

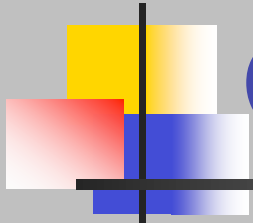
Dezvoltarea de Jucatori Virtuali cu  
Caracteristici Umane pentru Jocuri  
Formative cu Ajutorul Arhitecturii Cognitive  
ACT-R

Ion Juvina  
Department of Psychology  
Carnegie Mellon University



# Prezentare personala

- Produs al scolii romanesti de psihologie
  - Prima generatie: 1990 - 1995
    - Licenta: Eroarea umana in sistemele sociotehnice
  - Autoritatea Feroviara Romana
    - Ergonomie cognitiva si fiabilitate umana
  - Institutul de Medicina Aeronautica
    - Psihodiagnostic, selectie
  - Ministerul de Interne
    - Psihologie organizationala
  - Institutul de Psihologie
    - Sisteme de Instruire pe Web
- Universitatea din Utrecht
  - Interactiunea om-calculator
- Universitatea Carnegie Mellon
  - Modelare cognitiva



# Cuprins

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- Navigare si cautare in spatii informationale
  - Deficiente senzoriale si cognitive
- Control cognitiv inhibitor
  - Controlul impulsurilor, dependenta
- Gandire strategica in Teoria Jocurilor
  - Optimizare comportament prosocial



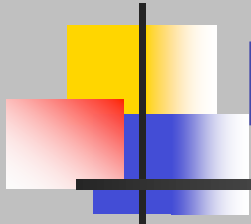
# Arhitectura cognitiva ACT-R

- Integrata
  - Module sezorio-motorii si cognitive
- Mixta
  - Simbolica si subsimbolica
- Robusta
  - IA, LISP
- Plauzibila din punct de vedere biologic

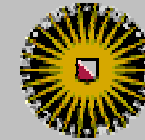


# De ce modelele cognitive

- Mediatoare între
  - Teorie și datele empirice
  - Teorie și aplicații informatice
- Promovează comunicarea
  - Intra- și interdisciplinară
- Testare
  - Înlocuitori de subiecți umani
- Aplicații informatice
  - Modelarea utilizatorului și a expertului



# Navigare si cautare



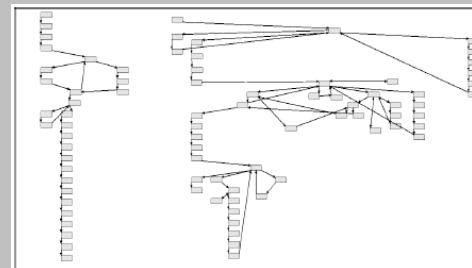
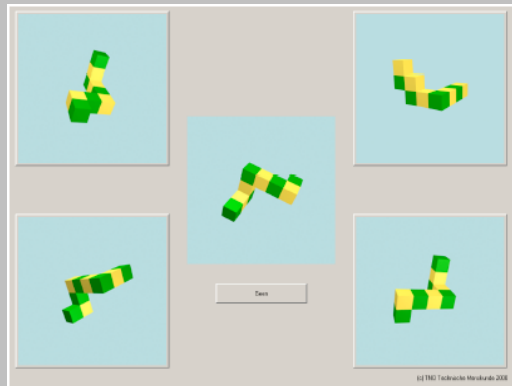
Universiteit Utrecht

- Spatiile informationale
  - Structura si continut
- Utilizatorii
  - Abilitati spatiale si semantice
- Revizitare, contexte, incarcare informationala

Juvina, I., Oostendorp, H. van, Karbor, P., & Pauw, B. (2005). *Toward Modeling Contextual Information in Web Navigation*. Paper presented at the The XXVII Annual Conference of the Cognitive Science Society, Stresa, Italy.

