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Informació

In this lab we are going to work on some of the concepts and phenomena related to pitch perception.

You can download here the sound examples and demonstrations. Each question in this quiz will indicate with yellow backgrounded text the filename(s) that you have to play and listen to before answering the questions.

As the quiz is divided into different pages, it is advisable to "save without submitting" every time you have to move to another page. You'll find a convenient link to do that in the navigation pane just to the left of this text.

Please, split the exercise into short sessions (up to 40 minutes each) in order to avoid fatigue or boredom, and also in order to do your best with the learning process.

Pregunta **1**

Correcte

Puntuació 1,00 sobre 1,00

Pitch Salience and Tone Duration

How long must a tone be heard in order to have an identifiable pitch? Very brief tones are described as "clicks," but as the tones lengthen, the clicks take on a sense of pitch which increases upon further lengthening.

It has been suggested that the dependence of pitch salience on duration follows a sort of "acoustic uncertainty principle", where there is a tradeoff between the uncertainty in frequency and the duration of a tone burst (delta-f times delta-t = K). K, which can be as short as 0.1, appears to depend upon intensity and amplitude envelope. The actual pitch appears to have little or no dependence on duration.

In the sound example AD29.wav, we present tones of 300, 1000, and 3000 Hz in bursts of 1, 2, 4, 8, 16, 32, 64, and 128 periods (complete cycles) and **you have to decide if you can establish a sense of pitch in each case**. **Write down how many periods are necessary to establish a sense of pitch in each case. You can also calculate the corresponding burst durations, to see whether your perception depends more on absolute duration than number of periods.**

For each of the presented frequencies make a 3-column table with columns being "#periods", "duration" and "pitch salience (yes/unsure/no)". This table will be pasted down below as an answer to another question.

Now please select the true statements below.

Trieu-ne una o més:

- [ ] a. The number of periods needed to establish a clear pitch sense is inversely proportional to its frequency
- [ ] b. We need at least 64 periods for any frequency
- [x] c. The duration needed to establish a clear pitch sensation for 300Hz is longer than the duration required for high(er) frequencies ✔
- [ ] d. 4 periods are enough for any frequency to yield a clear pitch sense
- [x] e. The first 3000Hz tone lasted less than a millisecond ✔
- [ ] f. We need at least 150ms to establish a clear pitch sense, irrespectively of frequency
- [x] g. The first 1000Hz tone that has been presented lasted one millisecond ✔

Les respostes correctes són: The first 3000Hz tone lasted less than a millisecond, The first 1000Hz tone that has been presented lasted one millisecond, The duration needed to establish a clear pitch sensation for 300Hz is longer than the duration required for high(er) frequencies

Pregunta **2**

Completa

Puntuació 1,00 sobre 1,00

Pitch Salience and Tone Duration

Paste below your results table and, using your knowledge and your data, answer to the question: **does the pitch salience depend on the duration of the sound or, alternatively, on the number of periods?**

1st

# periods	duration	pitch salience
	13.3 ms	no
	26.6 ms	no
	413 ms	no
	826 ms	no
	1653 ms	yes
	32100 ms	yes
	64213 ms	yes
	128426 ms	yes

2nd

# periods	duration	pitch salience
	11 ms	no
	22 ms	no
	44 ms	no
	88 ms	no
	1616 ms	yes
	3232 ms	yes
	6464 ms	yes
	128128 ms	yes

3rd

# periods	duration	pitch salience
	10.3 ms	no
	20.6 ms	no
	41 ms	no
	82 ms	no
	165 ms	no
	3210 ms	yes
	6421 ms	yes
	12842 ms	yes

I think its more related to the number of periods than the duration of the sound

Comentari:

Pregunta **3**

Correcte

Puntuació 1,00 sobre 1,00

Frequency Difference Limen or JND

Link each frequency with its approximate JND by using the graph you can find in the slides or elsewhere. Frequencies appear repeated in the left side in order to give the answer using Hz in one case and cents in another case.

