



Neuroscience du rythme

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BRAMS

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- Psychologie du temps, PUF, 1967.
- Psychologie du rythme. PUF, 1974
- Rhythm and tempo, *The psychology of music*, 1982

Paul Fraise 1911-1996

Ce résultat souligne que dans la synchronisation frappe-son, la frappe anticipe toujours le son. Fraise & Voillaume, 1971

avons, en effet, tendance à synchroniser nos mouvements avec les accents musicaux comme le prouvent nos réactions aux airs de marche ou à la musique de danse. Fraise & Ehrlich, 1955

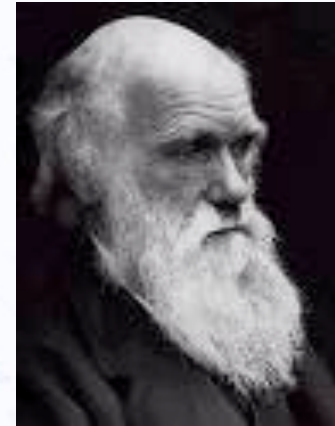
Dancing transcends time, place and culture

La danse:

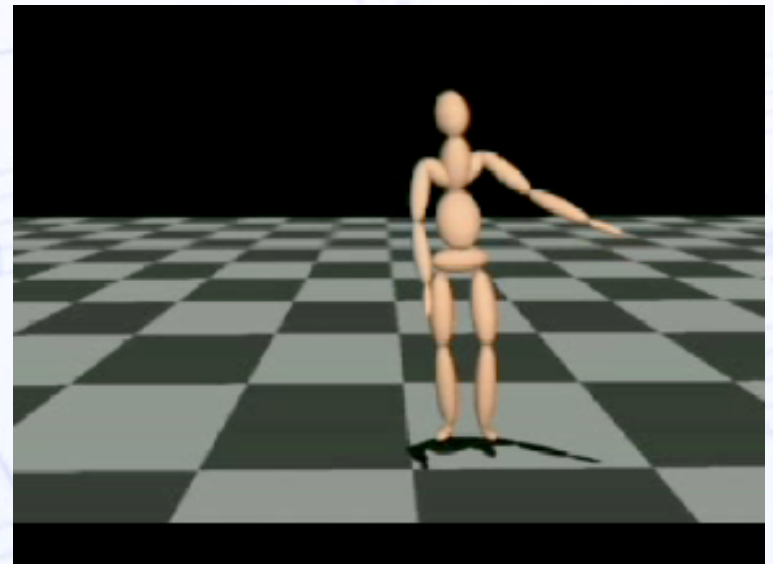
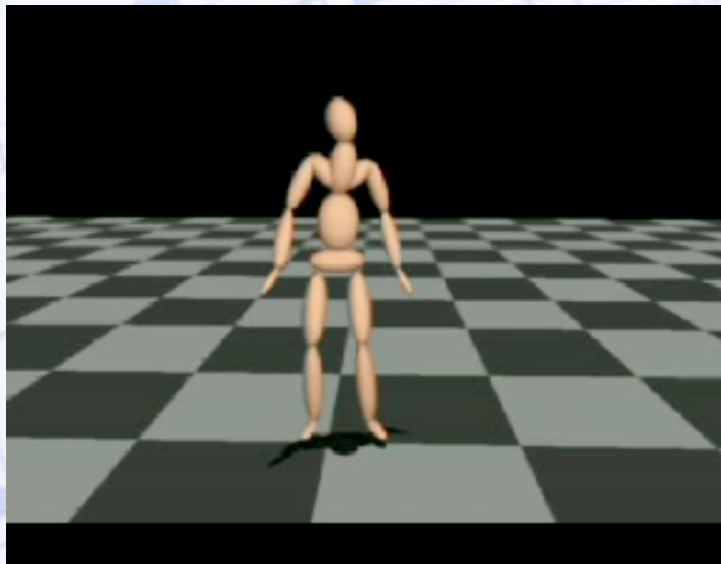
- ✓ Depuis les temps ancestraux
- ✓ Universel
- ✓ Spécifique aux espèces vocales
- ✓ Fondée sur la perception innée de la pulsation



La danse comme instrument de séduction



Darwin 1809-1882



Brown et al. (2005) *Nature*

La danse des perroquets

- ✓ Seulement chez les espèces vocales
- ✓ Non spontané: la synchronisation pourrait être un dérivé de la sélection naturelle de l'imitation vocale
- ✓ Dû à la modification des circuits neuronaux pour permettre la coordination auditive-vocale fine ?



Patel et al. (2009) *Current Biology*; Schachner et al. (2009) *Current Biology*



Courtoisie de Petri Toivianen



BREVIA

Feeling the Beat: Movement Influences Infant Rhythm Perception

Jessica Phillips-Silver and Laurel J. Trainor*

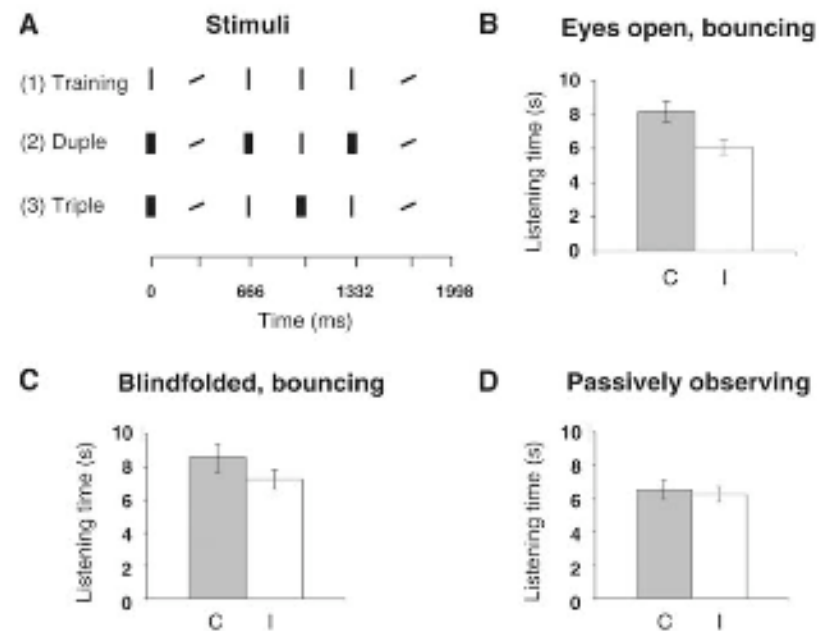


Fig. 1. Influence of bouncing on auditory encoding of rhythm patterns. (A) Stimuli. Vertical lines represent the snare drum sounds of the rhythm patterns, and oblique lines represent time-marking slapstick sounds (4). (B to D) Results. The y axis represents listening time preference; the x axis represents congruency between bouncing (duple or triple) during training and auditory accents (duple or triple) during testing. Error bars represent the standard error of the mean. C, congruent; I, incongruent.

Newborn infants detect the beat in music

István Winkler^{a,b,1}, Gábor P. Hádén^{a,c}, Olivia Ladinig^d, István Sziller^e, and Henkjan Honing^d