# Abilitati spatiale si semantice

- necesare pentru navigarea structurilor informationale



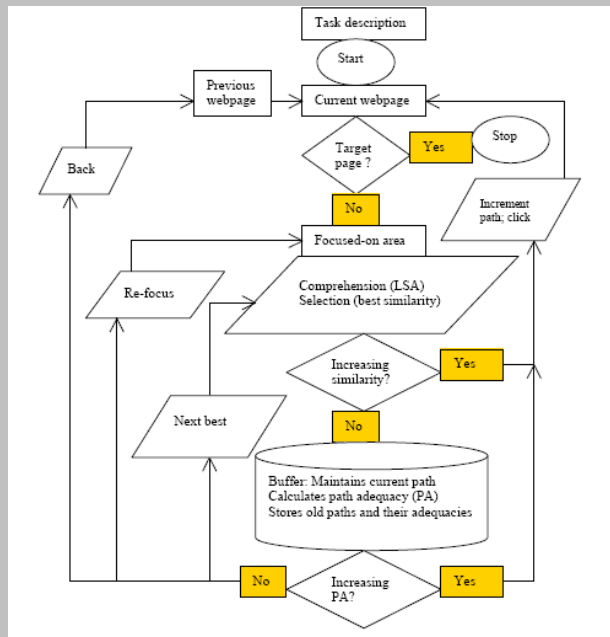
Study	Correlation coefficient (r)	Significance (p)	Number of participants
Individual differences	0.494	0.005	30
Voice suggestions	0.682	0.005	15 (control condition)
VIP	0.564	0.023	16 (control condition)

Task outcome	R square	Predictors	Beta
Performance	0,39	Spatial ability	0,496
		Finance expertise	0,385

Variables	Correlation coefficient (r)	Significance (p)	Number of participants
Spatial ability - re-visits	-0.442	0.014	30
Spatial ability - back button	-0.426	0.019	30
Spatial ability - fan degree	-0.427	0.019	30

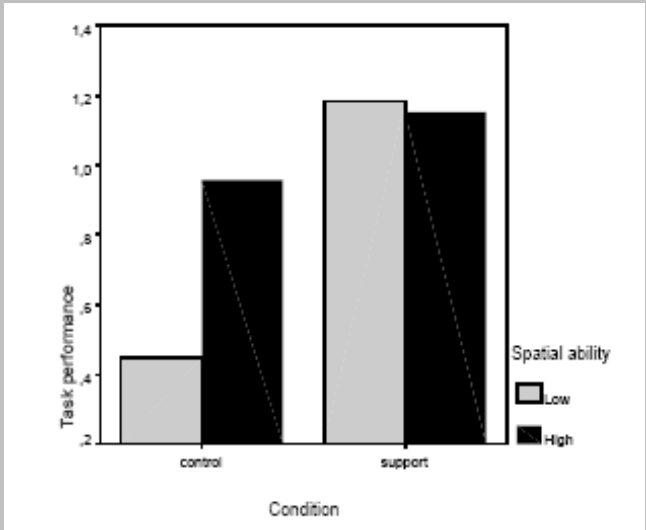
# Colides+ & IONS-VIP

- Modele cognitive genereaza sugestii de navigare



**Table of Contents:**

- > Introduction to How Coffee Works
- > [Catching the Buzz](#)
- > [The Bean Belt](#)
- > [Coffee Varieties](#)
- > [Red Cherry to Green Bean](#)
- > [Processing Cherries](#)
- > [Pop, Pop](#)
- > [Everyday Alchemy](#)
- > [Good to the Last Drop](#)
- > [Coffee Around the World](#)
- > [Lots More Information](#)
- > [Shop or Compare Prices](#)



Juvina, I. & Oostendorp, H. van (2005b). Cognitive Model Working Alongside the User. In J. McEwan, J. Gulliksen & D. Benyon (Eds.), *People and Computers XIX- The Bigger Picture* (pp. 409-420). London: Springer Verlag.





# Aplicatii

- Asistarea utilizatorilor cu deficiente
  - Perceptive
    - E.g., Vedere
  - Cognitive
    - E.g. Atentie, Memorie



# Publicatii

Juvina, I. (2007). *IONS-VIP: a cognitive model for navigating the web via screen readers*. Paper presented at the fourth annual conference of RoCHI, Constanta, Romania.

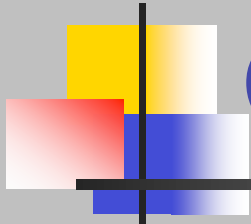
Juvina, I., & van Oostendorp, H. (2008). Modeling semantic and structural knowledge in Web navigation. *Discourse Processes*, 45(4), 346-364.

Van Oostendorp, H., & Juvina, I. (2007). Using a cognitive model to generate Web navigation support. *International Journal of Human-Computer Studies*, 65(10), 887-897.

Juvina, I., & van Oostendorp, H. (2006). Individual differences and behavioral metrics involved in modeling web navigation. *Universal Access in Information Society*, 4, 258–269.

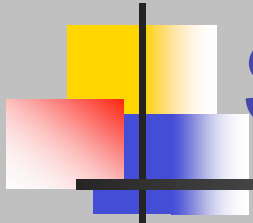
Juvina, I., & van Oostendorp, H. (2006). Enhancing internet experience of visually impaired persons by means of dynamic highlighting and selective reading. *Information Design Journal*, 14(1), 71-81.

