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ABSOLUTE PITCH AMONG NON-GLOBAL POSSESSORS - TIMBRE AND CATEGORIZATION -

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ABSTRACT

Perfect or absolute pitch (AP) is typically considered to be an asset for any musician, however it is not well understood and may have some drawbacks. From a case study among students from the Musicology and Analysis Department of the Conservatoire National de Musique et Danse de Paris (CNSMDP), under direction of Dr. Adrien Mamou-Mani (CNSMDP/IRCAM) and Dr. Michèle Castellengo (LAM), we noted important issues raised by the students, in particular the relevance of timbre for AP categorization and identification. Among our findings we can highlight: 1) the strong relationship between AP identification and primary instrument; 2) the importance of the piano (pointed as the easiest timbre for recognition) and the voice (pointed among the hardest timbres for recognition) during AP identification and, 3) the loss of musical pleasure indicated by a considerable number of AP possessors. These highlights call for further research in Psychoacoustics and Cognition fields, including to understand to what extent AP perception can hinder RP perception and therefore the joy of music.

Keywords: *Absolute Pitch, Timbre, Categorization, Music and Cognition.*

1. INTRODUCTION

Built around several preconceived ideas, Absolute Pitch once held a distinguished position among musicians. Perceived as a rare and special phenomenon, it functions in many cases to legitimize a certain superiority in the hearing of its possessors. Currently, we are seeing a shift in this image, with a new understanding of the subject, and the idea of Absolute Pitch is gradually being better constructed. Regardless of this social relationship, the ability to hear specific frequencies remains an interesting tool for musical listening and can represent an important mechanism for learning and performing music. Understanding its role can contribute to a better understanding of musical activity and the relationship between the individual and music.

AP is defined in the literature as the ability to identify the pitch of isolated tones using musical pitch labels or to produce the pitch of any tones designated by note names without comparing to any reference pitch [1-11]. The incidence of AP is estimated to be around 0.1-1% of the population [7,12-14]. Among musicians this number can increase considerably, with estimates varying from between 5 to 50% [15, 16]. There is disagreement in the literature as to how AP is acquired. A more recent and now commonly supported hypothesis falls somewhere between the two previous hypotheses: some individuals have a genetic predisposition that is activated via a critical period during early musical training and it is strongly linked to our pitch categorization process [17-20].

Absolute Pitch remains a rich subject and represents an important part of the study of musicality. The increasing amount of research on this subject, and the exchange between researchers is fundamental in this context. For this research we were particularly interested in aspects related to

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FORUM ACUSTICUM EURONOISE 2025

perception and the influence of timbre on pitch perception. Since music is composed mostly of complex sounds, timbre is a key attribute in this perception.

The discussion surrounding the definition of AP makes us reflect on the different aspects of this phenomenon. We can recognize different profiles depending on the type of difficulty encountered by individuals who possess it. We also find that musicians have a certain difficulty self-declaring that they possess this ability, given that, on the one hand, we have a certain lack of understanding of the definition and the different types of AP, and on the other hand, the difficulties encountered by these individuals can lead them to believe that they do not possess it or that they possess a so-called defective ear, given that it does not correspond to the common image of perfect AP. Research such as Bachem (1937) [5], and Takeuchi and Hulse (1993) [4] highlight already the different degrees of listening among those with Absolute Pitch. Differences in pitch perception depending on timbre and register, and difficulties related to singing or the accuracy of this identification lead us to classify them into categories or subgroups that can allow us to better analyze and understand this ability. We believe AP and RP (Relative Pitch) are not on the opposite ends of a continuum. Instead, AP and RP can both be present or absent in an individual.

2. THE CATEGORIZATION

The relationship between the individual and the environment in which they are located is marked by their interaction with objects and other individuals. In our understanding of the world, we need to find mechanisms that allow us to read this world and establish relationships between the different things that form it. We organize it in such a way as to separate and classify things in order to understand it. We classify them into large groups that both give rise to new subgroups and, in turn, form the basis for other subgroups depending on the degree of specialization we have in each concept. In this way, we classify objects, animals, colors, feelings, everything around us. Our perception is entirely based on these groups, which we build since childhood and which develop and subdivide throughout life according to the experiences and specific needs of each individual (in which language plays a fundamental role). In this sense, we can distinguish two types of categorization: prototypical categorization and perceptual categorization. The former refers to the type of categorization we construct based on our reading of the world, while the latter is more closely linked to established

systems that individuals must assimilate. In prototypical categorization, two concepts are important: similarity aggregation (operated at the basic level) and pattern (or "typicality") [21].