100Hz (in Hz)	Approx. 3Hz ✔
100Hz (in cents)	Approx. 51 cents ✔
200Hz (in Hz)	Approx. 3Hz ✔
200Hz (in cents)	Approx. 25 cents ✔
400Hz (in Hz)	Approx. 3Hz ✔
400Hz (in cents)	Approx. 13 cents ✔
1000Hz (in Hz)	5Hz ✔
1000Hz (in cents)	Approx. 8 cents ✔
2000Hz (in Hz)	10Hz ✔
2000Hz (in cents)	Approx. 8 cents ✔
4000Hz (in Hz)	More than 20Hz ✔
4000Hz (in cents)	Approx. 9 cents ✔

La resposta correcta és: 100Hz (in Hz) → Approx. 3Hz, 100Hz (in cents) → Approx. 51 cents, 200Hz (in Hz) → Approx. 3Hz, 200Hz (in cents) → Approx. 25 cents, 400Hz (in Hz) → Approx. 3Hz, 400Hz (in cents) → Approx. 13 cents, 1000Hz (in Hz) → 5Hz, 1000Hz (in cents) → Approx. 8 cents, 2000Hz (in Hz) → 10Hz, 2000Hz (in cents) → Approx. 8 cents, 4000Hz (in Hz) → More than 20Hz, 4000Hz (in cents) → Approx. 9 cents.

Pregunta **4**

Completa

Puntuació 1,00 sobre 1,00

Frequency Difference Limen or JND

The ability to distinguish between two nearly equal stimuli is often characterized by a *difference limen (DL)* or a *just noticeable difference (jnd)*. Two stimuli cannot be consistently distinguished from one another if they differ by less than a jnd. The jnd for pitch has been found to depend on the frequency, the sound level, the duration of the tone, and the suddenness of the frequency change. Typically, it is found to be about 1/30 of the critical bandwidth at the same frequency.

In exemple4.wav, 10 groups of 4 tone pairs are presented ([T1 T2] [T1 T2] [T1 T2] [T1 T2] x 10 times). For each pair, the second tone may be higher or lower than the first tone. Pairs are presented in random order within each group, and the frequency difference decreases by 1 Hz in each successive group, from 10 Hz to 1 Hz. One of the tones of each pair has a frequency of 1000 Hz. Your task is to decide in which group all the tones sound equal with respect to pitch. Please answer below.

Record whether the second tone of each pair seems higher ("H"), lower ("L") or equal (“E”) than the first. Start a new line in your notes for each set of four pairs. E.g.:

H L L H

L L L E

L H H L

etc.

H L H H
H L L L

L H H L

L H H L

H L H L

H L H H

L L H H

H L H L

L L L H

L H H E

Comentari:

Pregunta **5**

Completa

Puntuació 1,00 sobre 1,00

Frequency Difference Limen or JND

In the table below you will find the structure of the groups and the tone-pair types used in the exemple that you have just listened to (exemple4.wav). "H" means a pair where a tone T1 has a frequency f, whereas a tone T2 has frequency f + the difference in Hz that is indicated in the 2nd column. "H" means, therefore, a pair where frequency increases. "L", otherwise, denotes a tone-pair where T1 is f + the difference in Hz, and T2 has f (a pair where frequency decreases).

If you correct your answers by comparing them with those in the table you can maybe observe that, before reaching a group where all or nearly all pairs sounded with the same pitch, you have made some mistakes here and there (on previous groups). These mistakes can be judgements of inverted direction than the right one or considering as equal-pitch pairs that were not so. Please, indicate your errors in the answering text box.

Group	Difference in Hz	tone-pairs structure
1	10	H L H H
2	9	H L L L
3	8	L H H L
4	7	L H H L
5	6	H L H L
6	5	H L H H
7	4	L L H H
8	3	H L H L
9	2	L L L H
10	1	L H H L

I had one error in the last exercise, the last tone. I guess it is mostly because the difference in hertz is minimun?