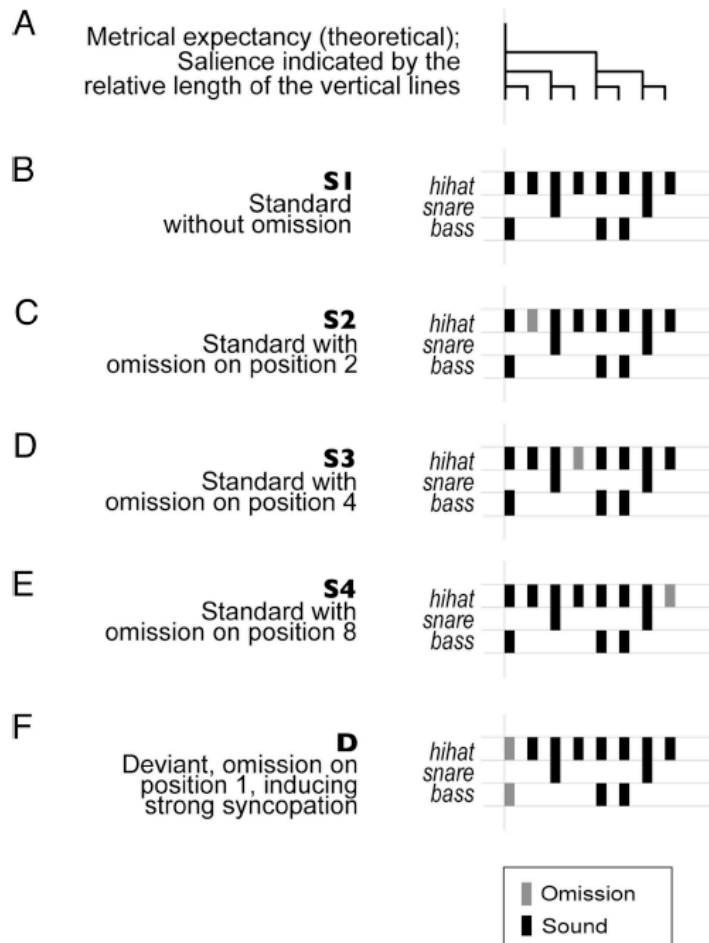
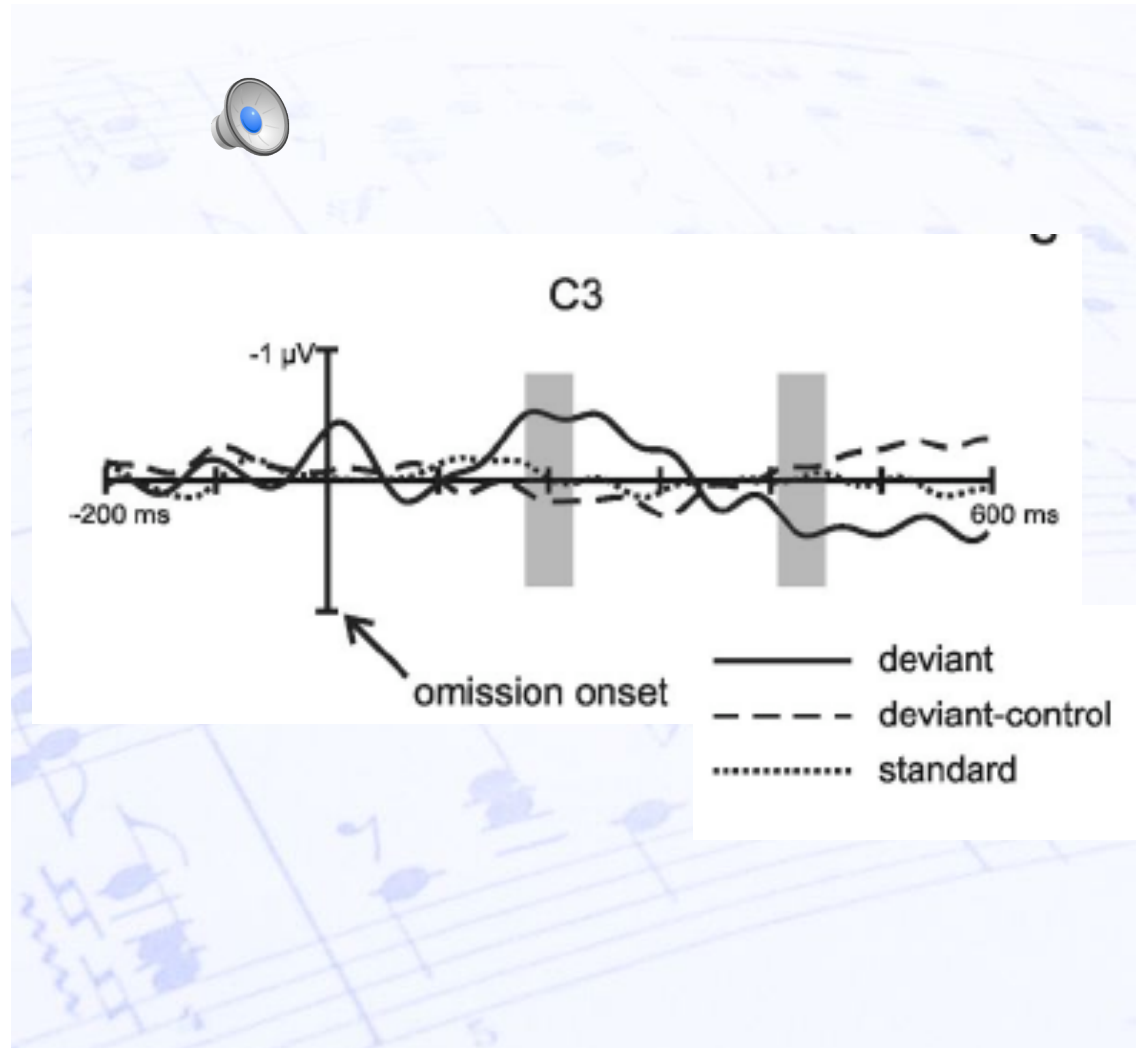
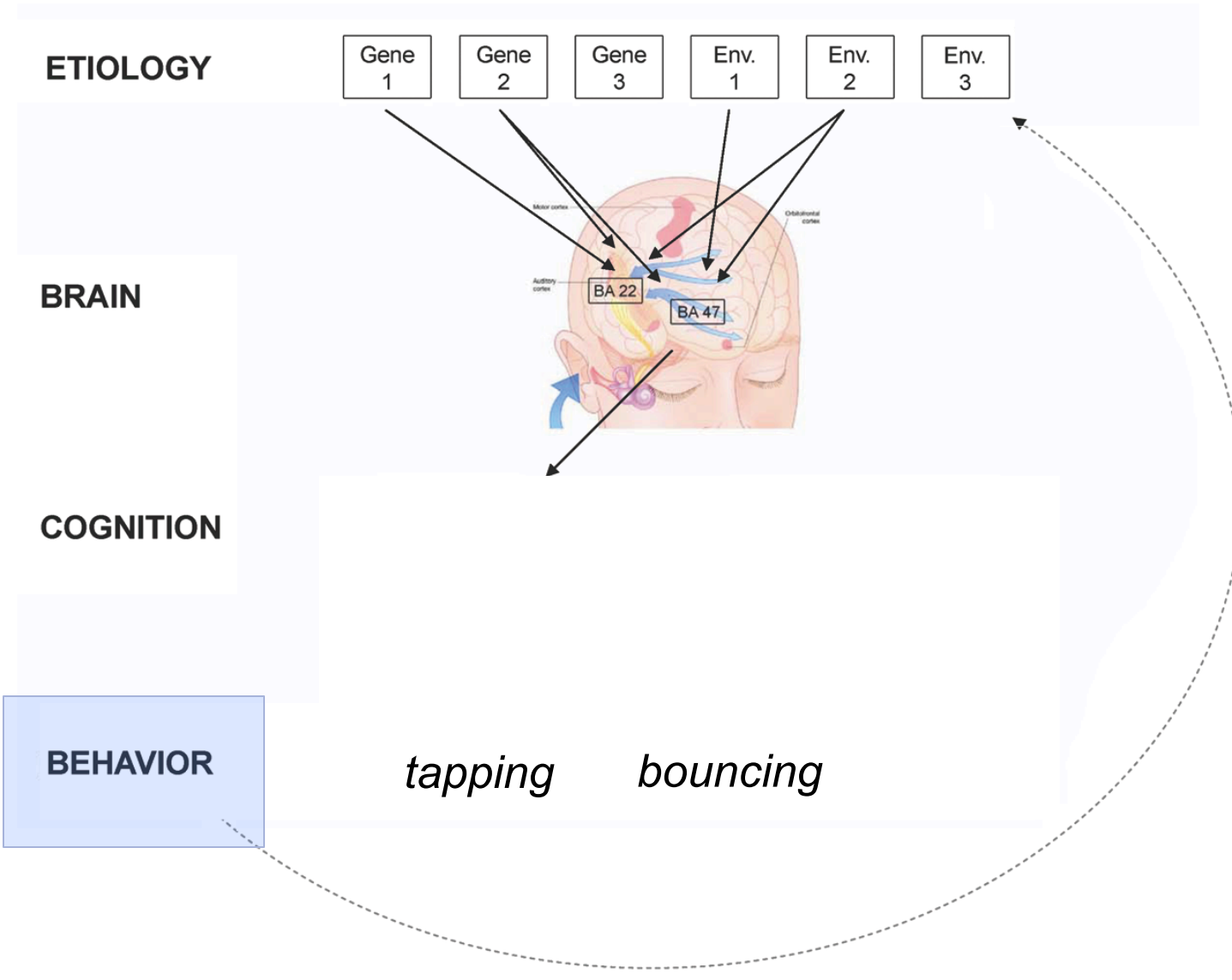


Fig. 1. Schematic diagram of the rhythmic stimulus patterns.





Bouncing: whole body movement





Jessica Phillips-Silver



Petri Toivianen
U. Of Jyväskylä



Sylvie Nozaradan

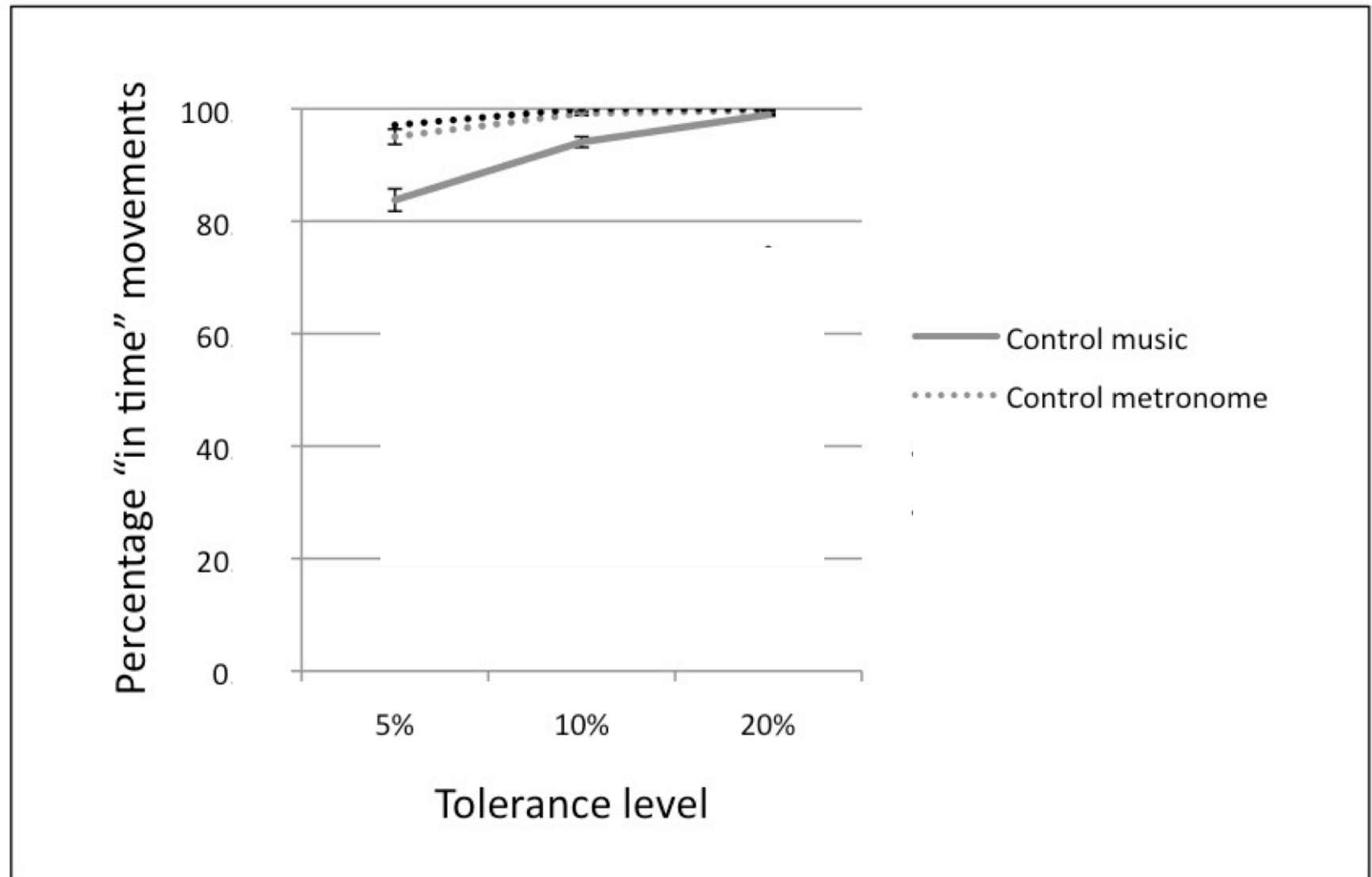
Phillips-Silver, Toivianen, Nozaradan & Peretz, in progress



