Hoe maak je een luisterende machine?

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Overzicht

- Wat is muziekcognitie?
  - Onderzoekscontext
  - Twee korte voorbeelden
- Hoe ziet een luisterende machine eruit?
  - Van kunstmatige intelligentie tot cognitiewetenschap
  - Voorbeeld: categorizatie van ritme

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- **Academic context**
  - University of Amsterdam (UvA), Institute for Logic, Language and Computation (ILLC), Cognitive Science Center Amsterdam (CSCA)
- **Domain of research**
  - Study of music cognition, perception and performance, using theoretical, empirical and computational methods
- **Mission**
  - Arrive at a cognitive science of music, with a special focus on its temporal aspects, such as rhythm, tempo and timing

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Voorbeeld *ritmisch cliché*

I . I I I . I . . . I . I

Een '*luide*' rust

Alternatieve notaties van een *syncope*

(Honing, 2004)

Voorbeeld *beat inductie*

(Honing, 2002)

Modellen van *beat inductie*

- Symbolic *(Longuet-Higgins, 1976)*
- Knowledge-based *(Mont-Reynaud et al., 1985)*
- Control theory *(Dannenberg et al., 1987)*
- Connectionist *(Desain & Honing, 1989)*
- Complex dynamics *(Large & Kolen, 1994)*
- ...

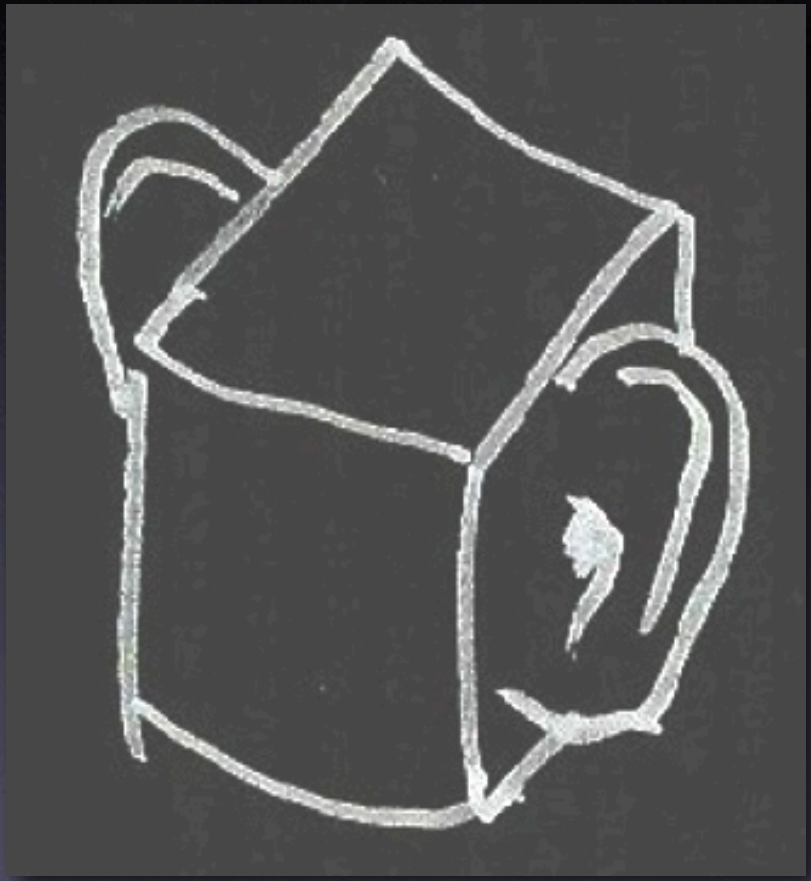
Voorbeelden uit 90er jaren

Google "Beat Induction Demo" voor deze video

Zatorre (2005) *Nature*

1.
Hoe ziet een luisterende machine eruit?

Black box model

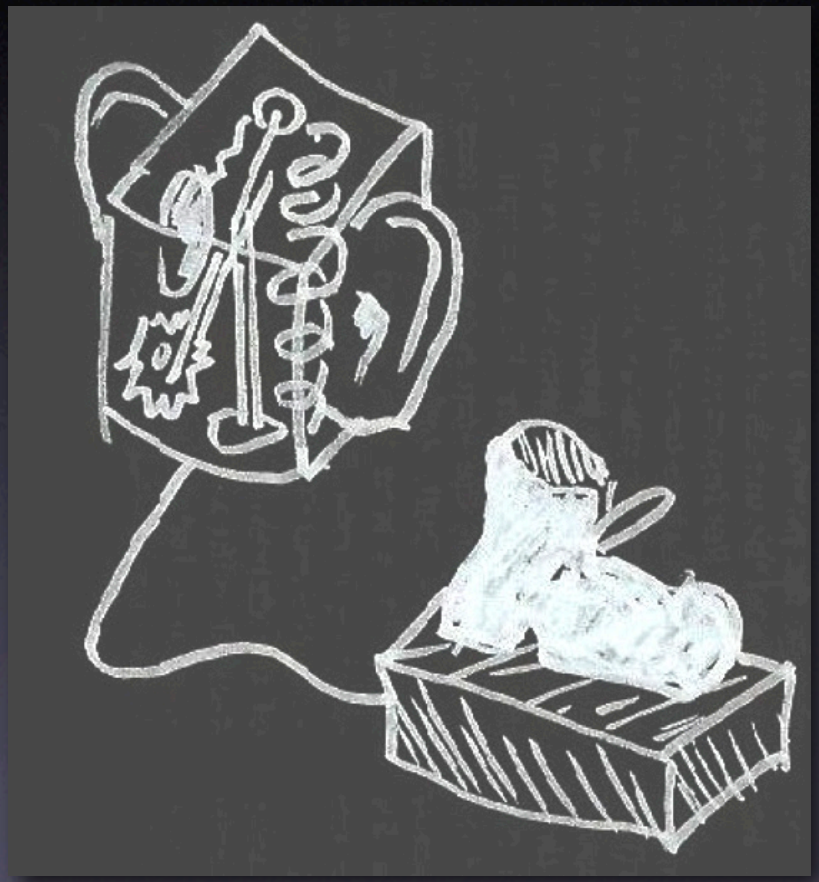


See EmCAP (EU-FP6): http://www.musiccognition.nl/EmCAP/

Transparant model

See EmCAP (EU-FP6): http://www.musiccognition.nl/EmCAP/

Model with overt behavior



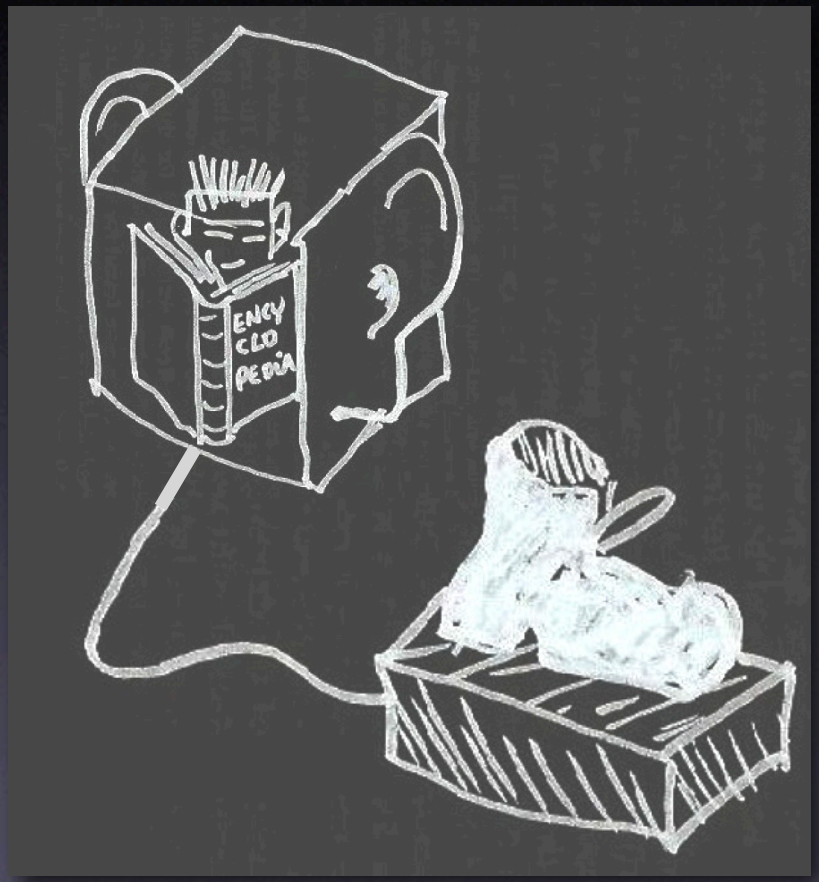
See EmCAP (EU-FP6): http://www.musiccognition.nl/EmCAP/