Juvina, I., & Herder, E. (2005). *The impact of link suggestions on user navigation and user perception*. The Tenth International Conference on User Modeling, Edinburgh. (Best paper award)



# Control inhibitor

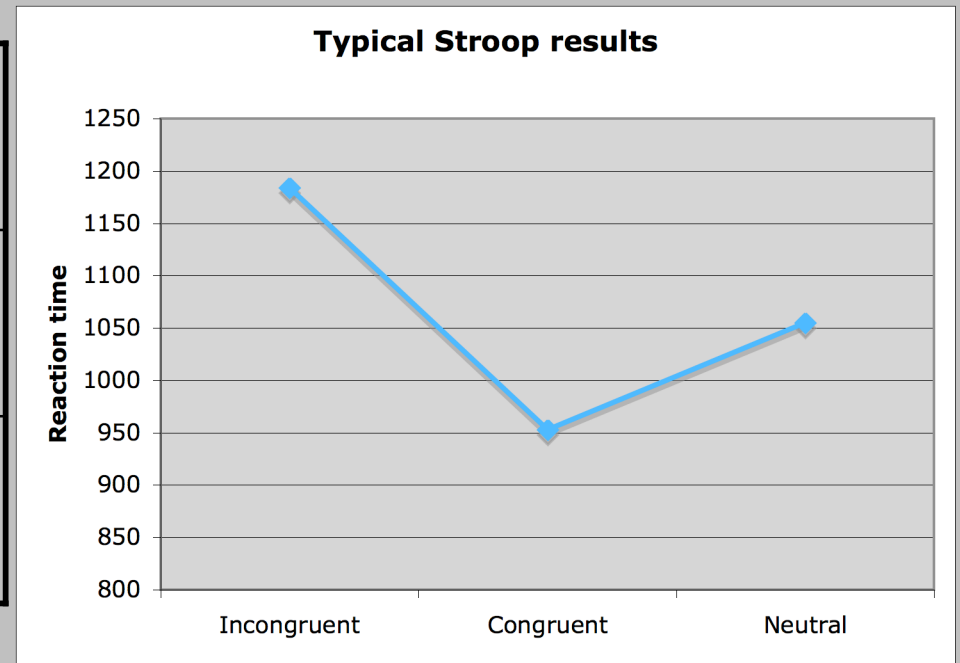
- Probe tipice de control inhibitor:
  - Go-NoGo, Stop signal (SSRT index clinic al controlului inhibitor), WCST, Stroop, RNG, Task switching (n-2 backward inhibition).
- Dezbateri
  - Inhibitia este esentiala pentru controlul exec.
    - (Aron, 2007; Houghton & Tipper, 1996)
    - Latenta necesara celorlalte functii executive (Barkley, 1997)
  - Inhibitia nu este necesara
    - (Egner & Hirsch, 2005; MacLeod, Dodd, Sheard, Wilson, & Bibi, 2003)



# Stroop

- Efecte la nivel de item

Incongruent	RED RED BLUE
Congruent	RED RED BLUE
Neutral	RED DESK BLUE

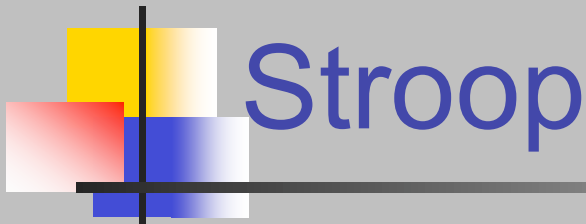




# Stroop

- Efecte la nivel de secvente de itemi

	Item anterior	Item actual	TR
W-C	<b>ROSU</b>	<b>VERDE</b>	Creste
C-W	<b>ROSU</b>	<b>GALBEN</b>	Scade
C-C	<b>ROSU</b>	<b>ALBASTRU</b>	Creste
W-W	<b>ALBASTRU</b>	<b>ALBASTRU</b>	Scade

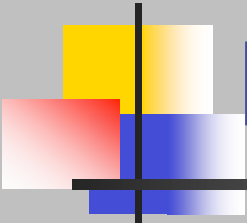


## ■ La nivel de Item si Secventa

All between-trial effects and their interactions.

