Creative Music Production

Professional Project

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How genetics, external influences and practise determine musical talent and ability.

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Abstract

The objective of this research project was to investigate the influence of genetics and environment on a person's musical talent and ability. This research was based on the question of whether nature or nurture make a person who they are. Previous research in the field has named certain characteristics such as perfect pitch, tone deafness and synthesia to be due to genetics, which can sequentially affect musical talent. Others have named a teacher's influence, family encouragement and practise as main determinators.

In order to determine what aspects of a music student's life impact their talent, a survey was conducted on 22 music students and their teachers. This survey graded each student's musical ability and asked questions on their family, environment, encouragement, practise and enjoyment. The students' answers and grades were compared in order to detect any patterns among their experiences. The teachers' opinions and experiences were also gathered for comparison. The results of the survey revealed that talent likely cannot be explained by genetics or environment alone. It was found that genetics, home environment, home encouragement, external environment, external encouragement, practise, confidence and enjoyment may all impact a person's musical talent.

These results encourage future research to prioritise all aspects mentioned, and how they impact each other in creating musical talent. In terms of musical talent, it now seems counterproductive to determine nature or nurture as a cause. It is evident from the survey that music talent can be influenced and built in many different ways.

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Introduction

The purpose of this research project was to explore musicality in music students and their families, in order to further understand how a person's genetics and environment can have an effect on their musical abilities and talent.

This study relates to the question of nature or nurture, a question which has been widely debated for many years. Psychologist Sir Francis Galton has been credited with beginning this debate in 1869 with his book *Hereditary Genius*, which studies the environmental influences and genetic inheritance of intelligence[1]. In other words, the question of nature versus nurture asks whether a person's behaviors and characteristics are due to their genetics or external influences. The current project further examined this argument in terms of musical ability. Some believe that music is mostly a natural gift, that a person either has a musical gene or does not.[2] Others believe that it varies by individual and that the musicality of a person's family alone has no direct effect on their abilities.[3] This research project aimed to answer the question of whether musicality is due to nature or nurture.

An understanding of how talent is achieved would provide further opportunities to encourage and improve upon those talents. For example, if it is known that a child has a specific gene for music, this can be encouraged and practised from an early age, in order to strengthen that talent to its highest capability. Alternatively, if a person's surroundings affect their musical abilities, a knowledge of how that environment can be shaped to strengthen an ability would also be advantageous to any student. An explanation as to how musical talent is achieved could also explain how differing levels of musical expertise are reached. Many people dedicate endless amounts of time to improving their musical talent, yet they never achieve the same level of expertise as others. If genetics and external influences are as influential on talent as practise is, this could explain why similar levels of practise achieve different results.

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[1] Galton, Francis. *Hereditary Genius*. London, Macmillan and Co, 1869.

[2] Park, Hansoo, Lee, Seungbok, Kim, Hyun-Jin, Ju, Young Seok, Shin, Jong-Yeon, Hong, Dongwan, von Grotthuss, Marcin, Lee, Dong-Sung, Park, Changho, Kim, Jennifer Hayeon, Kim, Boram, Yoo, Yun Joo, Cho, Sung-Il, Sung, Joohon, Lee, Charles, Kim, Jong-Il, Seol, Jeong-Sun. "Comprehensive genomic analyses associate *UGT8* variants with musical ability in a Mongolian population.", *Journal of Medical Genetics,* BMJ Journals, vol.49, no.12, p.747-752, 27 November 2012.

[3] Simonton, Dean Keith. "The Implications of an Emergenic–Epigenetic Model", *Genetics of Giftedness,* Cambridge University Press, New York, 31 May 1986, p.324. Print.

This project utilized the theories of other research in this area to build a survey on musicality and family influence. The three main focal points of the survey came to be; genetics, external influences and practise. The survey was answered by music students and answers were then compared, in order to determine the origin of the students' talents and compare backgrounds. The intention of the survey was to identify any patterns among the students' differing levels of talent, their families, their experience with music and their dedication to improving their talent. These patterns were what determined the influence genetics, external influences and practise have on musical talent and ability.

Literature Reviews

The aim of the current project was to investigate musical interest and talent, and how a person's genetics and surrounding environment can affect that musicality. Many believe that a person can be naturally more talented at certain hobbies and activities than others.[4] [5] The question here is whether that natural ability stems from a person's genetics and physicalities or whether it is due to what they learned and experienced in their environment as children and as they grew. The reasoning for this research is to discover whether people can choose their own areas of interest and expertise or whether this is predetermined, and how. A knowledge of a natural ability can be of great importance, as the earlier someone is aware of their talent, the further that talent can be nurtured. For example, if two parents were to share a gene for musical ability, it is likely that their child will also have this natural ability for music. A practise of this ability can then be emphasised from a young age, in order to bring out the child's most advanced capabilities. If a person's surroundings are more influential on the other hand, then the interests a person is exposed to by their family, friends and environment are more likely to determine their talents and interests. The intention of these reviews is to study previous work in similar fields, in order to determine the best approach for answering the questions of the current project. Areas under review include; a genetic ability for perfect pitch and synesthesia, the genetic nature of congenital amusia, the effects of practise on musical ability, the effects of nature and nurture on athletic ability, how much practise is needed for expertise, how genetic studies can shape our abilities and behaviors and a biological explanation of how humans use music.

The purpose of "Absolute pitch: an approach for identification of genetic and nongenetic components" by Siamak Baharloo, et al, February 1998, was to discover how absolute pitch (AP) develops. Results of this survey revealed that 48% of participants with AP also had family members possess AP, whereas only 14% of individuals without AP had family members with AP. These results confirm that AP accumulates in families and is likely to be due to an individual's

[4] Park, Hansoo, Lee, Seungbok, Kim, Hyun-Jin, Ju, Young Seok, Shin, Jong-Yeon, Hong, Dongwan, von Grotthuss, Marcin, Lee, Dong-Sung, Park, Changho, Kim, Jennifer Hayeon, Kim, Boram, Yoo, Yun Joo, Cho, Sung-Il, Sung, Joohon, Lee, Charles, Kim, Jong-Il, Seol, Jeong-Sun. "Comprehensive genomic analyses associate *UGT8* variants with musical ability in a Mongolian population.", *Journal of Medical Genetics,* BMJ Journals, vol.49, no.12, p.747-752, 27 November 2012.

[5] Yan,Xu, Papadimitriou, Ioannis, Lidor, Ronnie, Eynon, Nir. "Nature versus Nurture in Determining Athletic Ability.", *Genetics and Sports, ed.2*, Medicine and Sports Science, Karger, vol.61, p.15-28, 2016.

genetics. This survey also revealed that the age at which a person begins musical training or lessons is also associated with the likelihood of having AP. 40% of participants who began training before 4 years of age had AP whereas only 2.7% of individuals who began training after 12 years of age had AP. The results of this study strongly suggest that in order to possess AP, genetics and early training both play a critical role. This study indicates that musicality can be genetic, but that a person's surroundings, or early influences, may also determine their talents. This emphasises the question of whether any connections found between music ability and family in the current project is due to genetics or environmental influence.

Although the suggestion of a connection between absolute pitch and synesthesia has been previously proposed, authors Peter K. Gregersen, et al, of "Absolute pitch exhibits phenotypic and genetic overlap with synesthesia", May 2013, intended to establish a genetic and phenotypic overlap within a larger group of participants. Of 768 participants who were formerly tested for AP, 20.1% also reported synthesia. This is a significantly higher percentage than the amount of people thought to have synthesia in the general public (4%). Using linkage analysis, it was found that AP and synesthesia are in fact genetically and phenotypically closely related. In other words, it is common for AP and synthesia to be genetically inherited together. AP and synesthesia can both be thought of as an advantage to musicians. Absolute pitch provides pitch accuracy and the positive effects synesthesia has on memory can provide a faster ability to learn and compose music.[6] Therefore the possession of both of these genetic abilities provide greater musical ability than the average person, especially when combined with the proper practise and training. This research demonstrates the benefits that can come from further research into musicality and genetics, as according to Baharloo, a knowledge of natural ability can be enhanced by practise and surroundings.[7] It is also a definite example of how a person's area or level of talent can be predetermined by their genetics.

Authors Isabelle Peretz, et al, of "The Genetics of Congenital Amusia (Tone Deafness): A Family-Aggregation Study", September 2007, created a test in order to determine whether or not

[6] Witthoft, Nathan, Winawer, Jonathan, "Learning, Memory and Synesthesia", *Association of Psychological Science,* Sage Journals, vol.24, no.13, 1 March 2013.

[7] Baharloo, Siamak, Johnston, Paul A., Service, Susan K., Gitschier, Jane, Freimer, Nelson B., "Absolute Pitch: An Approach for Identification of Genetic and Nongenetic Components", *American Journal of Human Genetics, vol.62, no.2m p.224-231, February 1998.*

congenital amusia, otherwise known as tone deafness, is genetic. The test consisted of 72 melodies, some of which were altered so that certain notes were either out of time, out of tune or out of key. Participants who identified and tested to have congenital amusia invited siblings and children to also be tested, along with another control group without congenital amusia. Results were contrasting as 43% of the siblings of those affected also had congenital amusia, whereas only 11% of their children were also affected. The authors suggested that this may be due to a greater exposure to music in the younger generation. This theory would mean that although congenital amusia may be caused by genetics, it can also be overcome or outgrown. This is a similar belief as mentioned in the previous reviews, although these conditions may be genetic, early practise can improve or decrease their effects. As a whole, the results of the study did confirm that family members of affected participants were also more likely to have congenital amusia. As it can be seen as a musical disability, those with tone deafness are less likely to be involved with music. This provides another example of talents being predetermined and a genetic explanation as to why some families may be less musical than others.

Authors Miriam A. Mosing, et al, of "Practice Does Not Make Perfect: No Causal Effect of Music Practice on Music Ability", July 2014, examined the correlation between music practise and music ability. The purpose of this study was to determine whether music ability may be a natural genetic ability rather than an ability dependent on practise. This study of over 10,500 twins found that differing amounts of practise between twins, as much as 20,228 hours, had no direct effect on music ability. These results were measured using the Swedish Musical Discrimination Test, which evaluates a person's ability to recognize pitch, melody and rhythm. The title is slightly misleading, since practise can of course improve a person's ability to play an instrument or a specific song, which consequently improves their musical ability. This work does, however, suggest that practise does not affect a person's natural ear or ability for music. The current project builds on this work by examining whether the children of those with a talent for music are more likely to also exhibit the same abilities than those whose parents do not, while also comparing quantities of practise. The results of this study suggest that musicality is likely to be common among families and that time dedicated to practise may not have a direct effect on the students' musical talent.

Authors Xu Yan, et al, of "Nature versus Nurture in Determining Athletic Ability", 2016, conclude that nature and nurture are both important factors in athletic ability, meaning a person's genetics and environment both determine their abilities. This conclusion was reached by contrasting and discussing multiple studies in this field. Apart from beneficial physical aspects such as height, certain genetic variants were also found to be associated with athletic ability. One example in particular is the ACTN3 R577X polymorphism, which was supported by a study on genetically engineered mice to be associated with athleticism. Nurture was also found to impact a person's athletic abilities through five main variables; deliberate practise, family support, the coach's influence, relative age effect, and birthplace effect. In theory, true elite athleticism can be met once all these variables have been fulfilled, with even further abilities supported by a person's genetics. As noted by the authors, further study into the combination of nature and nurture is much more relevant than determining one superior to the other. Athleticism is often seen as a natural interest or talent, as with music. Similarly to Baharloo and Peretz, these authors conclude that a combination of our genetics and our upbringing are what determine our abilities and talents. [8] [9] This does however contradict Mosing's suggestion that practise does not have a causal effect on ability, providing a contrasting suggestion for the importance of practise in the current project.[10]

The purpose of the "The role of deliberate practice in expert performance: revisiting Ericsson, Krampe & Tesch-Römer (1993)" by Brooke N. Macnamara and Megha Maitra, August 2019, was to revisit and replicate a well known study conducted in 1993 on the amount of practise needed in order to achieve expertise. In the original study, it was found that the most advanced level of violin players in a school had significantly more practise than the middle level, and the same with the lower level of violin players. This study produced a widely known theory that 10,000 hours of practise of a skill will result in expertise. The results of this revisited study, however, contradict the original results. In fact it was found that the middle level of violin

[8] Baharloo, Siamak, Johnston, Paul A., Service, Susan K., Gitschier, Jane, Freimer, Nelson B., "Absolute Pitch: An Approach for Identification of Genetic and Nongenetic Components", *American Journal of Human Genetics, vol.62, no.2m p.224-231, February 1998.*

[9] Peretz, Isabelle, Cummings, Stephanie, Dube, Marie-Pierre. "The Genetics of Congenital Amusia (Tone Deafness): A Family-Aggregation Study." *The American Journal of Human Genetics*, vol.81, p.582-588, September 2007.

[10] Mosing, Miriam A., Madison, Guy, Pedersen, Nancy L., Kuja-Halkola, Ralf, Ullén, Fredrik. "Practice Does Not Make Perfect: No Causal Effect of Music Practice on Music Ability." *Association of Psychological Science*, Sage Publications, vol.25, no.9, p.1795- 1803, 30 July 2014.

players had more practise than the most and least advanced levels of violin players. The authors hypothesize that these differing results may be due to the fact that the researchers and participants of the original study were aware of the purpose, which may have subconsciously altered results. Another reasoning for this, however, could be due to genetics. As shown previously by Mosing's study on twins, genetics may be a more important factor in an individual's natural musicality than practise.[11] Perhaps the reason that the most advanced level of students had less practise is due to the fact that some have a natural genetic ability for music, therefore requiring less hours of practise to reach a high level of talent. Another explanation could be provided by Yan, who suggests that family support, a coach's influence, relative age effect, and birthplace effect are just as important as practise in determining someone's level of athletic abilities.[12] If the same is true for music, perhaps the most advanced level of violin players had a more advantageous environmental upbringing, resulting in advanced skills.

