

# A fizikai világ modelljének felfedezése az agyban

Orbán Gergő

CSNL Lendület Labor

MTA Wigner Fizikai Kutatóközpont



# Idegsejtek: Az idegrendszer építőkövei

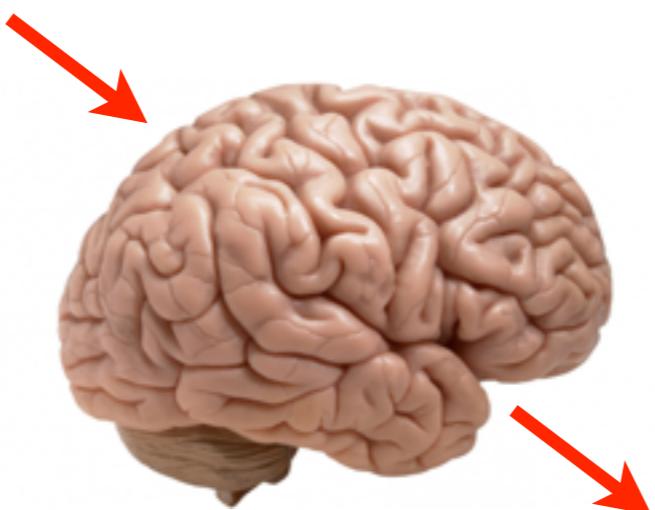


# Érzékelés, döntés, végrehajtás



# Agy vs. Környezet

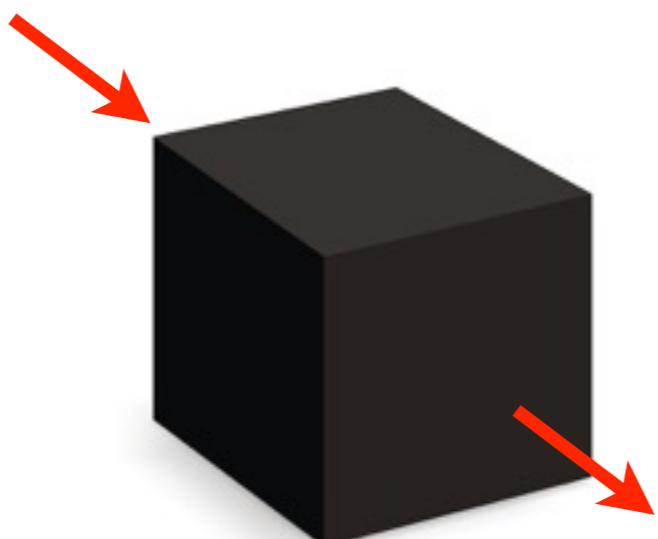
külvilág ingerei



döntések / viselkedés

# Agy vs. Környezet

külvilág ingerei



döntések / viselkedés

# Agy vs. Környezet



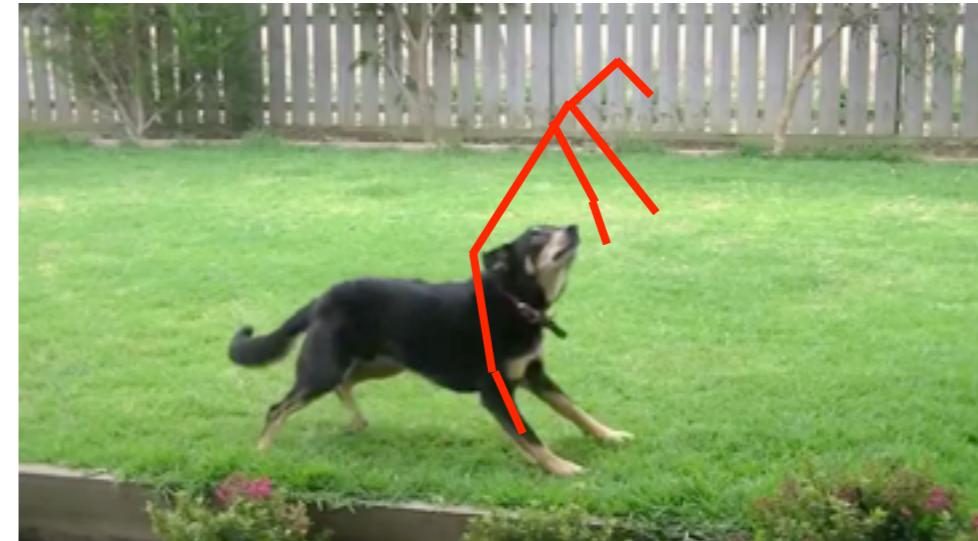
- az értelmezéshez **modellt** konstruálunk

# Agy vs. Környezet



- az értelmezéshez **modellt** konstruálunk

# Agy vs. Környezet



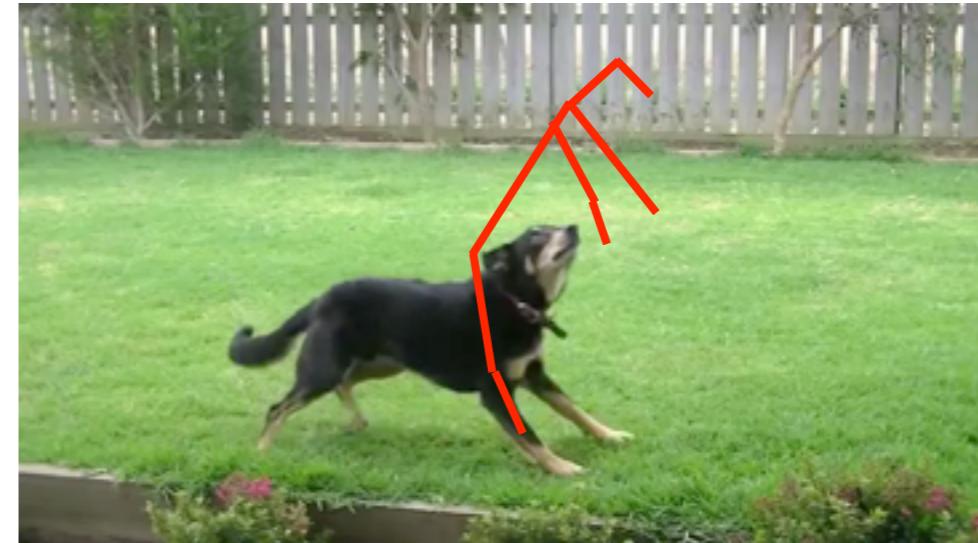
©TreeFearie, SXC



©patita , SXC

- az értelmezéshez **modellt** konstruálunk
- a modell **valózsínűségeket** használ

