zemansky, J., Bostrom, A., Freimer, N., & Gitschier, J. (2007). Dichotomy and perceptual distorsions in absolute pitch ability. *Proceedings of the National Academy of Sciences of the United States of America*, *104*(37), 14795-14800. https://doi.org/10.1073/pnas.0703868104

Bachem, A. (1937). Various types of absolute pitch. *Journal of the Acoustical Society of America, 9*, 146-151. https://doi.org/10.1121/1.1915919

Herceg, A., & Szabó, P. (2022). Az abszolút hallás: áldás vagy átok? *Magyar Pszichológiai Szemle, 77*(2), 271-290. https://doi.org/10.1556/0016.2022.00017

Herceg, A., & Szabó, P. (2023). Absolute pitch: a literature review of underlying factors, with special regard to music pedagogy. *Psychomusicology: Music, Mind, and Brain.* https://doi.org/10.1037/pmu0000298

Jackendoff, R., & Lerdahl, F. (2006). The capacity for music: What is it, and what's special about it? *Cognition, 100*(1), 33-72. https://doi.org/10.1016/j.cognition.2005.11.005

Miyazaki, K. (2004). How well do we understand absolute pitch? *Acoustical Science and Technology, 25*(6), 426-432. https://doi.org/10.1250/ast.25.426

Miyazaki, K. (2007). Absolute pitch and its implications for music. *Archives of Acoustics*, *32*(3), 529-540.

Müllensiefen, D., Gingras, B., Musil, J., & Stewart, L. (2014). The musicality of non-musicians: An index for assessing musical sophistication in the general population. *PLoS ONE, 9*(6), e101091. https://doi.org/10.1371/journal.pone.0089642

Ollen, J. E. (2006). *A criterion-related validity test of selected indicators of musical sophistication using expert ratings*. [Doctoral dissertation, Ohio State University].

Parncutt, R., & Levitin D. (2001). Absolute pitch. In S. Sadie (Ed.), *New Grove Dictionary of Music and Musicians, 1*. London: MacMillan. 37-39.

Reymore, L., & Hansen, N. C. (2020). A theory of instrument-specific absolute pitch. *Frontiers in Psychology*, *11*:560877. https://doi.org/10.3389/fpsyg.2020.560877

Takeuchi, A., & Hulse, S. (1993). Absolute pitch. *Psychological Bulletin*, *113*(2), 345-361. https://doi.org/10.1037/0033-2909.113.2.345

Weisman, R. G., Balkwill, L. L., Hoeschele, M., Moscicki, M. K., & Sturdy, C. B. (2012). Identifying absolute pitch possessors without using a note-naming task. *Psychomusicology: Music, Mind, and Brain*, *22*(1), 46-54. https://doi.org/10.1037/a0028940

Ziv, N., & Radin, S. (2014). Absolute and relative pitch: Global versus local processing of chords. Advances in Cognitive Psychology, 10(1), 15-25. https://doi.org./10.5709/acp-0152-7

Authorised list of publications on the subject of the thesis

UNIVERSITY AND NATIONAL LIBRARY
UNIVERSITY OF DEBRECEN
H-4002 Egyetem tér 1, Debrecen
Phone: +3652/410-443, email: publikaciok@lib.unideb.hu

Registry number: DEENK/262/2024.PL
Subject: PhD Publication List

Candidate: Attila Herceg
Doctoral School: Doctoral School of Human Sciences
MTMT ID: 10045487

List of publications related to the dissertation

Hungarian scientific articles in Hungarian journals (1)

1. **Herceg, A.**, Szabó, P.: Az abszolút hallás: áldás vagy átok?
   Magyar Pszichológiai Szemle. 77 (2), 271-290, 2022. ISSN: 0025-0279.
   DOI: http://dx.doi.org/10.1556/0016.2022.00017

Foreign language scientific articles in international journals (1)

2. **Herceg, A.**, Szabó, P.: Absolute pitch: A literature review of underlying factors, with special regard to music pedagogy.
   Psychomusicology: Music, Mind, and Brain. 33 (1-4), 40-47, 2023. ISSN: 0275-3987.
   DOI: http://dx.doi.org/10.1037/pmu0000298
   IF: 1.3 (2022)

List of other publications

Hungarian scientific articles in Hungarian journals (6)