No.	Repetition ID	Previous trial type	Current trial type	Previous stimulus	Current stimulus
1	WC-inc-inc	Incongruent	Incongruent	YELLOW (red)	GREEN (yellow)
2	WC-inc-neu	Incongruent	Neutral	BLUE (green)	DESK (blue)
3	CW-inc-inc	Incongruent	Incongruent	BLUE (yellow)	YELLOW (red)
4	CW-neu-inc	Neutral	Incongruent	SIDE (blue)	BLUE (green)
5	CC-inc-inc	Incongruent	Incongruent	GREEN (yellow)	BLUE (yellow)
6	CC-inc-neu	Incongruent	Neutral	BLUE (yellow)	PART (yellow)
7	CC-neu-inc	Neutral	Incongruent	TABLE (green)	BLUE (green)
8	CC-neu-neu	Neutral	Neutral	SCREEN (yellow)	ACTION (yellow)
9	WW-inc-inc	Incongruent	Incongruent	BLUE (green)	BLUE (yellow)
10	WW-neu-neu	Neutral	Neutral	ORDER (green)	ORDER (blue)
11	WC-CW-inc-inc	Incongruent	Incongruent	YELLOW (red)	RED (yellow)
12	WC-CC-cgr-inc	Congruent	Incongruent	RED (red)	BLUE (red)
13	WC-CC-cgr-neu	Congruent	Neutral	GREEN (green)	LOOK (green)
14	WC-WW-inc-cgr	Incongruent	Congruent	BLUE (yellow)	BLUE (blue)
15	CW-CC-inc-cgr	Incongruent	Congruent	GREEN (blue)	BLUE (blue)
16	CW-CC-neu-cgr	Neutral	Congruent	TABLE (green)	GREEN (green)
17	CW-WW-cgr-inc	Congruent	Incongruent	BLUE (blue)	BLUE (green)
18	CC-WW-inc-inc	Incongruent	Incongruent	YELLOW (blue)	YELLOW (blue)
19	CC-WW-neu-neu	Neutral	Neutral	ACTION (red)	ACTION (red)
20	REP-cgr-cgr	Congruent	Congruent	GREEN (green)	GREEN (green)

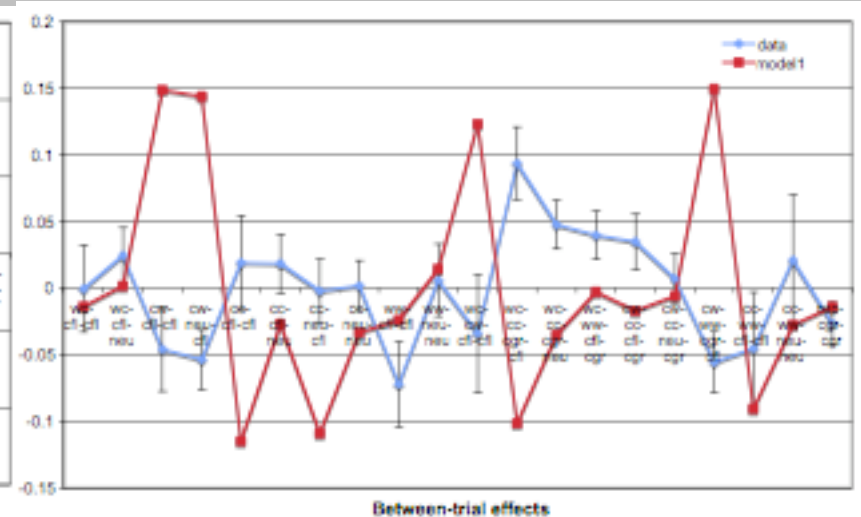
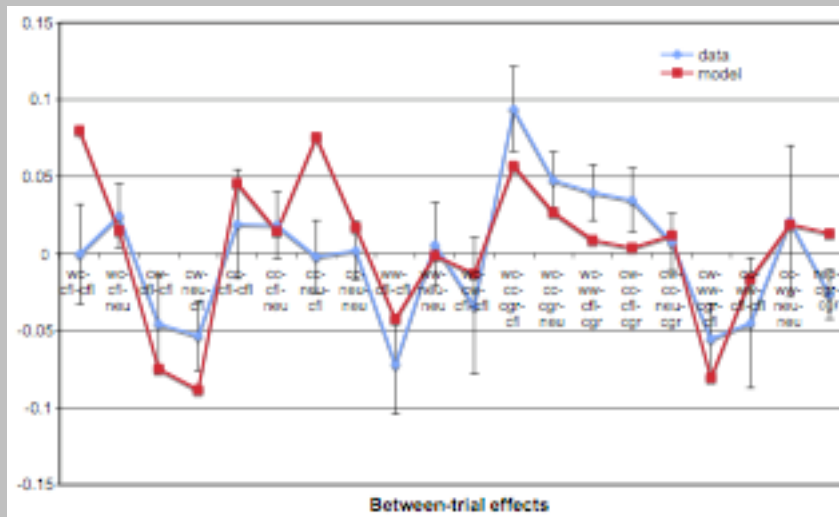
Note. The repetition ID is an acronym in which W = Word, C = Color, inc = Incongruent, cgr = Congruent, neu = Neutral, and REP = Repeat.