# Agy vs. Környezet



©TreeFrearie, SXC



©patita , SXC

- az értelmezéshez **modellt** konstruálunk
- a modell **valózsínűségeket** használ
- a modell a feladattól **független**

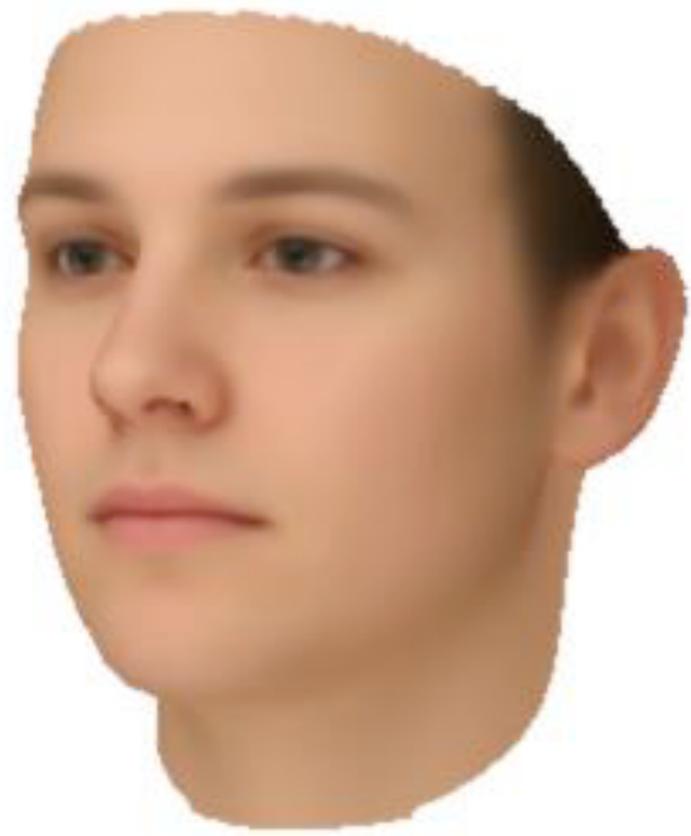
# A belső modell



# A belső modell

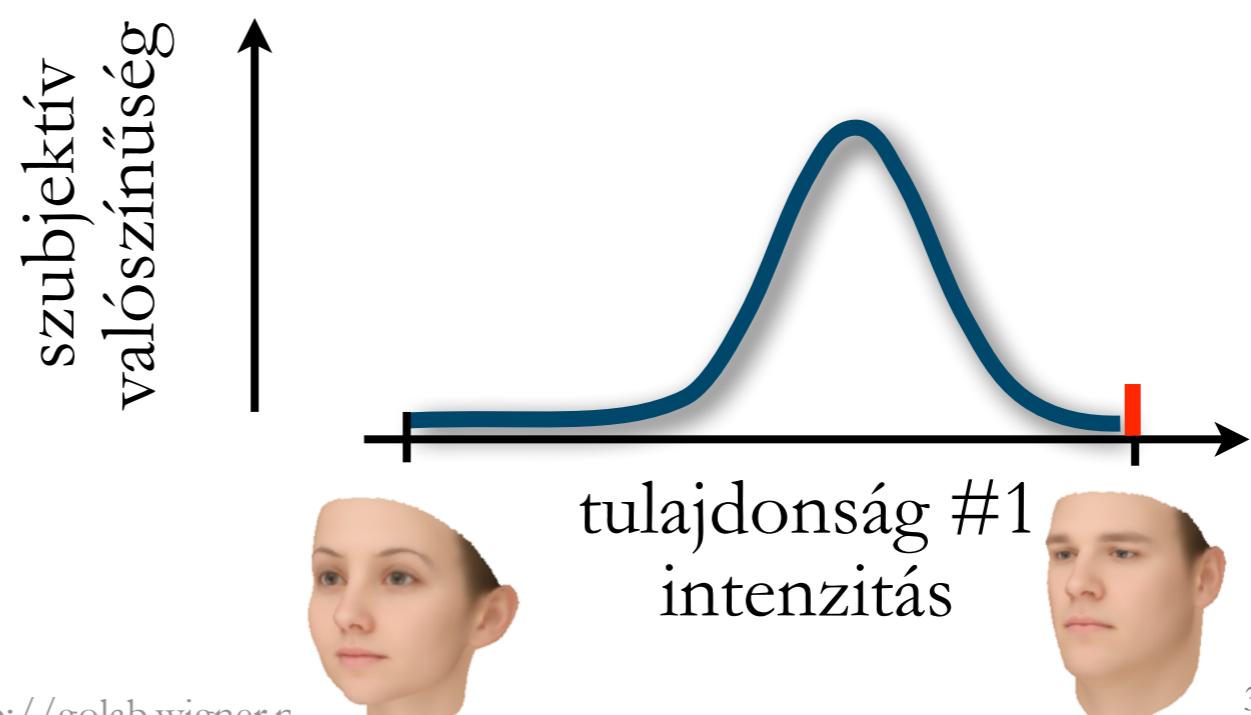


# Emberi arc reprezentációja



1. *komplex*
2. *ökológiaileg releváns*
3. *kiterjedt szubjektív élmények*
4. *az élmények szubjektívek*