Authors Leslie D. Leve, et al, of the "Refining Intervention Targets in Family-Based Research: Lessons From Quantitative Behavioral Genetics", September 2010, hoped to combine quantitative behavioral genetic studies with preventive science, in order to gain a new insight into how preventive measures, or differences in environment, can enhance or offset genetic traits. The purpose of preventive science is to use environmental intervention to reduce or improve a person's behavior or well being. Quantitative behavioral genetic studies, on the other hand, focus on how characteristics and behaviors can be genetically inherited. The authors have provided an outline in this paper on how to combine both areas of study. This study suggests that although certain traits and characteristics can be genetic, they could possibly be strategically influenced or offset through their environment and upbringing. This could provide an explanation as to how a parent's encouragement or discouragement can enhance or reduce the musical genetics in their child. This work also suggests that it may be valuable to examine if any patterns appear between encouragement and advanced musical ability in the current project. This research also encourages the results of Yan's study, which suggest a focus on both genetics and surroundings is more important than one or the other.

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[11] Mosing, Miriam A., Madison, Guy, Pedersen, Nancy L., Kuja-Halkola, Ralf, Ullén, Fredrik. "Practice Does Not Make Perfect: No Causal Effect of Music Practice on Music Ability." *Association of Psychological Science*, Sage Publications, vol.25, no.9, p.1795- 1803, 30 July 2014.

[12] Yan,Xu, Papadimitriou, Ioannis, Lidor, Ronnie, Eynon, Nir. "Nature versus Nurture in Determining Athletic Ability.", *Genetics and Sports, ed.2*, Medicine and Sports Science, Karger, vol.61, p.15-28, 2016.

Authors Kamraan Z. Gill and Dale Purves of "A Biological Rationale for Musical Scales", December 2009, have conducted this research in order to offer a biological rationale for the musical scales used by humans. When taken into consideration the fact that humans can hear roughly 240 pitches over an octave in the mid range, western music actually utilizes quite a small number of scales and consists of few tones, with only 12 pitches per octave. The researchers found that the intervals used in these scales are similar to a harmonic series, which are a notable part of human vocalization. This finding would suggest that the human preference towards these scales is due to the familiarity of our own vocalizations, offering a biological rationale for our use of scales and intervals. These results further support the current project's suggestion that music ability may come naturally, due to biology or genetics, and as a whole is a natural ability. Whether it is due to differing genetics or differing biological instincts, this research supports the idea that a person's talent and abilities may be predetermined.

The results of these reviews provide contrasting suggestions on where the direction of the current research should lead. The work of Mosing, Gill and Purves suggested that musicality is a natural, genetic or biological part of humans. Ericsson, Krampe & Tesch-Römer had previously suggested that a set amount of practise can make anyone an expert despite their genetics or abilities, however, this was contradicted by Macnamara and Maitra's revisited study as well as Mosing's research on practise. Yan's research on athletic ability, however, suggested that practise is an important factor. Early training and encouragement may also be worth investigating, as noted by Baharloo and Leve. The most common suggestion among this research, however, is that both a person's genetics and external influences should be a focus in determining how musical talent is achieved. By combining all of the above suggestions and standpoints, it was decided that genetics, environment, practise and encouragement should all be considered when studying the musicality of the students in the current study.

Methodology

This project's main intention was to understand how people become skilled and interested in certain activities and hobbies. The debate of nature versus nurture asks whether a person's characteristics, interests and behaviors stem from their genetic inheritance or from environmental influences. The current project concentrates this question specifically on musical talent and ability. Following a review of similar research, it seemed this could be due to a person's genetics, their surroundings and upbringing, their family or time dedicated to practise. The reason for further researching this debate in terms of musical ability is to further the understanding of how a high level of musical talent and expertise is achieved by students, as well as whether areas of talent may be predetermined. In order to do so, this project studied varying levels of musicality among music students. Genetics, environment, and practise were all a main focus in answering this question.

An online survey, following a mostly qualitative method, was designed to answer the questions previously posed. Surveys were used in multiple studies discussed in the literature review chapter, making it a reliable source of analysis in this field of research. This survey followed a very similar approach as taken by Macnamara and Maitra in comparing students with varying levels of talent in music.[13] A qualitative survey also ensured that students had the opportunity to answer all aspects of this research truthfully, with certain questions designed to provide answers on genetics, environment, practise, encouragement and early training. An online approach also meant that the survey could be sent to students throughout the country, providing an opportunity for a wider variety and higher volume of responses. The primary objective of the survey was to understand how these individuals have reached their level of talent for music, and whether other participants with similar experiences possess the same level of talent. The survey was sent to multiple music schools and music teachers in Ireland by email. The parents of students who were under age were asked to give their written consent for their child's participation and any question they did not wish to answer could be left blank. The teachers and students of the music schools were given the choice to participate or not.

[13] Macnamara, Brooke N., Maitra, Megha. "The role of deliberate practice in expert performance: revisiting Ericsson, Krampe & Tesch-Römer (1993)." *Royal Society Open Science*, vol.6, no.8, 21 August 2019, p. 4-5.

The main purpose of the student's survey was to examine their families musicality along with where their talent and interest in music stemmed from. The questions asked covered three main areas; their inspiration for learning music, their dedication to learning music and their families' shared interests/ hobbies. In the case that the participant's family was also musical, it was important to include questions designed to differentiate whether this was more likely due to their genetics or due to the family's environmental influence on the participant. This was attempted by asking further questions on how large a role music has played in their home environment. Questions were also asked on whether the participants share any other interests or talents with their family, in order to further support answers on whether their talents and interests seem to be similar to their family members. Although family was one of the main focuses of the research, it seemed from previous research that exposing the purpose of a study to its participants may alter results. As mentioned by Macnamara and Maitra in their revisited study, the fact that the participants of the original study were aware of its purpose may have affected the results.[14] For this reason, many of the questions were designed so that multiple answers could be given, rather than alluding directly to family. This ensured that answers about the student's environment and influences were honest and non biased. Students were also asked if them, or any family members, possessed any musical anomalies such as perfect pitch, synthesia or congenital amusia. Following the research of these anomalies in the literature review chapter, this could provide an example of a genetic benefit for music. The level of talent of those with these anomalies could be compared to those without.

As well as the survey for the students, a survey was designed for the music teachers. Although the survey for the students asked questions on their families, environment and practise, the teachers were asked for their opinions on musicality in families and the question of nature versus nurture, based on their experiences teaching. One of the reasons both music teachers and students were chosen for this research is so that the participants' level of musical talent could be evenly assessed by someone with experience in music. Talent can be difficult to measure, as there is no set figure to how skilled a person is at music. These teachers have worked closely with their

[14] Macnamara, Brooke N., Maitra, Megha. "The role of deliberate practice in expert performance: revisiting Ericsson, Krampe & Tesch-Römer (1993)." *Royal Society Open Science*, vol.6, no.8, 21 August 2019, p.3.

students in developing this skill, meaning they are aware of how it has grown and how that talent compares to other students. Although the survey could have been fully completed by the individual, an evaluation of their level of talent could be ambiguous. For example, in Baharloo's study, participants self- reported their absolute pitch. The author noted that some may have been more critical of themselves than others, which could have had an effect on the results of the study.[15] For this reason, the teachers were asked to aid their students in completing their surveys, while also submitting an evaluation for each student's level of talent. This provided a more uniform evaluation of musical talent, strengthening the accuracy of this research.

Another benefit to having music teachers participate in the research was that it provided additional insight into the question of whether nature or nurture determines musicality. Many of these teachers had years of experience in teaching music, to a variety of students and even among families. It was of benefit to the research to gather the teachers' own opinions on the topic. This meant that their answers could be analysed alongside the students' answers, to compare the teachers' viewpoints with the realities of the students' answers. Depending on the answers, the teachers' survey could either support or contradict the findings of the students' survey.

Since the teachers were able to submit an evaluation on the students' musicality, the identity of the participants were also able to remain anonymous. This meant the student's evaluation, or level of talent, could be submitted directly with their answers, without providing a name.
This method meant that once the surveys had been completed, the results of the students' surveys could be compared to each other by level of talent. The reason for this was to see if there were any patterns among answers, and whether students of similar levels of talent had similar answers. This would then reveal whether students with advanced skills tend to practise more, whether music is a central part of their environment or whether musicality is more common in their family. In other words, this method could reveal whether their talent is seemingly due to genetics, environment or practise.

[15] Baharloo, Siamak, Johnston, Paul A., Service, Susan K., Gitschier, Jane, Freimer, Nelson B.
"Absolute Pitch: An Approach for Identification of Genetic and Nongenetic Components"
American Journal of Human Genetics, vol.62, no.2, February 1998, p.28.

There were certain limitations to this method in terms of differentiating the influence of genetics and environment on the participants' musical abilities. Without genetic testing, it could not be definitively stated that the student's level of musical talent was due to their genetics. The intent of the survey, however, was to examine patterns and reveal whether musicality was common among families and why that seemed to be. Additionally, if it was found that a participant's family also has a talent for music, but it was not a central part of their environment, then their talent is more likely to be due to genetics. In the same way, if a student's family encouraged and exposed them to music, but they themselves do not have a talent for music, this is more likely due to their external influence rather than their genetics. Questions were designed in this way in order to compensate for limitations. Genetics and environment could also be differentiated if a student answered yes to themselves or family members having perfect pitch, congenital amusia or synthesia. As mentioned previously, these may have beneficial genetic influences on a person's talent for music. The accessibility of the survey also had its constraints, due to the chosen method. In order to compare experiences and talents, it was crucial that both the teacher and student wished to participate in the survey, as one answer would be insignificant without the other. This meant the survey was less accessible, or perhaps more time consuming, as the student and teacher had to complete the survey together.

The argument of nature versus nurture is extremely broad and there are many factors to consider, even when applied to musical talent alone. As observed from the literature review chapter, current research in the area still provides contradicting results and theories. For this reason, it seemed essential that a study on muscialty among families considered both genetics and environmental influences. Research on practise has also been contrasting, with some suggesting it is insignificant and others deeming it an essential aspect of talent. The survey was therefore designed to include each of these aspects and to further understand how genetics, environment and practise determine musical talent and ability.

Analysis

The results gathered from this research project's surveys provided similar findings to others discussed in the literature review chapter. The survey was designed to determine what aspects of a music student's life affect their talent. The main focus points in the creation of the survey were; genetics, environment, family and practise, which have all been previously considered as important influences on a person's talent and abilities. These aspects of the music students' lives were therefore compared and contrasted to each other. This analysis was based on their level of talent, which was determined by their teachers. The teachers' opinions on the role of nature and nurture on music talent were also considered and compared to the student's answers.

Students' survey results

27 responses were gathered for the students' survey. Of those 27, 3 were not accompanied by a teacher's evaluation and 2 were duplicates of previous answers. This gave a total of 22 responses from students to analyse. As over 100 schools and teachers were contacted, this is far less than originally anticipated. This lack of response is likely due to the constraints previously mentioned of teachers and students having to submit the survey together, as well as the fact that schools were following remote learning at the time of the survey, due to the COVID-19 restrictions. Nonetheless, 22 was a sufficient number of responses for the purpose of this analysis. For the evaluation, teachers were asked to rank their student's ability to play their instrument, as well as how quickly they improved upon the instrument, on a scale from 1-10. These two evaluations divided each student's talent into two different concentrations. The student's ability to play their instrument was more likely to provide insight into their overall talent, whereas the speed at which they improved was more likely to provide insight into their dedication to improving upon the instrument. For both of these questions students were divided into three different groups for the purpose of analysis; higher level, middle level and lower level. This is similar to the approach used by Ericsson et. al and Macnamara et. al in their revisited study.[16] The lowest grade given to a student for any of the evaluations was a 3 and the highest was a 10, with 6-7 being the average. Using this feedback, groups were divided so that a score of 3-5 equalled the lower group, a score of 6-7 equaled the middle group and a score of 8-10 equaled the highest group of musicians.

[16] Macnamara, Brooke N., Maitra, Megha. "The role of deliberate practice in expert performance: revisiting Ericsson, Krampe & Tesch-Römer (1993)." *Royal Society Open Science*, vol.6, no.8, 21 August 2019, p.4.

The questions posed in the survey were designed to find out where each student's level of talent and interest in music came from. The responses to the survey showed whether the students had family members that also play music, whether their family encouraged them to learn, whether their home environment influenced their musical interests, how much time they dedicated to practise, whether they enjoy playing music, the age they began learning their instrument and whether their friends or school environment had any influence on their musical interests. In terms of the age they began learning, the time they spent practising, whether they enjoy playing their instrument and whether they had any family members who play, these questions were asked directly in the survey (See Q.4, Q.5, Q.7, Q.8 in Appendix A). Information on whether their home, family or school environment had any influence on or encouraged their musical interests was gathered through more open questions (See Q.6, Q.9, Q.10, Q.14, Q.17 in Appendix A). This ensured that a focus on family wasn't implied and that students would be honest about what influenced, inspired and encouraged their interests and talent.

