INTRODUCTION
Numerous predictors of foreign language pronunciation accuracy have already been recognised, and research is constantly conducted to determine which factors indeed influence foreign language pronunciation and to what extent. As multiple studies (e.g. Purcell and Suter 1980) have shown, foreign language pronunciation is influenced by many factors, both internal and external. External factors include, among others, the type of instruction (Elliott 1995), while the internal factors include cognitive styles (Dreyer et al. 1996), personality and motivation (Baran-Lucarz 2007), and different types of aptitude (Nardo and Reiterer 2009). Among the types of aptitude being investigated, the focus is placed mainly on musical aptitude and language aptitude. However, their influence on L2 pronunciation accuracy has not yet been verified.

While some studies (e.g. Sleev and Miyake 2006) confirm, others (e.g. Flege et al. 1995) reject the role of musical aptitude in L2 pronunciation accuracy. The relationship between language aptitude and L2 pronunciation has not been widely researched yet and neither has been the possible relationship between individual components of musical aptitude and language aptitude, although their overall scores appear to correlate weakly.

The article offers a review of the literature concerned with the possible relationships between musical aptitude, language aptitude and foreign language pronunciation accuracy. It provides us with what is already known about the relationships between these variables as well as some comments on the methodology and the results of the previous research.

MUSICAL APITUDE AND PRONUNCIATION ACCURACY
The influence of musical aptitude on foreign language pronunciation accuracy has been the most extensively researched relationship among the ones being the subject of this paper. Multiple studies have been conducted in the area, their results being inconclusive since some of them confirm, while others reject the existence of a link between musical talent and L2 sound acquisition.

Firstly, Purcell and Suter (1980) investigated which out of several internal and external factors were the strongest predictors of a non-accented L2 speech. The investigated factors
included e.g. age of arrival, years of residence in an English environment, the amount of formal instruction and pronunciation instruction, L1, gender, economic and integrative motivation, aptitude for oral mimicry and personality type (extraversion or introversion). The analysis of the results revealed that the strongest predictor of pronunciation accuracy was the learner’s L1, which accounted for almost 42% of the variance. What is more, the learner was the most likely to achieve good English pronunciation not only if their native language was a ‘favoured’ language, but if they also had an aptitude for oral mimicry, had lived in an English speaking country for a considerable number of years, preferably lived with a native English speaker and were concerned about their own pronunciation accuracy. As can be seen, the factors which were recognised as predictors of pronunciation accuracy did not include musical aptitude. However, it is important to note that the authors emphasised the role of mimicry ability in L2 pronunciation accuracy, and mimicry ability has been recognised by some scholars as an element of musical aptitude (Gordon 1989a).

Similarly, Thompson (1991), who also investigated possible predictors of foreign language pronunciation accuracy, did not recognise musical ability as one of them. Nevertheless, she has also recognised mimicry ability as an important factor in achieving a native-like L2 pronunciation. The factors which the author found to be the most significant were the age of arrival, gender, already mentioned mimicry ability and overall language proficiency.

Flege, Munro and MacKay (1995) also investigated the internal factors affecting the degree of a foreign accent, the main subject of the research being the age of learning. The analysis of the results confirmed the hypothesis that the age of learning had a significant impact on pronunciation accuracy, followed by language use factors and gender. Again, musical aptitude was not acknowledged as one of the factors having significant effect on the degree of a foreign accent. This time, however, not even the mimicry ability was recognised as influential.

In all three of the studies mentioned so far, the learners’ pronunciation accuracy was rated by a panel of native speakers, while the data about the investigated factors were taken from questionnaires which the subjects filled in themselves. While the judgement of pronunciation accuracy and accentedness by a panel of native speakers (if the inter-rater reliability is assured) is a highly reliable methodological tool, a questionnaire does not seem to be a reliable technique to elicit certain information. It can be reliably used to elicit information about the age of learning, age of arrival, gender or motivation and many others, but it should not be used to elicit information about the testee’s own abilities. The reliability of such procedures may be very strongly influenced by the testee’s lack of awareness of their own abilities (due to e.g. lack of training in a certain field) or by lack of objectivity in self-rating, i.e. the learners may over- or underestimate their own abilities. In order to reliably reject the possible influence of musical aptitude on pronunciation accuracy, musical aptitude should be reliably tested, e.g. by means of standardised test batteries.