# Emberi arc reprezentációja



# A belső modell

tulajdonság #2

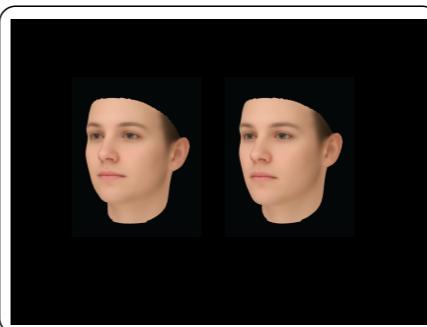


tulajdonság #1

# Hogyan mérjük?



# Hogyan mérjük?



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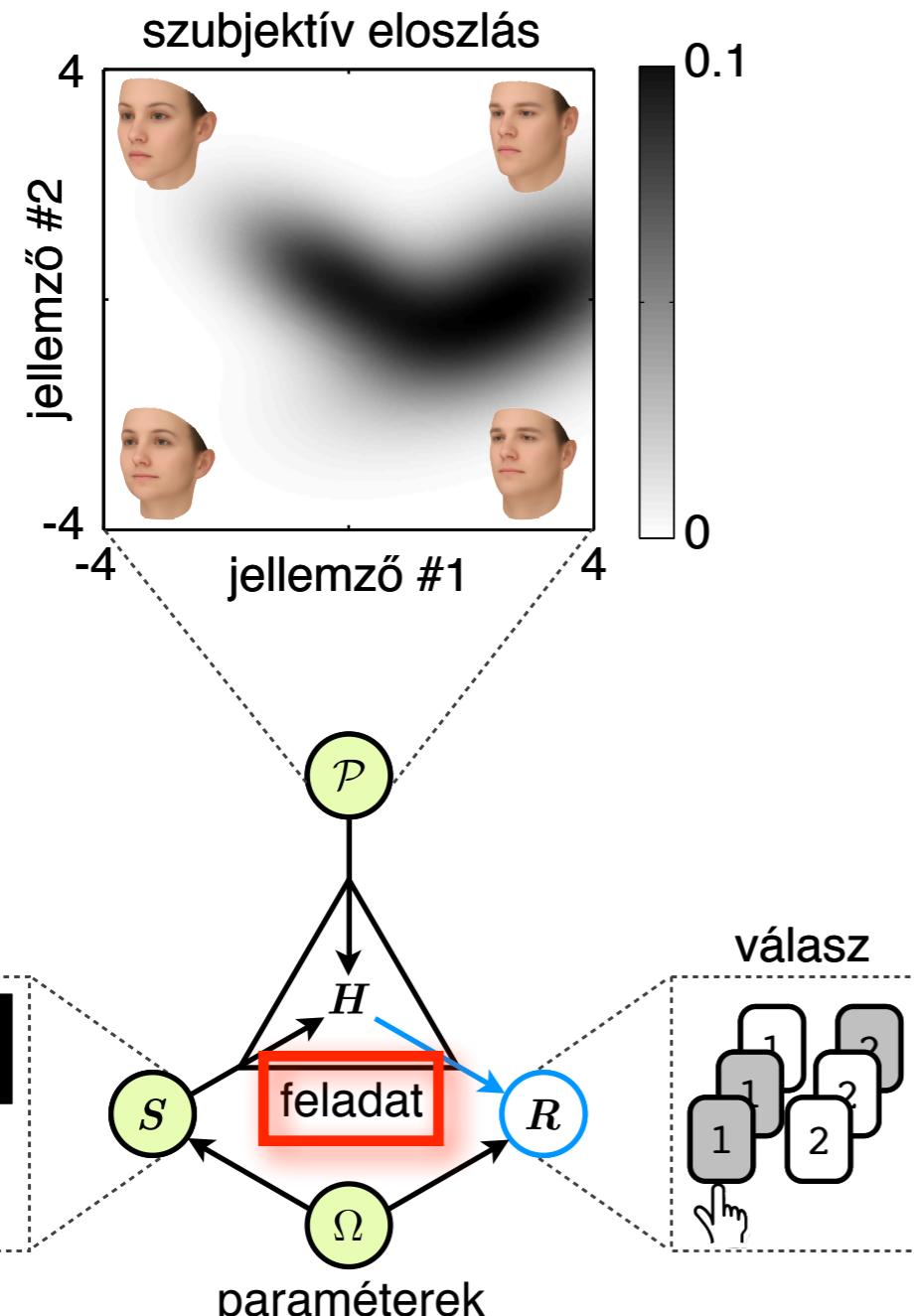
Current Biology 23, 2169–2175, November 4, 2013 ©2013 The Authors <http://dx.doi.org/10.1016/j.cub.2013.09.012>

## Cognitive Tomography Reveals Complex, Task-Independent Mental Representations

Neil M.T. Houlsby,<sup>1,4</sup> Ferenc Huszár,<sup>1,4</sup>  
Mohammad M. Ghassemi,<sup>1</sup> Gergő Orbán,<sup>1,2</sup>  
Daniel M. Wolpert,<sup>1,5</sup> and Máté Lengyel<sup>1,3,5,\*</sup>