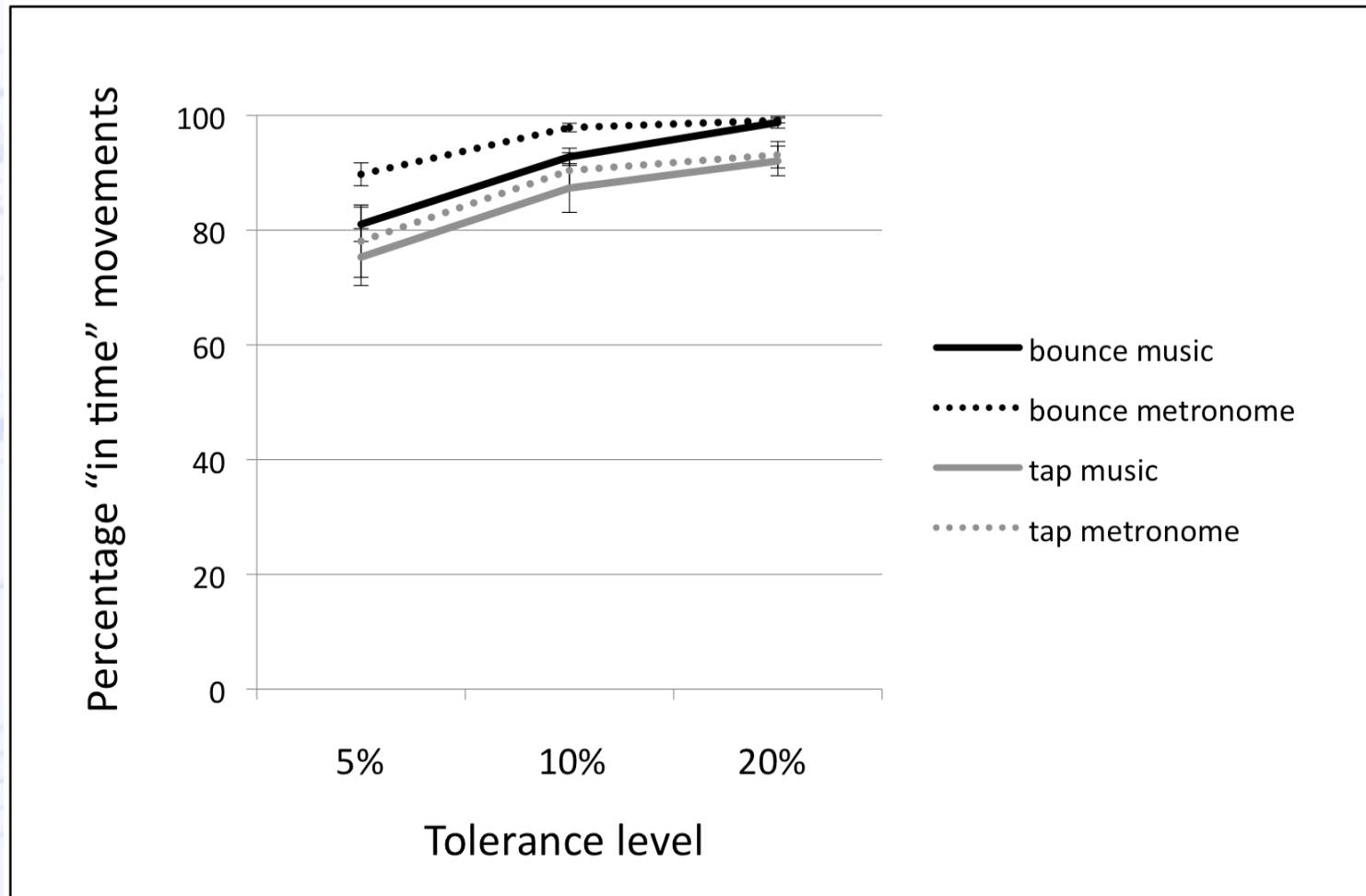
Body beat corresponds to point of maximal downward velocity:
-periodicity of body movement
-phase locking of movement to music

Two conditions / 2 tempi:
merengue song (64 beats)
metronome

Periodicity



Bouncing vs. tapping



The Montreal Battery of Evaluation of Amusia (MBEA)

■ 6 tests (30 essais par test)

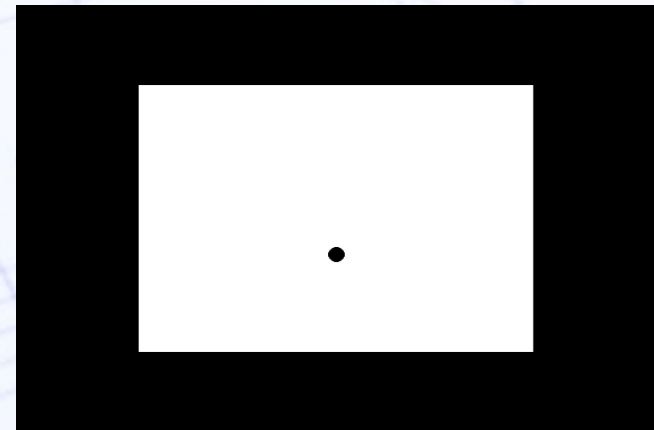
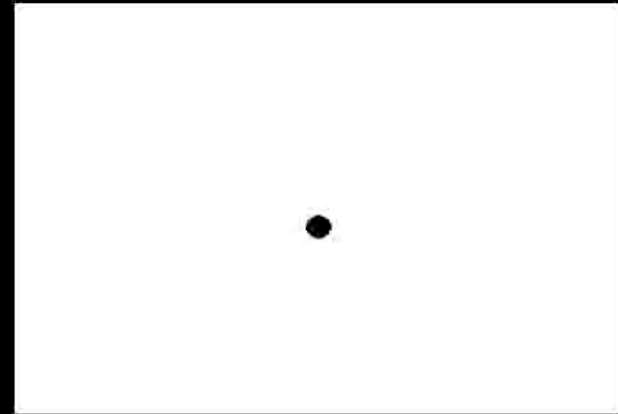
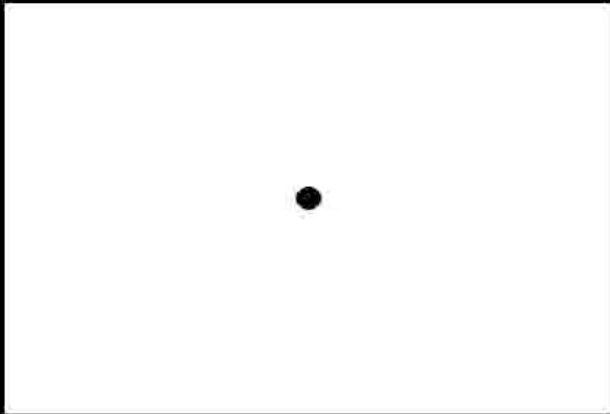
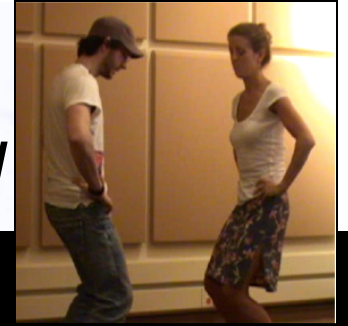
Incidental memory recognition

96.7

Stimuli	Response choice	<i>Mathieu</i> % R.C.
(A) <i>contour</i>	=	79.2
(B) <i>scale</i>	≠	83
(C) <i>intervals</i>		80
(D) <i>rhythm</i>		90
(E) <i>meter</i>	=	66.7
(F)	=	

Normal subject

Mathieu



Mathieu// metronome

Is she dancing on time with the beat ?



une nouvelle forme d'amusie congénitale

- ✓ Un accident cérébral peut compromettre la perception du rythme et de la mélodie sélectivement (double dissociation)
- ✓ Chez l'amusique « tone-deaf », les problèmes de rythme seraient la conséquence du trouble mélodique (Foxtan et al., 2006)

Tone-deafness: très variable en « tapping »



Dalla Bella & Peretz (2003) Annals of the NYAS

Another case of tone-deafness



Emilie

Maîtrise en sciences infirmières

















Age: 59

The Montreal Battery of Evaluation of Amusia (MBEA)

■ 6 tests (30 essais par test)

Incidental memory recognition

66.7

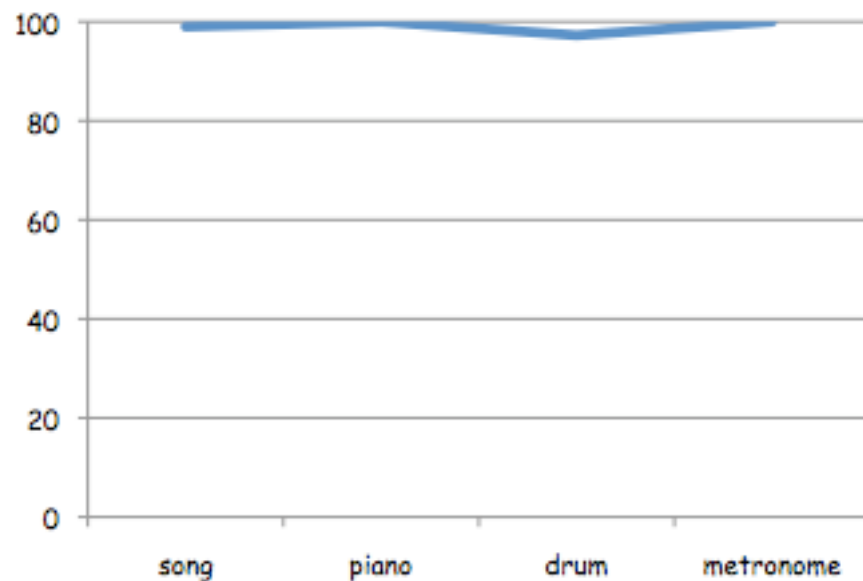
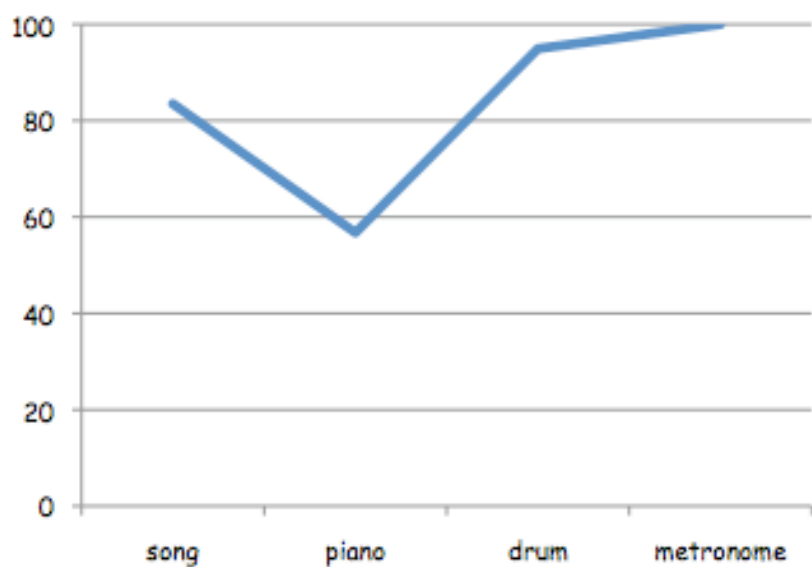
Stimuli	Response choice	<i>Emilie</i> % R.C.
(A) 		
(B) <i>contour</i> 	  	63
(C) <i>scale</i> 		53
(D) <i>intervals</i> 		53
(E) <i>rhythm</i> 		63
(F) <i>meter</i> 	  	73