To summarise, I may refer to the review by Piske, MacKay and Flege (2001), who thoroughly examined the existing literature on the factors affecting the degree of foreign accent in L2 speech. Reviewing multiple studies, they concurred with the conclusions drawn by Thompson (1991) and Flege et al. (1995), summarising that “musical ability has as yet not been identified as one of those variables that have an important influence on the degree of L2 foreign accent” (Piske et al. 2001: 202). However, it is also important to note that the authors concurred with the conclusions drawn by Purcell and Suter (1980), i.e. that mimicry ability had a significant effect on foreign language pronunciation.

On the other hand, there are multiple studies indicating that musical aptitude is, in fact, a predictor of pronunciation accuracy. Since the thirties of the twentieth century there have been studies (e.g. Dexter and Omwake 1934, Pimsleur et al. 1962) which succeeded at confirming that the levels of musical ability, especially pitch discrimination ability, correlate (sometimes strongly) with pronunciation accuracy. What validates the reliability of those early studies is their reliance on standardised test batteries, mostly the Seashore Measures of Musical Talents (Seashore 1919, 1939), in their musical ability ratings. For a review of the studies confirming the existence of this relationship from the thirties until the sixties of the twentieth century see Blickenstaff (1963).

Flege, Yeni-Komshian and Liu (1999) did not recognise musical aptitude as a predictor of pronunciation accuracy, but as one of the components of an amalgam which undoubtedly had an effect on L2 accent. This amalgam called ‘sound processing ability’ consisted of musical ability, the ability to imitate foreign speech, and the ability to remember how English words are pronounced. Nonetheless, the study suffers from the same methodological issues as the already mentioned studies by Flege et al. (1995) and Thompson (1991), that is, the subjects self-rated their musical abilities in a questionnaire. In this particular study, each of the components of the sound processing ability was self-rated, which, in my opinion, as it was mentioned before, constitutes a major reliability problem.

Slevc and Miyake (2006), in turn, correlated the results of a standardised musical aptitude test (Wing 1968) with the results obtained by Japanese learners of English in four language domains: speech perception, speech production, syntax and lexical knowledge. Some other variables possibly influencing L2 pronunciation, such as the age of arrival, the length of residence in L2 environment, motivation or non-verbal intelligence were also taken into consideration. While no correlation was found between the levels of musical aptitude and lexical or syntactic accuracy, very strong correlations were observed between musical aptitude and both perception and production of L2 speech. The second strongly correlated factor was the length of residence in an L2 environment. The authors concluded that “[t]he popular conjecture that musical ability is associated with L2 proficiency is not a myth. Although the link may be restricted to L2 phonology, individuals who are good at analyzing, discriminating, and remembering musical stimuli are better than other people at
accurately perceiving and producing L2 sounds” (Slevc and Miyake 2006: 679).

It is important to note at this point that Slevc and Miyake (2006) also asked their subjects to fill in a self-rating questionnaire about their own abilities, but did not take its results into consideration when calculating the correlations. Interestingly, the authors claimed that if the results of the questionnaire had been the basis of establishing the researched relationships, no relationships would have been discovered (Slevc and Miyake 2006: 678-679). The results of a standardised musical aptitude test differed substantially from the results of a questionnaire, namely, the subjects underrated their own musical abilities. These data call into question the reliability of the already mentioned research by Thompson (1991). Flege et al. (1995) and Flege et al. (1999), whose conclusions about the influence of musical aptitude on pronunciation accuracy were based solely on the subjects’ musical aptitude self-rating.

Zybert and Stepien (2009) conducted four tests: music perception, speech perception, music production and speech production tests and correlated their scores with one another. The results indicated, firstly, that the perception of both music and language strongly correlated with the production of music and language respectively. This suggested that an accurate production of sounds stemmed from their accurate perception. What is more, subjects with higher levels of musical ability appeared to be better than the ones with lower levels at recognising intonation patterns. Interestingly, the subjects experienced similar problems with discriminating foreign vocalic sounds regardless of their musical aptitude level. For musically talented subjects, music perception correlated with speech perception as well as music production correlated with speech production. Such relationships were not noted among the subjects with low levels of musical aptitude, which led the authors to conclude that musical talent facilitated pronunciation accuracy and was a predictor and a determinant of a native-like foreign accent.