Pachet's *Continuator*

Google "Coninuator Turing Test" voor deze video

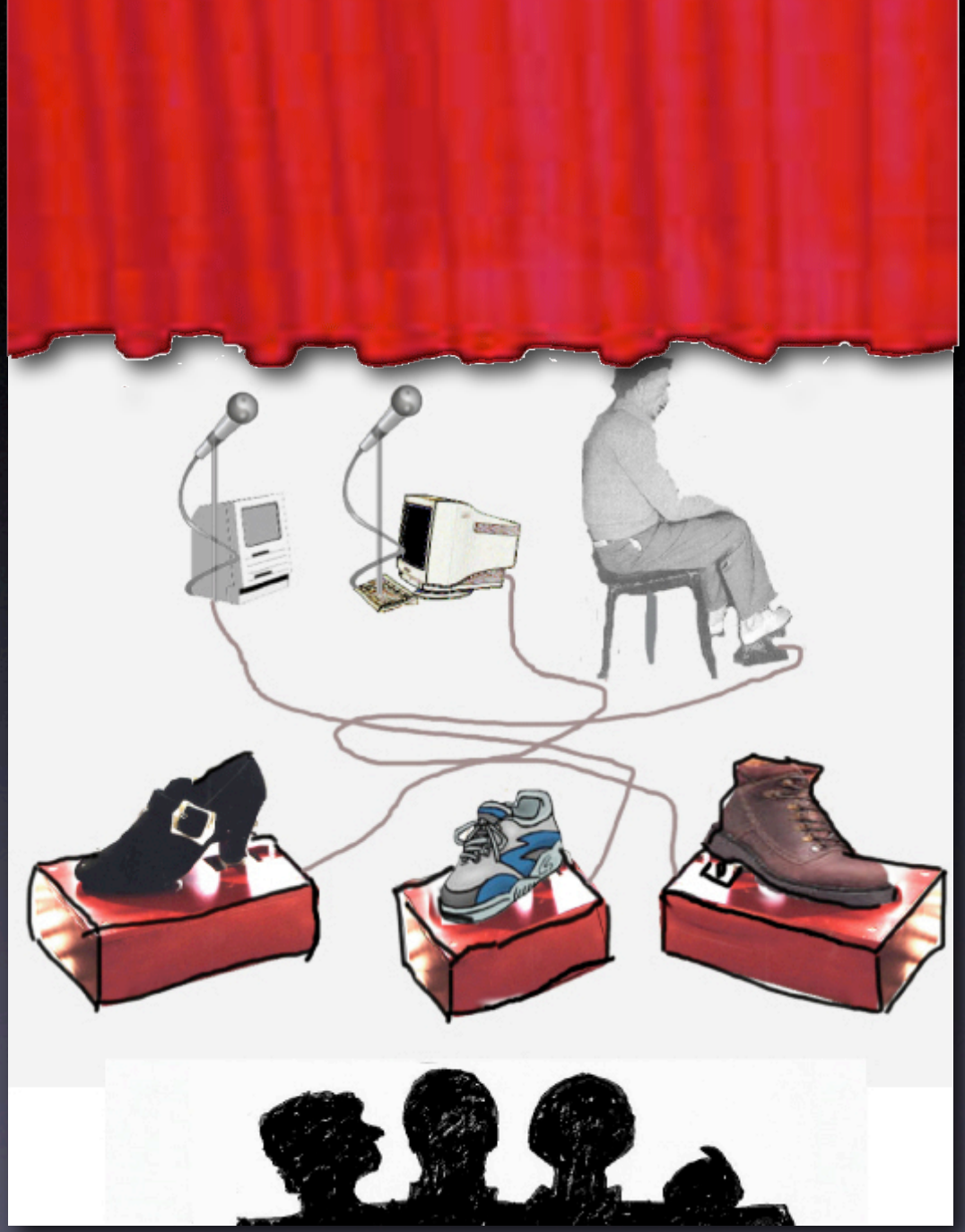
(Sony CSL Paris)

Too good a model?



See EmCAP (EU-FP6): http://www.musiccognition.nl/EmCAP/

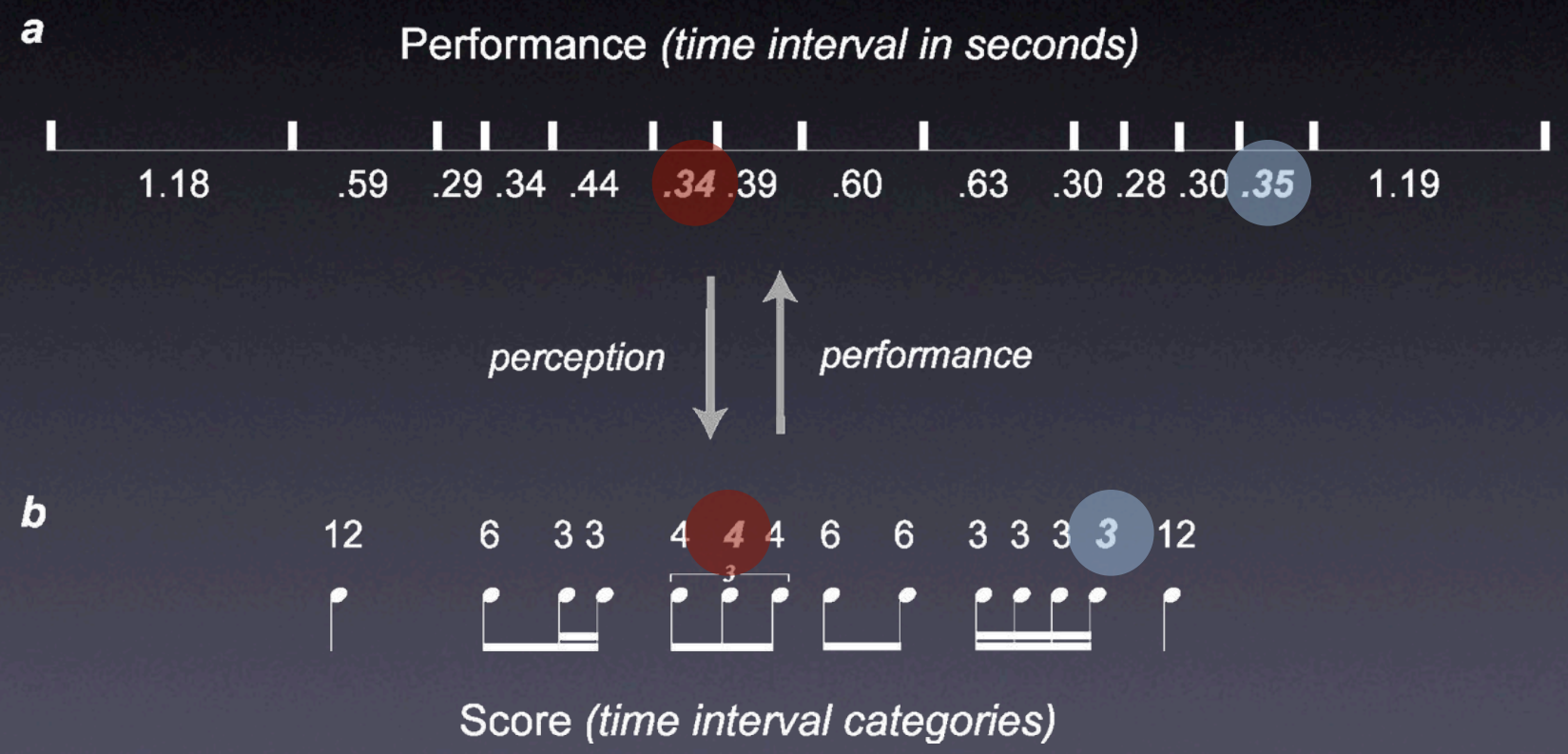
Google "Beat Induction Turing Test"



Google "Beat Induction Turing Test"