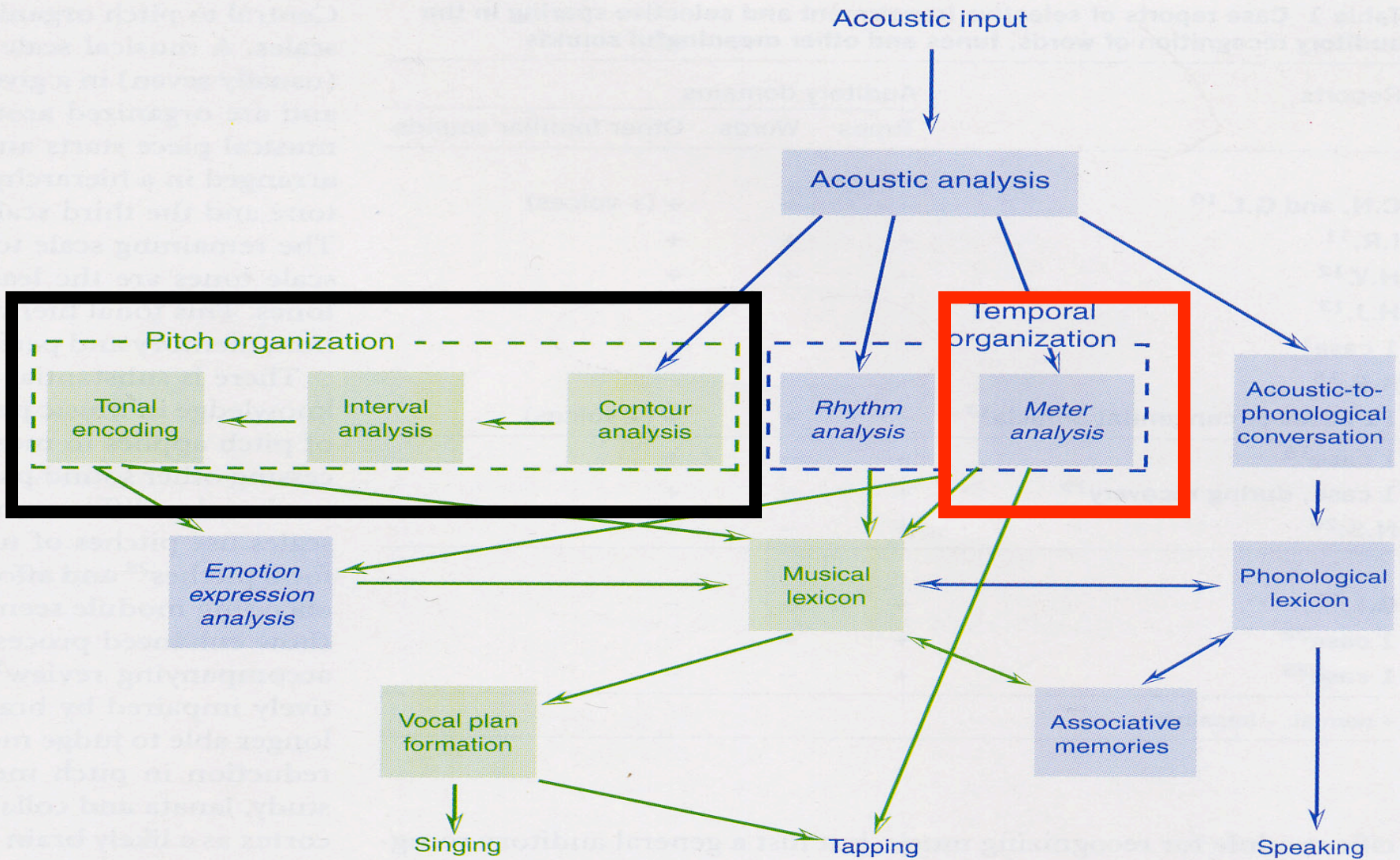
Periodicity: interference of pitch variations