Comentari:
Indeed you are performing better than many listeners. 1Hz JND for this freq range is outstanding. Could it be related with your main musical instrument?

Pregunta **6**

Correcte

Puntuació 1,00 sobre 1,00

Frequency Difference Limen or JND

Considering that the base frequency in the previous example was 1000Hz, and taking into account what we already know aboug pitch JND, then....

Trieu-ne una o més:

- [ ] a. We could expect that perceiving tones as being equal in pitch and other errors would be nearly absent
- [x] b. We could expect that perceiving tones as being equal in pitch and other errors would start in the 6th or 7th group of tones ✔
- [ ] c. We could expect that the JND was 1Hz
- [ ] d. We could expect that perceiving tones as being equal in pitch and other errors would start in the 2nd or 3rd group of tones
- [x] e. We could expect that the JND was 5Hz or less, because musical training/experience improves this skill ✔

Les respostes correctes són: We could expect that perceiving tones as being equal in pitch and other errors would start in the 6th or 7th group of tones, We could expect that the JND was 5Hz or less, because musical training/experience improves this skill

Pregunta **7**

Correcte

Puntuació 1,00 sobre 1,00

Octave Matching

A 500Hz tone alternates with a stepwise increasing comparison tone near 1000Hz. Which step seems to represent a correct octave? Please listen to exemple5.wav, **count and write down the ordinal of the pair you feel as being "matched"**.

Resposta: 5 ✔

Experiments on octave matching usually indicate a preference for ratios that are greater than 2.0. This preference for stretched octaves is not well understood. It is only partly related to our experience with hearing stretch-tuned pianos.

Most listeners will probably select a tone somewhere around 1010 Hz.

La resposta correcta és: 4

Pregunta **8**

Correcte

Puntuació 1,00 sobre 1,00

Virtual pitch

One of the most remarkable properties of the auditory system is its ability to extract pitch from complex tones. When the complex tone consists of a number of harmonically related partials, the pitch corresponds to the "missing fundamental." This pitch is often referred to as pitch of the missing fundamental, virtual pitch, or musical pitch.

When the partials are not exactly harmonics of a missing fundamental, we arrive at a "virtual pitch" by some strategy that may weigh several possibilities, and when the choice is difficult the pitch may be ambiguous.

Familiar examples of such virtual pitch are the bass notes we hear from loudspeakers of very small size that radiate negligible power at low frequencies, and the subjective strike note of carillon bells, tuned church bells and orchestral chimes.

In AD37.wav you will hear a complex tone (200Hz) with ten harmonics, first complete (10 harmonics, same amplitude each) and then with the lower harmonics successively removed. The sequence sounds twice. **Does the pitch of the complex change? Pay attention to timbre and pitch sensations.**

Once you have listened to the example, please select the sentences below that you consider to be true.

Trieu-ne una o més:

- [x] a. The pitch of the complex tone does not change even though the spectral changes it suffers ✔
- [ ] b. The "missing fundamental" cannot be experienced when the lowest harmonics have disappeared
- [x] c. The most noticeable change in the different versions is related to timbre ✔
- [ ] d. The pitch of the complex tone changes when the lowest harmonics do not sound
- [ ] e. The pitch of the complex tone changes when the fundamental frequency is absent
- [x] f. The pitch of the complex tone is determined by the spectral structure, which makes possible here the "missing fundamental" phenomenon ✔

Les respostes correctes són: The pitch of the complex tone does not change even though the spectral changes it suffers, The pitch of the complex tone is determined by the spectral structure, which makes possible here the "missing fundamental" phenomenon, The most noticeable change in the different versions is related to timbre

Pregunta **9**

Correcte

Puntuació 1,00 sobre 1,00

Shift of Virtual Pitch

In AD38.wav you will hear a three-tone harmonic complex with its partials shifted upward in equal steps, till the complex is harmonic again. The tone has strong partials with frequencies of 800, 1000, and 1200 that progressively (in 10 jumps of 20Hz) go up in frequency. Which could be the pitch sensations in each case?