2.
Hoe maken we het onderscheid tussen ritme en timing?

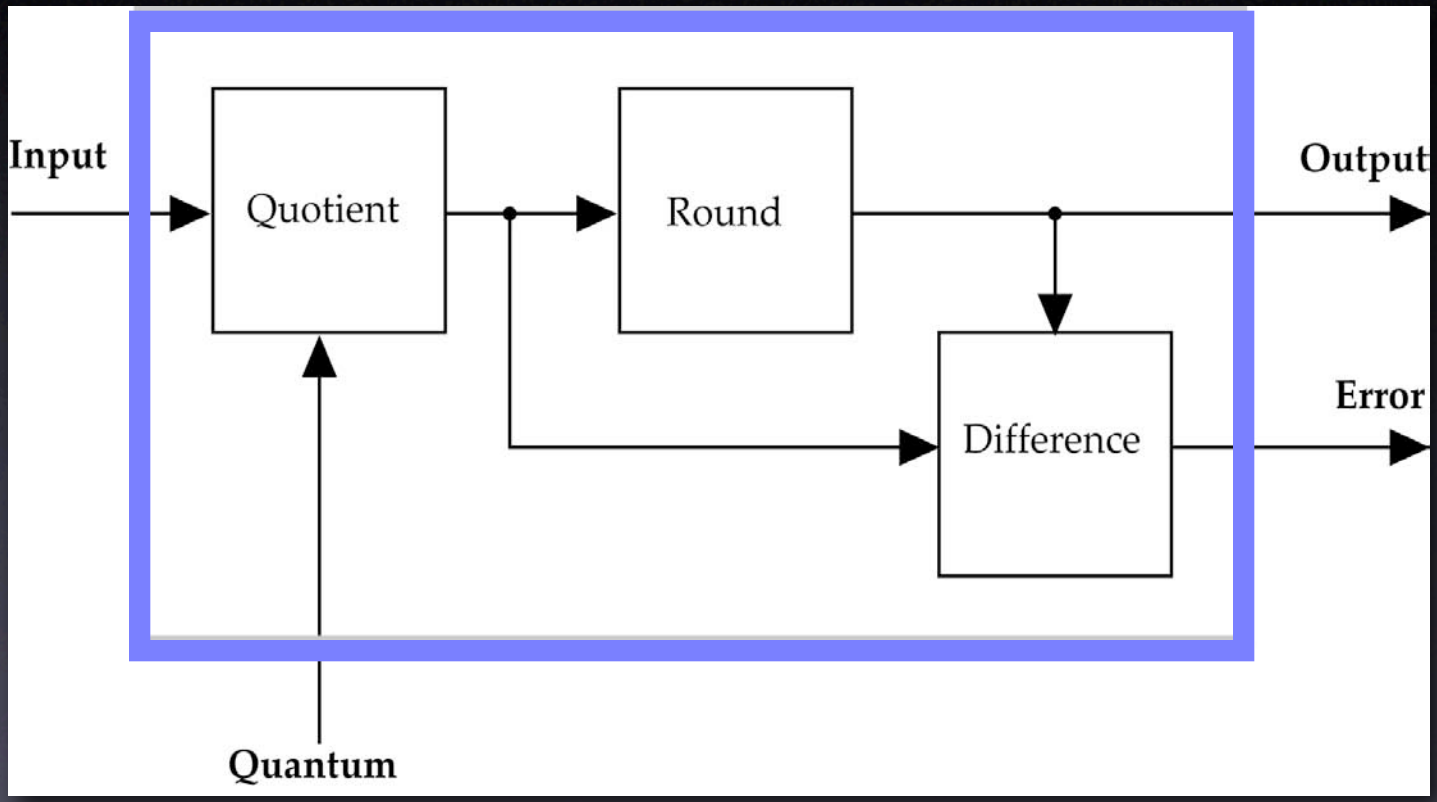
Rhythmic categorization



(Desain & Honing, 1989; 2003)

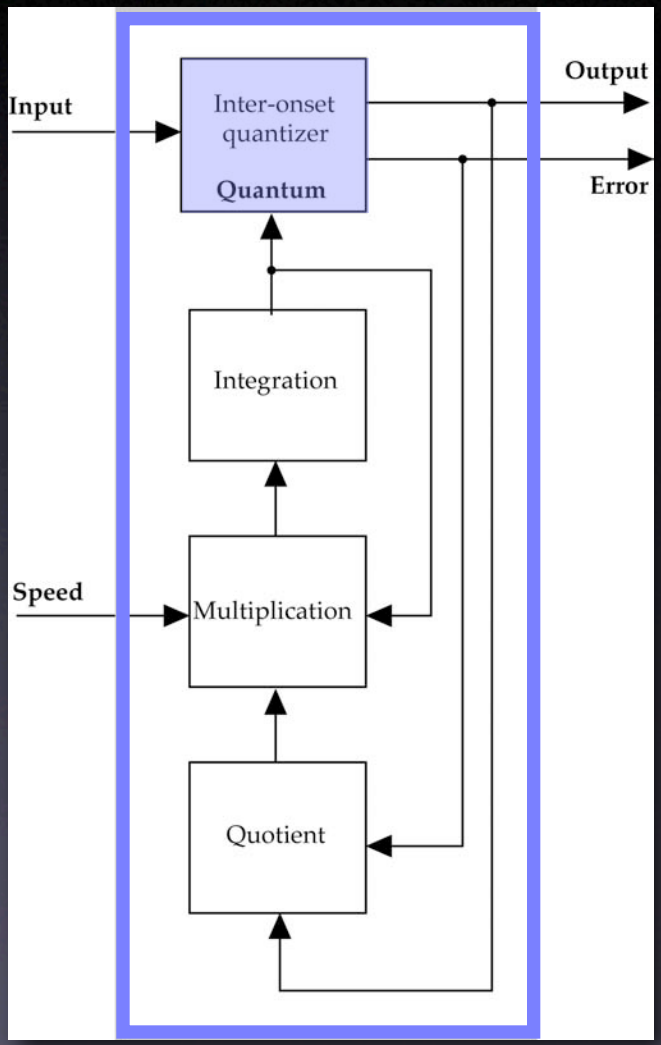
3.
Is dit te formaliseren?

Inter-onset quantizer



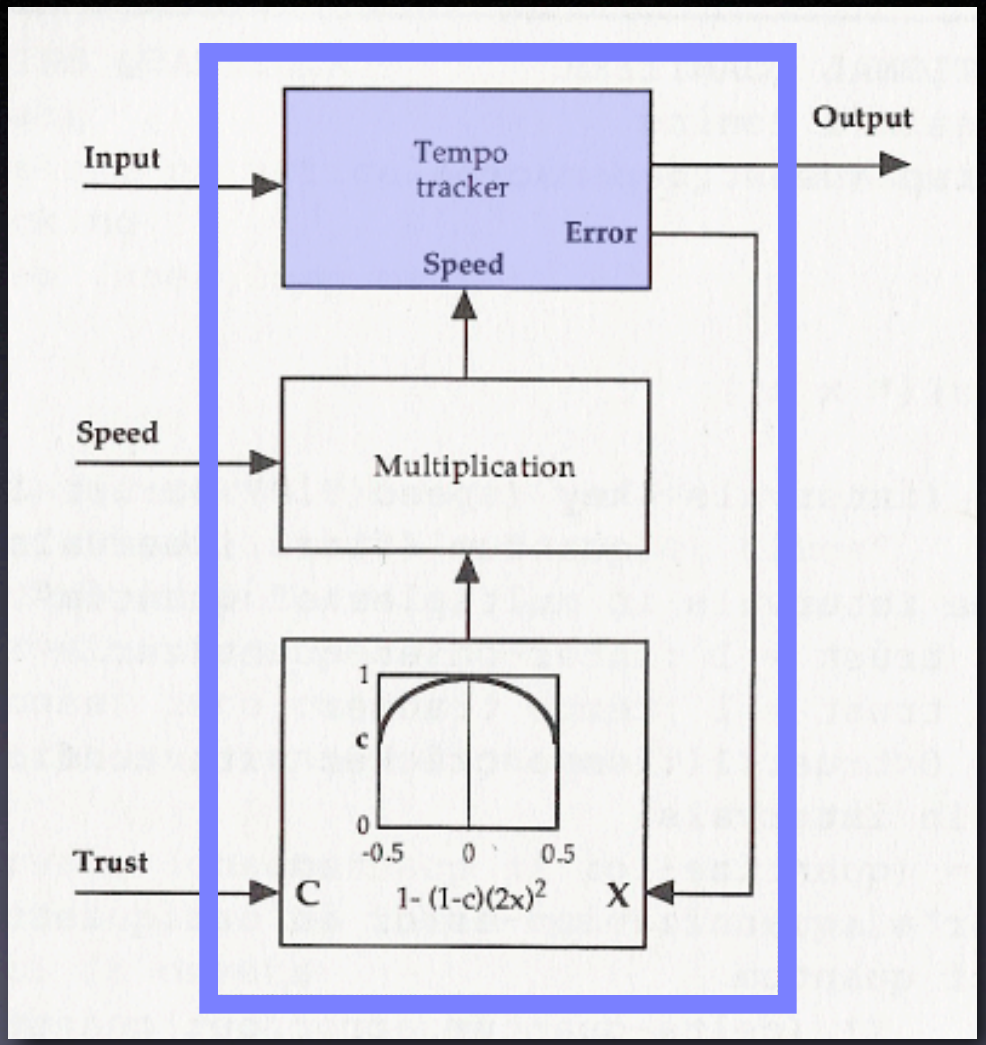
(Desain & Honing, 1992)