- *Proportion of body beats within +/-10% of music beat period*

Émilie

2 Matched Controls

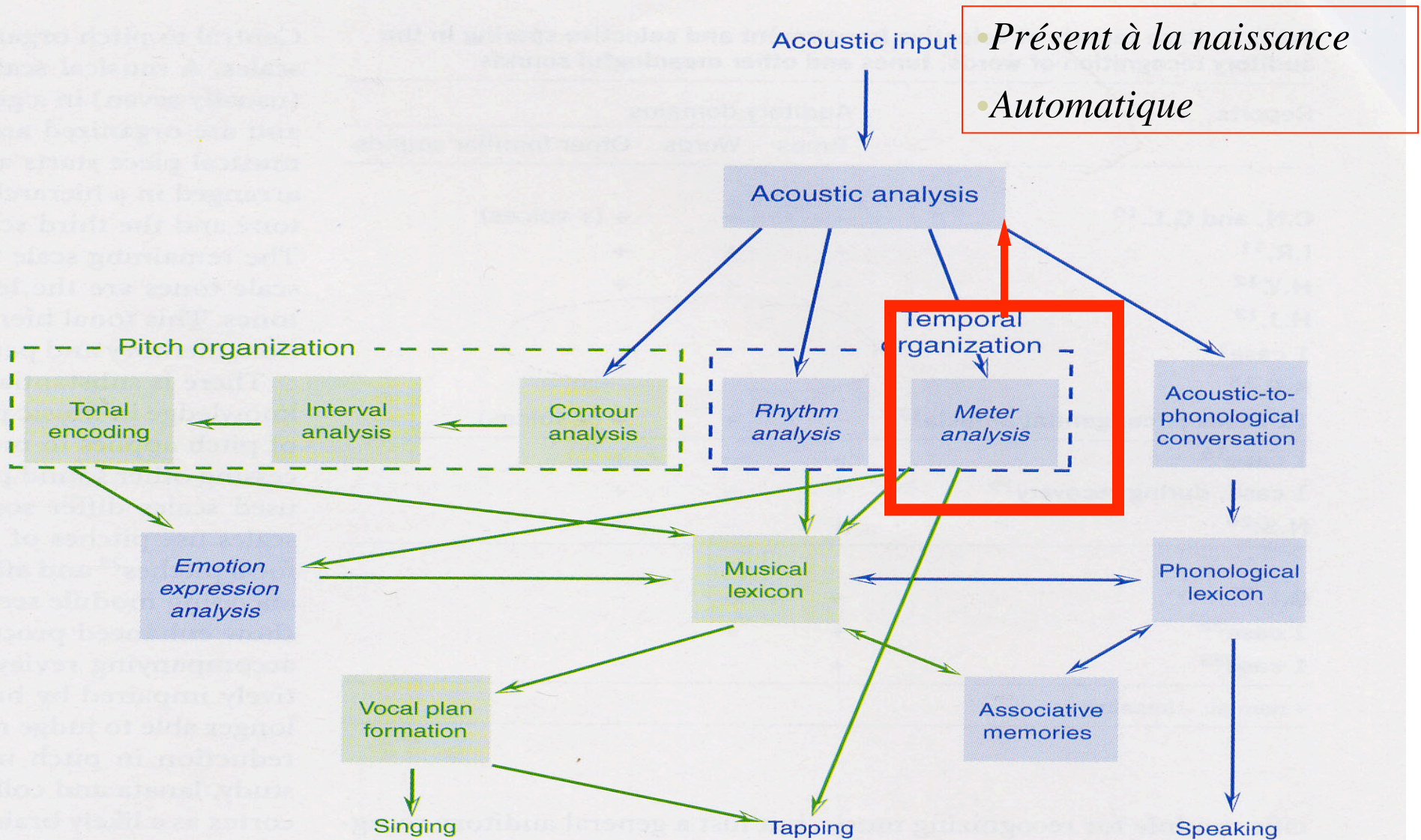




Peretz & Coltheart (2003) *Nature Neuroscience*

Ivelisse Robles

Beat perception

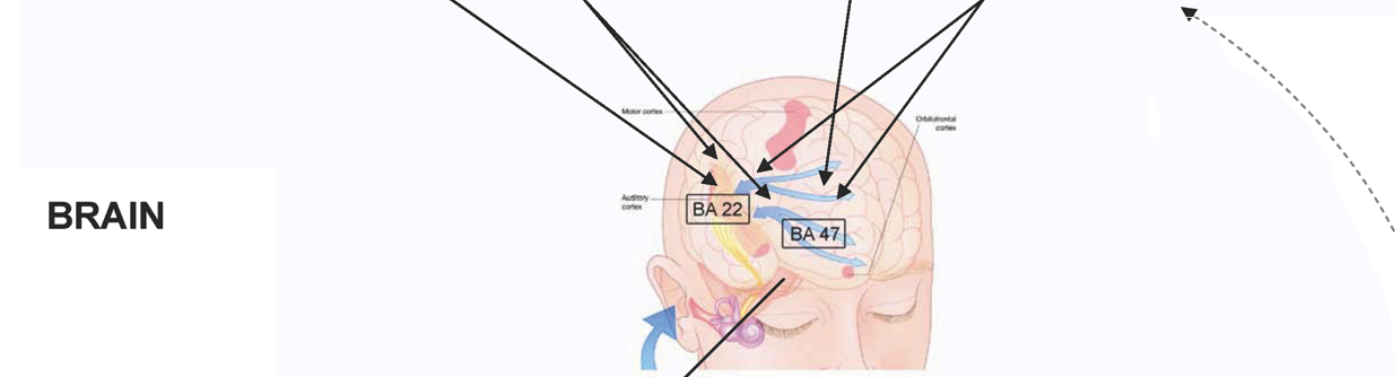


Peretz & Coltheart (2003) *Nature Neuroscience*

Ivelisse Robles

ETIOLOGY

Gene 1 Gene 2 Gene 3 Env. 1 Env. 2 Env. 3