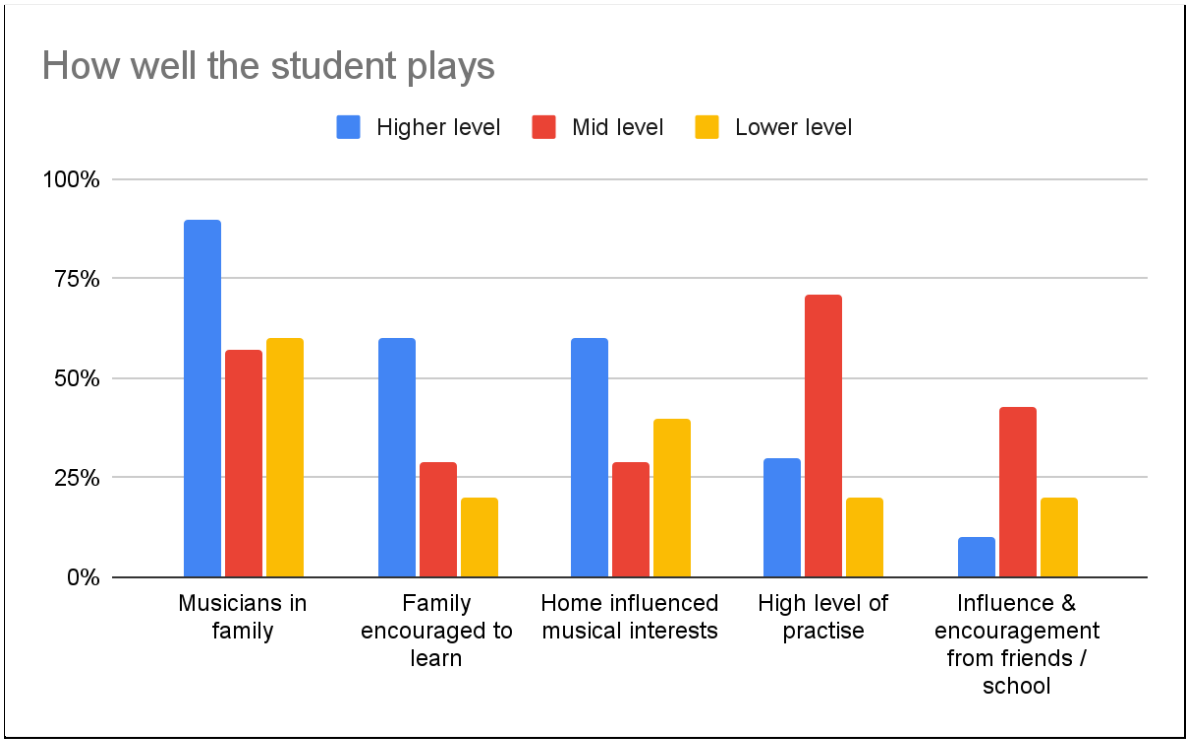

Fig.1 The percentage of each group with the associated qualities, arranged by how well they play their instrument.

Analysis was first conducted using the students' grades in terms of how well they play. Each student was divided into the higher, middle or lower level group and their answers were compared to create the chart seen in figure 1. As seen in the chart, a higher percentage of the higher level of students had family members that were musicians, encouragement from family and musical influences from their home life. The middle and lower level of students had similar experiences in these areas. In terms of time spent practising and influence/encouragement from friends and school, however, the middle group of students ranked higher than both the lower and higher level of students. The results of this chart suggest that students whose family also share their interest in music are more likely to excel at playing music than those whose family don't.

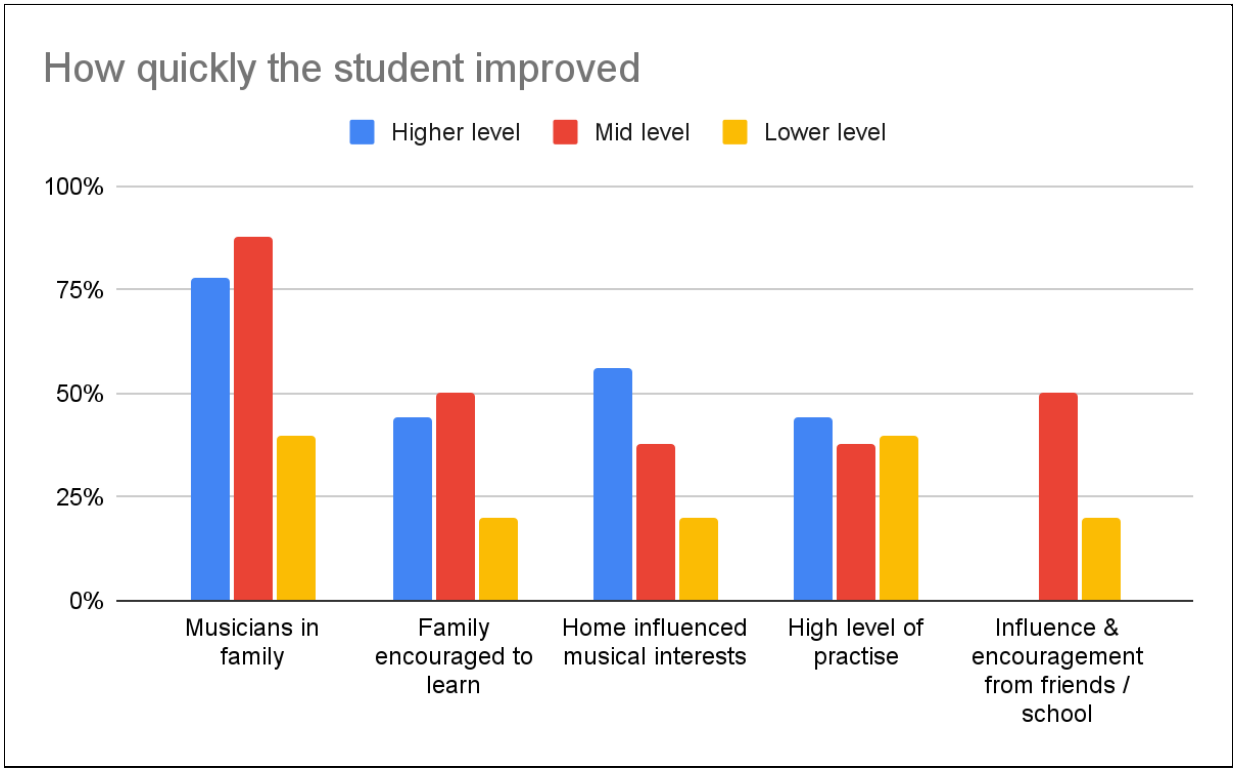

Fig.2 The percentage of each group with the associated qualities, arranged by how quickly they improved upon their instrument.

Results were also analysed based on how quickly the students improved upon their instruments. Again the students were put into either the higher, middle or lower level group, as seen in figure 2. The results from these groups show both the higher and middle level groups of students having a higher involvement of music in their families and home life than the lower level. The

middle group also had a higher percentage of encouragement from friends or school than the other two groups. Most notably, there were no drastic differences in time spent practising between the groups. It was expected that analysis of how quickly the students improved would provide insight into their dedication to improving and practising, but this does not appear true based on these results. This highlights Xu Yan, et al, theory that there are multiple variables to consider when determining talent.[17] Even though levels of practise remain similar, it can be seen in this chart that the higher and middle level groups of students had more external influences and encouragement overall in comparison to the lower level of students.

Nature versus nurture

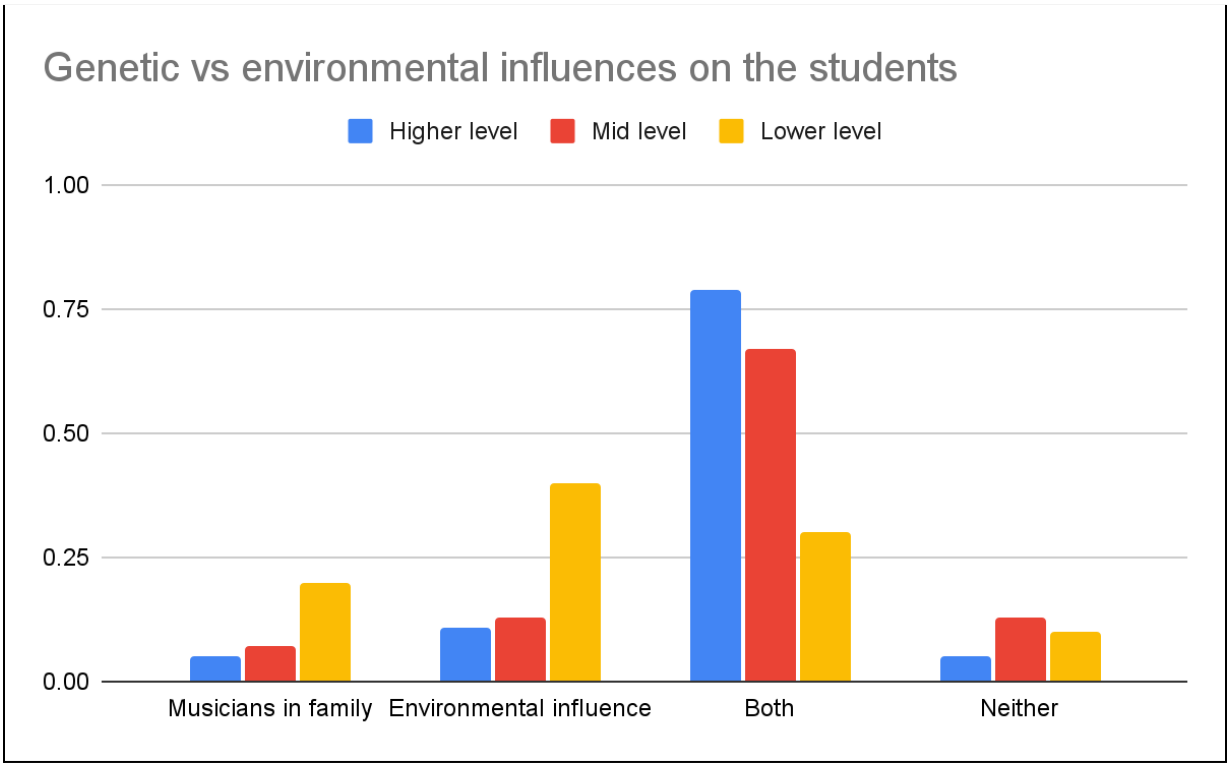

Fig.3 Percentage of each group of students with genetic influences, environmental influences, both or neither.

One of the main focuses of this study was to determine whether musical talent is more likely to stem from nature or nurture, genetics or environment. As mentioned in the methodology chapter,

[17] Yan,Xu, Papadimitriou, Ioannis, Lidor, Ronnie, Eynon, Nir. "Nature versus Nurture in Determining Athletic Ability.", *Genetics and Sports, ed.2*, Medicine and Sports Science, Karger, vol.61, 2016, p.15.

there were limitations to differentiating genetics and environmental influences through the survey. However, it was hypothesized that this could be determined by comparing musicians in the family with the presence of music in the students environment. As can be seen in figure 3, the majority of the higher and middle level groups of students had both family members that were musicians and musical influence/encouragement in their home environment. The lower level had a lot more variety in these areas, with a higher percentage having environmental influences alone.

If viewing those whose family members also play music as having a genetic talent, then it would appear that genetics and environment both play an important part in determining talent and are likely strongest when both are present in a student's life. These results would agree with the work of Baharloo, Peretz, Yan and Leve, which suggest that research should focus on combining nature and nurture, rather than determining which one is best.[18] [19] [20] [21] The students were also asked if they had perfect pitch, tone deafness or synthesia, as far as they were aware. If any student had answered yes to this question, this could have been considered a genetic influence, however, no student answered yes to this question.

Having learned that genetics and environment are both important factors in talent, this would now suggest that those who do not possess a genetic capability or do not have an encouraging environment, may be at an immediate disadvantage when compared to those who do. This finding suggests that a person's musical talent may be predetermined by aspects outside of their control. The results of the survey are an example, however, of how this does not guarantee that those with favourable genetic and environmental upbringing are guaranteed to be more talented. As seen in figure 3, there are multiple higher and middle level group students who only had a genetic influence, environmental influence or even neither. There are also lower level students

[18] Baharloo, Siamak, Johnston, Paul A., Service, Susan K., Gitschier, Jane, Freimer, Nelson B. "Absolute Pitch: An Approach for Identification of Genetic and Nongenetic Components" *American Journal of Human Genetics*, vol.62, no.2, February 1998.
[19] Peretz, Isabelle, Cummings, Stephanie, Dube, Marie-Pierre. "The Genetics of Congenital Amusia (Tone Deafness): A Family-Aggregation Study." *The American Journal of Human Genetics*, vol.81, September 2007.
[20] Yan,Xu, Papadimitriou, Ioannis, Lidor, Ronnie, Eynon, Nir. "Nature versus Nurture in Determining Athletic Ability.", *Genetics and Sports, ed.2*, Medicine and Sports Science, Karger, vol.61, 2016.
[21] Leve, Leslie D., Harold, Gordon T., Ge, Xiaojia, Neiderhiser, Jenae M., Patterson, Gerald. "Refining Intervention Targets in Family-Based Research: Lessons From Quantitative Behavioral Genetics." *Perspectives on Psychological Science*, Sage Publications, vol.5, no.5, September 2010.

that had both positive genetic and environmental influences. As a result of this survey, it is becoming clear that there are multiple variables that impact and determine a person's talent. Family, genetics and environment, however, appear to be some of the most prominent variables in determining these students' levels of talent. .