Tempo tracker



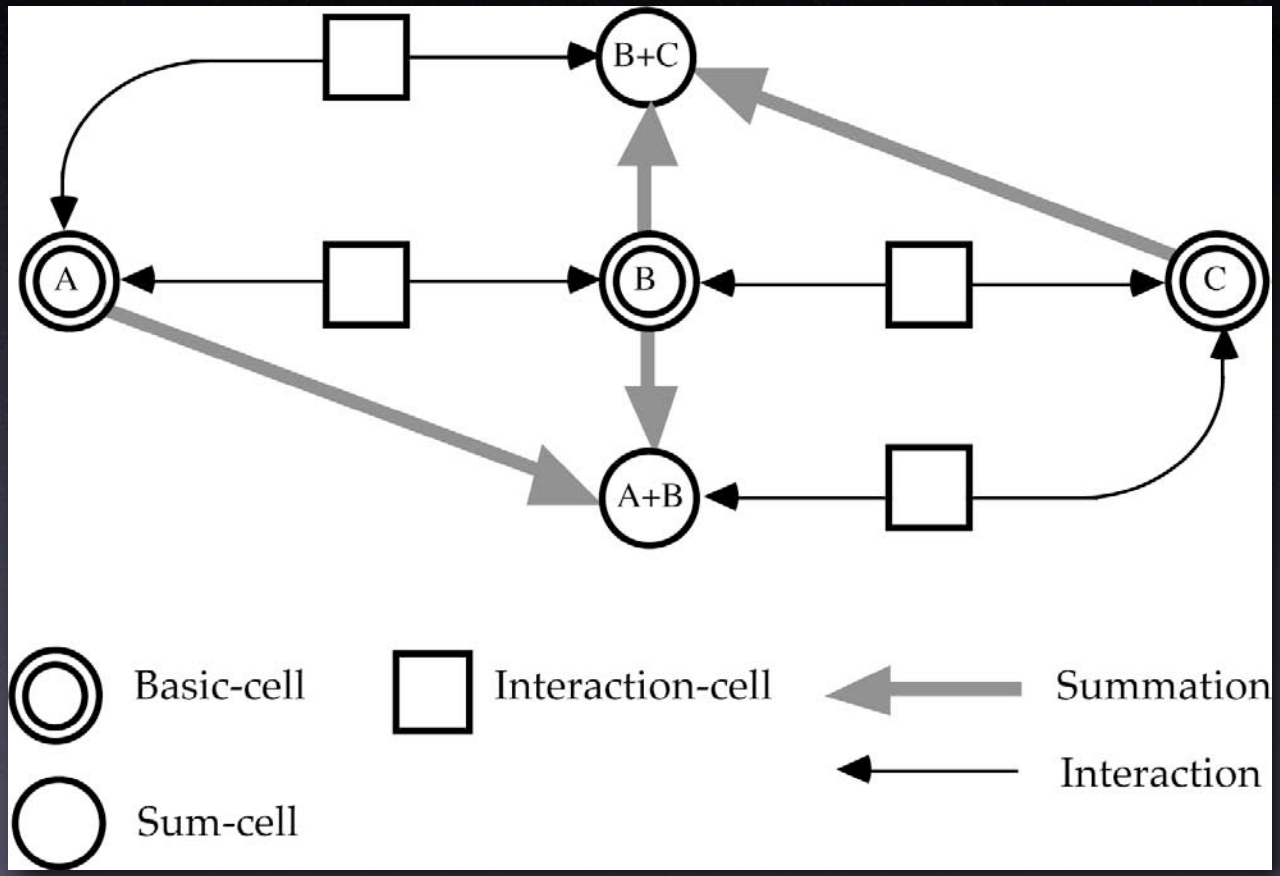
(Desain & Honing, 1992)

Tempo tracker with confidence



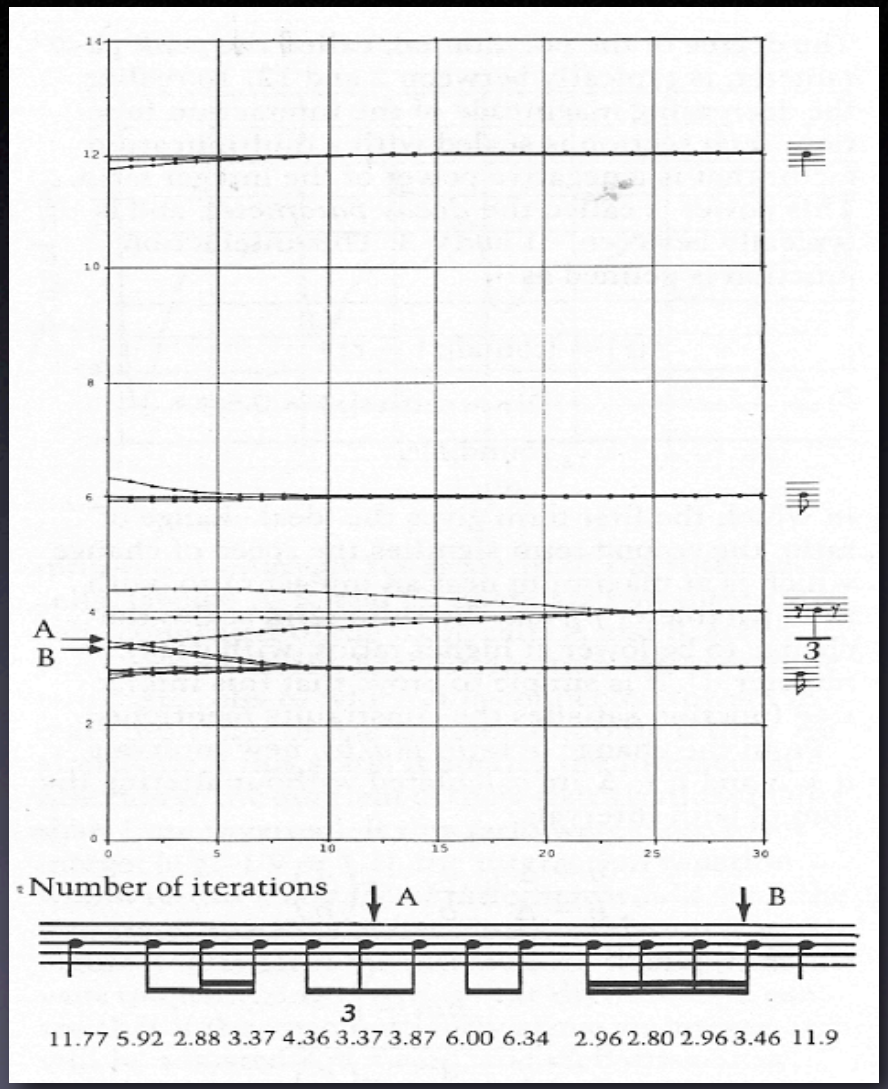
(Desain & Honing, 1992)

Connectionist quantizer



(Desain & Honing, 1989)