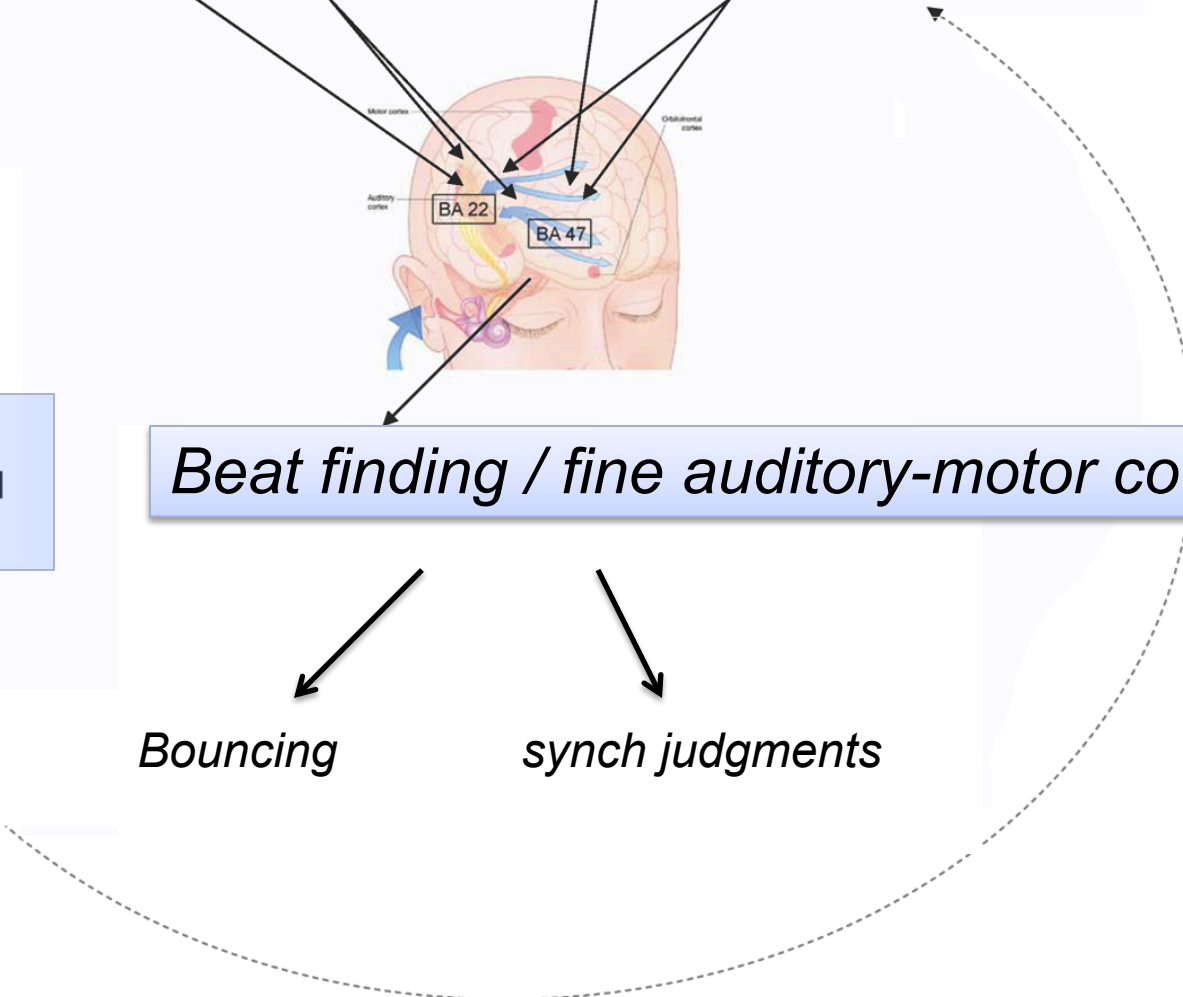
BRAIN

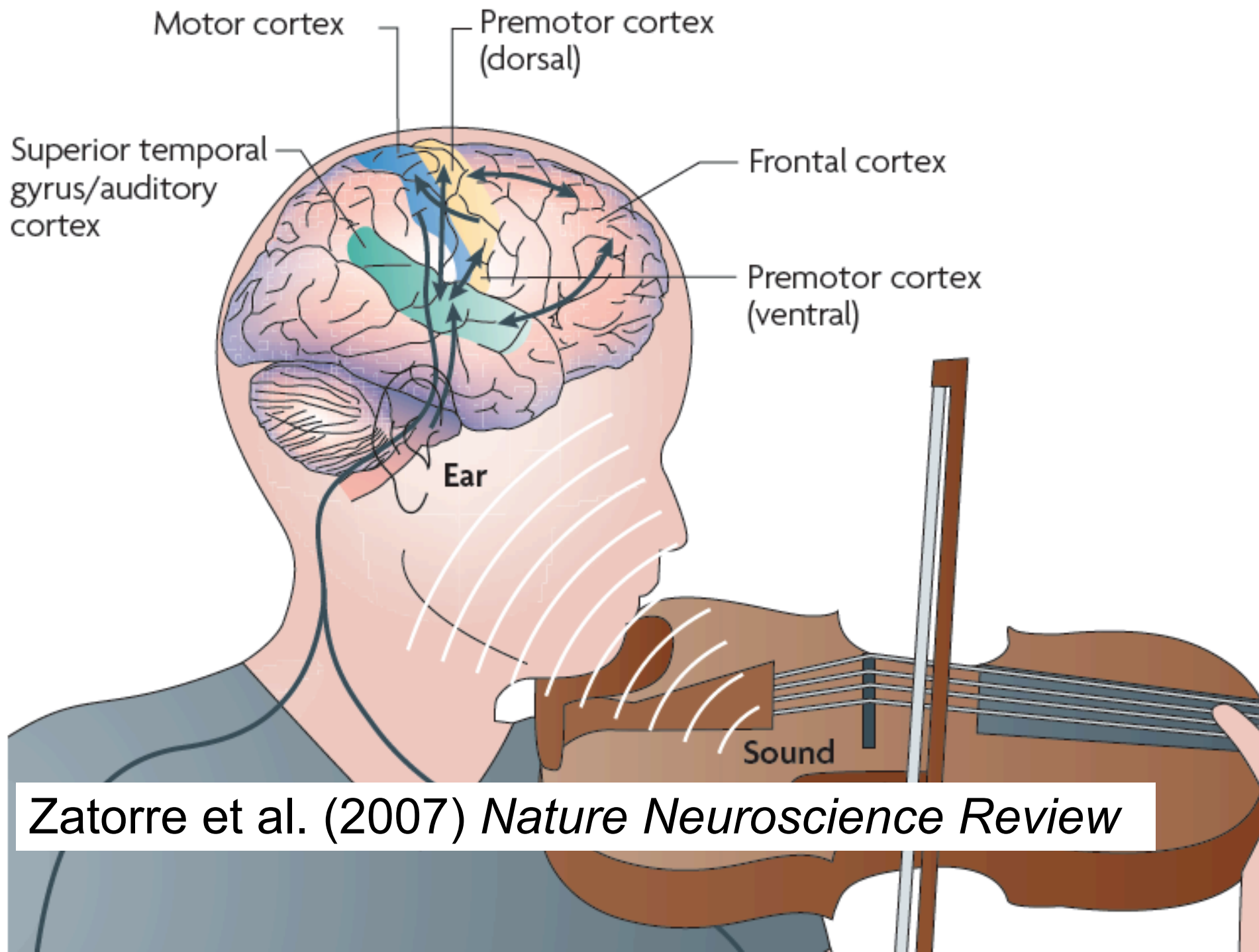
COGNITION

Beat finding / fine auditory-motor coupling

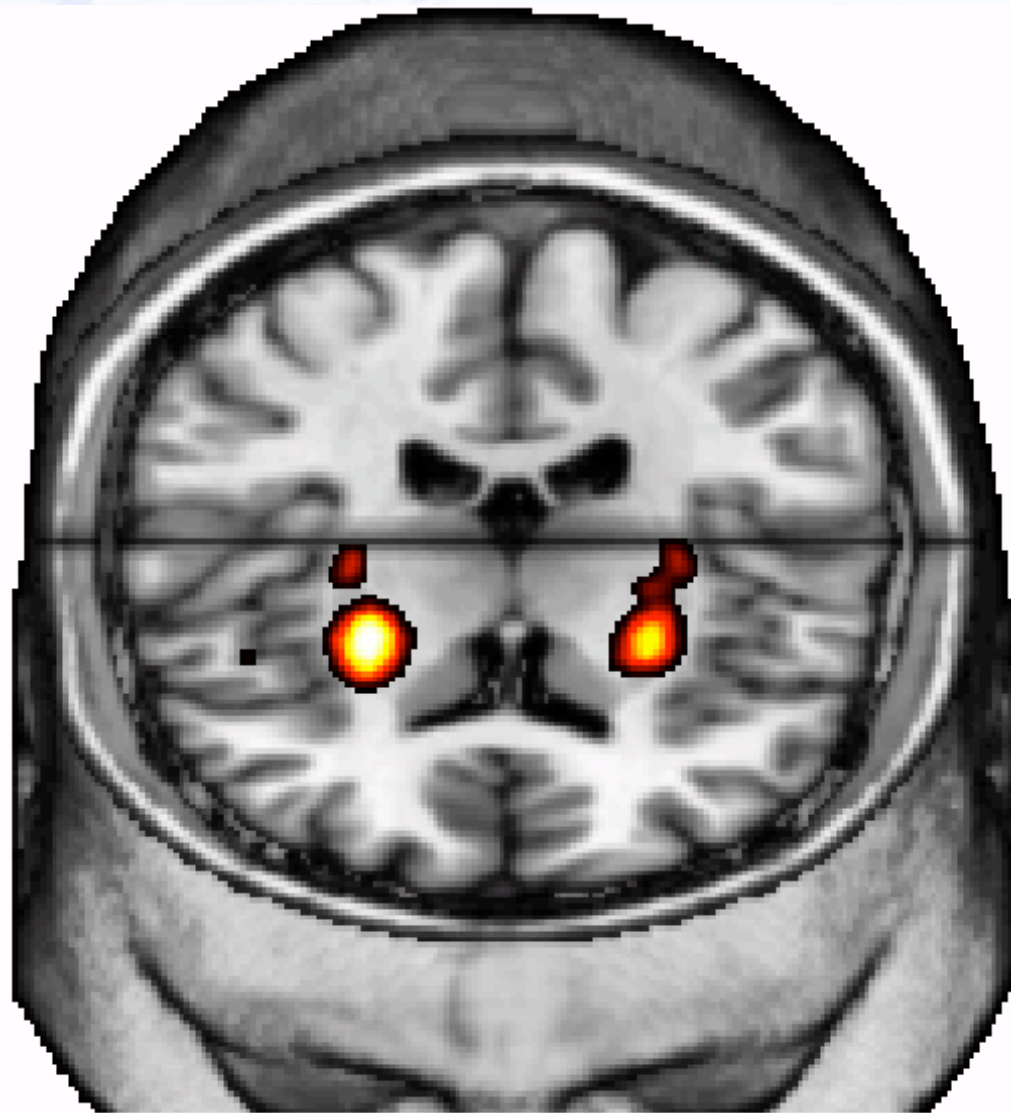
BEHAVIOR

Bouncing *synch judgments*

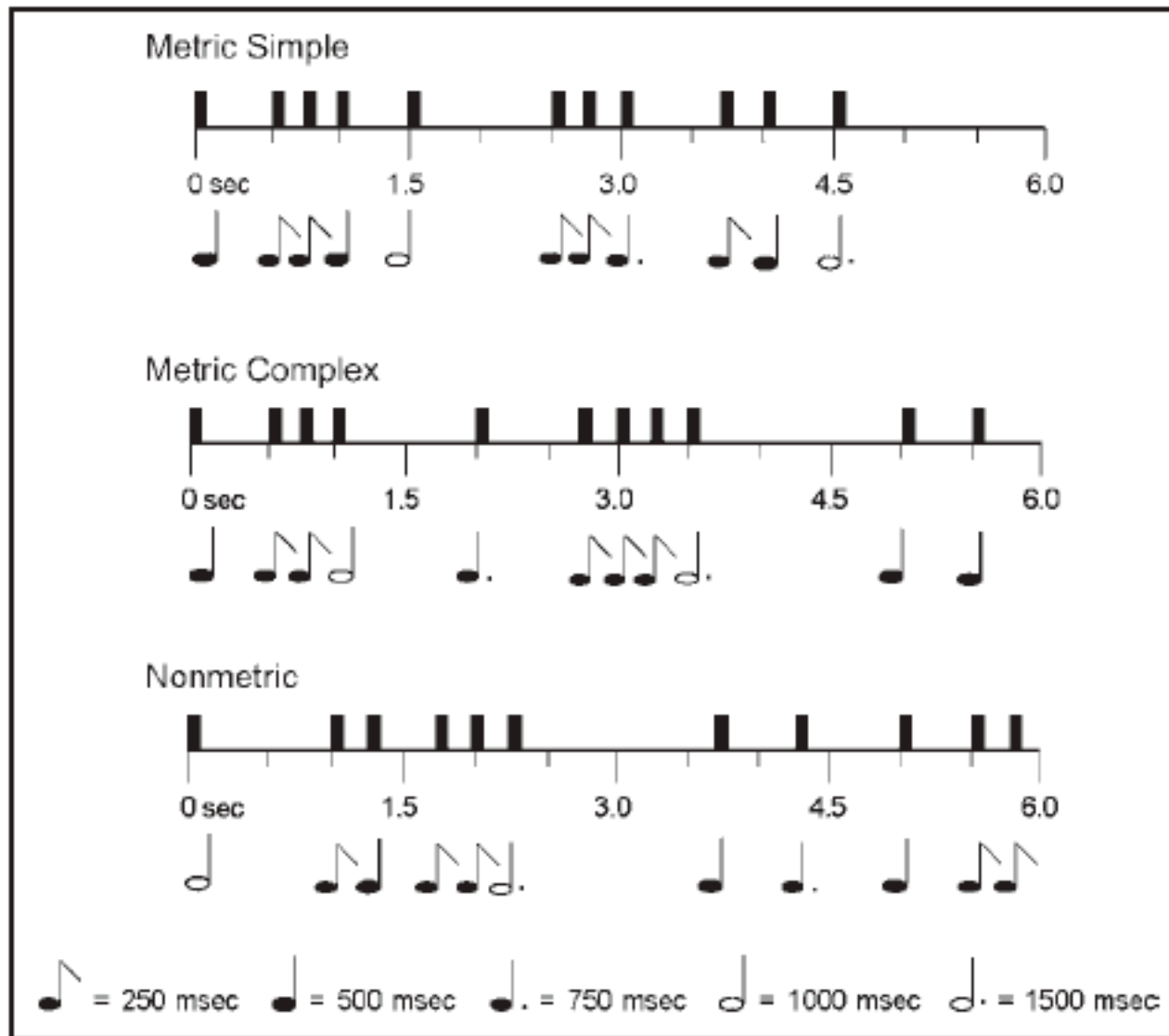




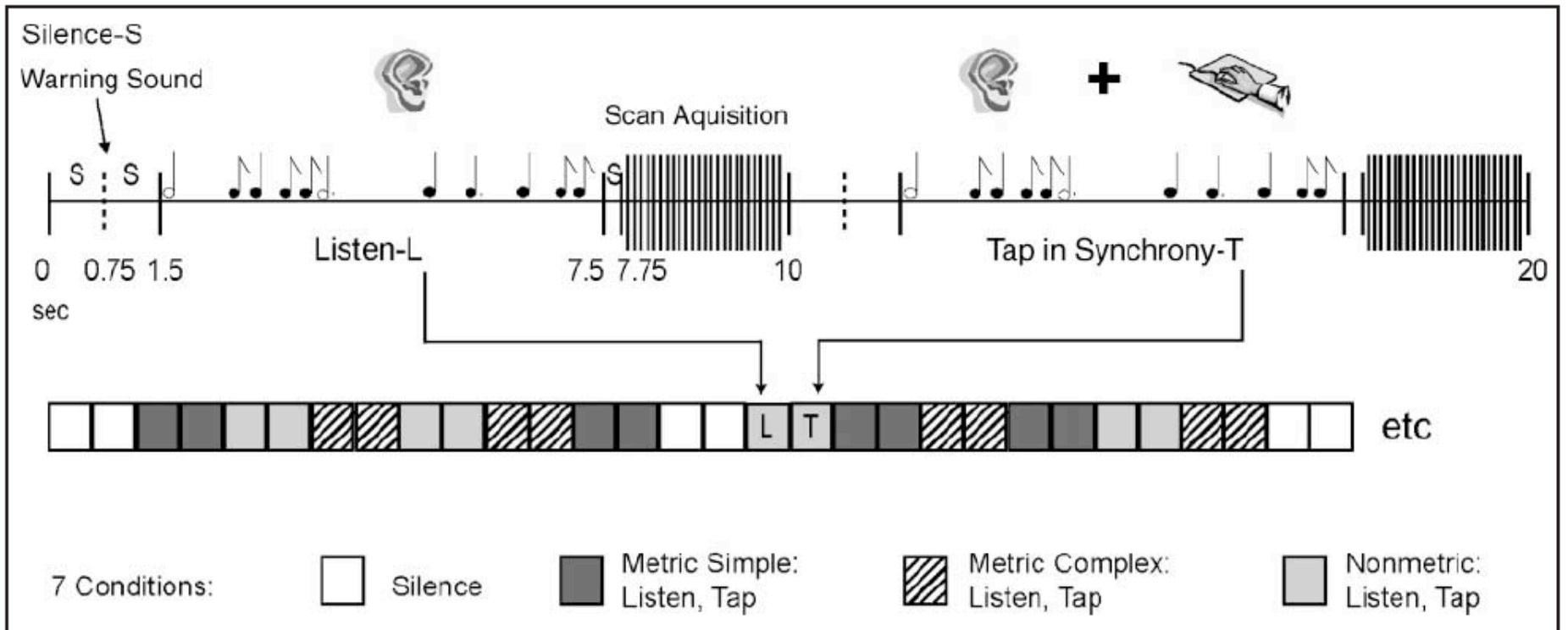
Zatorre et al. (2007) *Nature Neuroscience Review*