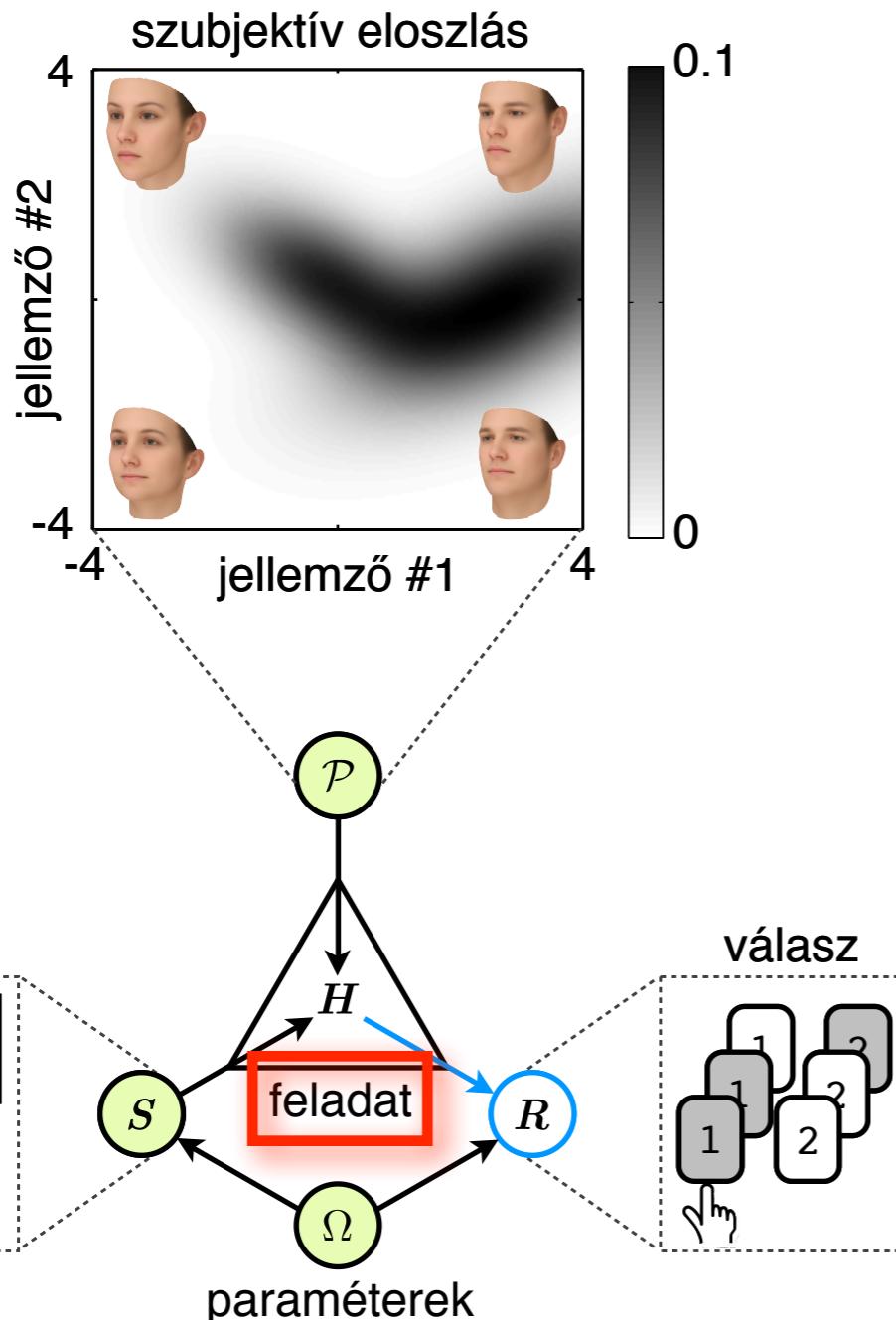
# Kognitív tomográfia

## Ideális megfigyelő

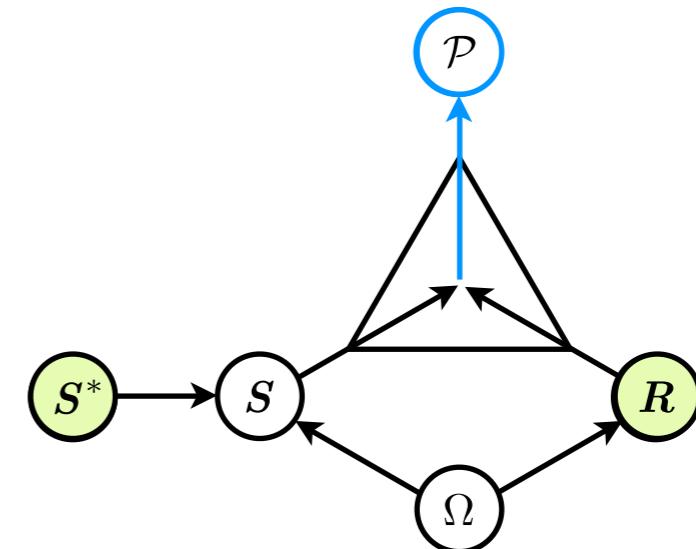


# Kognitív tomográfia

## Ideális megfigyelő

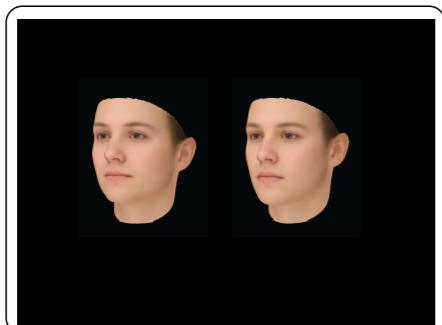


## Kognitív tomográfia



# A belső modell felfedezése

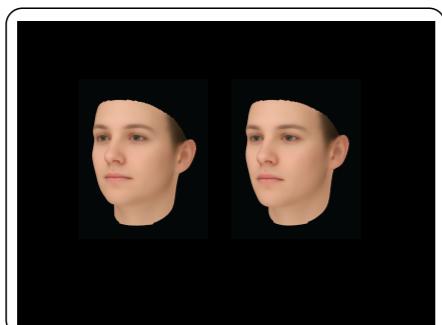
## ISMERŐSSÉG



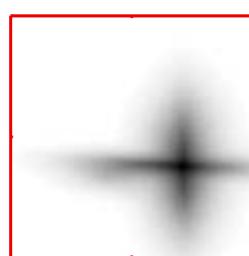
kísérleti  
alany #1

# A belső modell felfedezése

## ISMERŐSSÉG



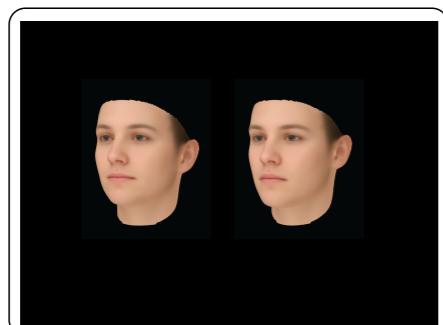
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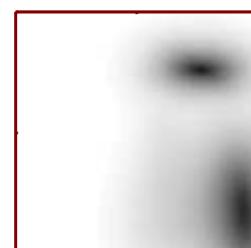
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# A belső modell felfedezése