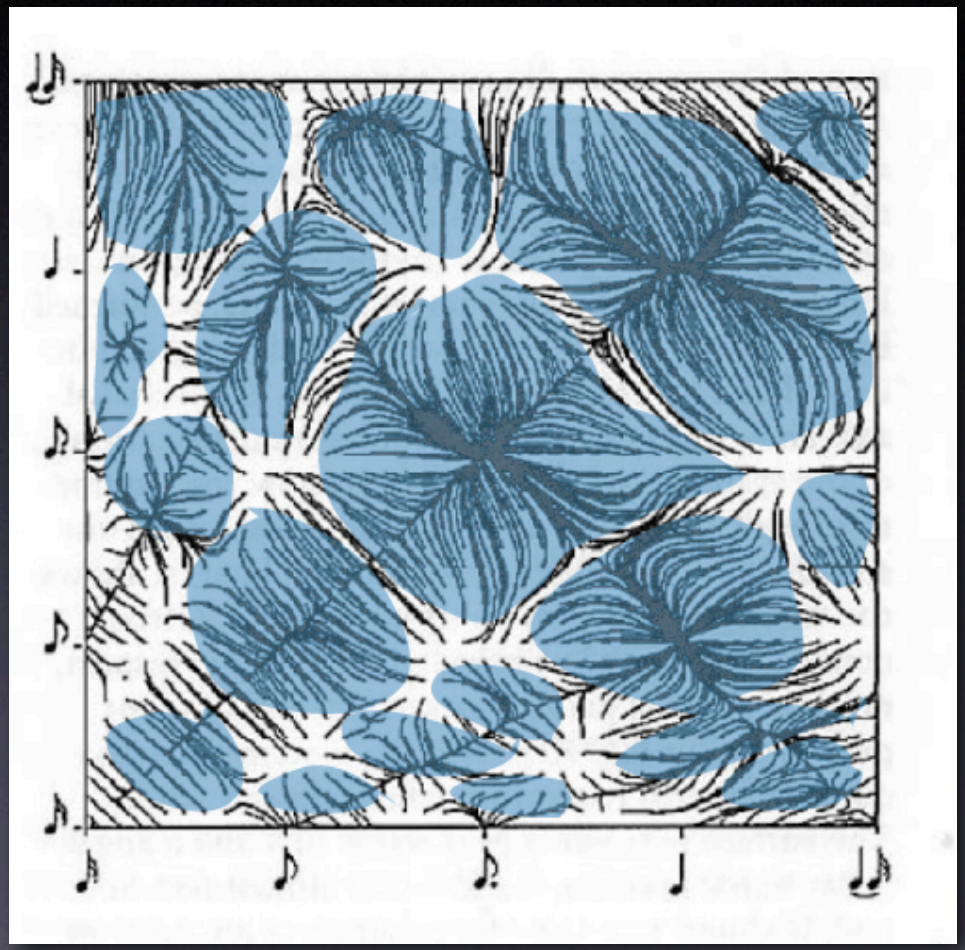
Iteration state diagram



(Desain & Honing, 1989)

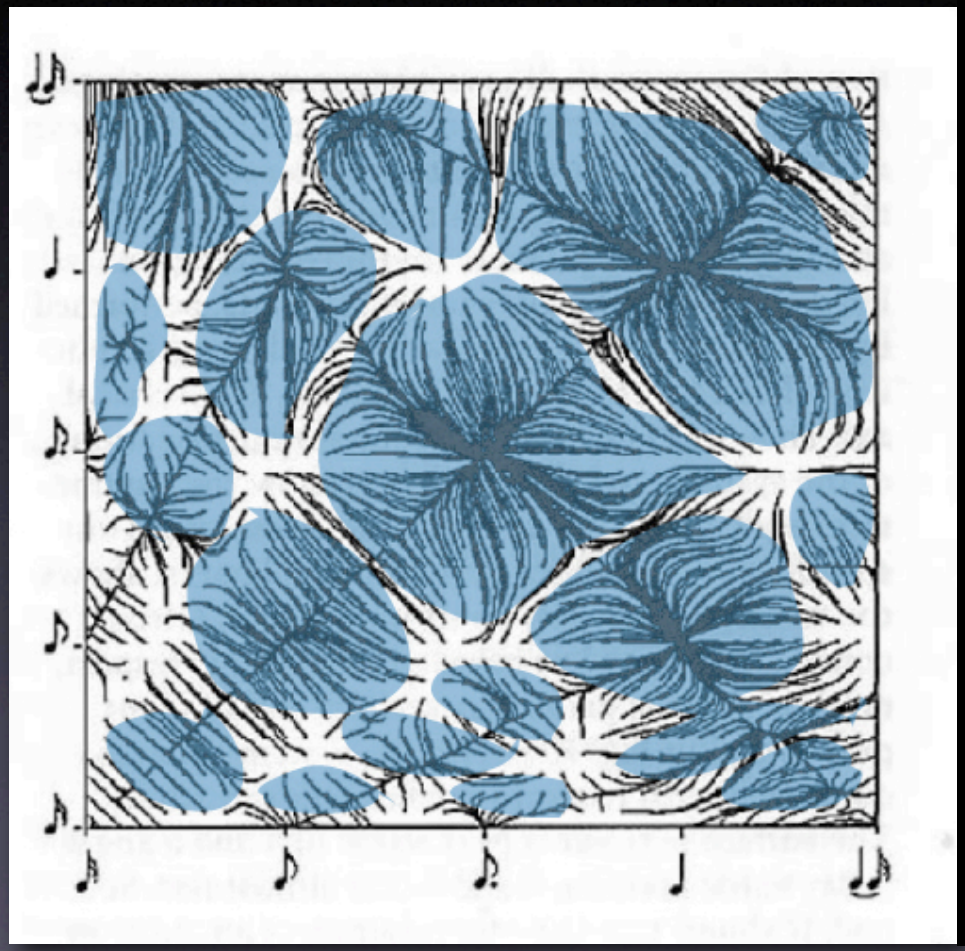
4.
Wat voorspellen deze modellen?

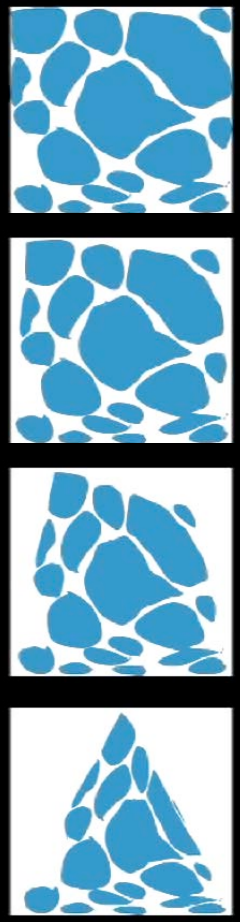
Rhythm space



(Desain & Honing, 1989)