Grahn & Brett (2007) Journal of Cognitive Neuroscience



Chen, Penhune & Zatorre (2008) *J. Cognitive Neuroscience*



Chen, Penhune & Zatorre (2008) *J. Cognitive Neuroscience*

Brain regions modulated by metrical organization

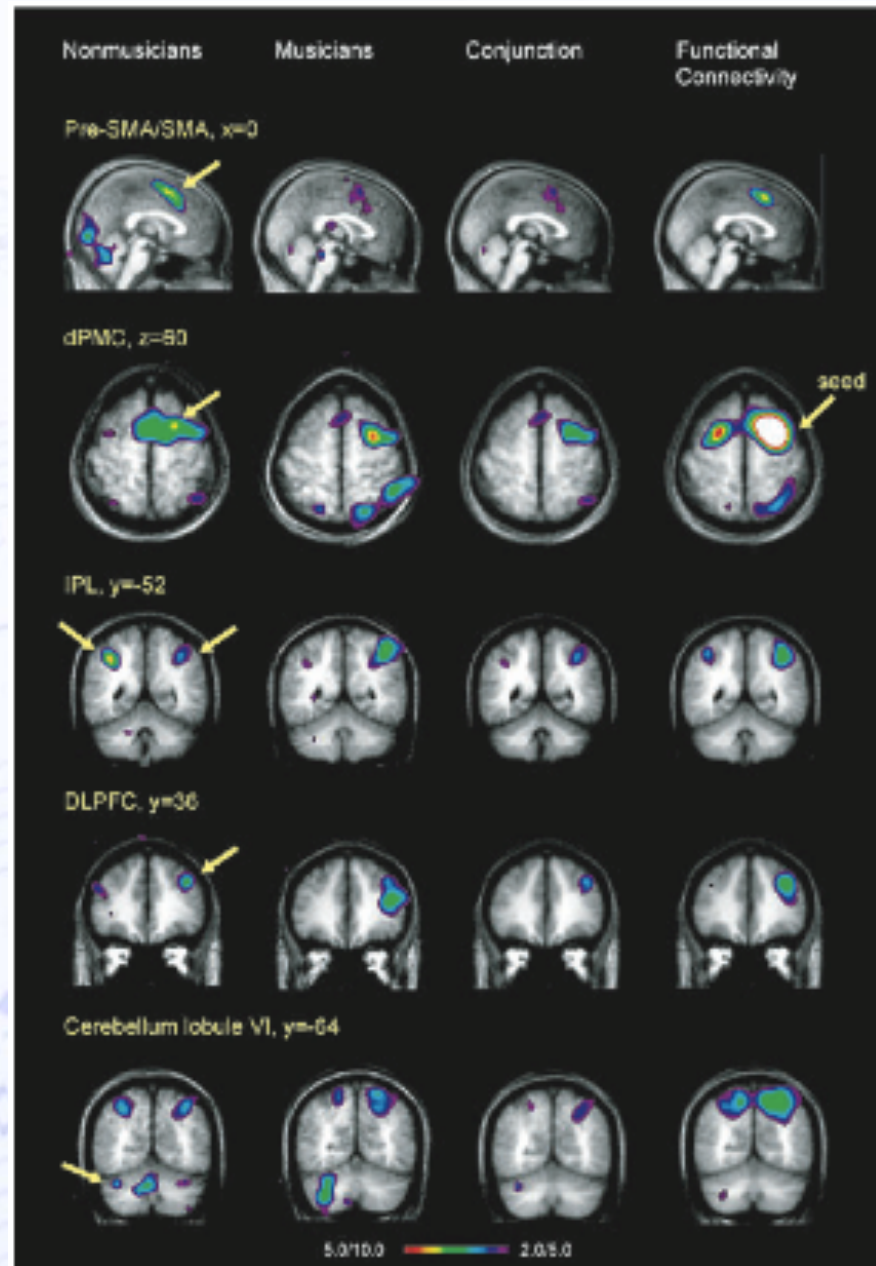
Pre/supplementary area

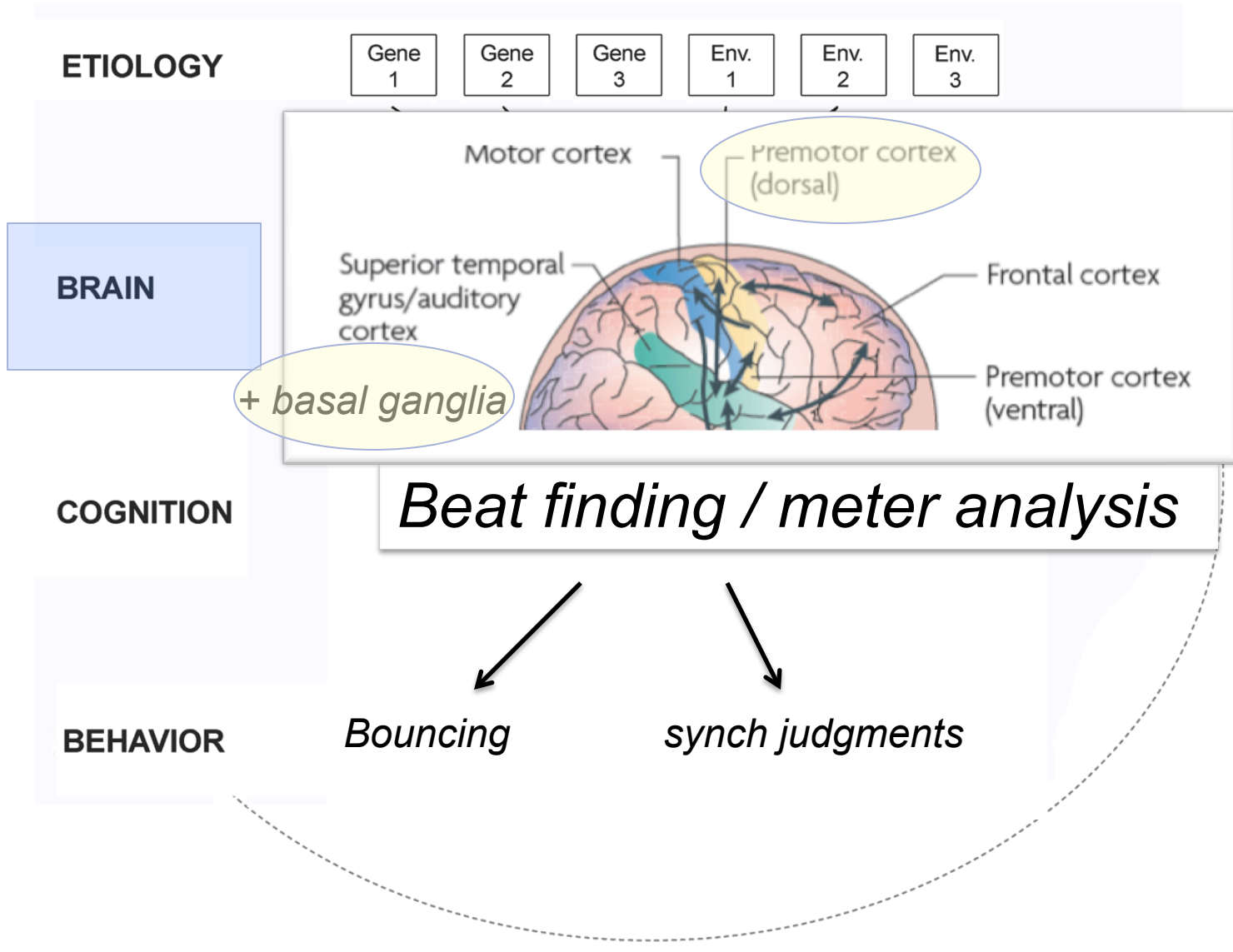
Dorsal premotor cortex

Inferior parietal lobule

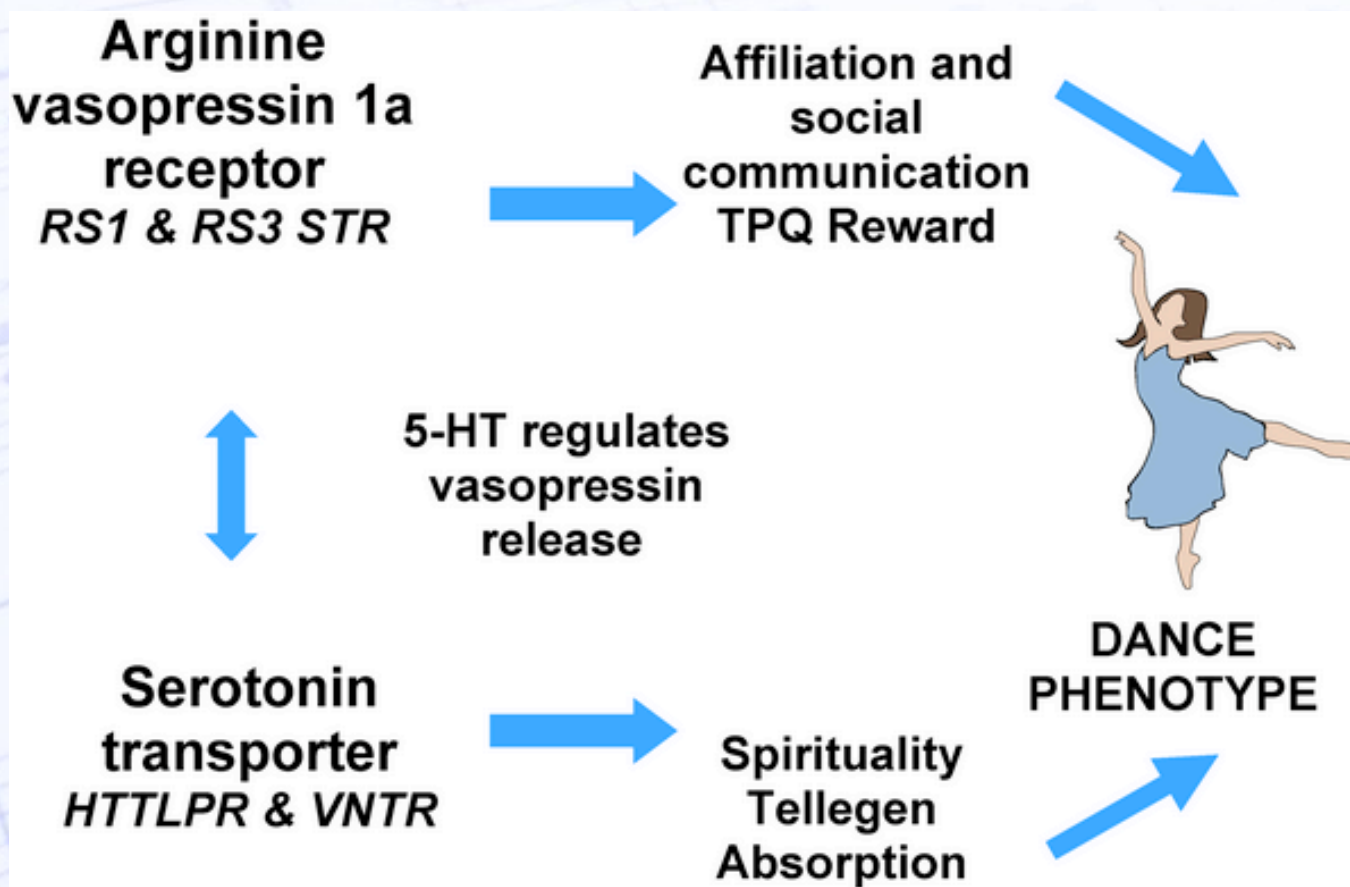
Dorsolateral prefrontal cortex

cerebellum





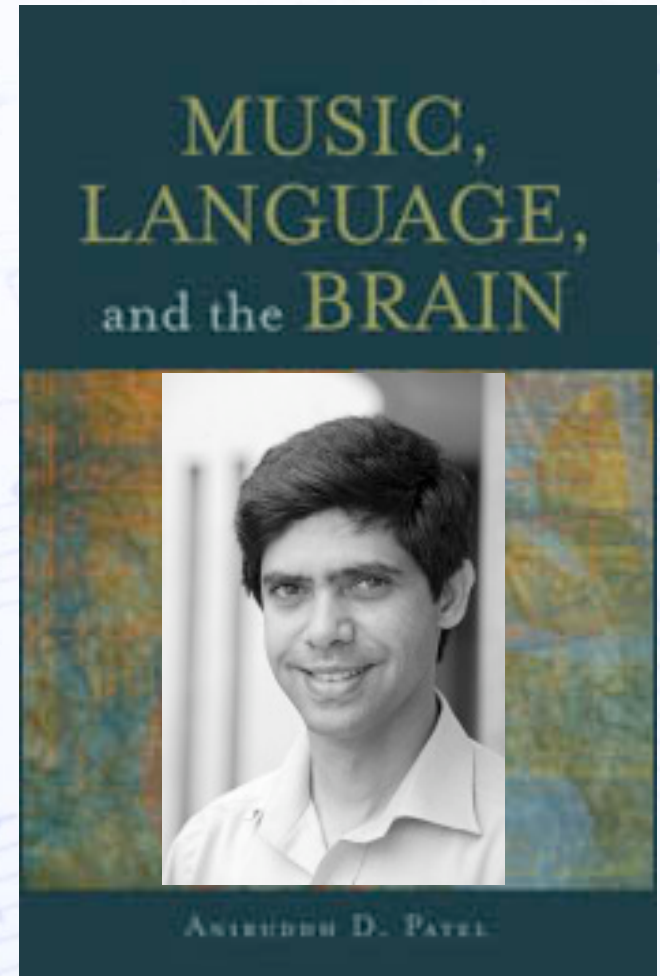
Génétique: Genes AVPR1a and SLC6A4



Bachner-Melman et al. (2005) PloS genetics

Influence de l'environnement (langage) ?