# Model cognitiv al Stroop

Cu inhibitie

Fara inhibitie





# Aplicatii

- Inhibitie si formarea comportamentului pro-social
  - Performanta la Stroop coreleaza cu capacitatea de a rezista impulsului de a exprima opinii inadecvate social (Hippel & Gonsalkorale, 2005).
- ADHD
  - Copii cu ADHD au performante slabe la Stop signal, Go-NoGo (Schachar et al., 2007)
  - Dimensiune scazuta/crescuta a creierului in RIFC (Durston et al., 2004)
- Dependente
  - Stimularea electrica a creierului creste abilitatile de inhibare (Isoda & Hikosaka, 2007)
- Traumatism cranian (TBI) in zona lobilor frontali
  - Pacientii cu TBI au simptome de tip ADHD (Barkley, 1997)





# Publicatii

Juvina, I., & Taatgen, N. A. (2009). A repetition-suppression account of between-trial effects in a modified Stroop paradigm. *Acta Psychologica*, 131(1), 72-84.

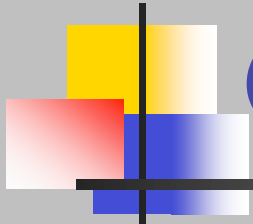
Taatgen, N.A., Juvina, I., Schipper, M., Borst, J., & Martens, S. (2009). Too much control can hurt: A threaded cognition model of the attentional blink. *Cognitive Psychology*, 59, 1-29.

Juvina, I., & Taatgen, N.A. (2009). *Adding distractors improves performance by boosting top-down control*. Paper presented at The Annual Conference of the Cognitive Science Society, Amsterdam, The Netherlands. (acceptance rate 32%)

Juvina, I., & Taatgen, N. A. (2007). *Modeling control strategies in the N-Back task*. Proceedings of the eight International Conference on Cognitive Modeling (pp. 73-78). New York: Psychology Press.

Juvina, I., (under review). Cognitive Control: componential and yet emergent. *Topics in Cognitive Sciences*.

Juvina, I, (submitted). Neural substrates of inhibitory control: a review and critique. *Revista de Psychologie*.

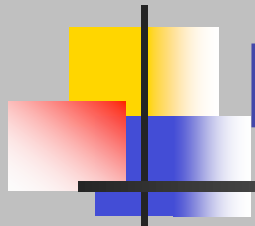


# Gandire strategica in jocuri

- Teoria Jocurilor = studiul luarii deciziilor strategice interactive de catre subiecti rationali
  - Exemplu: Dilema Prisonierului

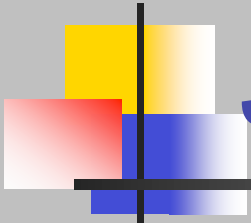
		Jucator2	
		C	D
Jucator1	C	1/1	-4/4
	D	4/-4	-1/-1

- Rezultatul DD este in echilibru Nash
  - Rezultatul CC este Pareto optimal
- Fundamentare cognitiva si afectiva a teoriei jocurilor
  - Rezultatele empirice nu confirma intotdeauna predictiile Teoriei Jocurilor
  - Rationalitate limitata



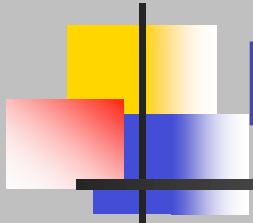
# Decizii din experienta

- Dilema Prisonierului fara matrice
  - Nivel de cooperare foarte scazut
  - Model cognitiv bazat pe principiile memoriei
    - Experientele recente si frecvente afecteaza estimarile de probabilitati
      - Jucatorii nu pot depasi experientele recente si frecvente de tradare
    - Matricea ofera estimari initiale fara bias



# Jocul IPD<sup>2</sup>

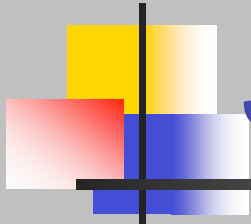
- Dilema prizonierilor intre grupuri cu jocuri de putere intra grupuri
  - Motivare
    - Validitate ecologica
    - Decizii din experienta
    - Complexitate si zgomot previn fixarea pe un anumit rezultat



# Echipe

- Sunt 2 echipe
  - Echipa-F si
  - Echipa-G

Echipa	Jucator	Decizie	Putere	Scor Echipa	Scor Jucator	Scor total jucator
Echipa-F						
Echipa-G						