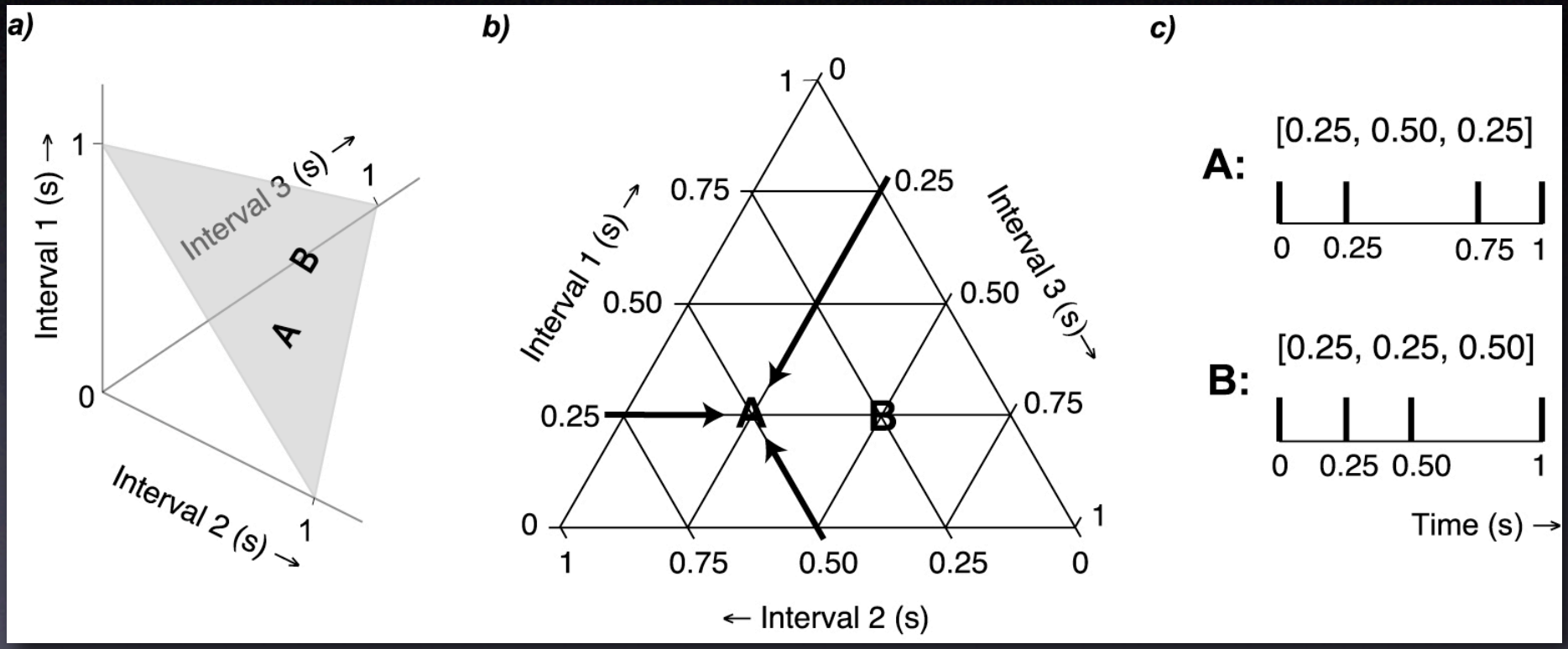
Rhythm space



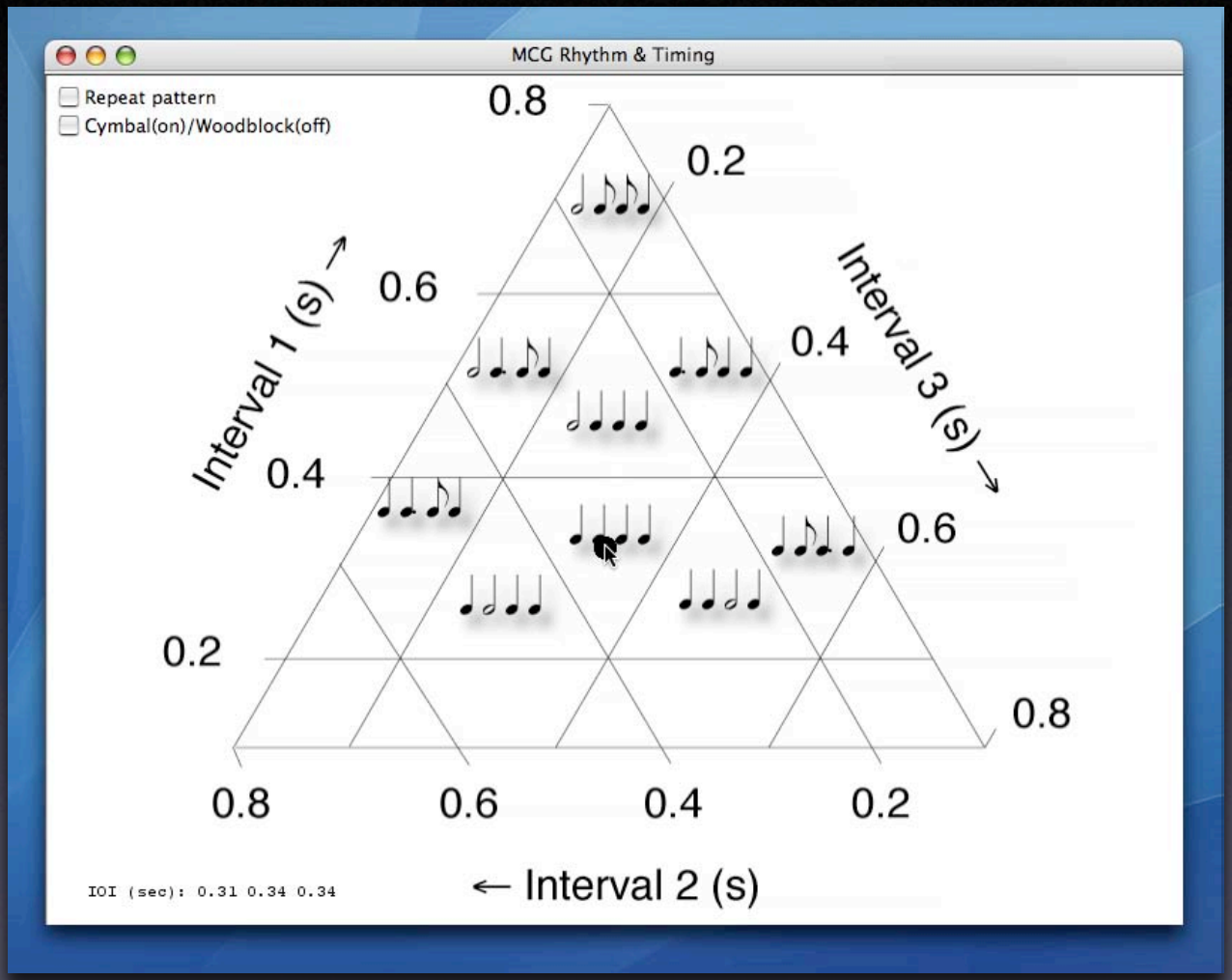


(Honing, 2002)

Rhythm space



Rhythm space

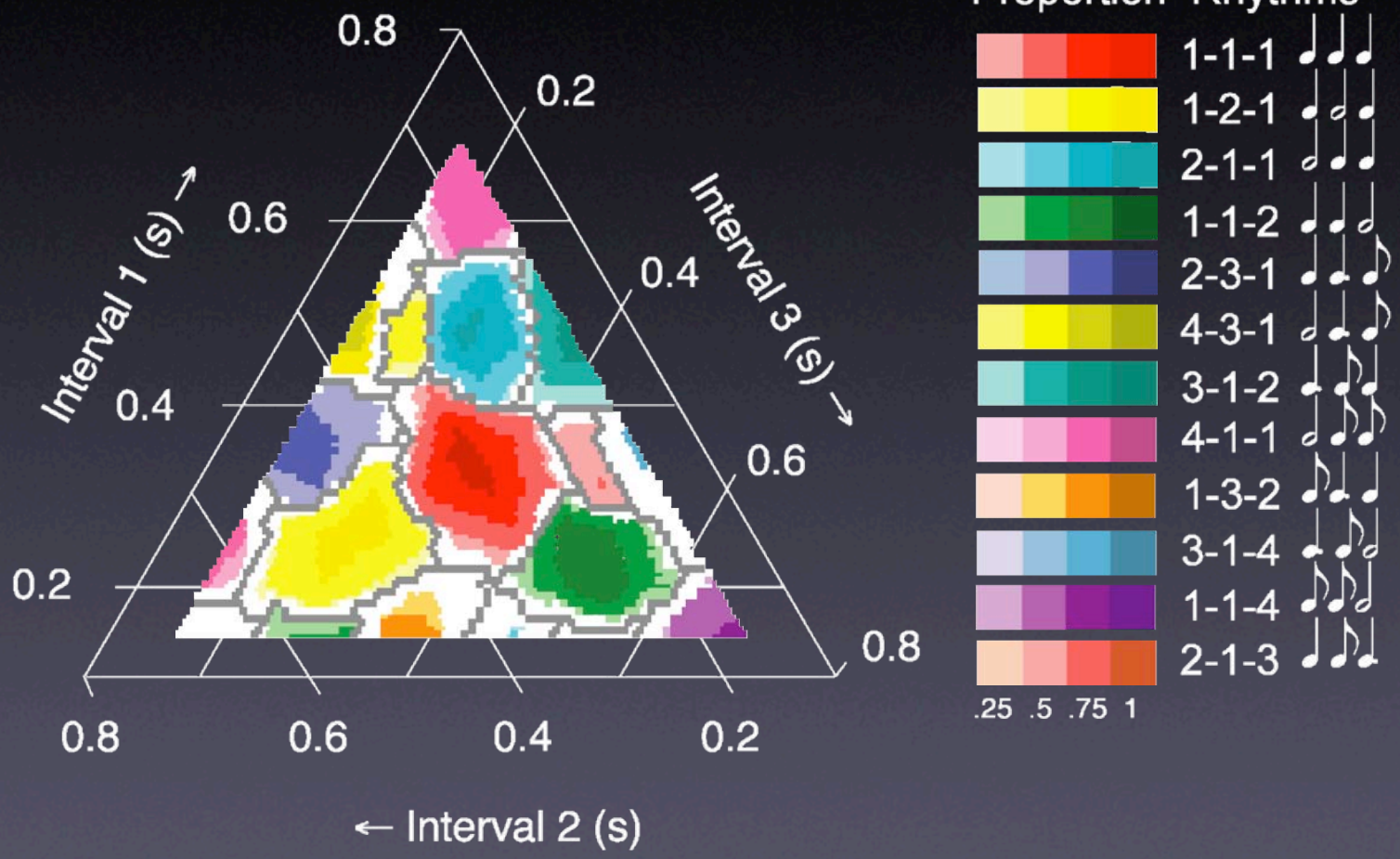


See elaborate demo at http://www.hum.uva.nl/mmm/demos.html

5.
Wat horen luisteraars?

Results categorization *(N=29)*

"Time clumping map"