The basic level encompasses the more general references we build since childhood and allows us, for example, to distinguish between the different objects that make up our environment. Throughout life, we create subcategories, as needed, to specify the differences between objects in the same group. The second type of categorization refers to specific learning, specific to a given culture. It is linked to a theory with fixed boundaries, based on measurements, and has a more scientific perspective, unlike the prototypical categorization, which relates to more variable phenomena and has a more psychological perspective.

3. THE TIMBRE

Among the various aspects of sound, one seems particularly interesting for musical listening and is also important in analyzing aspects of Absolute Pitch. Timbre can be defined as the fingerprint of sound. Each timbre is unique and results from the way the sound is produced. It can vary depending on the musician's playing style, the instrument used (such as a bow or fingers), and also depending on atmospheric conditions such as humidity and temperature, which modify the quality of the resonant materials [22]. We encounter a large number of possessors whose ability to label pitches is directly linked to timbre. The instruments they play have a fundamental role in this process and can even characterize the ability of the AP for a single instrument. This phenomenon is frequently observed in the case of the piano, widely used as a basic instrument in music theory courses [23]. This connection to specific timbre is relatively common and makes us reflect on the relationship between the perception of pitch and timbre. We also question the role of spectra in this context. In this sense, we may ask whether there are instruments that are more difficult to identify, as well as the relationship with their spectra, and also the role of formants and specific harmonics/partials in this process. The temporal envelope, also called ADSR, represents the four temporal stages of the sound: Attack, Decay, Sustain and Release, where the attack is very important for the timbre perception. Human perception does not evolve in a linear, additive relationship. It follows a logarithmic logic. The auditory system also does not behave the same way in different registers. Similarly, parameters such as intensity, duration, and timbre can also influence our perception of other musical elements.





FORUM ACUSTICUM EURONOISE 2025

4. CASE STUDY

4.1 Participants and Method

The research was conducted among students in the Department of Musicology and Analysis at the Conservatoire National de Musique et Danse de Paris (CNSMDP) after approval of the department's director, and the support of student representatives. The students enrolled in the department were between 18 and 30 years old and come from a variety of backgrounds and instrumental practices. Most enrolled at the National Conservatory between 2007 and 2014 and were currently pursuing programs such as Musicology, Musical Culture, Analysis, Pedagogy, Composition, Music Writing/Notation, Music History, and Aesthetics.

An electronic survey consisting of 25 questions was proposed to the 80 students of the department between November and December 2014, of whom 39 agreed to participate to this self declared research. Among the 39 participants, 36 were native French speakers, and the 3 foreign students were at an advanced level of language skills. The students began their music studies between the ages of 5 and 14 years old, and most followed the traditional curriculum of French conservatories (fixed do). The participant identification was not mandatory.

The questions we aimed to understand were: 1) the role of timbre in the students pitch identification; 2) aspects related to their auditory perception such as register, identification time, and vocal reproduction of notes; 3) the difficulties related to defining the term Absolute Pitch; and 4) the specificities and characteristics of the group that claims not to be sure if they have AP.

4.2 Results

4.2.1 Timbre

Participants were asked which timbres they found most difficult to identify. Of the twenty-five responses (five of which contained two answers), most (8) indicated the voice. Seven responded with wind instruments, with five specifying: English horn (2), oboe (1), clarinet (1), and brass (1). Lower register instruments were mentioned three times (one of which was the piano) and percussion three times (one of which was bells). The following instruments were mentioned once: piano, guitar, violin, viola, and organ. Two participants reported having no difficulties related to timbre, and one did not specify. Regarding the most easily identifiable timbres, we obtained twenty

responses (three of which had two answers each). The highest number of responses was for the piano (6). The oboe and violin were mentioned three times. The harpsichord, voice, strings, and cello appeared once. Strings and woodwinds in general were also mentioned once each. Three participants did not report any particular timbres. We can see the most difficult and easiest timbres for pitch recognition in the Tab. 1.

Table 1. The most difficult and easiest timbres for pitch recognition.