Practise

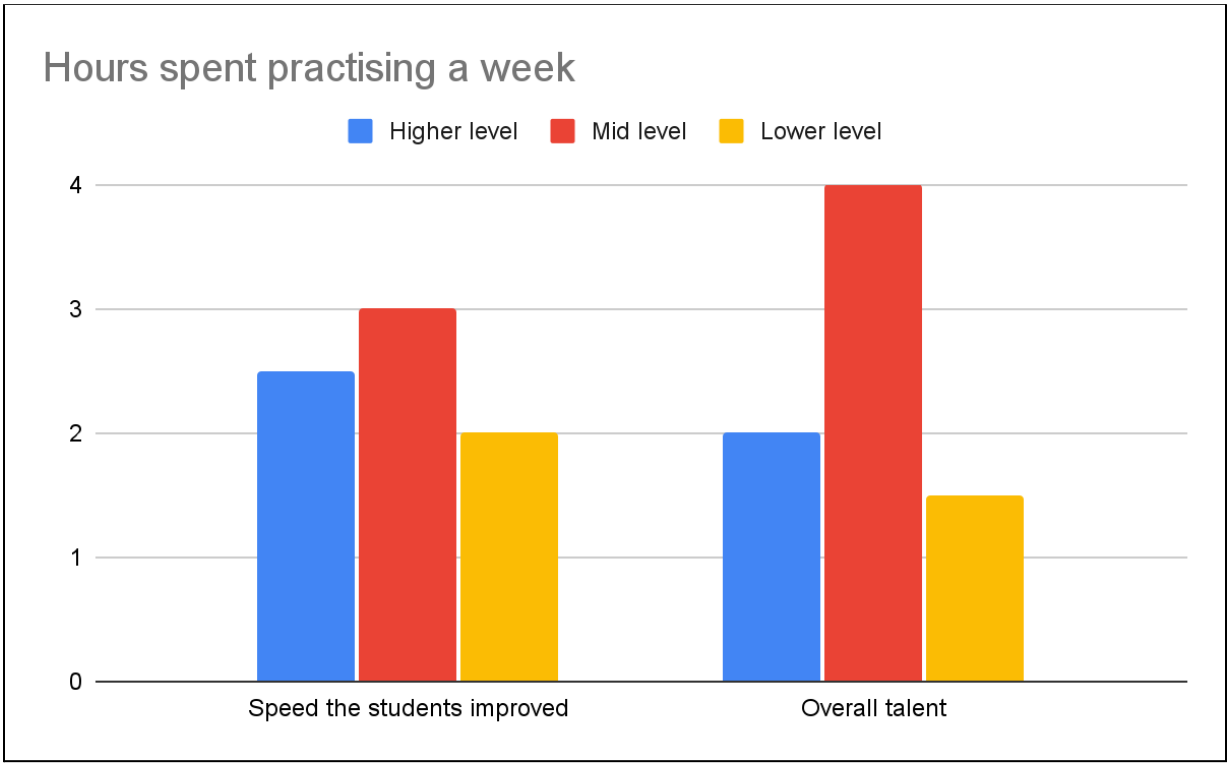

Fig.4 Average hours each group of students spent practising per week.

Practise is an obvious yet complicated variable in the role of musical talent. As seen in figure 2, when the percentage of students that spent a large amount of time practising were compared, results didn't differ much between the different levels in terms of how well they improved. In terms of overall talent, a higher percentage of the middle level group spent a large amount of time practising, as seen in figure 1. For more exact analysis, the average time spent practising each week was also calculated for each group, which can be seen in figure 4. When comparing the speed at which students improved upon their instrument, the average amount of hours spent practising per week is still somewhat similar among the three levels of talent. However, when

looking at how well the students play overall, the middle level group of students spent on average double the amount of hours practising when compared to the lower and higher levels of students. In each instance, although less significant in the evaluation of the students' improvement, it is the middle group that spent the most time practising, the higher level that spent the second most amount of time practising and the lower level that spent the least amount of time practising. These results support Brooke N. Macnamara and Megha Maitra's revisited study, which took a similar approach of dividing students into three levels of talent. [22] This study found it was the middle group of students that spent the most time practising, similarly to the current study.

This is a significant result as it suggests that practise does affect a person's talent, but it is not a sole or main determinator. If this were the case, the highest ranking students would spend the most time practising, as suggested by the original study. A likely explanation for the middle group not gaining higher grades in the current survey could be due to the fact that they had lower percentages in other variables, such as musicality in their family and home environment. Although not drastic, it is worth noting that the lower level of students averaged less practise than both other groups. These results suggest that dedication to practise may be the main differentiator between a middle level and a lower level student, if they have similar experiences in other aspects.

An unexpected outcome of this section of the survey was that the amount of time spent practising did not have a significant effect on how quickly the students improved upon their instrument. When designing the survey, it was expected that dedication to practise was important in building upon and improving talent, meaning those who improved quickest on their instrument would have spent more time practising. Based on these results, this does not appear to be true. This finding does, however, coincide with Miriam A. Mosing, et al, research claiming that there is no causal effect of music practise on music ability.[23]

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[22] Macnamara, Brooke N., Maitra, Megha. "The role of deliberate practice in expert performance: revisiting Ericsson, Krampe & Tesch-Römer (1993)." *Royal Society Open Science*, vol.6, no.8, 21 August 2019.
[23] Mosing, Miriam A., Madison, Guy, Pedersen, Nancy L., Kuja-Halkola, Ralf, Ullén, Fredrik. "Practice Does Not Make Perfect: No Causal Effect of Music Practice on Music Ability." *Association of Psychological Science*, Sage Publications, vol.25, no.9, 30 July 2014, p.1801.

Although averaging the hours spent practising proved successful in finding a pattern, it is still difficult to define the role of practise in musical talent. As suggested in much of the literature discussed earlier in this project, it seems talent can not be defined or predicted by practise alone. A likely explanation is that practise may be the differentiator between two students with similar levels of experience and talent. Although practise may be what differentiates two similar students between two different levels of talent, a higher quantity of practise alone does not guarantee a higher level of talent.

Enjoyment

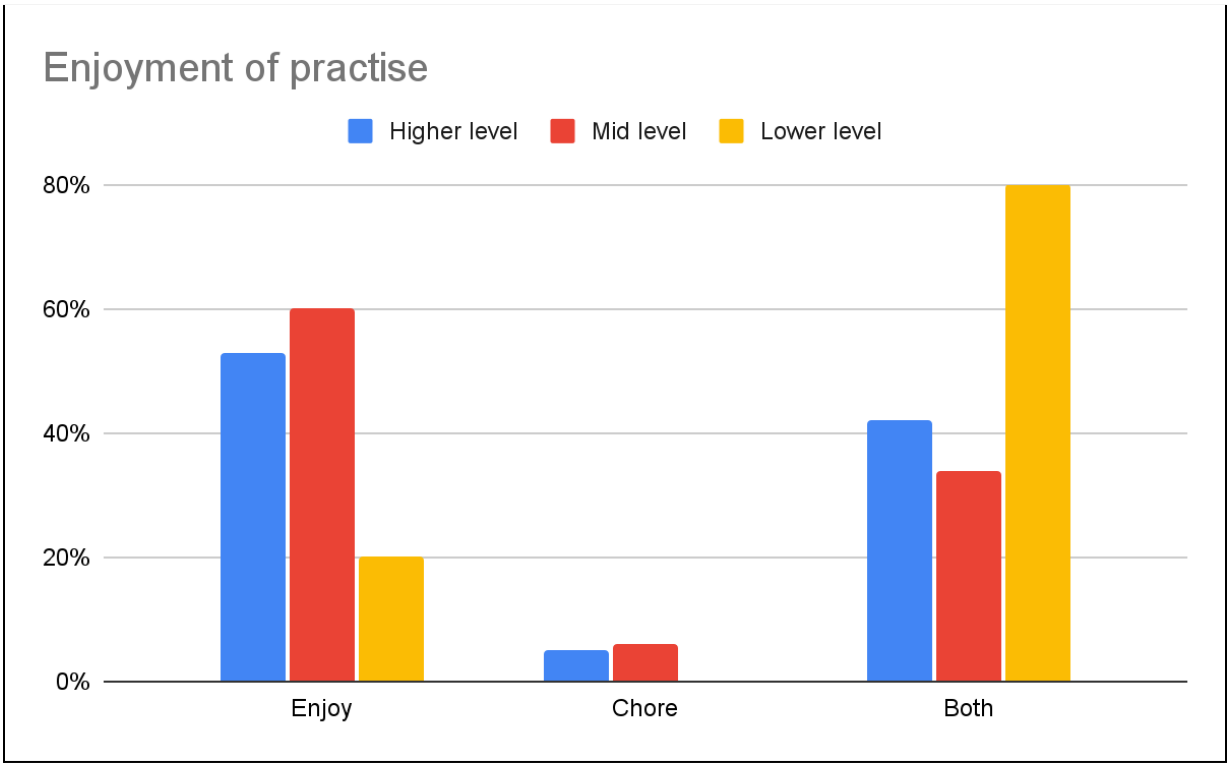

Fig.5 Percentage of each group of students that enjoy practise, see it as a chore or both.

The students were also asked whether they enjoy practising their instrument or whether it feels like a chore. The answers to this question suggest whether the students feel there is a pressure to practise and improve or whether they do it out of their own enjoyment and intention. When divided into the two groups of how well they play and how quickly they improve, the results

were quite scattered. When combined, however, there is a clear pattern as seen in figure 5. More of the higher and middle groups saw music practise as an enjoyable task rather than a chore. That said, a percentage of these two groups also saw practise as a task alone, rather than something to be enjoyed at all. The majority of the lower group, on the other hand, saw practise as both an enjoyment and a chore.

The connection between the enjoyment of playing an instrument and how well it is played may be explained with muscle memory. Performative muscle memory can be used to explain how musicians remember how to play songs.[24] Through habits and practise, musicians can perform songs without thinking about the notes. This is an advantageous part of muscle memory as students can learn to play songs effortlessly. However, if the student is also under stress or pressure when creating this muscle memory, it is no longer effortless. Rather than being able "to direct our always limited resources of explicit consciousness to other places that need it.", these students direct their consciousness to thoughts of stress every time they play.

Perhaps the lower level students tend to enjoy playing, though they also feel pressure, whether it is from themselves, their teachers or their parents, to improve. Taking into consideration the fact that a person is more likely to excel at a task they enjoy than one they feel pressure to achieve, perhaps too much pressure has limited the lower group's capabilities, whereas the sole enjoyment the higher and middle groups find in practise has strengthened theirs.[25]

[24] Shusterman, Richard. "Muscle Memory and the Somaesthetic Pathologies of Everyday Life". *Human Movement,* vol.12, no.1, 1st March 2011, p.8.
[25] Graves, Laura M., Ruderman, Marian, Ohlott, Patricia, Weber, Todd J. "Driven to Work and Enjoyment of Work" *Journal of Management,* Sage Publications, vol.38, no.5, September 2012, p.1676.

Age

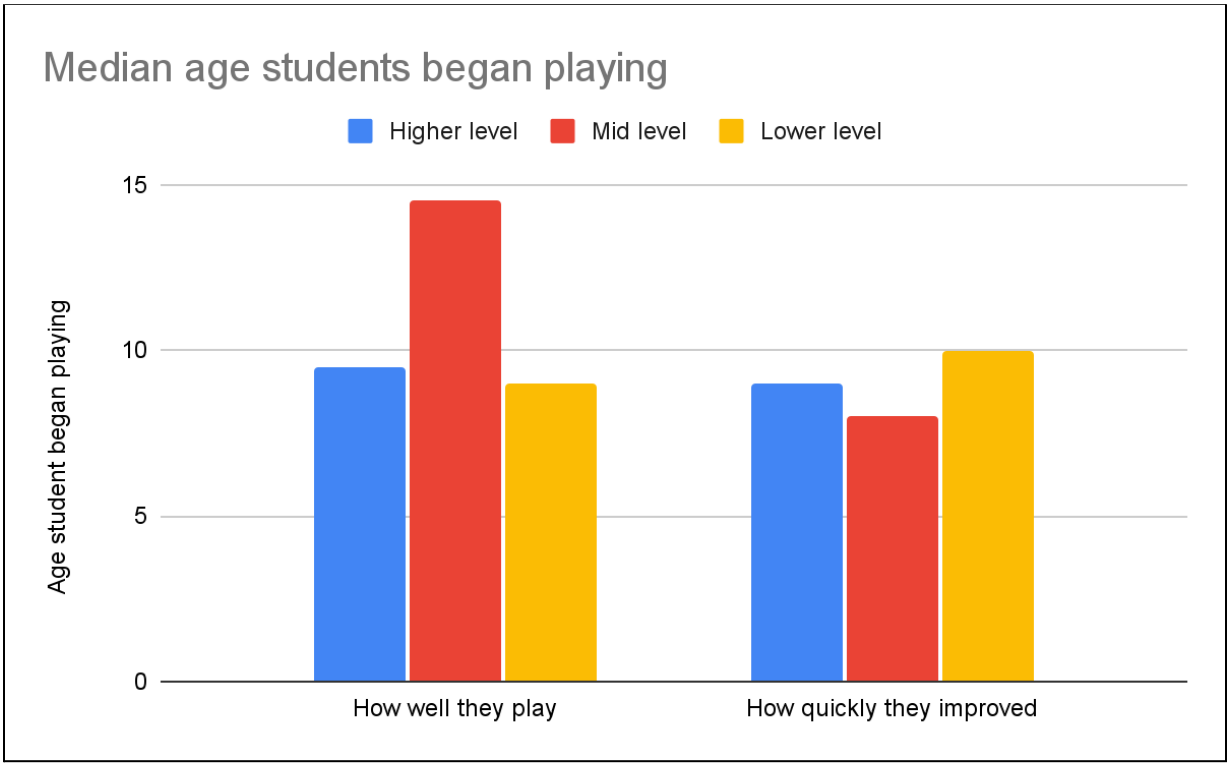

Fig.6 The median age students began playing an instrument.