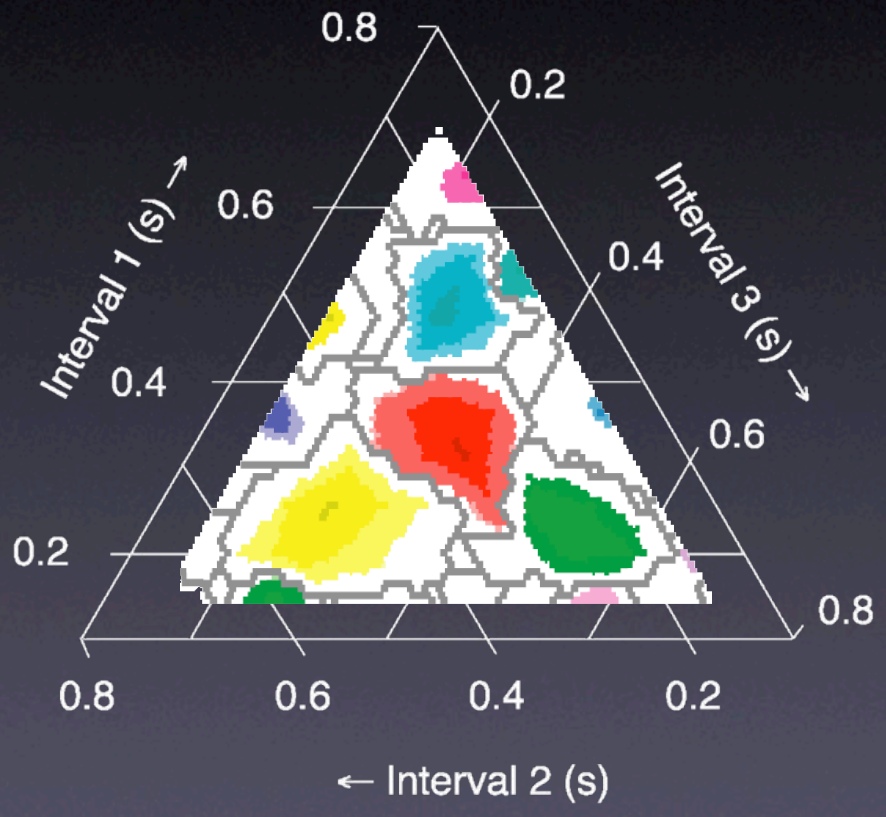


See elaborate demo at http://www.hum.uva.nl/mmm/demos.html

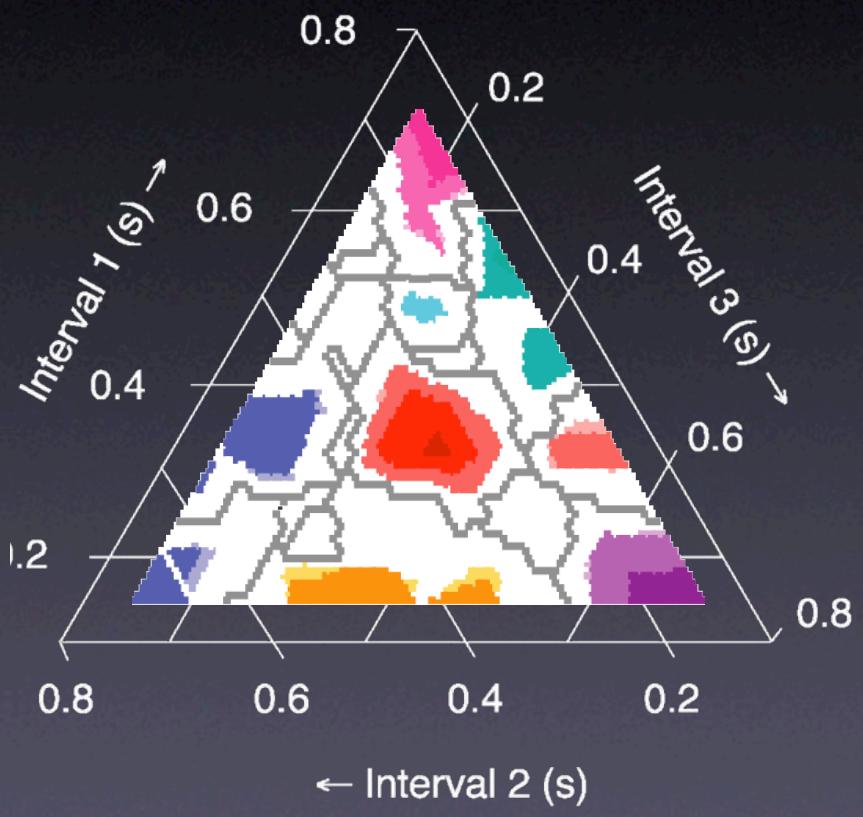
Desain & Honing (2003) *Perception*

Meter influences categorization

Duple meter



Triple meter



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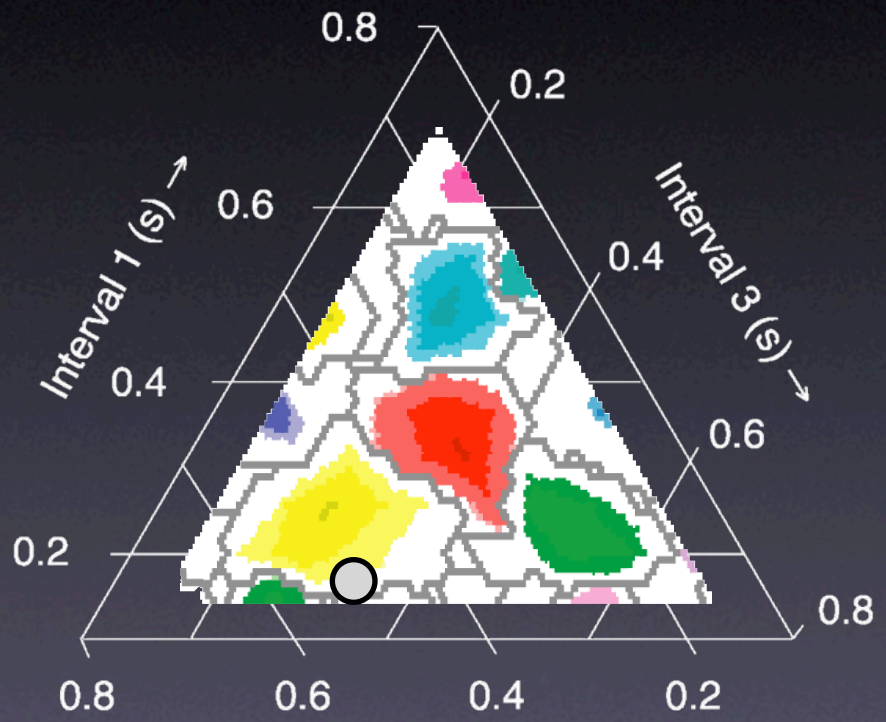
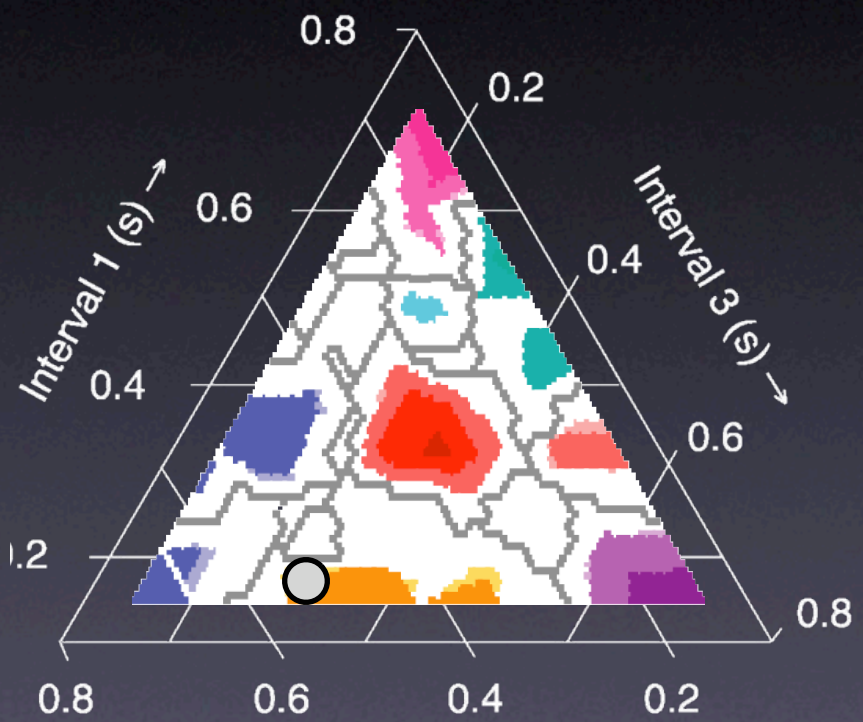
Desain & Honing (2003) *Perception*