# Jucatori

- Repartizati pe echipe la intamplare.
  - In acest exemplu, participantul uman (G-YOU) este membru al echipei G

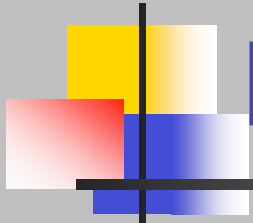
Echipe	Jucator	Decizie	Putere	Scor Echipe	Scor Jucator	Scor total jucator
Echipe-F	F-C					
	F-T					
Echipe-G	G-D					
	G-YOU					



# Decizii

- Fiecare jucator alege A sau B
  - Consecintele unei decizii depind de celelalte decizii

Echipa	Jucator	Decizie	Putere	Scor Echipa	Scor Jucator	Scor total jucator
Echipa-F	F-C	A				
	F-T	B				
Echipa-G	G-D	B				
	G-YOU	A				

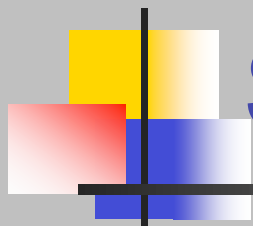


# Putere

- Doar decizia jucatorului la putere (in magenta) conteaza ca decizie a grupului

Echipa	Jucator	Decizie	Putere	Scor Echipa	Scor Jucator	Scor total jucator
Echipa-F	F-C	A	0.471			
	F-T	B	0.529			
Echipa-G	G-D	B	0.533			
	G-YOU	A	0.467			

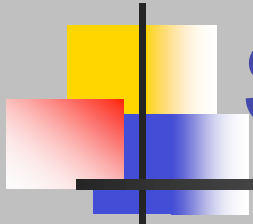




# Scorul echipei

- In functie de deciziile celor 2 echipe, una din cele 4 posibilitati:
  - $(-1, -1)$     $(4, -4)$     $(-4, 4)$     $(1, 1)$ .

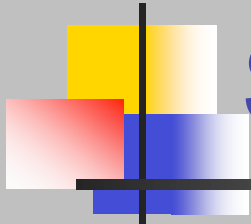
Echipe	Jucator	Decizie	Putere	Scor Echipe	Scor Jucator	Scor total jucator
Echipe-F	F-C			1		
	F-T					
Echipe-G	G-D			1		
	G-YOU					



# Scorul jucatorului

- Depinde de
  - Scorul echipei si puterea jucatorului
    - $Scor = (Scor\ echipa * Putere) / 100$

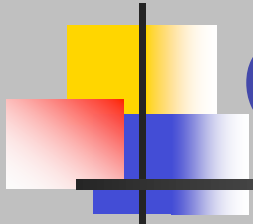
Echipe	Jucator	Decizie	Putere	Scor Echipa	Scor Jucator	Scor total jucator
Echipe-F	F-C		0.576	1	0.006	
	F-T		0.424		0.004	
Echipe-G	G-D		0.261	1	0.003	
	G-YOU		0.739		0.007	



# Scor total jucator

- Scor cumulative. In:
  - Rosu daca este negativ
  - Albastru daca este pozitiv

Echipa	Jucator	Decizie	Putere	Scor Echipa	Scor Jucator	Scor total jucator
Echipa-F	F-C		0.576	1	0.006	-0.097
	F-T		0.424		0.004	-0.093
Echipa-G	G-D		0.261	1	0.003	0.147
	G-YOU		0.739		0.007	0.303



## Cum se schimba puterea

- $Decizie_{jucator} = Decizie_{coleg}$ 
  - $Putere_{jucator} = Putere_{jucator} + r$
  - $Putere_{coleg} = Putere_{coleg} - r$
- $Decizie_{jucator} \neq Decizie_{coleg}$ 
  - $Putere_p = Putere_p + ScorEchipa/100$
  - $Putere_o = Putere_o - ScorEchipa/100$



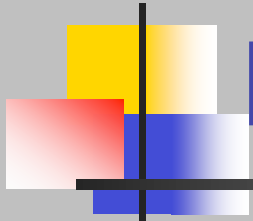
# Studiu empiric

- 68 participanti
  - Joaca impotriva unor strategii computerizate
- 1 joc de “incalzire”
  - 50 repetari
- 10 jocuri
  - 50 repetari pe joc