The most difficult timbre		The easiest timbre	
Voice	8	Piano	6
Winds	7	Oboe	3
Percussion	3	Violin	3

Many students prefer the timbre of the instruments they practice when identifying pitches. However, this is not always the case. Other instruments may play an important role, as is the case with two pianists indicating the voice and the violin, or a bassist indicating the voice as the easiest timbre for pitch identification. The piano occupies an important position. Many instrumentalists consider it easier even if they do not practice it. This may be related to its use in theory lessons, leading to greater familiarity with its timbre and, in some cases, the development of what is called "absolute piano" (Instrument-Specific Absolute Pitch [24]). The difficulty in recognizing and notating vocal music with text was also mentioned. The voice occupies an important place among the hardest timbres for recognition, due, probably, to the overlap between AP label and the lyrics of the song during AP identification

We have cases where the instrument being practiced is cited as more difficult to identify than others, such as the case of a violinist who indicates the piano as the easiest and the violin as the most difficult, and that of a clarinetist for whom the piano comes first, unlike the clarinet, which occupies the ninth place, for which pitch identification is the easiest.

4.2.2 Time, Accuracy and Frequency range

Most of the participants (twenty) declared to recognize pitches instantly. Fourteen participants needed between 3



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and 5 seconds, and two participants needed between 5 and 10 seconds. One student reported needing more than 10 seconds for recognition, and one reported not being able to do so (See Fig. 1).

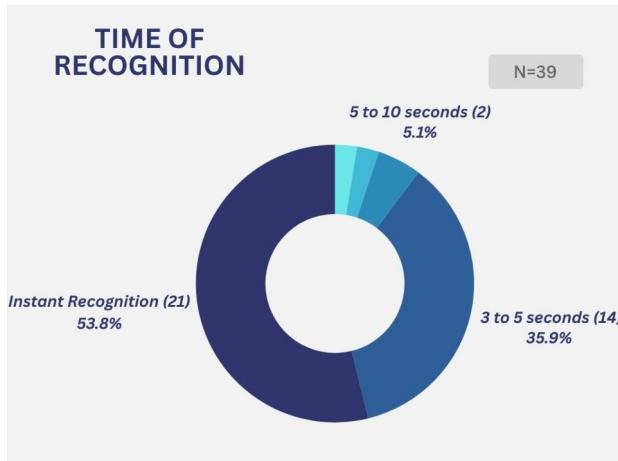


Figure 1. Time of recognition.

Regarding the accuracy of this identification, twelve participants reported always identifying the notes correctly. Twenty-two made errors of a semitone, and three were off by a whole tone or more. A half-tone error was quite common, and difficulties with atonalism and double-sharp or flat keys were also encountered (See Fig. 2).

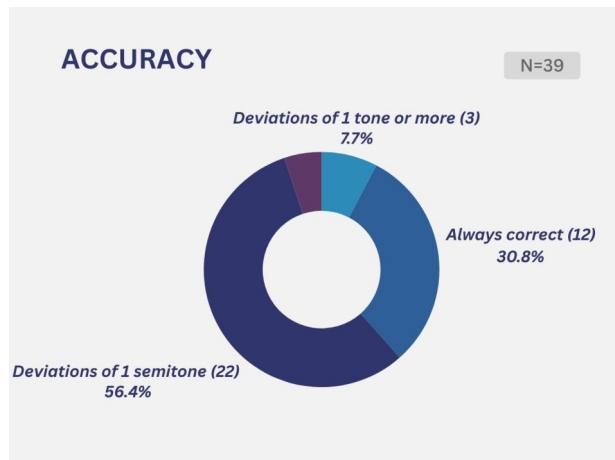


Figure 2. Accuracy of recognition.

Regarding the frequency range, 76.9% of the participants identified the middle register as the easiest register for pitch

identification. Six participants (15.4%) identified the high register and two (5.1%) the low register - including one bassoonist (who started at the age of 14 after having previously played violin for six years) who stated he was unsure whether he had the AP, and the other, a pianist since the age of six, who stated he did not have the AP (See Fig. 3).

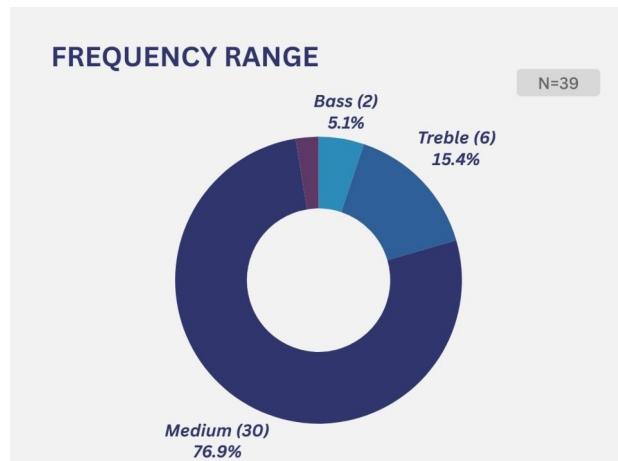


Figure 3. Preferred frequency range

5. DO I KNOW IF WE HAVE AP?

When asked how to recognize pitches, twenty-two participants (56.4%) said they did in the absolute way, compared to seventeen (43.6%) who declared the necessity of a reference note (such as A 440 Hz, for example).