As suggested through the studies of Baharloo, et al and Peretz, et al, the age at which the students began learning to play music were also taken into consideration.[26] [27] These studies showed that it may be advantageous to begin musical training from a younger age. A median age was calculated for each group, again divided by how well the students played and how quickly the students improved upon their instrument. All students were aged 6-13 when they began playing, apart from one participant who was 32 years old. For this reason, a median age was more suitable than a mean. As seen in figure 6, the median age the students began playing did not have any consistent effects on their abilities. The most notable difference is that by category of how well students play, the middle level group of students started an average of five years later than both the higher and lower level of students. In contrast, the middle group by category

[26] Baharloo, Siamak, Johnston, Paul A., Service, Susan K., Gitschier, Jane, Freimer, Nelson B. "Absolute Pitch: An Approach for Identification of Genetic and Nongenetic Components" *American Journal of Human Genetics*, vol.62, no.2, February 1998, p.227

[27] Peretz, Isabelle, Cummings, Stephanie, Dube, Marie-Pierre. "The Genetics of Congenital Amusia (Tone Deafness): A Family-Aggregation Study." *The American Journal of Human Genetics*, vol.81, September 2007, p.585

of how quickly the students improved was lower than the other two groups by 1-2 years. Perhaps early influence could be more important than early training, but most importantly, this highlights the need to consider multiple aspects in the student's life when determining what influences their talent.

Teachers' survey results

The teachers were given a separate survey where they could contribute their own opinions on the current topic. The teachers were asked what effect they believe practise and encouragement has on ability, whether musicality appears among families and whether they believe that music talent is a genetic gift. A total of 11 teachers participated in this survey. As these teachers work with multiple students from differing backgrounds, it was beneficial to compare their answers to the results of the students' surveys.

Practise

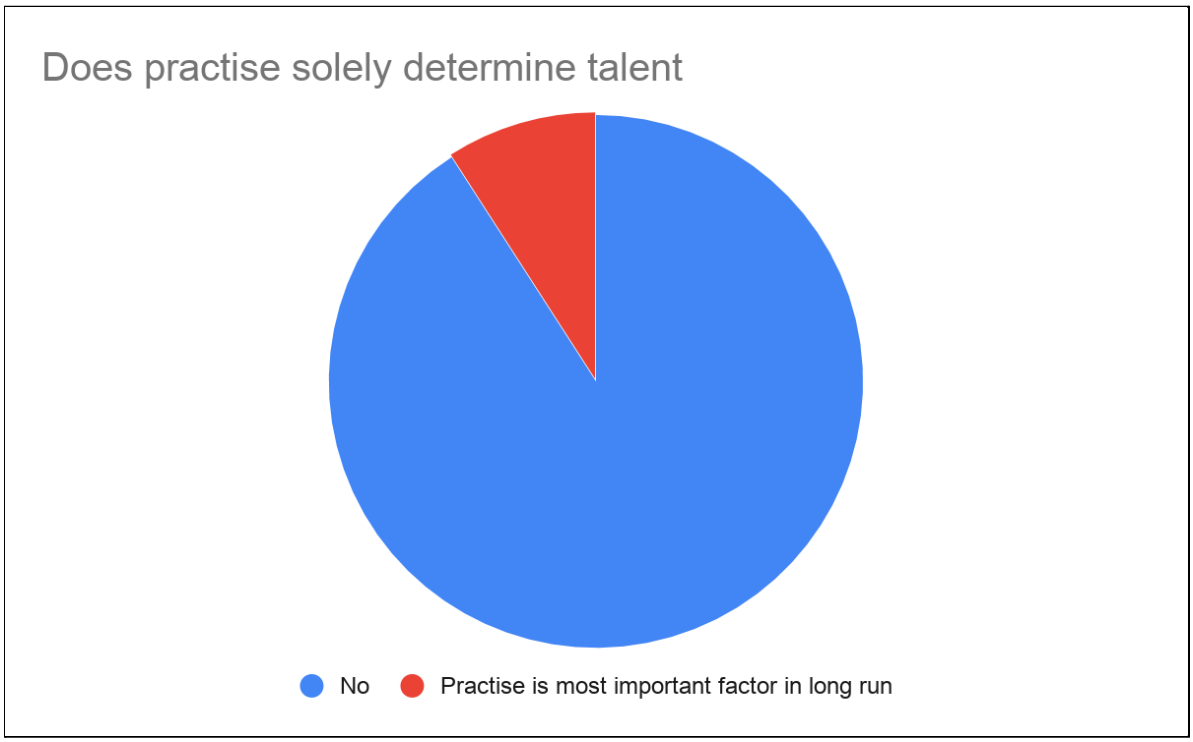

Fig.7 Results of whether teachers believe practise solely determines talent.

To begin with, teachers were asked whether the amount of practise dedicated to music solely determines a person's level of talent. 91% of teachers agreed that practise does not determine a person's talent alone, with 9% believing that it's the most important factor in the long run. Although teachers often encourage their students to practise, these results are not surprising following the results of the students' survey. These responses encourage the idea that practise, although beneficial, is not the most important variable in the talent of a music student. Having already learned that the amount the students practised did not significantly differ based on how quickly these teachers believed their students improved upon their instrument, these responses definitely conform to the students' results.

Musicality in families

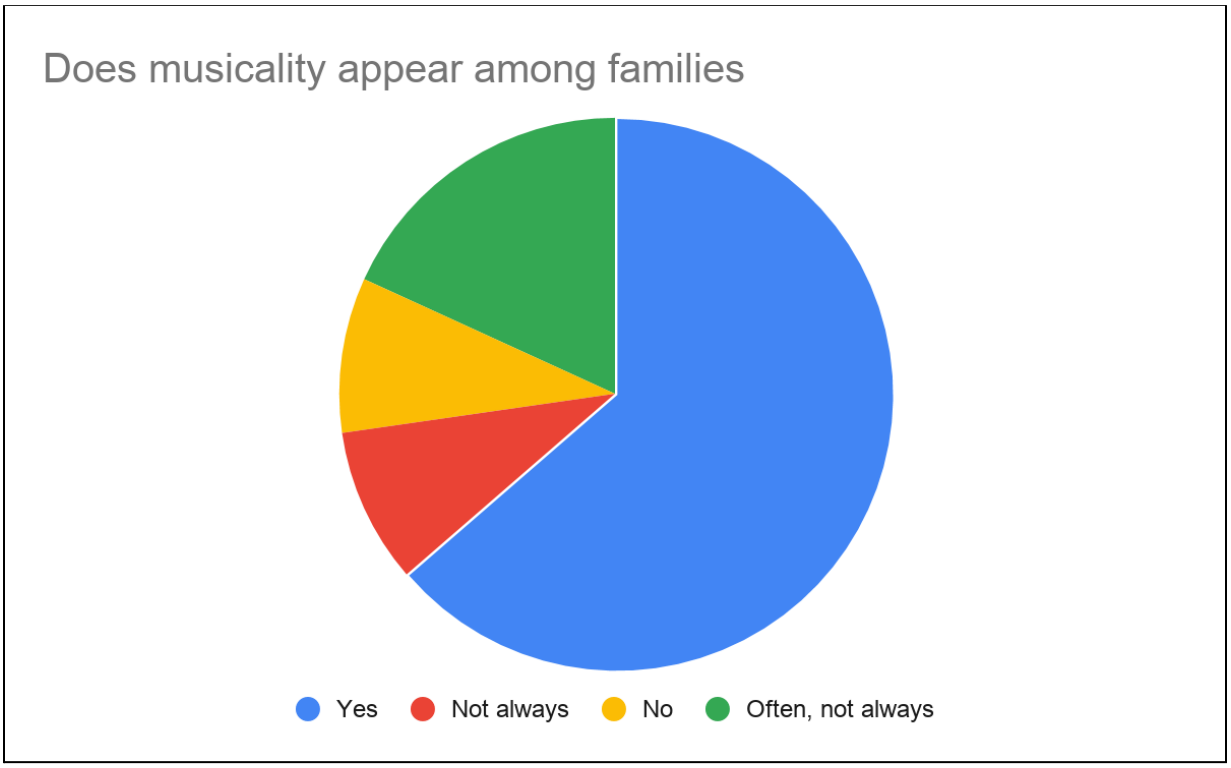

Fig.8 Results of whether teachers believe that musicality appears among families.

The teachers were asked whether they believe musicality tends to appear among families. Rather than focusing on whether this is due to nature or nurture, this question was simply asked to ascertain whether this is a common pattern seen by teachers. 64% of teachers answered yes, 18%

believe it happens often but not always, 9% answered not always and a further 9% answered no. This would suggest that a total of 82% of teachers have previously observed this pattern, though it is not a guarantee. This opinion also coincides with the students' responses. As can be seen in figure 1, as many as 90% of the higher level students had a musical family, which confirms there is a pattern of musicality among families.

Encouragement

A wide variety of answers were given by the teachers when asked whether encouragement from family has an effect on a person's abilities or if a person's talent is dependent on themselves. That said, in every answer it was agreed that encouragement from family can always help a person's ability in some way.

Some teachers believed that a person's talent is dependent on themselves, but their ability to build upon that initial talent can be greatly impacted by the encouragement found at home, "For me ability + talent are two different things, while an ability can grow over time + does flourish through encouragement from family + friends, talent is what you built on.". One teacher noted that encouragement "definitely aids a person's interest in music and allows them more opportunities to play music with others, but I do not believe if someone comes from a non-musical family they are automatically at a disadvantage.". Another teacher answered that "gentle encouragement works wonders for the confidence, and so the abilities of a person", although "there have been many cases of family members pushing a person to practice and so killing their love of music and by extension their abilities." Another teacher noted that "If the verbal or nonverbal message from any member of the family is negative, it has a significant impact."

As a whole, the beliefs of these teachers are that encouragement can promote ability and confidence, as discouragement can demote ability, although encouragement or discouragement alone do not define a person's talent (See Q.3 in Appendix C for full responses). The responses to this question greatly emphasised the importance of encouragement when developing a talent. This can also be seen in the students' answers, in figures 1 and 2, with the higher and middle

level groups of students having more encouragement overall from family, friends and school than those in the lower level.

Genetics

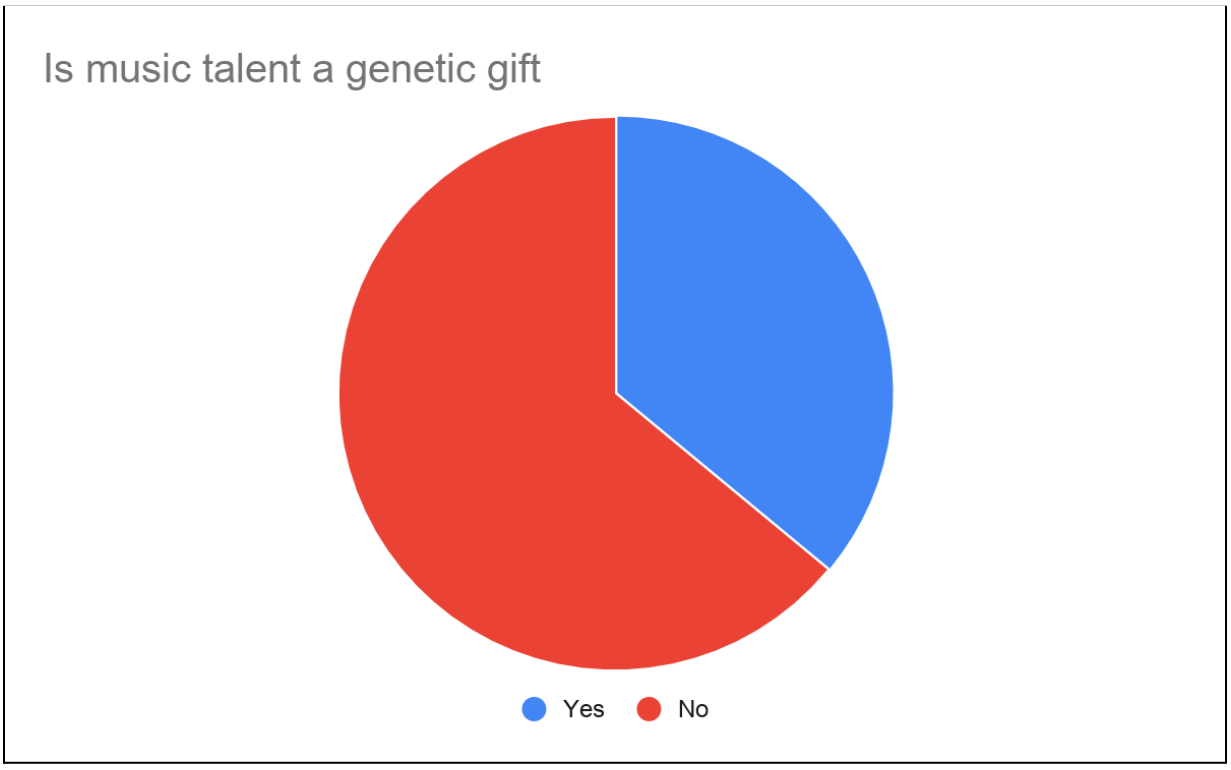

Fig.9 Results of whether teachers believe music talent is a genetic gift.