Please select the answers that should be true in this context.

Trieu-ne una o més:

- [x] a. When the harmonics are 1000, 1200 and 1400 Hz we will probably perceive a 200Hz pitch ✔
- [x] b. When the harmonics are 800, 1000 and 1200 Hz we will perceive a 200Hz pitch ✔
- [ ] c. The perceived pitch increases uniformely as the partials or tones go up in frequency
- [ ] d. When the harmonics are 800, 1000 i 1200Hz we will probably perceive a 800Hz pitch, as it is the lowest one in the series
- [x] e. When the harmonics are 900, 1100 and 1300 Hz we will probably perceive a lower-than-200Hz pitch ✔
- [ ] f. When the harmonics are 900, 1100 and 1300 we will probably perceive a 200Hz pitch

Les respostes correctes són: When the harmonics are 800, 1000 and 1200 Hz we will perceive a 200Hz pitch, When the harmonics are 900, 1100 and 1300 Hz we will probably perceive a lower-than-200Hz pitch, When the harmonics are 1000, 1200 and 1400 Hz we will probably perceive a 200Hz pitch

Pregunta **10**

Correcte

Puntuació 1,00 sobre 1,00

Shift of Virtual Pitch

In the example AD39.wav it is shown that virtual pitches of a complex tone having partials of 800, 1000, and 1200 Hz and one having partials of 850, 1050, and 1250 Hz can be matched to tones with different fundamentals. You will first hear the two complex tones, and then sinusoids at 200 and 210 Hz. Please, select the sentences that are true, according to your experience and knowledge.

Trieu-ne una o més:

- [x] a. The pitch for the first complext tone will be 200Hz whereas for the second one will be 210 approx. ✔
- [x] b. The pitch perceived for the second tone will be 210 because this value is quite close to 850/4, 1050/5, and 1250/6 ✔
- [ ] c. In both cases the pitch sensation is similar, corresponding to 200Hz
- [ ] d. The second tone sounds flatter (lower pitch) than the first one
- [ ] e. The second tone will generate a 210Hz pitch because this value is an exact divisor of its harmonics

Les respostes correctes són: The pitch for the first complext tone will be 200Hz whereas for the second one will be 210 approx., The pitch perceived for the second tone will be 210 because this value is quite close to 850/4, 1050/5, and 1250/6

Pregunta **11**

Correcte

Puntuació 1,00 sobre 1,00

Masking Spectral and Virtual Pitch

In the example AD40.wav you will hear a familiar melody played with pairs of tones. The first tone of each pair is a sinusoid, the second a complex tone of the same pitch (harmonics 4th, 5th and 6th only, f0 is absent).

Then, in AD41.wav, the pure tone notes are masked with low-pass filtered noise.

Based on your listening experience, select the true statements below.

Trieu-ne una o més:

- [x] a. We perceive a complex tone with a missing fundamental that has not been affected by the masking ✔
- [ ] b. We perceive a sinusoid because of the missing fundamental
- [ ] c. We hear a complex tone with a pitch that corresponds to the frequency of the first present harmonic
- [ ] d. When we listen to the masking example the cochlea has been exicted in a single point, corresponding to that of the fundamental frequency that we have heard
- [x] e. When masking is happening in this example the coclea has been excited in several places, each one corresponding to the frequency of one of the present harmonics, but not at the place of the fundamental that we hear ✔
- [ ] f. We hear a sinusoidal tone with a pitch that corresponds to the frequency of the first present harmonic

Les respostes correctes són: When masking is happening in this example the coclea has been excited in several places, each one corresponding to the frequency of one of the present harmonics, but not at the place of the fundamental that we hear, We perceive a complex tone with a missing fundamental that has not been affected by the masking

Pregunta **12**

Correcte

Puntuació 1,00 sobre 1,00

Masking Spectral and Virtual Pitch

We change a bit the previous example as now the complex tone is masked by high-pass filtered noise. Listen to AD42.wav and, according to your experience, chose the correct statements below.

