

Is Intrinsic Pitch language-dependent? Evidence from a cross-linguistic vowel pitch experiment

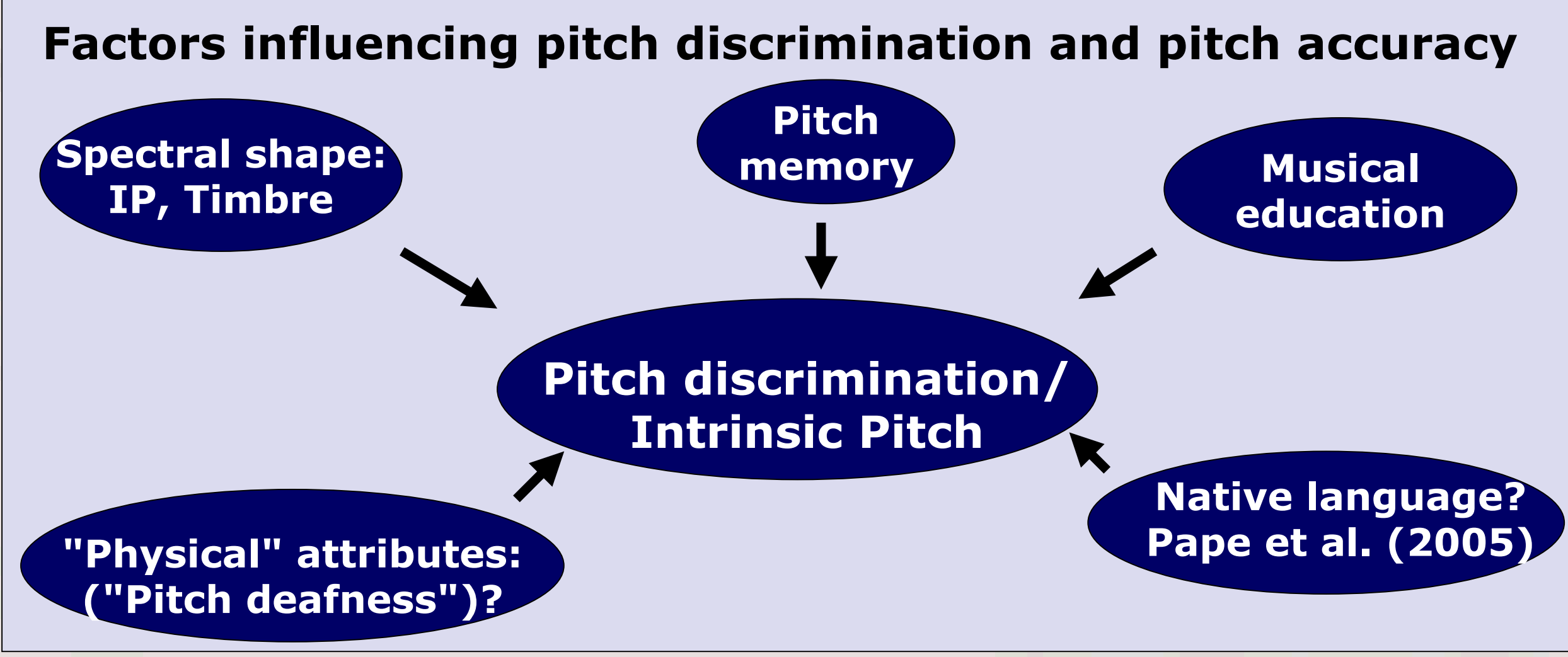
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Abstract: Intrinsic Pitch differences (perceived pitch differences between high vs. low vowels) were found for Germanic languages. Our previous results gave evidence for a strong cross-linguistic difference when examining non-Germanic languages. We therefore designed a cross-linguistic vowel pitch discrimination experiment to examine the existence of intrinsic pitch in non-Germanic languages in comparison to Germanic languages. The experiment was conducted separately with two groups of listeners: professional musicians and listeners who did not play an instrument at all. In a pre-experiment we screened the difference limen (dl) for the pitch discrimination of (1) musical stimuli and (2) speech stimuli. The reason was to screen the listeners' ability to successfully manage the following vowel pitch discrimination experiments and to allow listeners to train to identify pitch differences, which facilitates the following experiment. Results for German listeners indicate intrinsic pitch differences corresponding to values given in literature. However, when examining groups differing in musical education it was found that intrinsic pitch is a weak phenomenon, with no significant results for the professional musicians. Results for Italian listeners show no pitch bias at all, indicating that intrinsic pitch is not present in this Romance language. We therefore give first evidence to the presented hypothesis that intrinsic pitch has to be classified as a language-specific phenomenon: It is assumed that the cue F0 is not used to classify vowel quality differences in the examined Romance languages.