The teachers were then asked whether they believe musical talent is a genetic gift. Overall, 36% answered yes and 64% answered no. This is a much lower percentage than those who believed musicality appears among families. This would suggest that many of the teachers that believe music talent is common in families, believe it's more likely due to nurture rather than nature.
For many of the teachers this question was not a simple yes or no, but a question with many different perspectives and variables.

One teacher believed that "musical elite's that are considered virtuosos" such as "Mozart, Beethoven, Wes Montgomery, Miles Davis, Herbie Hancock, modern day musicians such as Guthrie Govan, Jacob Collier", "definitely had an initial talent for it, along with a social environment that fed and nurtured that talent". One teacher said it's not genetic and talent "has to

be nurtured and developed by good teaching/mentoring and hard work". Another observation made by one teacher was "that certain types of thinkers pick up different diciplins better than others. Eg. Someone who is good with pattern recognition may pick up an instrument better that others.". This is an interesting consideration as it returns to the idea of genetic abilities impacting talent, though they are not the talent themself. This refers to the likes of musicians having perfect pitch or basketball players being of a tall height. Others said that they believe music talent can be genetic but "people are given it in various levels and you don't have to have it to learn a musical instrument".

It is unsurprising that the question of talent being genetic evoked such a variety of opinions and explanations, as it alludes to the debate of nature or nurture (See Q.4 in Appendix C for full responses). Following research of others in the literature review chapter and the uncertainty surrounding genetics in the students' answers, it appears the genetics of talent is still a topic in need of further discussion and research.

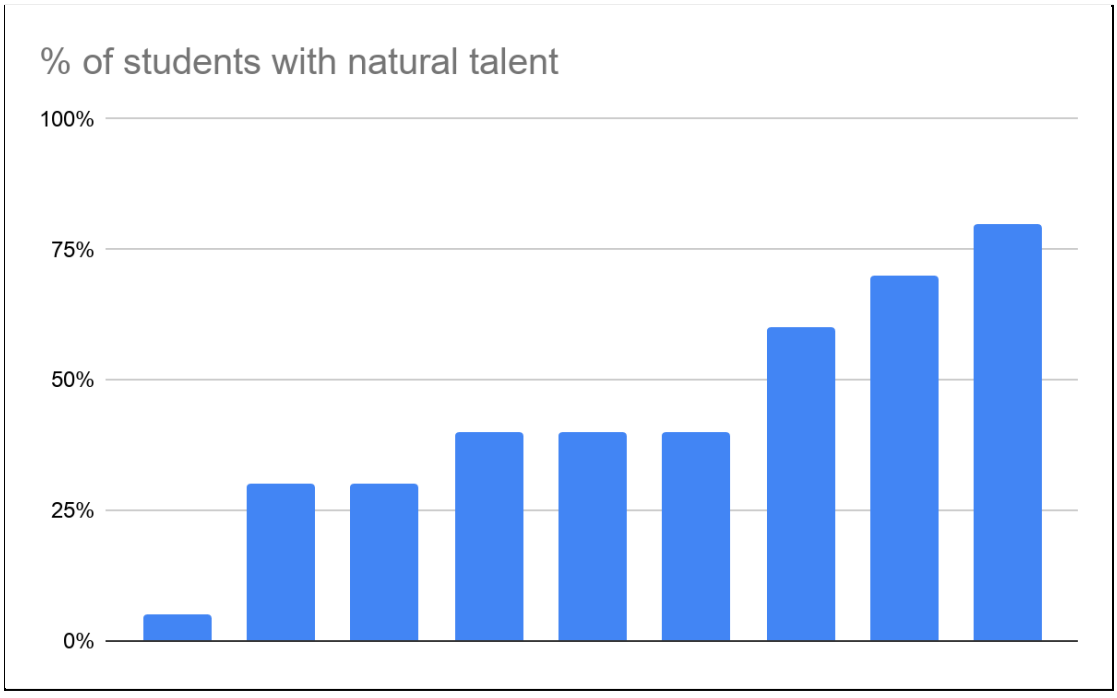

Fig.10 The percentage of students that teachers believed had a natural talent for music.

Lastly the teachers were asked what percentage of their students they believe have a natural talent for music. Answers to this question varied greatly, with one teacher answering less than 5% and another answering 80%. Out of the 9 who answered, however, 30% - 40% was the most common answer. It is evident from the variety of percentages and opinions provided in the previous question that even amongst music teachers, many people possess a different opinion on what the definition of a natural music talent is, along with how common or rare that genetic capability may be.

Conclusion

This survey proved to be a successful method of discovering what aspects of a music student's life impact their talent, and how. The survey offered a clear answer from each student on their level of playing, musicality in their family, practise, upbringing, encouragement, mindset and other external influences. It also proved beneficial to provide the teachers with their own survey to voice their opinions on this research. It was significant to learn that many of the teachers' opinions also agreed with the results found in the students' surveys. Of all aspects studied, family appears to have a significant impact. That said, based on the teachers' opinions and students' answers, it is still uncertain what role genetics, or nature, play in this influence. The results of these surveys are a clear example of how there are many different aspects that determine a person's musical talent and ability.

Discussion

The initial aim of this research project was to investigate how genetics and home environment determine musical talent and ability. Following further research, this expanded to investigating genetics, external influences both within and outside the family, support and encouragement, practise and mindset. Numerous researchers have debated the argument of nature versus nurture, with others claiming adequate practise is all that's needed to achieve expertise, and others claiming it's a combination of all researched aspects mentioned. This survey aimed to investigate each of these aspects and following analysis of the participants' answers, it is evident that the latter is most likely to be true.

Survey

The survey proved successful in answering many of the project's questions. In the majority of areas, there was a distinct pattern between the experiences of the students and their ability to play music. Additionally, many of the opinions given by the teachers equated to the answers of the students. This is a significant takeaway as it strengthens the dependability of the results and acknowledges a noticeable pattern between a student's talent and their experiences.

Following the direction of Macnamara et. al, the exact purpose of the study was not made apparent to the students.[28] This way students didn't immediately focus on family when answering questions, but instead gave honest answers about the influences in their life. This method, although appropriate, brought limitations to the project.

Questions on family genetics and encouragement could not be asked directly, but rather were drawn from their answers. For example, encouragement can come in many different forms, whether verbal or nonverbal, as mentioned in one teacher's answer. "If the verbal or nonverbal message from any member of the family is negative, it has a significant impact." (See Q.3 in Appendix C). This could mean that although a student has felt encouragement from their family, there was nowhere in the survey where it needed to be mentioned. There are also differing amounts of encouragement. Perhaps one student constantly feels encouraged and supported to

[28] Macnamara, Brooke N., Maitra, Megha. "The role of deliberate practice in expert performance: revisiting Ericsson, Krampe & Tesch-Römer (1993)." *Royal Society Open Science*, vol.6, no.8, 21 August 2019, p.4.

improve upon their music, whereas another student may have simply been encouraged to start. A more direct question about how encouraging the students' families are would have contributed more in depth answers and explanations to the importance of encouragement in creating talent. This method also limited the success of differentiating the influences of genetics and environment on the students' talent. No student reported to have genetic anomalies, such as perfect pitch, congenital amusia or synesthesia. Originally it was also thought that genetics and environment may be possible to differentiate by analysing which students had musicians in their family and which had a lot of music influence in their home environment. This method proved unsuccessful, as the majority of students who had musicians in their family, also had a lot of music in their home environment. Although this suggests that both nature and nurture are important, the survey was unable to distinctly differentiate the two as there were no direct questions surrounding genetics.

Having analysed the effectiveness of this method, perhaps a more suitable approach for future similar projects would be to conduct two surveys, on two different groups of students. One using a more anonymous approach, and another with more direct and obvious questions surrounding family and genetics. This way the benefit of not having any bias from the first group of students could be compared to the benefit of asking direct questions about the second group's family and upbringing. With enough participants, it should also become apparent whether or not revealing the purpose of the study does or does not create bias. This approach would be likely to create more exact answers to the project's questions.

Findings

As seen in the literature review chapter, many researchers recommend that both nature and nurture be of focus rather than determining one more significant than the other. This theory has also proved true in the current project. Talent seems to be more complicated than simply being something a person is born with or something that can be achieved with a set amount of hours of practise. Having analysed the answers of the students' surveys, it seems there are many significant aspects that influence a person's musical talent.

The results of the survey have revealed that talent may be affected by practise, home environment, genetics, encouragement, teachers, friends, mindset or enjoyment and presumably more. On its own, one of these aspects may not be enough to determine whether or not a person will be of a higher or lower musical talent. When combined, however, the pattern becomes much clearer. This theory is similar to the five aspects deemed necessary by Yan in determining athletic ability.[29] Initially it was thought that music talent is likely due to nature or nurture, or perhaps both. As a result of this survey, this no longer seems to be a relevant question. A more relevant focus of research may be on how the previously mentioned aspects of a person's life interact and affect each other and the person's talent.

Having compared each of these aspects together, as seen in figures 1 and 2 of the analysis chapter, it does appear that certain aspects may have a bigger impact than others. This is specifically in reference to the impact family and home environment seem to have on a person's musical talent. This is unsurprising as it is returning to the central meaning of nature versus nurture. When looking at the students' overall abilities to play their instrument, the higher level students had the highest amount of influence and musicians in their home. When looking at how quickly the students improved, the higher and middle groups had the highest percentage in these areas. There is no doubting that there is some connection between family and musical talent. In support of this, 82% of teachers also recognised this connection from their experience in teaching. There could be many explanations for this, including; genetics, an encouraging atmosphere or even subconscious influence. Although the exact cause hasn't been found, and may even differ from person to person, it can be said in confidence that a music student with a musical family is more likely to perform to a higher standard than those without. This also suggests that talents and interests may in fact be predetermined, either by a person's nature or nurture. However, having learned that there are many other aspects that influence talent, it seems true that traits and characteristics may be influenced or offset by other aspects, similarly to the suggestion made by the research of Leve, et al. [30] All that said, this finding does not mean that a

[29] Yan,Xu, Papadimitriou, Ioannis, Lidor, Ronnie, Eynon, Nir. "Nature versus Nurture in Determining Athletic Ability.", *Genetics and Sports, ed.2*, Medicine and Sports Science, Karger, vol.61, 2016, p.25

[30] Leve, Leslie D., Harold, Gordon T., Ge, Xiaojia, Neiderhiser, Jenae M., Patterson, Gerald. "Refining Intervention Targets in Family-Based Research: Lessons From Quantitative Behavioral Genetics." *Perspectives on Psychological Science*, Sage Publications, vol.5, no.5, p. 516-526, September 2010.

student without any musical influence in their family is destined to be a lower level student. As seen in the survey results, there are higher and middle level students without any family influence or musicians. This can be easily explained by the proposed theory that other aspects such as practise, enjoyment and encouragement outside of the home are also significant in determining talent. Perhaps a positive experience in these aspects earned these students their higher rankings.

A further example of this can be seen from the results of how often the students practise. At first it was expected that those who improved more quickly than others would have practised the most. Alternatively, the average time spent practising among the groups were somewhat similar, with the middle group practising the most. Although practise is necessary to improve upon an instrument, it is now evident that other aspects of a person's life can also affect their talent. This means that two students who spend the same amount of time practising each week, may see extremely different results in their progression. Another important aspect, which works closely with practise, is whether or not the students enjoy practising their instrument. As mentioned in the analysis chapter, practise creates muscle memory. If students create a habit, or muscle memory, of associating disenjoyment or stress with practise, they are less likely to practise as often. Unsurprisingly, results of the survey also show that the group of students that practised the most, the middle group, was also the group that reported enjoying practise the most, rather than finding it to be a chore. This is a clear example of how a positive experience in one aspect, such as enjoyment, can be of advantage to and influence another aspect, such as practise.

One of the most useful outcomes of this survey was that the focus on what aspects determine talent expanded further than initially expected. The survey was designed with genetics, home environment and practise as the main focus. Although these were the focus, the survey was designed so that family was not an apparent focus to the participants, and so further questions were developed. This led to the realisation that some students had encouragement from school or friends, rather than family. Interestingly, this was most often found in the middle group students, followed by the lower group and lastly the higher group. Answers from the teachers survey also heavily emphasised the importance of encouragement on a student's abilities. Encouragement was also mentioned by most students, whether it was from family, school, friends or music

teachers. Due to the findings that higher level students had more encouragement from family and middle level students had more encouragement from school/friends, it is possible that encouragement from family has a greater effect than other external forms of encouragement. Initially encouragement was not expected to be a main aspect of determining talent, but was included following analysis of the work Leve, et al.[31] Following the students' answers and the teachers' emphasis on encouragement, it now seems an important area for future research. Another unexpected outcome of the survey was the result that the age at which students began playing music did not have an evident impact on their talent. Although age was not one of the main focuses of the project, it was expected from the research of others that early training would be of benefit.[32] [33] The most notable result in terms of age was when looking at how well the students play, the middle group started an average of 5 years later than the other groups. This could possibly provide an explanation as to what differentiates the middle level students from the higher level students, although it could not be guaranteed without comparing the other aspects of the students' lives as previously discussed.

Conclusion

The survey was successful in confirming that there are many different aspects in a person's life that can determine their musical talent. Family, home environment and encouragement were found to be the most significant aspects, with the age at which students began learning and the amount students practised being of lesser importance. The project was not successful in answering the question of whether nature or nurture determines a person's musical talent. As a result of the survey, however, it is now evident that this should not be the question in research. A more suitable focus in future research may be on what aspects of a music student's life impact or encourage their musical talent.