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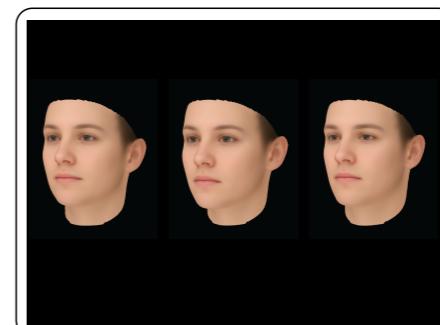


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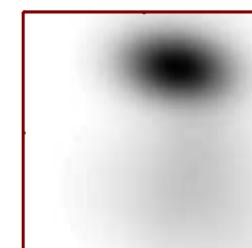


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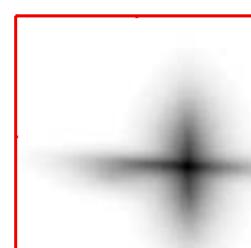
BÖKJ-A-NEMODAILLÓRE



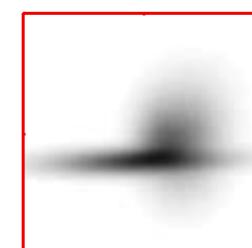
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kísérleti  
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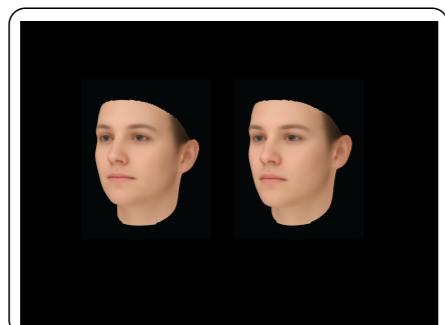
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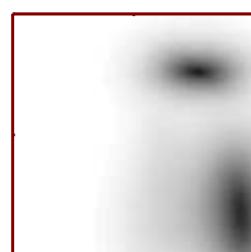
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# A belső modell felfedezése

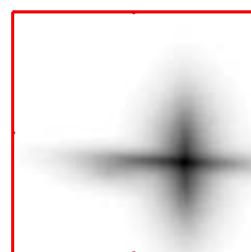
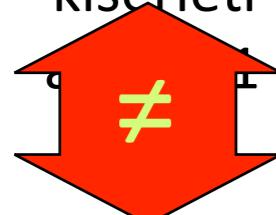
ISMERŐSSÉG



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kísérleti

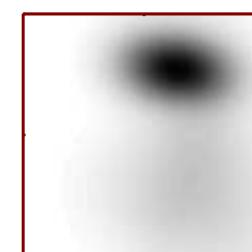
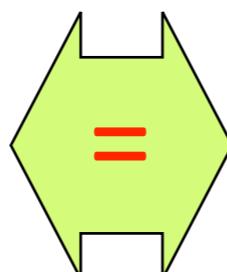


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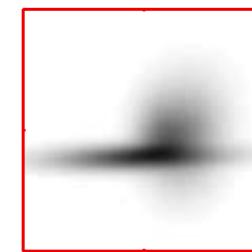
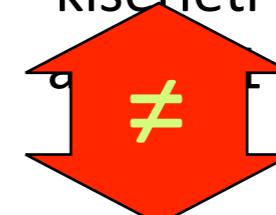
BÖKJ-A-NEMODAILLÓRE



1      2      3



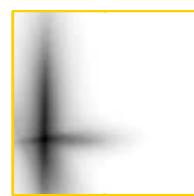
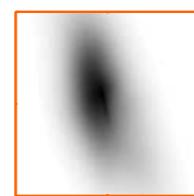
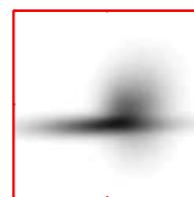
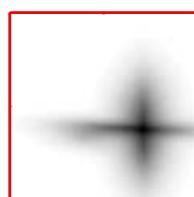
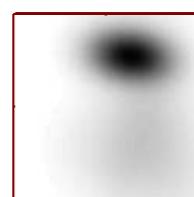
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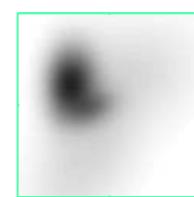
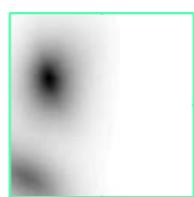
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alany #2

# A belső modell felfedezése

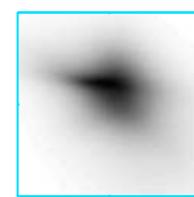
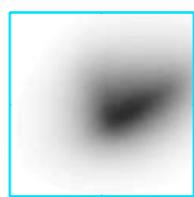
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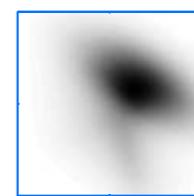
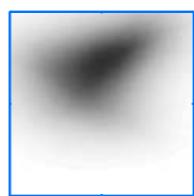
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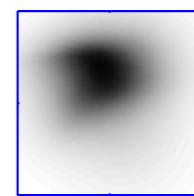
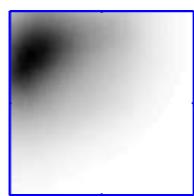
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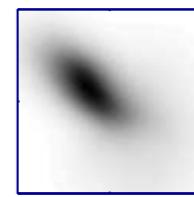
Subject 8