INTRODUCTION

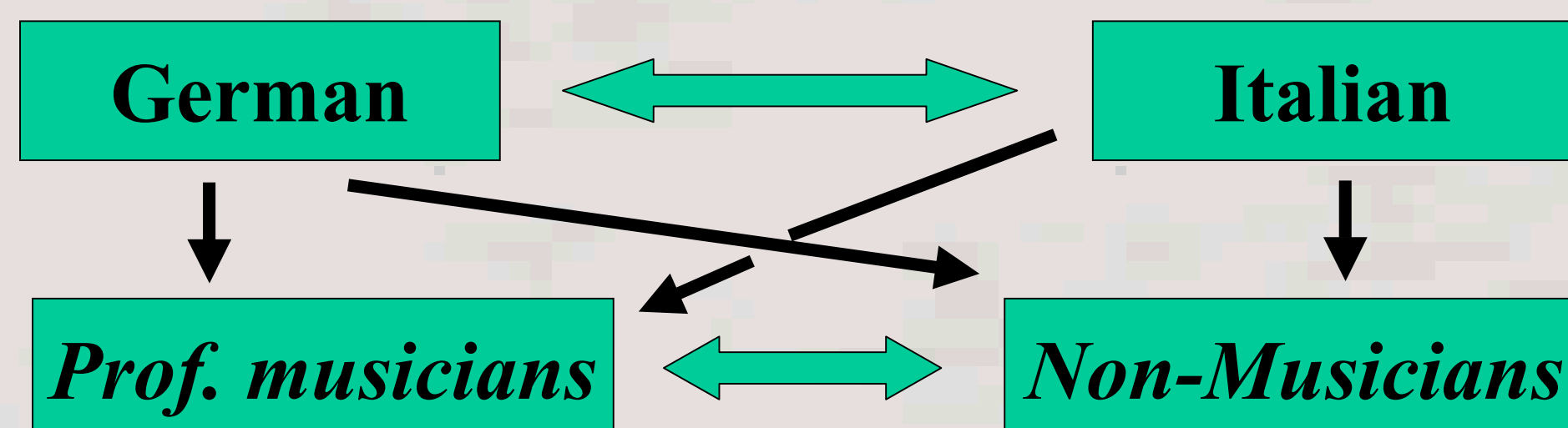
PERCEPTION: Intrinsic Pitch (IP)

- High vowels (/i:/) have to exceed low vowels (/a:/) by a few Hertz (3.5Hz) to sound equal in pitch
- Fowler (1984):** compensation for IF0 for stable prosodic parsing -> but IP only 1/10th of IF0 (criticism: stimuli were not aligned by psychoacoustic pitch shift)
- Stoll (1982):** psychoacoustic phenomenon due to pitch shift, introduced by different spectra of the vowels
- Traunmüller (1981):** F0 differences attribute to openness perception (facilitates vowel identification)



MOTIVATION / AIMS

- Examine the following factors:
 - Language influence: **German vs. Italian**
 - Is intrinsic pitch language dependent?
 - Musical education: **professional musicians vs. non-musicians**



METHOD

First experiment: "dl differences"

- 212AFC, base F0=120Hz, 0.08s duration all, loudness adjusted (AES loudness), staircase proc.
- 1. Musical tone:**
 - violine tone, PSOLA shifted
- 2. Vowel:**
 - native vowel /i:/
 - German for German listeners
 - Italian for Italian listeners
- listener was able to avoid "higher/lower" dimension due to test design, practice was provided for following test