Meter influences categorization

Duple meter



Triple meter



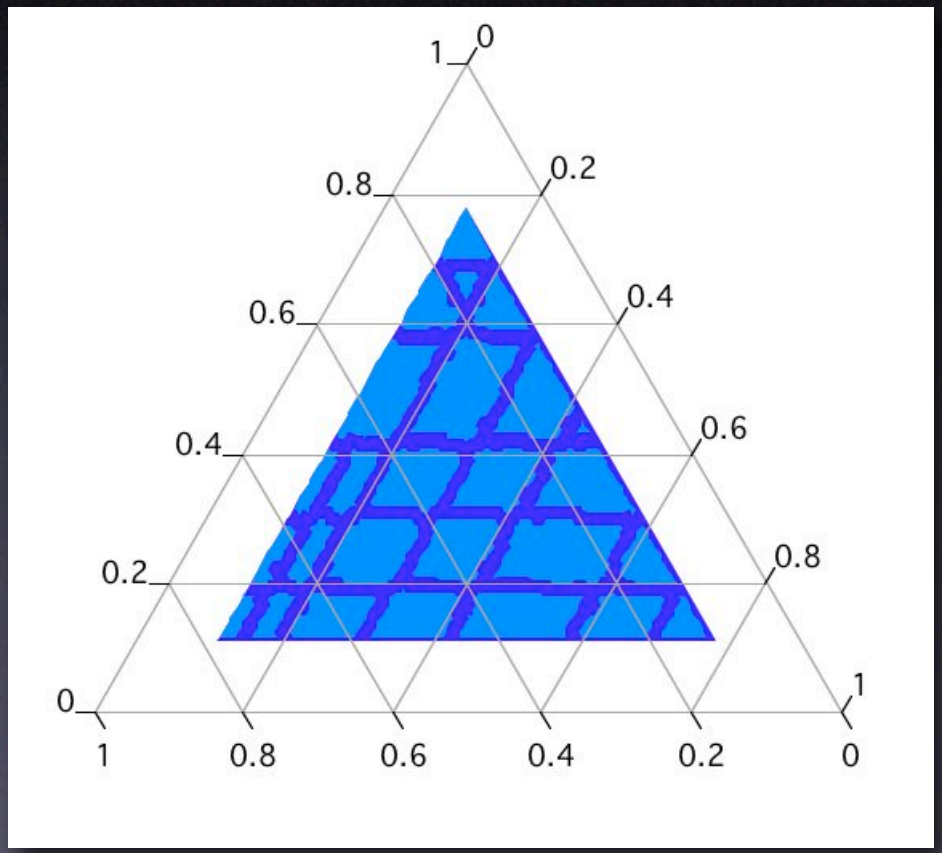
64% **1-2-1** ← **0.263 0.421 0.316** → **1-3-2** 36%
10% 1-3-2 1-2-1 0%

See elaborate demo at http://www.hum.uva.nl/mmm/demos.html

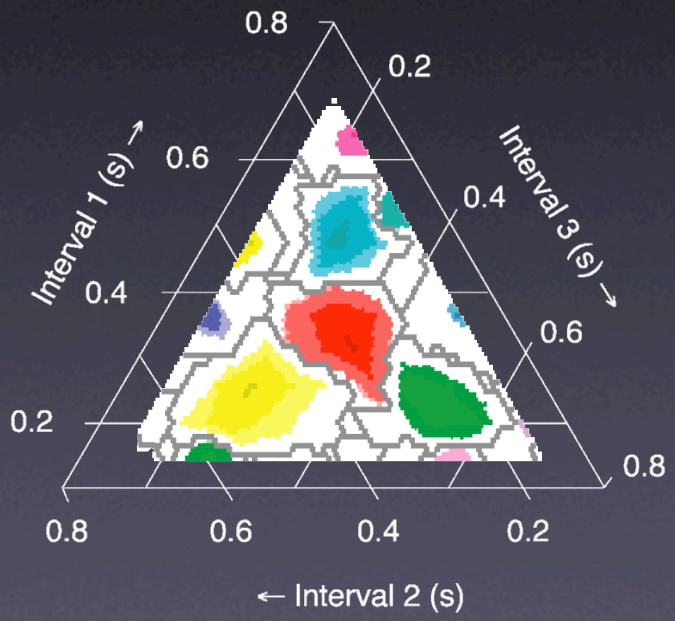
Desain & Honing (2003) *Perception*

Commercial quantizers

Finale



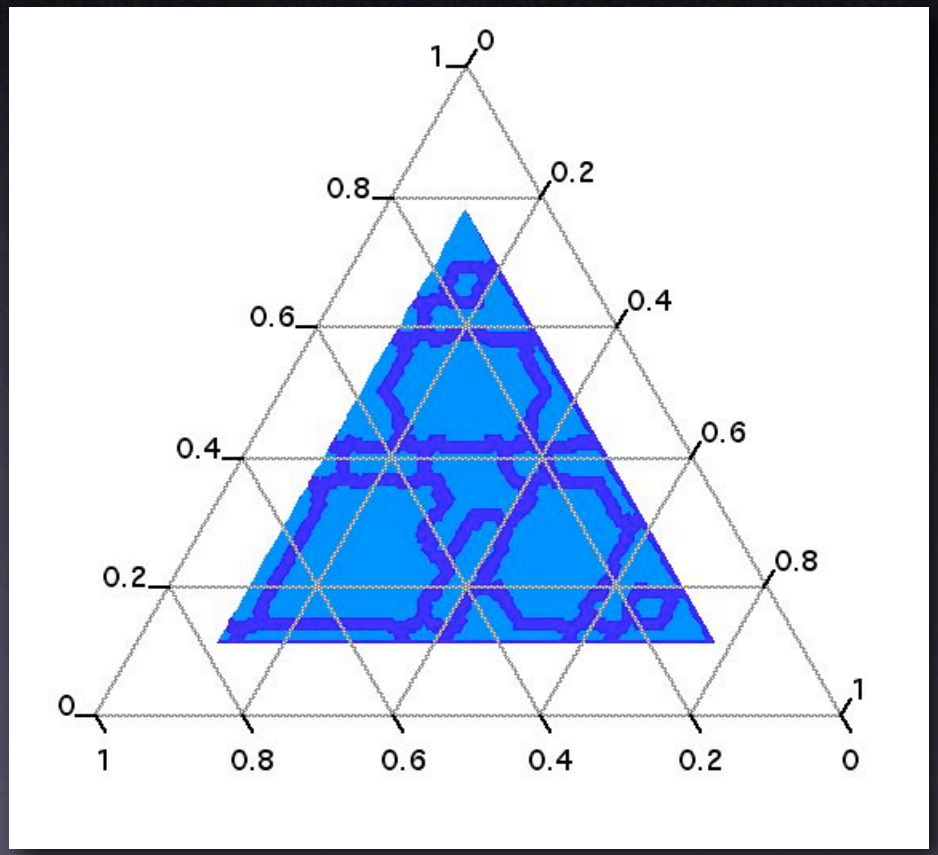
Empirical data



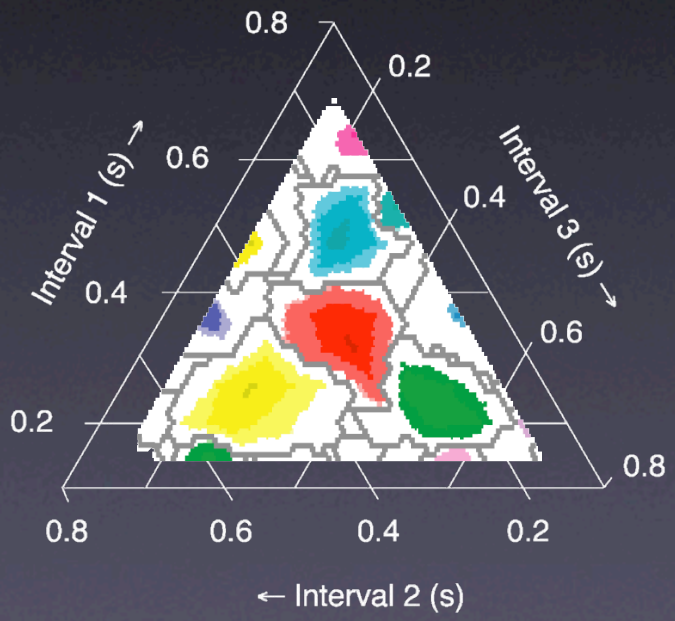
(Trilsbeek & van Thienen, unpublished)

Commercial quantizers

Performer 6



Empirical data



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Samenvatting

- Muziek is een uniek menselijk verschijnsel
- Muziek is verweven met onze cognitie
- Computationeel modelleren als methode
- Maar, methode is een middel —het geeft de tekortkomingen aan—, dat wat we nog niet begrijpen is interessant

Meer informatie

www.musiccognition.nl

Referenties

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Voor complete artikelen (pdf) zie: www.hum.uva.nl/mmm/publications.html