Regarding the question of whether or not a participant has Perfect Pitch, an objective answer suggests some hesitation. Among the thirty-nine responses, eleven participants (28.2%) stated they have Absolute Pitch, seventeen (43.6%) stated they do not, and eleven participants were unsure. This last figure represents 28.2% of the responses and can tell us something about the difficulties in defining oneself as a possessor or not. A certain lack of understanding of the definition and the diversity of problems encountered (related to timbre or to the accuracy, for example) make the self identification as a possessor even more difficult. The preconceived ideas that arise from it, also plays an important role.

Eleven students made up the group who reported being unsure whether they had Absolute Pitch, including four pianists (one of whom is also a guitarist), three violinists,





FORUM ACUSTICUM EURONOISE 2025

two oboists, one bassoonist, and one clarinetist. The ages at which they began practicing ranged from 5 to 14 years old. Ten reported identifying pitches without the need for a reference note such as A 440 Hz, and only one relatively. Seven could do so instantly, and four did so after a 3 to 5 seconds of reflection. These ten participants (unsure if they have AP, but stated do not need a reference note for pitch identification) reported experiencing discrepancies of a semitone, while the one who do it relatively report always correct identification. Eight prefer the middle register, two the high register (the oboist—who also reports difficulty with all lower register instruments—and one violinist), and one student the lower register (the bassoonist). Regarding the reproduction of a required note for singing, nine report not needing reference notes (including the one who responded that they identify in relative form), and two report needing them. Three do it instantly, and eight need between 3 and 5 seconds to do it.

AP can appear in many forms. While there are some AP possessors with highly accurate AP across the board, some possessors have more limited AP capabilities. We refer to these groups as "global" and "non-global" AP possessors respectively. Possessors are also able to develop RP at different levels. It is not known how well RP develops among people with AP. As such, AP may actually be detrimental to some critical parts of the musical experience. The lack of understanding the definition and the different types of possessors we may encounter may be the source of this hesitation in declaring oneself a possessor. The group that hesitates to define itself as possessors is probably part of the non-global possessor group. One of the important aspects that differentiates possessors from non-possessors is the natural and intuitive nature of this pitch identification. AP is linked to "pitch memory," a labeling ability, to match a sound to a pre-established word or name. It is not a matter of just trying to identify a note. The sound heard and the associated name of the note (culturally chose) are, for most of these individuals, inseparable.

6. SUMMARY

Possessing AP can be a determining factor in the musical careers of many musicians. AP can be a very effective tool for success in music education in many countries. The importance given to identifying pitches in dictations and music theory lessons creates a favorable environment for those who possess it. In this case, this type of listening will always earn them good grades by giving the sensation of musical evolution. But this situation quickly changes when

these musicians are confronted with other practices such as group music without the use of music scores when faced with improvisation within a piece. In some cases, possessors musicians may succeed in their path, but their approach and the relationship they establish with this type of piece are undoubtedly different. In this case, many players will rely on theoretical knowledge, such as tonality, the chords and the scales, rather than on the feeling of improvisation based on sound research. We also encounter cases where the players who hesitate to play in these conditions and remain completely dependent on the scores, and also situations where they change career paths, frustrated by not feeling comfortable playing in groups, either professionally or in informal settings, such as at friends' or family's houses, for example. During the course of this case study, we questioned ourselves a lot about the place of the individual player in the musical world. More than trying to understand how the AP works per se, we are also interested in understanding how these musicians relate to this skill and the relationship they establish with their musical practice.

The way possessors relate to music and code pitch are central to our understanding of music language and have clarified the extent and limits humans approach music, how we categorize acoustic stimuli, how the brain plasticity adapts to different ways of hearing and the impact it has in the music culture and the traditional music education. Some possessors, unlike those without AP, may have the tendency to lose the pleasure derived from music, which, in turn, negatively impacts their musical career. The study of the Non-global possessor subgroups can bring new knowledge to better understanding of AP ability and how humans and, musicians in particular, create different paths according to their abilities and limitations to make music. Despite the increasing number of studies and research about AP, a relatively small number of studies have been dedicated to non-global AP possessors. Studying the differences and the different levels possessors can present, we will be able to have a fine understanding about the categorization process in humans, the strategies non global possessors develop, and the influence of the musical pleasure in this process.

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FORUM ACUSTICUM EURONOISE 2025

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