Nardo and Reiterer (2009) researched not only the relationship between musical aptitude and pronunciation accuracy, but also added language aptitude to the equation, opening the area for discovering more potentially existing relationships (see section Musical aptitude and language aptitude below). Several tests were conducted, i.e. musical aptitude test (Gordon 1989b), musical aptitude self-rating questionnaire, L2 pronunciation talent test, L2 pronunciation performance test, English grammar test, and the four components of the Modern Language Aptitude Test (MLAT – Carroll and Sapon 1959). The values of Pearson correlation coefficient were calculated between the results of each test. The conclusions drawn from the analysis of the results were that a strong correlation existed between musical aptitude and L2 pronunciation performance. Rhythm and tone perception as well as good attitude towards singing were “the best ingredients for achieving talent and expertise in foreign language pronunciation” (Nardo and Reiterer 2009: 238).

Finally, apart from the presented empirical evidence, there are also numerous neural and psycholinguistic studies confirming the relationship between music and foreign language acquisition (see Gaab and Schlaug 2003, Koelsch et al. 2003, Reiterer et al. 2005, 2008). Specifically, imaging techniques show that music and language are processed by the same areas of the brain. What is more, there are studies based on both empirical and neural evidence (see Milovanov 2009). For a comprehensive review of the neural and psycholinguistic studies on the relationship between music and second language learning see Chobert and Besson (2013).

**LANGUAGE APTITUDE AND PRONUNCIATION ACCURACY**

The relationship between language aptitude and pronunciation accuracy is rather difficult to establish since sparse studies have been conducted in the area. Language aptitude is a person’s potential to acquire a foreign language. This does not mean that a person with low language aptitude will not learn a foreign language, but that they will most probably do it with more difficulty and at a slower pace than a person with high aptitude. However, even though language aptitude should facilitate pronunciation accuracy by definition (language acquisition entails its pronunciation acquisition), standardised tests measuring language aptitude do not test speech production. As Hinton (2013: 104) notes, none of the commonly used aptitude tests, including the best known MLAT (Carrol and Sapon 1959) and PLAB (Pimsleur 1966) and their several innovations, require the testee to produce speech. Thus, neither speech nor its phonetical and phonological aspects can be assessed by means of existing aptitude tests. As a result, whether language aptitude is a predictor of pronunciation accuracy has not, in fact, been established yet.

The hypothesis that such a relationship exists has not been widely tested, either. Only the study by Baker Smemoe and Haslam (2013) investigated, among others, the relationship between the results of the PLAB test and pronunciation accuracy. The overall score of the PLAB test correlated with accurate L2 pronunciation. However, it is important to note that the components of PLAB which correlated strongly with pronunciation accuracy were auditory aptitude and motivation, which are absent in the MLAT, and which measure components other than the four standard components of language aptitude introduced by Carroll and Sapon (see Skehan 1989: 26). Thus, even though the conclusion drawn from the research is that language aptitude affects pronunciation accuracy, it has to be noted that the overall results were strongly influenced by high results of the additional language aptitude test components, which did not in fact refer to standard language aptitude components. As a result, a potential relationship between the traditional operationalisation of language aptitude and pronunciation accuracy is still not known and needs to be verified.

**MUSICAL APTITUDE AND LANGUAGE APTITUDE**

Few studies were conducted to verify whether a relationship between the levels of musical and language aptitudes exists. However, some trends seem to be visible in the existing liter-
Firstly, Tucker (2000) compared the results of the MLAT, a musical aptitude test (Seashore 1919, 1939) and self-rated L2 proficiency of Japanese and English native speakers. The analysis of the results revealed significant correlations between the MLAT results and both self-rated L2 proficiency and the Seashore Measures of Musical Talent components testing pitch and rhythm discrimination. As can be seen, language aptitude correlates with at least some of the components of musical aptitude.

As self-rating was used as one of the data collection techniques, the results concerning the relationships between the MLAT results and overall L2 proficiency may not appear to be reliable. However, since the correlation between musical aptitude and language aptitude was calculated on the basis of standardised tests scores, I consider this part of the research reliable in terms of elicitation techniques used. The only problems with the reliability of the study may result from the size of the population, which consisted of only 34 English and 58 Japanese native speakers.