A key difference [between music and speech] is temporal periodicity, which is widespread in musical rhythm but lacking in speech rhythm (p.177)



Testing over internet



Laboratoire Isabelle Peretz
Université de Montréal

Block 1 of 3

Do you think this melody contains an unusual delay?
Answer as quickly and accurately as you can.

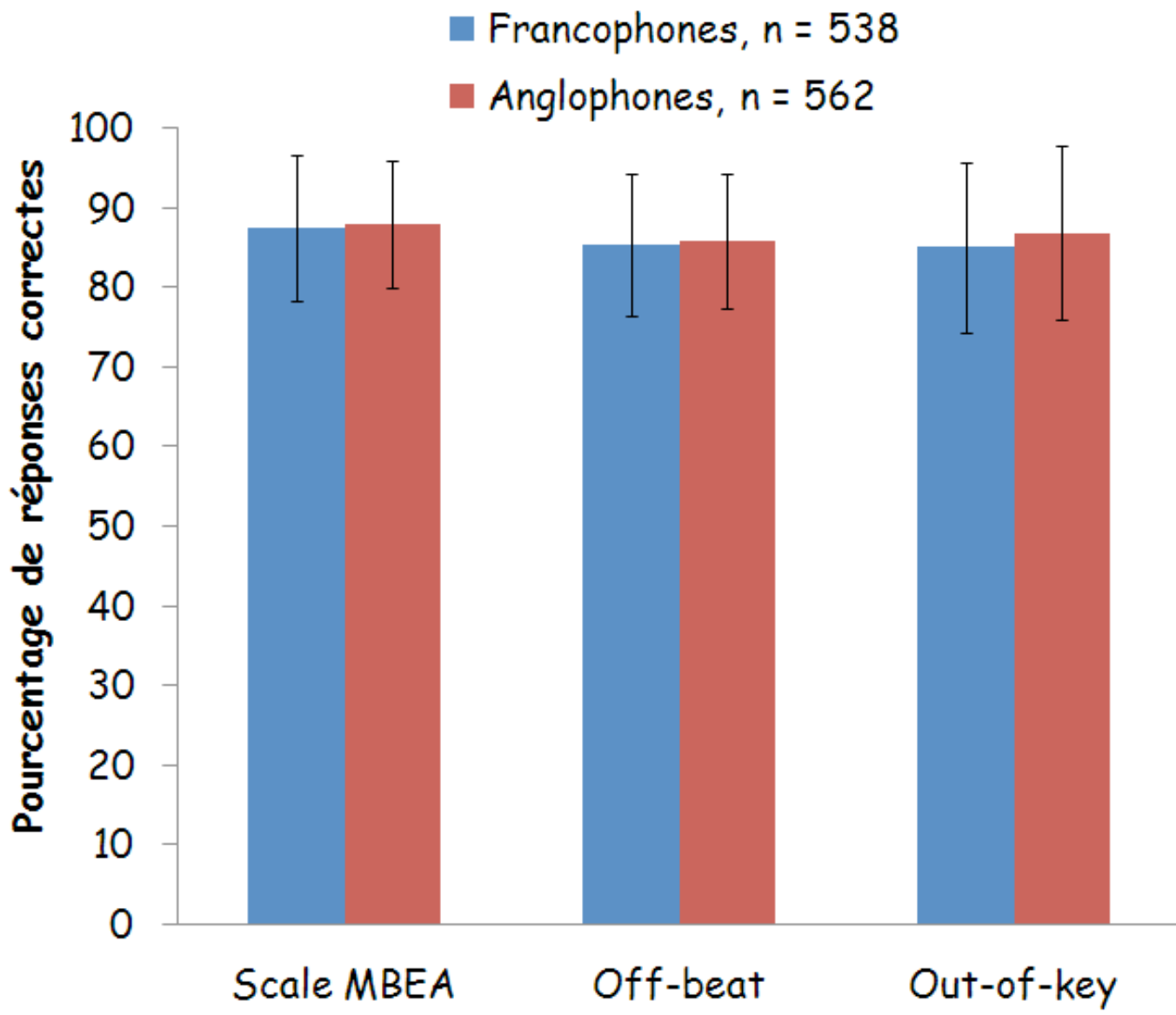
- Yes, this melody contains an out-of-time note.
- No, this melody does not contain an out-of-time note.



Progression:

- Introduction
- Registration
- Examples 1
- Block 1
- Examples 2
- Block 2
- Examples 3
- Block 3
- Break
- Questionnaire
- End of test





Mélanie Provost

Amusie congénitale: du comportement aux gènes

■ phenotype

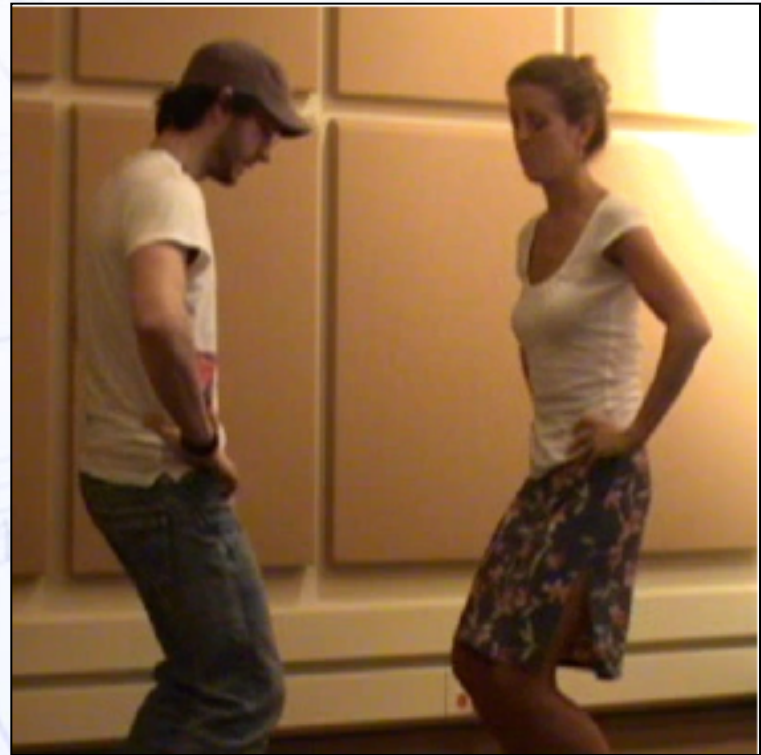
- Pitch-based deficit (tone-deaf variant)
- Beat perception deficit (beat-deaf variant)

■ Neural phenotype

- impoverished connectivity in a right-hemisphere based network involving the inferior frontal cortex and the auditory cortex (ventral pathway)
- Reduced connectivity along the dorsal pathway?

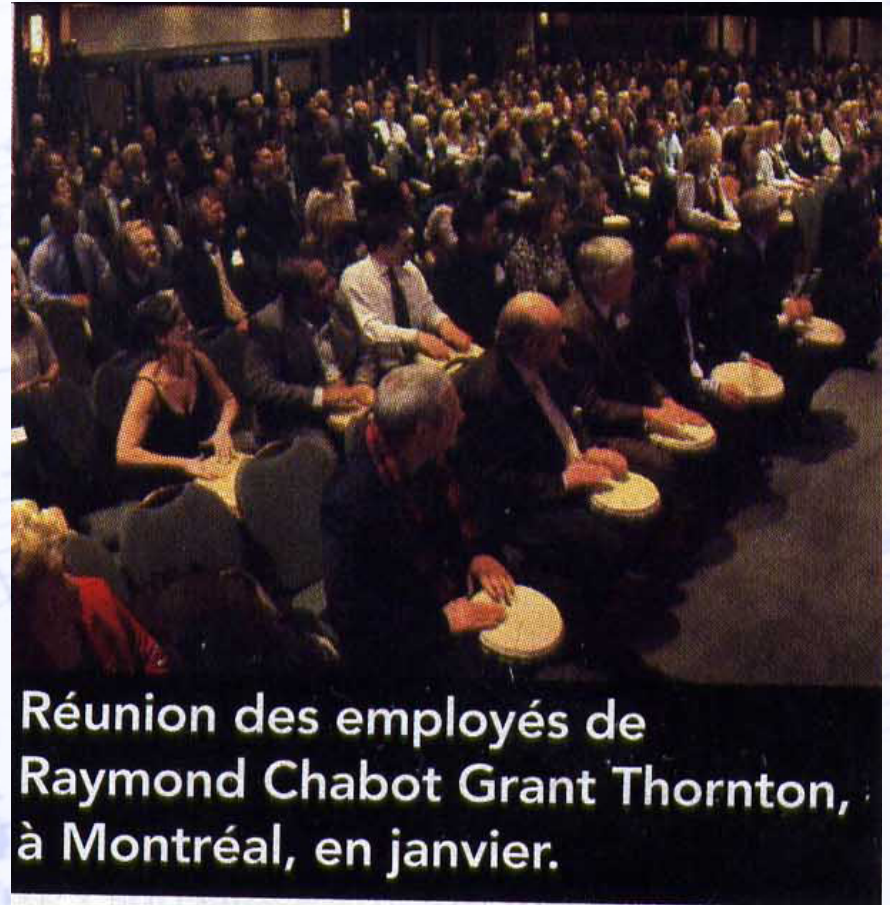
■ Genes

- Unknown



Questions en suspend et perspectives nouvelles

- Problème de « awareness »
- Comparaison musique et langage (Lidji, en cours)
- Corrélation chant et danse
- Synchronisation sociale (mutuelle; Kirshner & Tomasello, 2009, *J. of Experimental Child Psychology*)
- Synchronisation et cohésion sociale (Wiltermuth & Heath, 2009, *Psychological Science*)



Réunion des employés de Raymond Chabot Grant Thornton, à Montréal, en janvier.

Pour plus d'information

www.brams.umontreal.ca/peretz

Et l'aide financière:



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