Subject 9

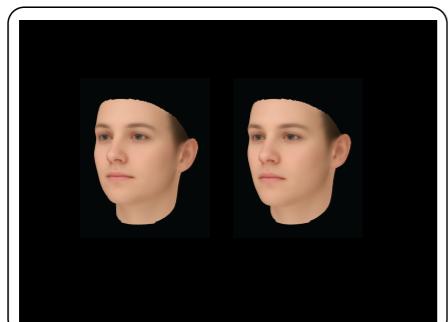


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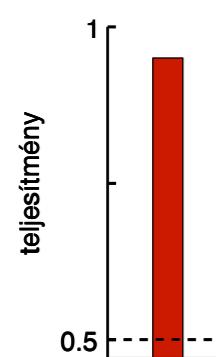
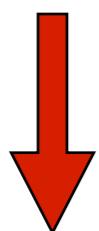


# Döntések jóslása

## ISMERŐSSÉG

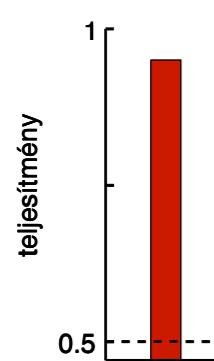
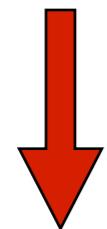
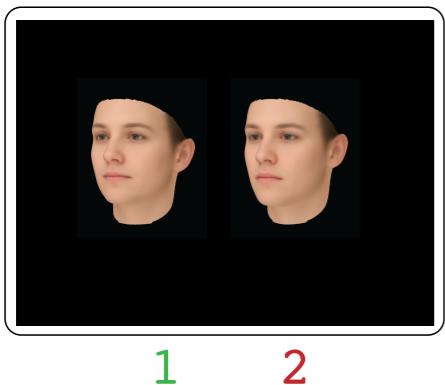


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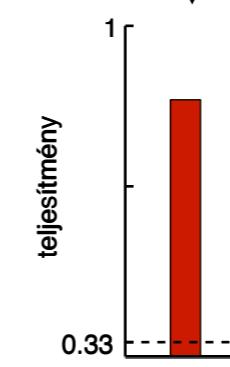
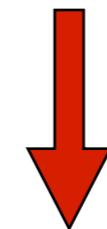
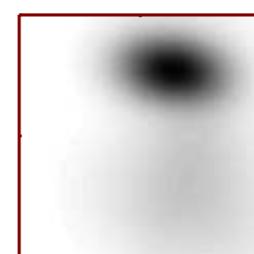
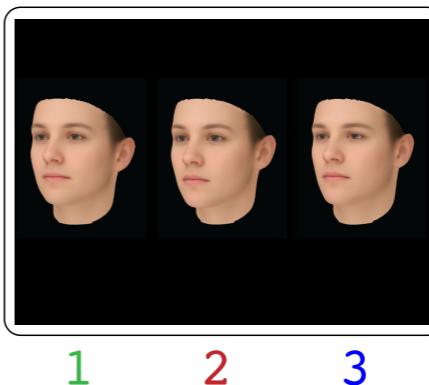


# Döntések jóslása

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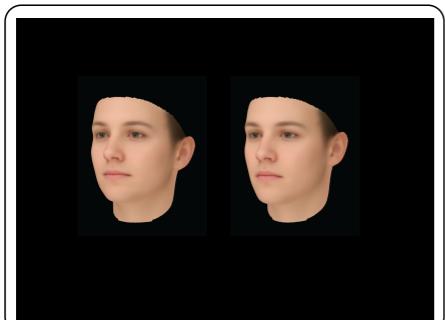


BÖKJ-A-NEMODAILLÓRE

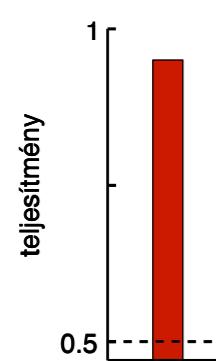
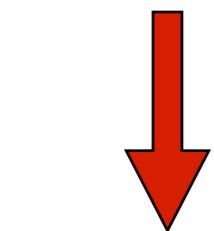
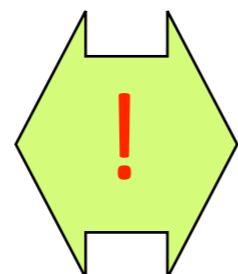
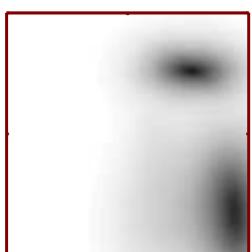


# Döntések jóslása

ISMERŐSSÉG



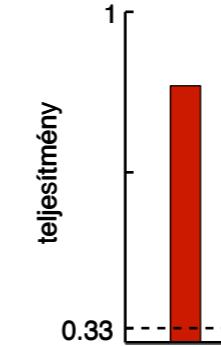
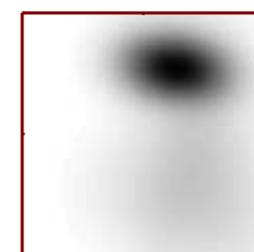
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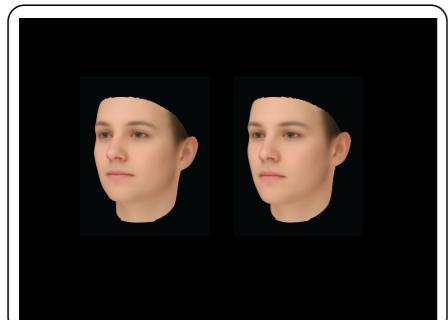