The doctoral dissertation by Gilleece (2006) was devoted to the investigation of the relationship between musical aptitude and language aptitude. Apart from the batteries measuring musical aptitude (Bentley 1966) and language aptitude (a modified version of the MLAT), the subjects took also a non-verbal intelligence test (Raven et al. 1998) as well as their music and speech production were evaluated. The results revealed that non-verbal intelligence was a moderating variable between musical and language aptitudes, as non-verbal intelligence was found to be a predictor of language aptitude. The discovered correlations between the musical and language aptitudes were weak to moderate, and even stronger when the variable of non-verbal intelligence was taken into consideration. Thus the conclusion that a relationship between musical aptitude and language aptitude indeed existed, and according to Gilleece, it was not connected with musical training, but with basic innate musical talent. It is also worth noting that Gilleece (2006) found a strong link between the perception and production of L2 speech, which, again, suggested that accurate speech perception was necessary for its accurate production.

Finally, the already mentioned study by Nardo and Reiterer (2009), in which not only the relationship between musical aptitude and pronunciation accuracy, but also the relationship between musical and language aptitudes was investigated. Musical aptitude was measured by a music perception test (Gordon 1989b) and a self-assessed musical abilities questionnaire, while language aptitude was measured by the MLAT. As the results indicated, a strong correlation existed between musical aptitude and a grammatical sensitivity component of language aptitude, while a low correlation was observed between musical aptitude and phonetic coding ability component of language aptitude. These results might be considered slightly surprising since it is the phonetic coding ability that is connected with phonetic and phonological language acquisition. Thus, theoretically, it should be more strongly linked to musical aptitude than grammatical sensitivity, which is seemingly unrelated to sound acquisition. No correlation was discovered between musical aptitude and MLAT subtests related to vocabulary acquisition. In summary, overall language aptitude scores correlated with musical aptitude levels, but these correlations were low.

CONCLUSIONS

While the influence of musical aptitude on foreign accent has been researched relatively widely, little is known about a possible relationship between language aptitude and pronunciation accuracy. The studies concerning the relationship between musical aptitude and language aptitude offer partly inconsistent results.

To summarise numerous studies on the relationship between musical aptitude and pronunciation accuracy, reliable studies support the claim that musical abilities facilitate L2 phonetic and phonological acquisition. Although some studies reject such an influence, the reliability of the tools used in them to rate musical abilities may be questioned. Questionnaires may be reliably used as a tool to elicit certain information, such as the age of arrival or the age of learning, as well as information about the subjects’ attitudes and motivation. However, self-rating of the subjects’ own abilities may appear to be unreliable for a number of reasons, the main one being a high probability of lack of objectivity in self-evaluation. Since the rating of musical abilities may not be reliable, neither may be the conclusions drawn from it. Especially, when Slevc and Miyake (2006) indicated that if the results of their study had been based on self-rating rather than on standardised tools, the correlations would not have been discovered. For this reason, it appears reasonable to rely more on empirical evidence where musical aptitude was measured by means of standardised test batteries. Such studies (e.g. Slevc and Miyake 2006, Nardo and Reiterer 2009) advocate the existence of a link between musical aptitude and pronunciation accuracy. Some researchers (Zybert and Stepien 2009, Nardo and Reiterer 2009) even claim that musical aptitude is a determinant of accurate perception, and consequently, of production of foreign speech sounds. What is more, neural and psycholinguistic evidence (e.g. Milovanov 2009) also indicates that there is a relationship between foreign language learning and music.

Finally, some studies which rejected musical aptitude as a facilitator of pronunciation accuracy (Purcell and Suter 1980, Thompson 1991), recognised mimicity ability, which may be considered a component of musical aptitude (Gordon 1989a), as an important factor influencing L2 sound acquisition.

It is also important to note that the studies which reject the potential influence of musical abilities on pronunciation accuracy are the studies which aimed at verifying the influence of many potential variables at once. On the other hand, studies which aimed at verifying the influence of a limited number of variables, or even only the one variable of musical aptitude, confirmed such an influence. The conclusion to be drawn from these data is that the influence of musical talent on foreign sound acquisition may exist, but is probably significantly weaker than the influence of the variables indicated by the
studies by Purcell and Suter (1980) or Flège et al. (1995), such as e.g. age of arrival.

The relationship between language aptitude and pronunciation accuracy theoretically should exist, but practically, the study by Baker Smemoe and Haslam (2013) indicates that it is rather weak. It may be considered stronger if additional components of language aptitude are taken into consideration, namely motivation and auditory aptitude. However, if language aptitude is defined faithfully to Carroll and Sapon’s definition, that is, it consists of four standard components, such relationship still needs to be researched and verified.