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[31] Leve, Leslie D., Harold, Gordon T., Ge, Xiaojia, Neiderhiser, Jenae M., Patterson, Gerald. "Refining Intervention Targets in Family-Based Research: Lessons From Quantitative Behavioral Genetics." *Perspectives on Psychological Science*, Sage Publications, vol.5, no.5, p. 516-526, September 2010.

[32] Baharloo, Siamak, Johnston, Paul A., Service, Susan K., Gitschier, Jane, Freimer, Nelson B. "Absolute Pitch: An Approach for Identification of Genetic and Nongenetic Components" *American Journal of Human Genetics*, vol.62, no.2, February 1998, p.227

[33] Peretz, Isabelle, Cummings, Stephanie, Dube, Marie-Pierre. "The Genetics of Congenital Amusia (Tone Deafness): A Family-Aggregation Study." *The American Journal of Human Genetics*, vol.81, September 2007, p.585

Conclusion

This research project began by questioning whether nature or nurture determine a person's musical talent. Following further investigation, it is now evident why this question has been debated by so many, for so many years. It seems the answer to this question could be neither, or both. The results of the surveys conducted on music students and their teachers suggest that nature and nurture contain many more aspects than initially expected. This question can not be answered by solely studying the genetics and home environment of a musician. From this research, it is now apparent that genetics, home environment, home encouragement, external environment, external encouragement, practise, confidence and enjoyment may all impact the talent of a music student. This study also revealed that although each of these aspects may impact talent, some aspects may be more significant than others. Family remains a major focus of this research, whereas practise and early training do not appear to be as significant on their own. It appears, however, that even the less significant aspects may have an impact on talent depending on the other aspects of the student's life.

In terms of future research in the development of musical talent, there are still many aspects in need of further study. Following this study, these primarily include; genetics, encouragement and how the numerous aspects of a musician's life interact and impact each other. A similar study as the current project could achieve some of these results, by asking more direct and in depth questions on each of these aspects. Another method that could further this research would be by studying individuals with mostly similar experiences, and studying how their minor differences impact their talent. For example, this approach could demonstrate how practise impacts talent if it's the only differentiator between two student's experiences, or if one student was encouraged by a family member and another by a teacher, how does this difference alone impact their talent?

The expansion of this research question means there are many more aspects in need of study than initially expected in order to state what impacts and determines musical talent. This may be a positive outcome, however, as it suggests that although certain traits may be predetermined, there is an abundance of other aspects that can shape a person's talents and interests.

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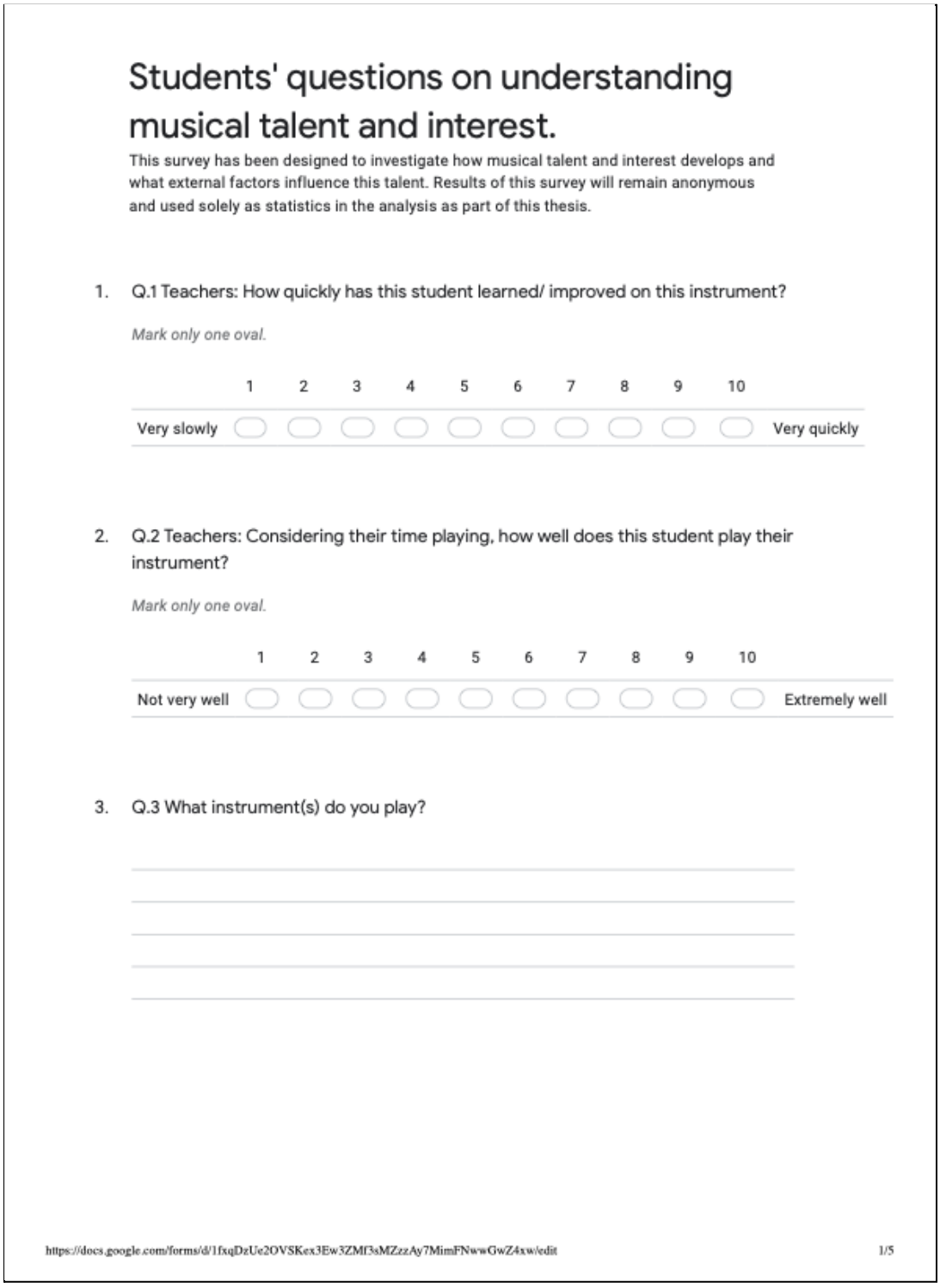
Appendices

Appendix A

Students' survey questions



Students' questions on understanding musical talent and interest.

This survey has been designed to investigate how musical talent and interest develops and what external factors influence this talent. Results of this survey will remain anonymous and used solely as statistics in the analysis as part of this thesis.

1. Q.1 Teachers: How quickly has this student learned/ improved on this instrument?

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Very slowly											Very quickly

2. Q.2 Teachers: Considering their time playing, how well does this student play their instrument?

Mark only one oval.

	1	2	3	4	5	6	7	8	9	10	
Not very well											Extremely well

3. Q.3 What instrument(s) do you play?

https://docs.google.com/forms/d/1fxqDzUe2OVSKex3Ew3ZMf3sMZzzAy7MimFNwwGwZ4xw/edit 1/5

4. Q.4 At what age did you start learning this/these instrument(s)?

5. Q.5 Are any of your family members musicians? (If so, who, and what instrument(s) do they play?)

6. Q.6 What/ who inspired you to start learning music?

7. Q.7 How many hours on average do you spend practising music a week?

8. Q.8 Do you enjoy practising your instrument or does it feel more like a chore?

9. Q.9 Has music always been a big part of your life? In what way?

10. Q.10 Did you decide to learn to play music yourself or was it suggested by someone else? If it was someone else, who?

11. Q.11 Do you have any other hobbies / past times?

12. Q.12 If so, do any of your friends / family share these other hobbies / past times?

13. Q.13 What's your favourite genre of music?

14. Q.14 How were you introduced to this genre?

15. Q.15 As far as you are aware, do you possess any of the following?

Check all that apply.

- [ ] Perfect pitch
- [ ] Tone deafness
- [ ] Synesthesia

16. Q.16 If yes, do any family members also possess the same anomaly?

17. Q.17 Is there anything else you would like to add about your involvement with music?

Appendix B

Teachers' survey questions

Teachers' questions on understanding musical talent and interest.

This survey has been designed to investigate how musical talent and interest develops and what external factors influence this talent. Results of this survey will remain anonymous and used solely as statistics in the analysis as part of this thesis.

1. Do you think the amount of practise dedicated to music solely determines a person's talent?

   Mark only one oval.

   - ◯ Yes
   - ◯ No
   - ◯ Other: _____

2. In your experience, does musicality tend to appear among families?

   Mark only one oval.

   - ◯ Yes
   - ◯ No
   - ◯ Other: _____

3. In your opinion, does encouragement from family have an effect on a person's abilities? Or is a person's talent dependent on themselves?

_____

_____

_____

_____

_____

4. Overall, do you believe that musical talent is a genetic gift?

5. If yes, what percentage of your students would you say possess this natural talent for music?

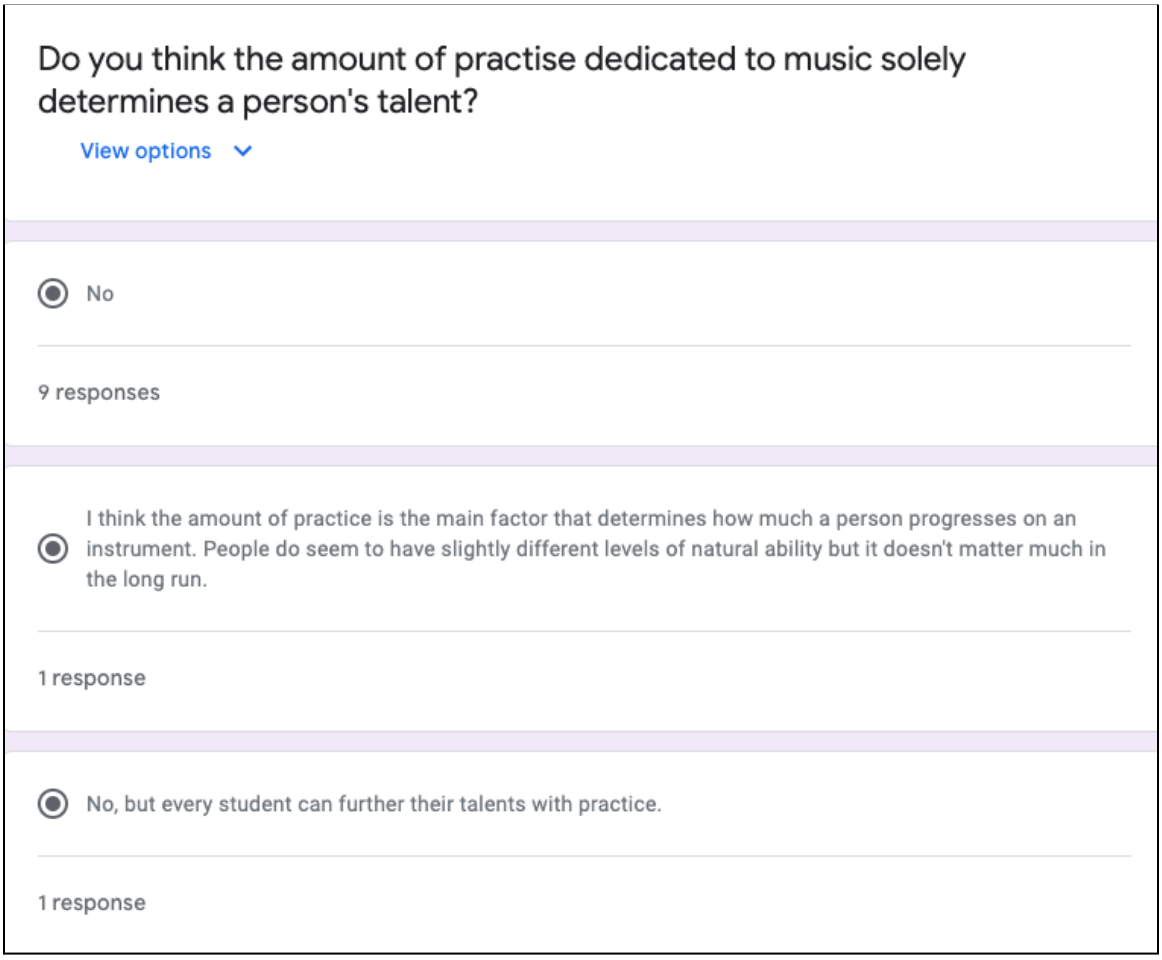
Mark only one oval.