Trieu-ne una:

- ( ) a. We hear both the sinusoid and the missing fundamental corresponding to the complex tone
- ( ) b. We perceive a sinusoidal tone because of the "missing fundamental" that corresponds to the frequency of the first harmonic of the sound
- ( ) c. We perceive a complex tone with a pitch corresponding to the fundamental frequency
- ( ) d. Noise masks the harmonics of the complex tone and we perceive the pitch of its fundamental frequequency because this one is the only spectral component that has not been masked
- ( ) e. When we perceive the tone with a clear pitch the cochlea has been excited in multiple places
- (•) f. We perceive the sinusoidal tone but not the complex tone as its its harmonics have been masked ✔

La resposta correcta és: We perceive the sinusoidal tone but not the complex tone as its its harmonics have been masked

Pregunta **13**

Correcte

Puntuació 1,00 sobre 1,00

Masking Spectral and Virtual Pitch

The previous examples suggest (or demonstrate) that...

Trieu-ne una o més:

- a. Pitch perception is an unreliable process
- b. A place theory of pitch sensations cannot explain why the masking of the fundamental does not impede to listen to it ✔
- c. A pitch perception theory has to explain why the masking of the fundamental does not impede perceiving it ✔
- d. Masking some harmonics of a sound impossibilitates the perception of its fundamental frequency
- e. Pitch perception is a process that is mostly based on cochlear mechanics

Les respostes correctes són: A pitch perception theory has to explain why the masking of the fundamental does not impede perceiving it, A place theory of pitch sensations cannot explain why the masking of the fundamental does not impede to listen to it

Pregunta **14**

Correcte

Puntuació 1,00 sobre 1,00

Virtual Pitch with Random Harmonics...

Listen to the following 3 melodies AD43.wav, AD44.wav i AD45.wav and select the true statements below.

Trieu-ne una o més:

- a. All melodies have the same notes but played with different timbres ✔
- b. All the melodies have the same notes and their pitches are clear and well defined independently of which harmonics can be perceived ✔
- c. The timbre of the 3 melodies is inharmonic
- d. The same melody is played, first, with harmonics that are closer to the fundamental frequency, whereas in the last example harmonics are away from the fundamental ✔
- e. The higher the harmonics, the more clear or well defined the pitch

Les respostes correctes són: All melodies have the same notes but played with different timbres, All the melodies have the same notes and their pitches are clear and well defined independently of which harmonics can be perceived, The same melody is played, first, with harmonics that are closer to the fundamental frequency, whereas in the last example harmonics are away from the fundamental

Pregunta **15**

Completa

Puntuació 1,00 sobre 1,00

Analytic versus synthetic pitch

Our auditory system has the ability to listen to complex sounds in different modes. When we listen analytically, we hear the different frequency components separately; when we listen synthetically or holistically, we focus on the whole sound and pay little attention to its components.

Explain below your perceptual experience when listening to the example AD48.wav.

My experience was analytical, i could hear both frequencies playing at the same time in every burst.

Comentari:

Pregunta **16**

Completa

Puntuació 1,00 sobre 1,00

Analytic versus synthetic pitch

Try again with the previous example (AD48.wav). It is a complex tone made of 800 and 1000 Hz sinusoids, followed by another tone made of 750 and 1000 Hz sinusoids.

Try to listen to them in diffeent ways: if you listen to them "analytically" you will hear a partial going down in pitch; contrastingly, if you listen to them "synthetically", you will hear that the missing fundamental goes up (a major third leap, from 200 to 250 Hz).

Do not worry if you cannot switch the modes as not everybody finds the way. In any case, **explain your sensations, now that you have got more information about the example. Did the information in this question change somehow the perception you reported in the previous question?**

From the first time I heard the audio, I could listen to both tones playing. The noise in the back made it a little bit hard to notice but it's quite obvious anyways.

Comentari:

◄ Lab3: Loudness Lab

Salta a...

Team creation: summary of your skills and background ►