Few studies have been conducted aiming at verifying the relationship between musical and language aptitudes, but some trends are already visible in their results. In summary, such a relationship probably exists, but it still has to be researched more deeply. The study by Gilleece (2006) indicates that there are weak to moderate correlations between the two variables, but offers few conclusions concerning the relationships between the particular components of both types of aptitude. On the one hand, the study by Tucker (2000) suggests that the MLAT results correlate with only some individual components of musical ability, while, on the other hand, Nardo and Reiterer (2009) suggest that musical aptitude correlates with only some individual components of language aptitude.

What is more, as Nardo and Reiterer (2009) indicate, a strong relationship exists between musical aptitude and grammatical sensitivity, but interestingly, not between musical aptitude and phonetic coding ability, i.e. a component strictly connected with speech and pronunciation. It may be thus hypothesised that a relationship between general musical aptitude and general language aptitude exists, however, more detailed research should be done concerning the relationships between certain components of both types of aptitude. Such research may prove fruitful since its results appear to be unpredictable so far.

**FUTURE RESEARCH**

The study to be conducted aims at verifying all three of the aforementioned relationships, that is, between musical aptitude and pronunciation accuracy, between language aptitude and pronunciation accuracy, and between musical aptitude and language aptitude.

In the planned study, musical aptitude is divided into music perception and production, language aptitude consists of four standard components, and pronunciation accuracy is defined as the correct perception and production of individual sounds, words stress and intonation.

The tools to be used include:

- a musical aptitude test in perception (Gordon 1989b) and in production (conducted by professional musicians from the academy of music, resembling entrance exams to the academy of music);
- each of the components of the language aptitude test TUNJO (Rysiewicz 2006) – a Polish adaptation of the MLAT (Carroll and Sapon 1959);
- a pronunciation accuracy test, evaluating three different components of pronunciation: articulation, word stress and intonation, each evaluated in three subtests: reception, imitation and production. Pronunciation accuracy will be rated by a panel of native English speakers.

The subjects of the study will be two groups of at least 30 people of both sexes, who had started learning English at a similar age and are at a similar level of proficiency. The first group will consist of musically proficient people (e.g. academy of music students), while the second (control) group will consists of people with no musical background.

The scores obtained by the subjects in each of the tests will be the basis for establishing correlations between each of the researched variables. The correlations will be calculated between overall scores (e.g. overall language aptitude) as well as individual components (e.g. phonetic coding ability). Statistical measures to be used include Pearson correlation coefficient and multiple regression.

The calculation of the results of the tests will allow me to draw conclusions about the possible relationships between the variables. It will help to gain more detailed knowledge about the relationship between musical talent and pronunciation accuracy, to verify a possible relationship between language aptitude and pronunciation accuracy and make some preliminary assumptions about the relationships between the individual components of musical aptitude and language aptitude.

I hypothesise that there is a relationship between musical aptitude and pronunciation accuracy as well as a weak relationship between language aptitude and pronunciation accuracy. As for the relationship between musical aptitude and language aptitude, I hypothesise that there is a weak one, but I cannot at this point hypothesise about the relationships between their individual components.

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**MUSICAL APITUDE, LANGUAGE APITUDE AND L2 PRONUNCIATION ACCURACY – A LITERATURE REVIEW**

Katarzyna Zaloga-Kociuga

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**UZDOLNIENIA MUSZCZNE, UZDOLNIENIA JĘZYKOWE I POPRAWNOŚĆ WYMOWY JĘZYKA OBCEGO – PRZEGŁĄD LITERATURY**

Streszczenie


Planowane badanie w obszarze relacji pomiędzy uzdolnieniami muzycznymi i językowymi oraz poprawnością wymowy określa wartości tych zmiennych w oparciu o ich podział na elementy składowe. Uzdolnienia muzyczne zawierając będą percepcję i produkcję muzycy. Uzdolnienia językowe składają się będą z czterech standardowych komponentów (Skehan 1989: 26), podczas gdy wymowa rozłożona będzie na czyniki percepcji i produkacji pojedynczych dźwięków, akcentu wyrazowego oraz intonacji. Na podstawie wyników osiągniętych przez grupę osób muzycznie uzdolnionych oraz grupę kontrolną możliwe będzie dokładniejsze określenie wspomnianych relacji.

SŁOWA KLUCZOWE: uzdolnienia muzyczne; uzdolnienie językowe; wymowa języka obcego