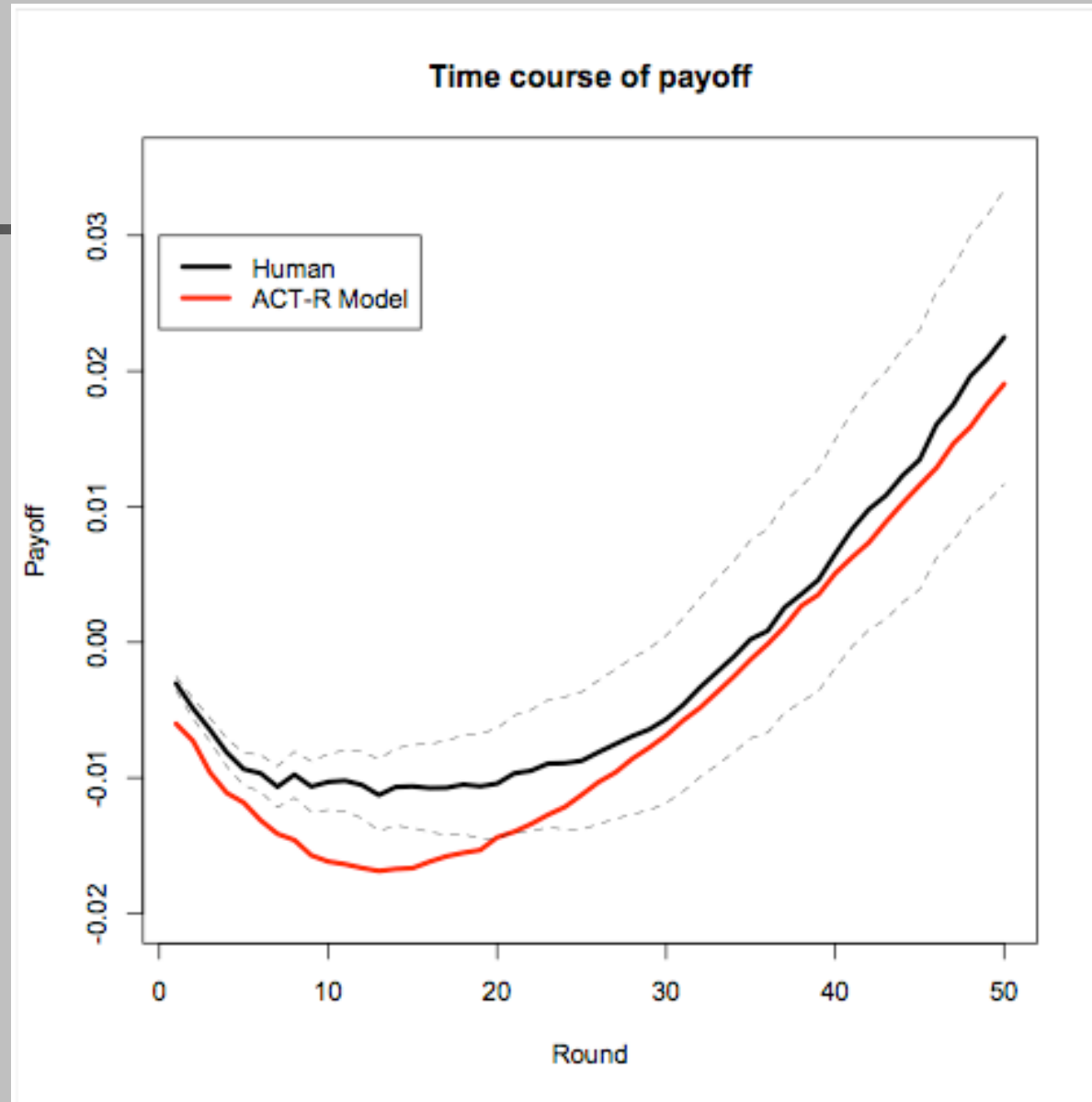
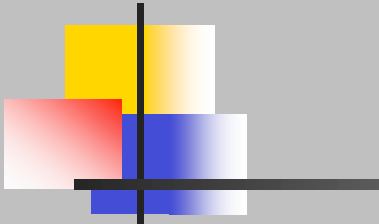
# Strategii

- Intotdeauna cooperare (C)
- Intotdeauna defectare (D)
- Ochi pentru ochi (Tit-for-tat)
- Caut-puterea
  - La putere: Ochi pentru ochi (Tit-for-tat)
  - In opozitie:
    - Consens intre echipe (scor simetric): C
    - Lipsa de consens (scor asimetric): D
- Exploatator
  - La putere: castig-continui, pierd-schimb
  - In opozitie: Caut-puterea