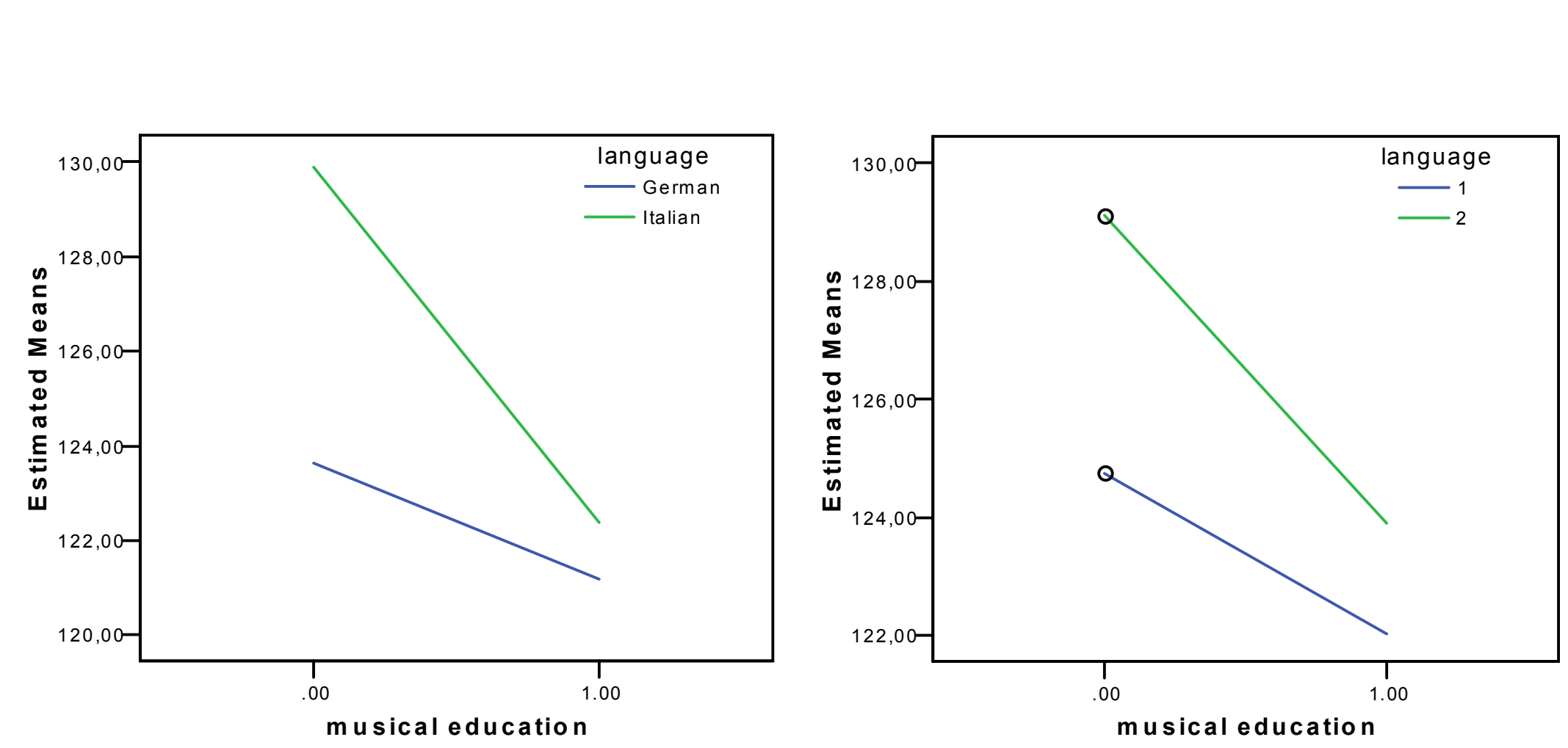
Second experiment: "Intrinsic pitch differences"

- Pairs of /i:/ and /a:/ with flat F0 contour
- Duration normalized
- complete contour shifted up (+10Hz) and down (-10Hz) in 2.5Hz steps (PSOLA), randomly paired
 - listeners asked to decide which of the stimulus in the pair was higher in pitch (2AFC)
 - 3 repetitions with 70 pairs (35 pairs with changing order)
 - 63 German listeners (10 professional musicians, 13 amateurs) and 32 Catalan listeners (13 prof. musicians)
- Stimuli adjusted to same loudness (since pitch judgements are dependent on presented loudness level)
- Probit analysis of listeners (F0 difference at 50%) followed by a T-test to see a significant deviation from the 0Hz difference (indicating a equality in pitch perception)

RESULTS

Experiment 1: DL of the listeners

- Cross-linguistic significant differences:**
- Germans better DL values compared to Italians (both prof. musicians and non-musicians)
 - better DL for both musical tone and vowel
- Significant Differences in musical education:**
- As expected, prof. musicians better DL values
 - both musical tone and vowel



Experiment 2: Intrinsic pitch differences

- Cross-linguistic differences:**
- German:
 - significant Intrinsic pitch effect (collapsed over all listeners)
 - same amount as in literature (1.7Hz)
 - Italian:
 - NO significant Intrinsic pitch effect
- Differences in musical education:**
- German: only significant for non-musicians
 - Italian: NOT significant for neither group

		Mean (SD)	Significance
German	All listeners	1.7 (3)	t(43)=3.697, p<0.001
	Professional mus	1.4 (3)	t(14)=1.739, p<0.104
	Non-musicians	2.6 (3.4)	t(18)=3.306, p<0.04
	Amateur mus.	0.5 (1.7)	t(9)=-0.896, p<0.394
Italian	All listeners G.S.	0.8(2.5)	t(19)=1.5, p<0.15
	All listeners I.S.	-0.9 (2)	t(19)=-1.69, p<0.1
	Professional G.S.	0 (2.1)	t(11)=0.2, p<0.88
	Professional I.S.	0.2 (1.6)	t(9)=-0.37, p<0.72
	Non-mus. G.S.	2 (2)	t(4)=-2.3, p<0.082
	Non-mus. I.S.	-1 (2.6)	t(5)=-0.934, p<0.4

DISCUSSION / CONCLUSION

- Intrinsic pitch not measurable in Italian**
 - F0 is used for stress and prosody
 - Therefore only explanation: F0 is not used as a vowel quality cue (see experiments of distance F0-F1 of Traunmüller, 1981)
- Intrinsic pitch is rather weak in German**
 - neither professional musicians show IP nor do amateur musicians

- Rejected theories:**
 - Stoll: Pape et al. (2005)
 - Fowler: current study
 - compensation does not take place in Italian
- Assumed explanation:**
 - F0 in Germanic languages used as a vowel quality cue
 - In Romance languages F0 is not used at phoneme level

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