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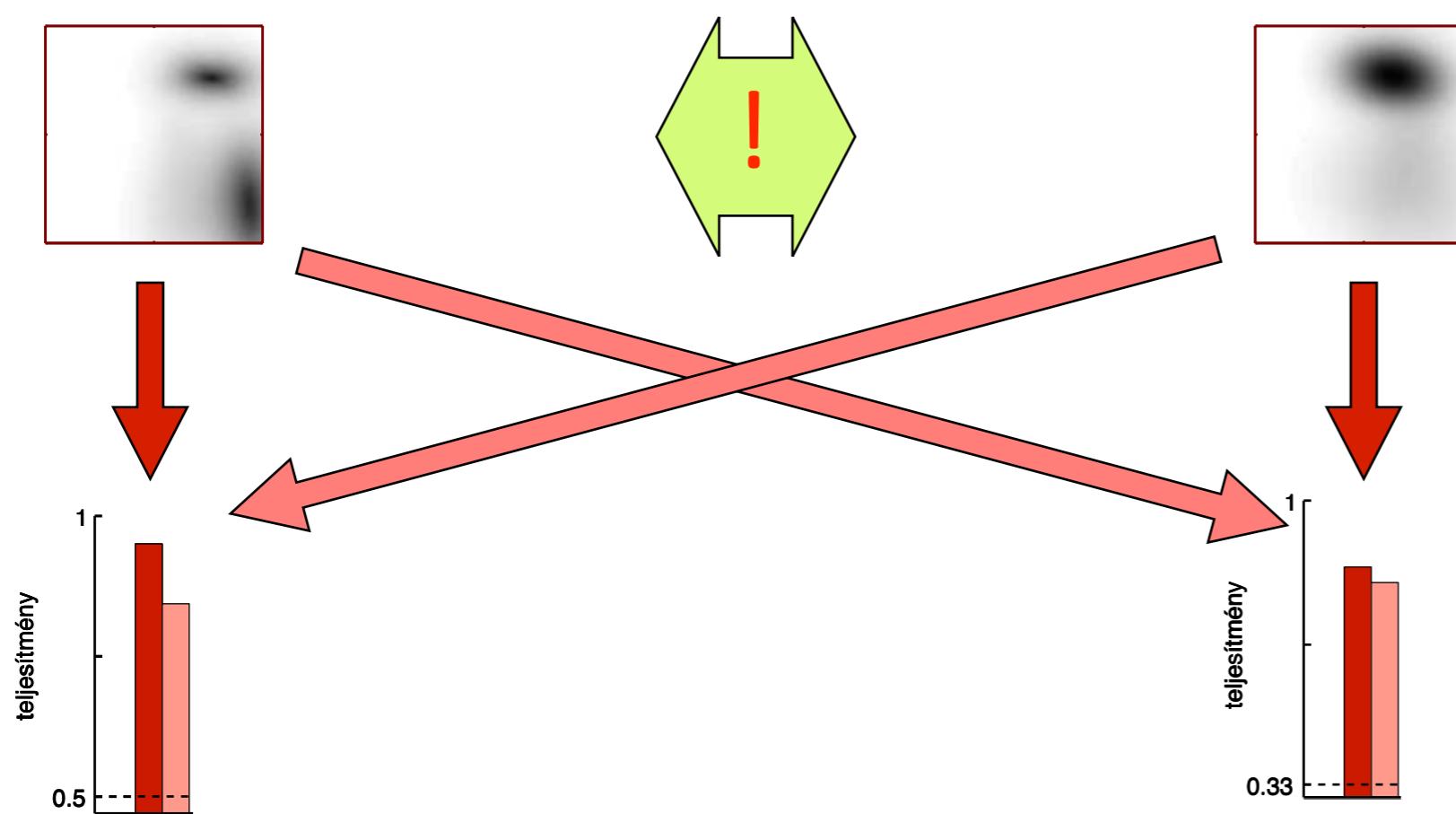
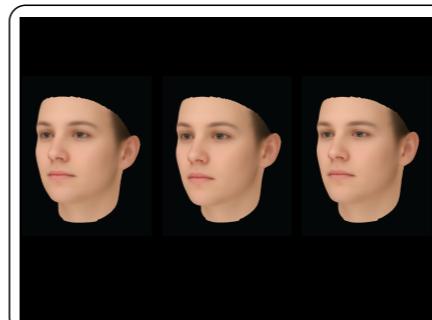


# Döntések jóslása

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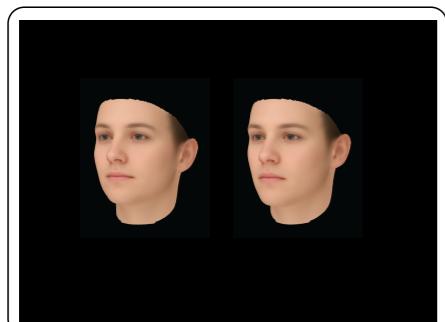