3. **Herceg, A.**: Abramo Baseví munkássága és jelentősége.
   Parlando. 4, 1-6, 2017. ISSN: 0133-2767.
4. **Herceg, A.**: Hermeneutikai kérdések a zenei interpretációban.
   Parlando. 3, 1-4, 2016. ISSN: 0133-2767.
5. **Herceg, A.**: A mentális gyakorlás szerepe a zenei képességfejlesztésben.
   Parlando. 2015/6, 1-5, 2015. ISSN: 0133-2767.
6. **Herceg, A.**: A motiváció szerepe a versenyfelkészülésben illetve -felkészítésben.
   Parlando. 1, 1-6, 2015. ISSN: 0133-2767.
7. **Herceg, A.**: Zeneiskola vagy zeneterápia?
   Parlando. 4, 1-5, 2014. ISSN: 0133-2767.

UNIVERSITY of DEBRECEN

UNIVERSITY AND NATIONAL LIBRARY
UNIVERSITY OF DEBRECEN
H-4002 Egyetem tér 1, Debrecen
Phone: +3652/410-443, email: publikacio@lib.unideb.hu

8. **Herceg, A.**: Az információfeldolgozási stratégiák szerepe a zenetanulásban.
Parlando. 2013/6, 1-3, 2013. ISSN: 0133-2767.

Hungarian conference proceedings (4)

9. **Herceg, A.**: Gyógyítható-e az abszolút hallás?
In: Közös tudományos sikerek című X. Ph.D. jubileumi konferencia előadásai. Szerk.: Koncz István; Szova Ilona, Professzorok az Európai Magyarországért Egyesület, Budapest, 85-89, 2015. ISBN: 9789638991553

10. **Herceg, A.**: Misztikus abszolút hallás.
In: Tavaszi Szél 2014 Konferenciakötet IV.. Szerk.: Csiszár Imre; Kőmüves Péter Miklós, Doktoranduszok Országos Szövetsége, Debrecen, 332-339, 2014. ISBN: 9789638956088

11. **Herceg, A.**: Meghatározza-e információfeldolgozási stratégiánk zenei képességeinket?
In: Együtt a biztosabb tudományos karrierért, a jövőtervezésért : PEME VII. Ph.D. konferencia. Szerk.: Koncz István; Szova Ilona; Fürj Zoltán; Farkas Péter; Egri Tímea, Professzorok az Európai Magyarországért Egyesület, Budapest, 100-109, 2013. ISBN: 9789638991508

12. **Herceg, A.**: Vakok és látók zenei képességeinek összefüggései.
In: Nemzedékek együttműködése a tudományban. Szerk.: Koncz István; Nagy Edit, Professzorok az Európai Magyarországért Egyesület, Budapest, 61-67, 2012. ISBN: 9789638843371

Hungarian abstracts (1)

13. **Herceg, A.**: Az abszolút hallás és az abszolút tonalitás vizsgálata transzponáló és nem transzponáló hangszeren játszók között.
In: Innováció, kutatás, pedagógusok : Absztrakt kötet, Magyar Nevelés- és Oktatáskutatók Egyesülete, Budapest, 87-87, 2017. ISBN: 9786155657023

Informational/educational articles (4)

14. **Herceg, A.**: A zene "árnyoldalai".
Mindennapi Pszichol. 8 (3), 58-60, 2016. ISSN: 2060-2626.

15. **Herceg, A.**: Láthatatlan zene.
Mindennapi Pszichol. 7 (3), 44-47, 2015. ISSN: 2060-2626.

16. **Herceg, A.**: Tehetséges a gyermekem?
Mindennapi Pszichol. 6 (3), 32-35, 2014. ISSN: 2060-2626.

UNIVERSITY AND NATIONAL LIBRARY
UNIVERSITY OF DEBRECEN
H-4002 Egyetem tér 1, Debrecen
Phone: +3652/410-443, email: publikaciok@lib.unideb.hu

17. **Herceg, A.**: Látod vagy hallod?
Mindennapi Pszichol. 5 (6), 28-31, 2013. ISSN: 2060-2626.

Total IF of journals (all publications): 1,3
Total IF of journals (publications related to the dissertation): 1,3

The Candidate's publication data submitted to the iDEa Tudóstér have been validated by DEENK on the basis of the Journal Citation Report (Impact Factor) database.

15 May, 2024