- 0%
- 10%
- 20%
- 30%
- 40%
- 50%
- 60%
- 70%
- 80%
- 90%
- 100%
- Other: _____

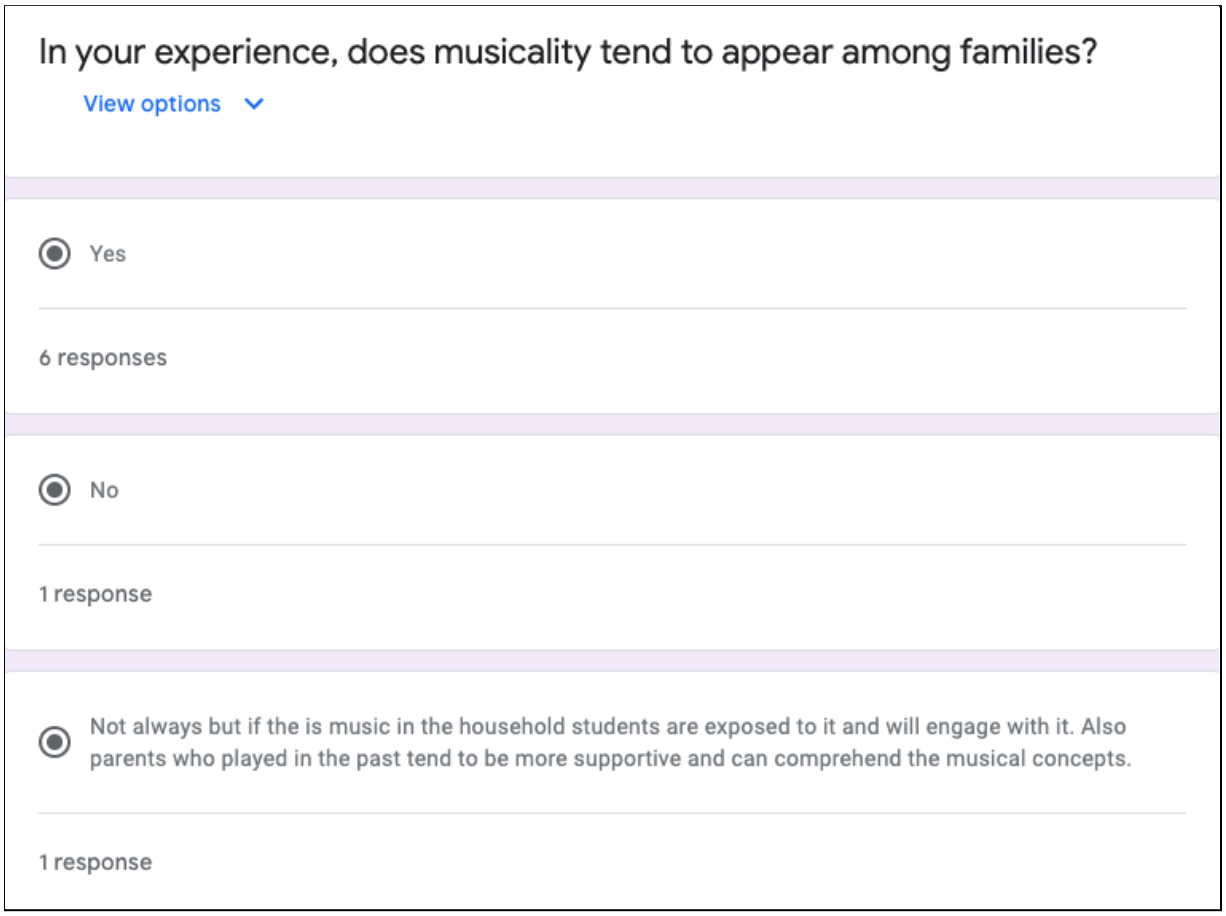
Appendix C

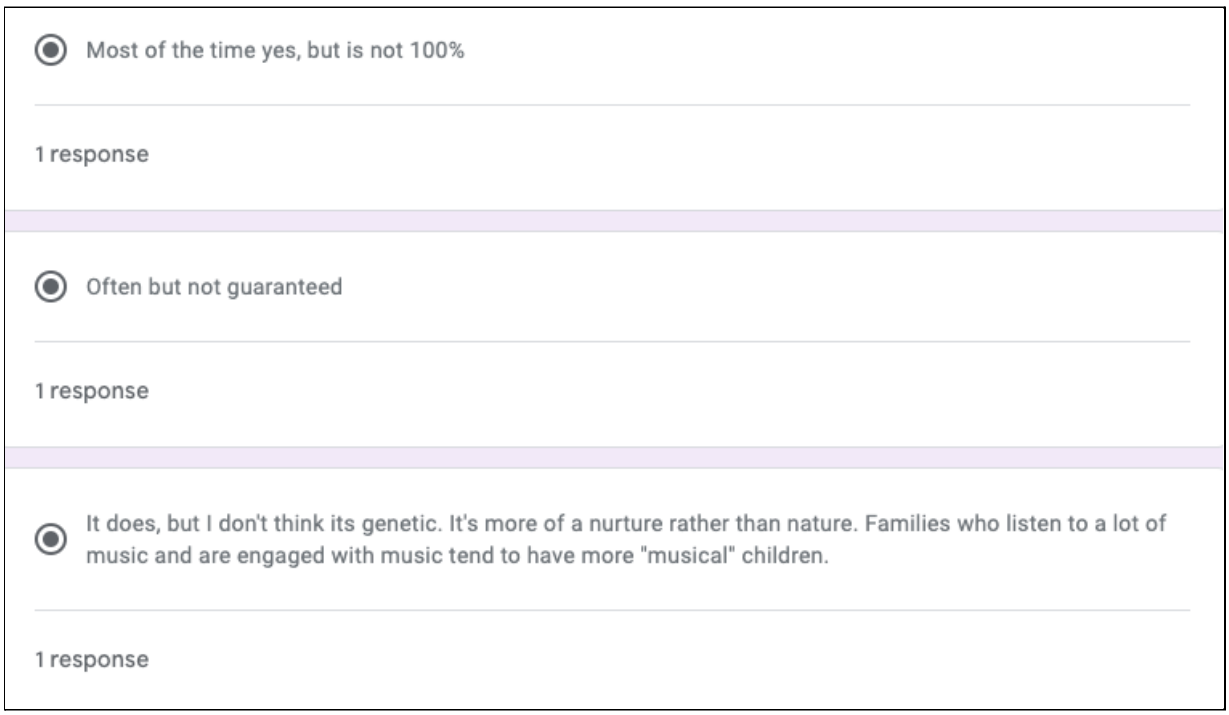
Teachers' survey responses

Question 1:



Question 2:


In your experience, does musicality tend to appear among families?
View options
Yes
6 responses
No
1 response
Not always but if the is music in the household students are exposed to it and will engage with it. Also parents who played in the past tend to be more supportive and can comprehend the musical concepts.
1 response


Most of the time yes, but is not 100%
1 response
Often but not guaranteed
1 response
It does, but I don't think its genetic. It's more of a nurture rather than nature. Families who listen to a lot of music and are engaged with music tend to have more "musical" children.
1 response

Question 3:

In your opinion, does encouragement from family have an effect on a person's abilities? Or is a person's talent dependent on themselves?

My first thought is that there have been many cases of family members pushing a person to practice and so killing their love of music and by extension their abilities. However gentle encouragement works wonders for the confidence, and so the abilities of a person. Encouragement in the form of there simply being a lot of music in the house also makes a massive difference in a person's abilities. Mostly I do believe a persons talent depends on themselves, their own drive and willingness to learn and perform. If they want it enough they can overcome any encouragement from family that would attempt to dissuade them from music or push them too hard.

1 response

Encouragement is highly important. If a child believes they are musical, they practice more and subsequently will do better at learning an instrument. If the verbal or nonverbal message from any member of the family is negative, it has a significant impact.

1 response

Encouragement from families I believe definitely aids a person's interest in music and allows them more opportunities to play music with others, but I do not believe if someone comes from a non-musical family they are automatically at a disadvantage.

1 response

Encouragement from family has a huge effect. Some may progress without it but the norm is that the supportive family behind a student's musical studies enhances and encourages natural ability to succeed.

1 response

For me ability + talent are two different things, while an ability can grow over time + does flourish through encouragement from family + friends, talent is what you built on.

1 response

Encouragement can and does effect abilities, you can practice and improve but it has no impact on talent - talent does not mean a high level of abilities.

1 response

Encouragement definitely helps but it's a bit of both!

1 response

Encouragement in my opinion is a huge factor

1 response

Definitely has effect.

1 response

encouragement helps

1 response

Yes. greatly

1 response

Question 4:

Overall, do you believe that musical talent is a genetic gift?

Above all else, I truly believe that anyone can learn music to a professional level however, if we are talking about reaching a level of the musical elite's that are considered virtuosos and leaders in their instrument/voice... Then those people definitely had an initial talent for it, along with a social environment that fed and nurtured that talent. I'm talking about the likes of Mozart, Beethoven, Wes Montgomery, Miles Davis, Herbie Hancock, modern day musicians such as Guthrie Govan, Jacob Collier. Each one of these virtuosos might have had a degree of musical talent to begin with, but talent means nothing without time and dedication to mastering a craft. I can guarantee you, all of those musically talented people have dedicated their lives to honing their craft.

1 response

Partly. I Believe that talent comes primarily from nurture. My most "naturally" talented students were exposed to music from a young age. Though I do believe that certain types of thinkers pick up different diciplins better than others. Eg. Someone who is good with pattern recognition may pick up an instrument better that others.

1 response

Not entirely. There are people born more inclined towards music than others, some with a natural knack for singing or playing, but I've seen many students without a natural intuition or talent who love music practice and learn until musicality becomes something they have an ear for and understand.

1 response

No, to be honest I would change the word talent for readiness, like someone who have readiness to learn something faster than others.

1 response

yes but people are given it in various levels and you don't have to have it to learn a musical instrument

1 response

No, general intelligence and concentration levels along with a regular practice routine are key.

1 response

No, it has to be nurtured and developed by good teaching/mentoring and hard work

1 response

Define overall! It's more likely, yes, but not a given.

1 response

No - environmental gift maybe but rarely genetic

1 response

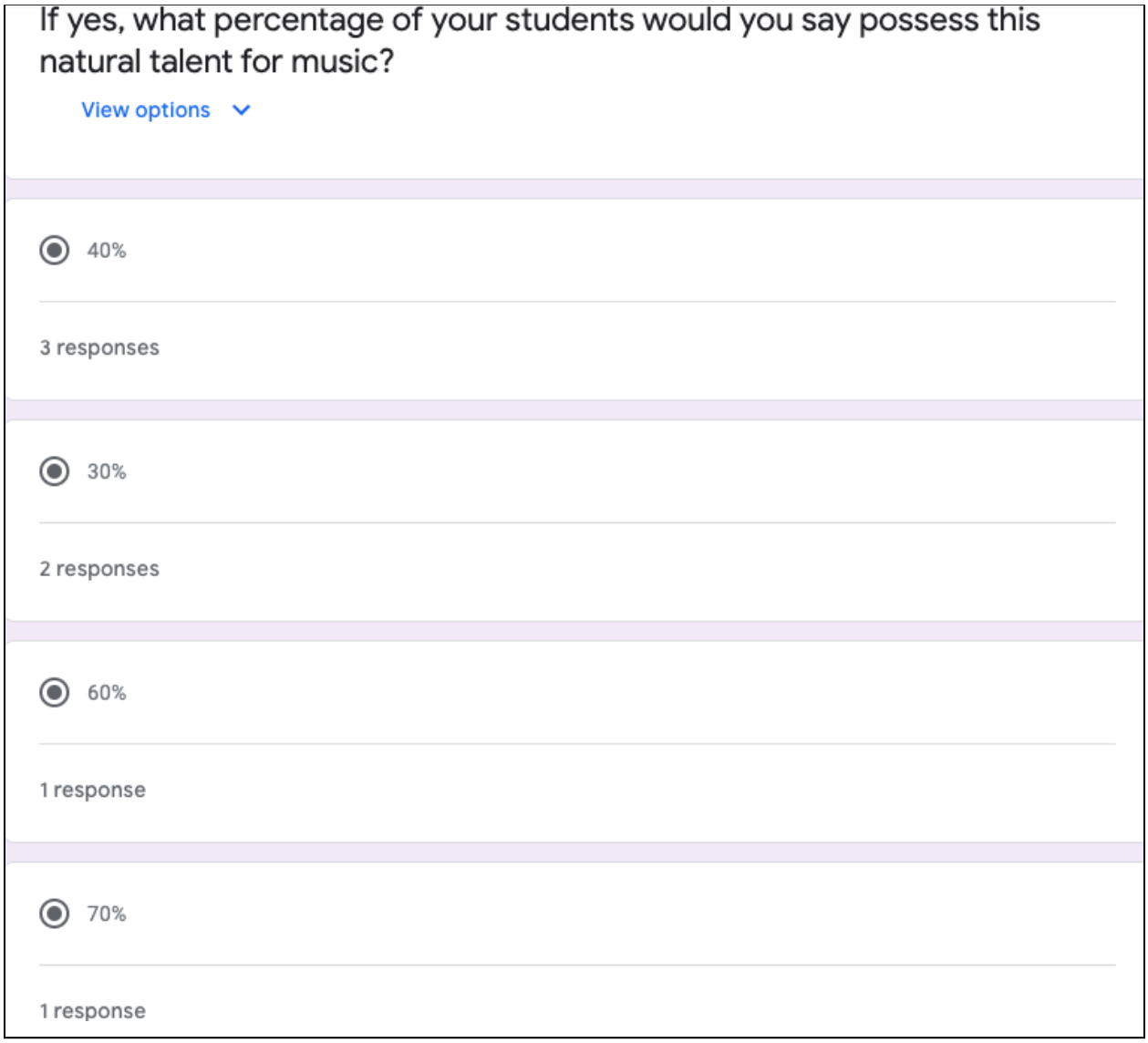
Definitely not.

1 response

Yes, I do.

1 response

Question 5:


If yes, what percentage of your students would you say possess this natural talent for music?
View options
40%
3 responses
30%
2 responses
60%
1 response
70%
1 response

◉ 80%

1 response

Question left blank

1 response

◉ As stated above, some of my students seem to have more of a natural ability when it comes to music as a beginner, but these nearly always come from families with other musicians or where music is regularly listened to and encouraged in the household.

1 response

◉ Less than 5%

1 response