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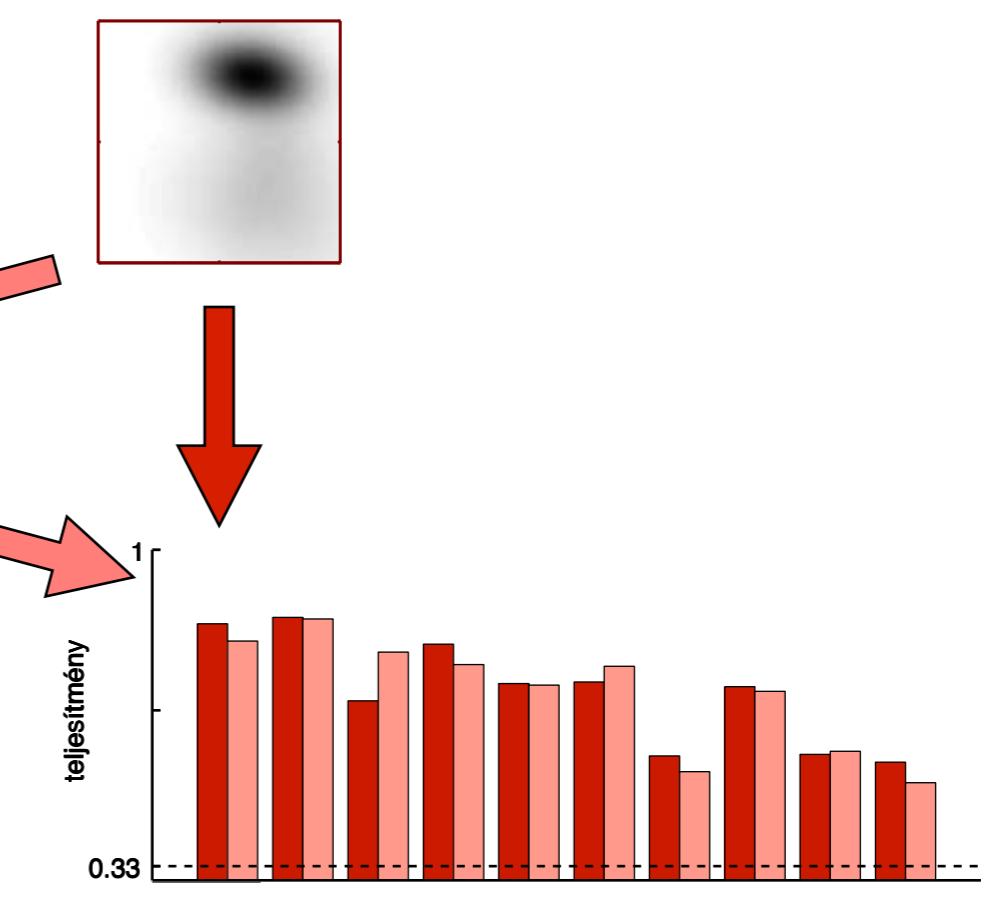
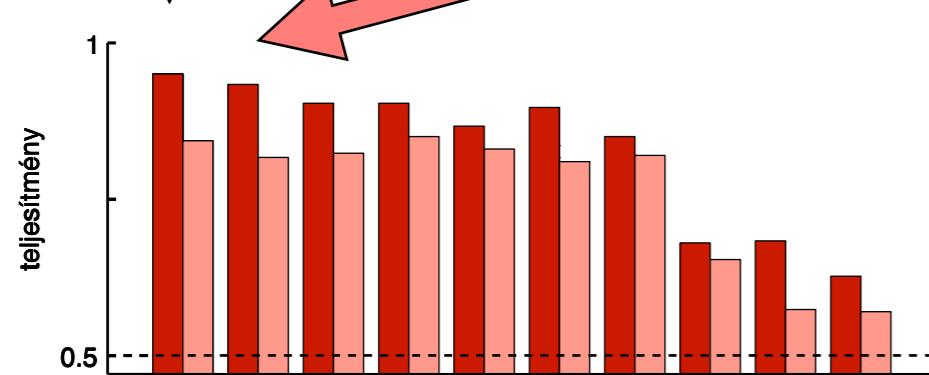
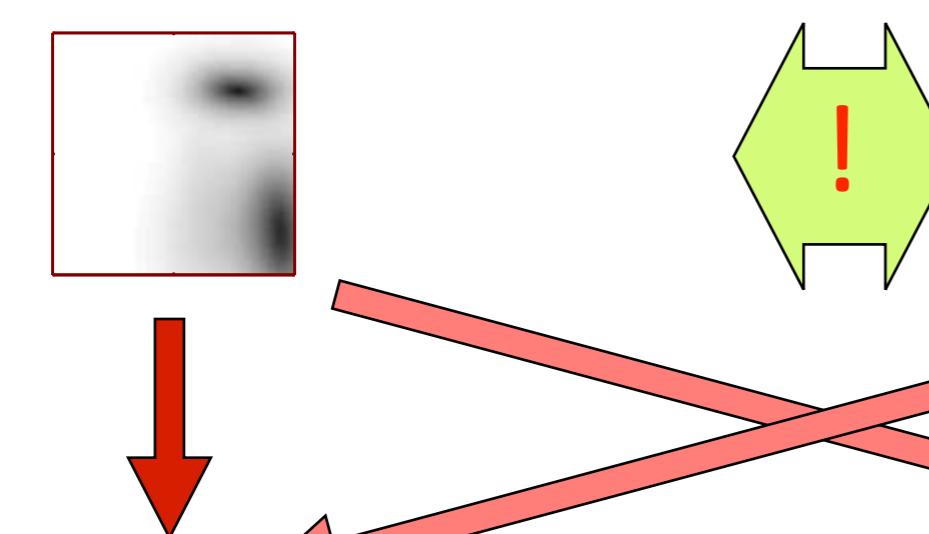
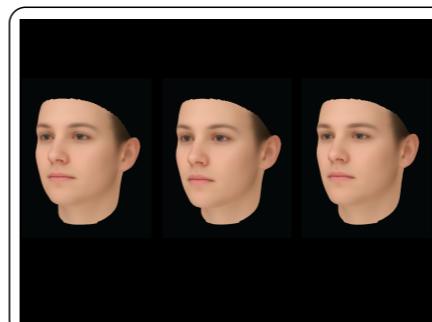


# Döntések jóslása

ISMERŐSSÉG



BÖKJ-A-NEMODAILLÓRE



# S egy hazavihető tanulság



az agy a külvilág értelmezésekor automatikusan *felépíti*, és  
— ha szeretnénk, ha nem —  
*felhasználja* annak modelljét

# Együttműködők



Mohammed Ghassemi  
*MIT*



Neil Houlsby  
*University of Cambridge*



Ferenc Huszár  
*University of Cambridge*



Máté Lengyel  
*University of Cambridge*



Daniel Wolpert  
*University of Cambridge*