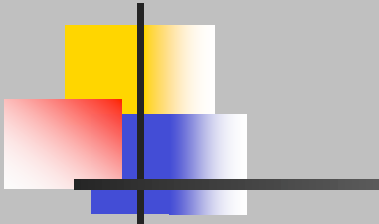


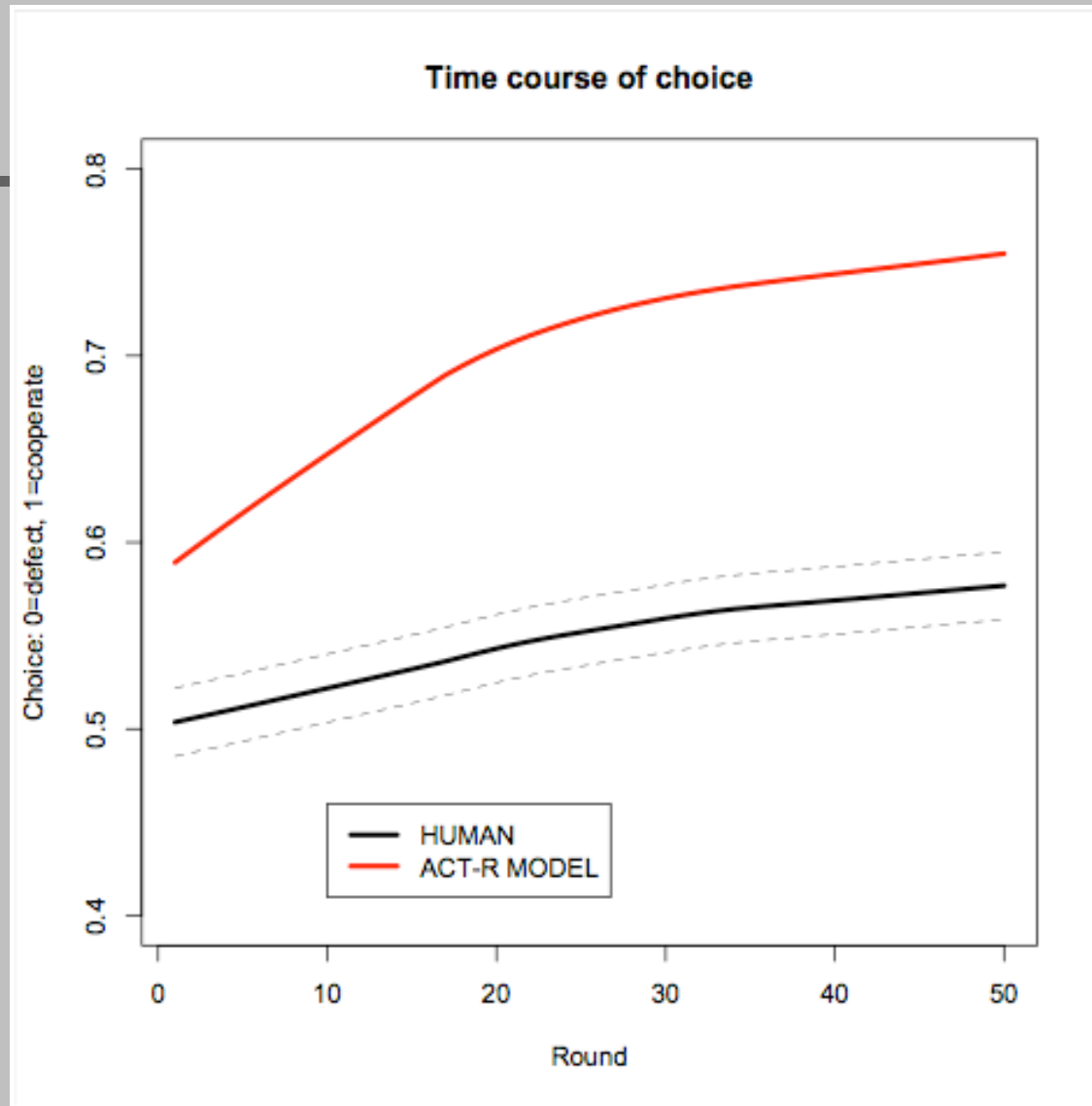
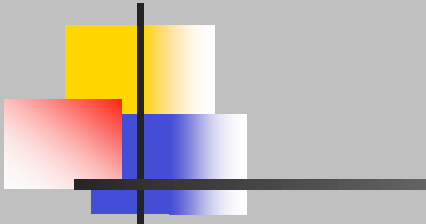
# Model cognitiv

- Invatare bazata pe instantieri
  - Gonzalez, Lerch & Lebiere, 2003
- Bazat pe memorie
  - Toate instantierile jocului sunt stocate in memorie
  - Activare si uitare
- Reguli de actiune:
  - Reamintire decizie din trecut in situatie actuala
  - Repeta decizia reamintita
  - Daca nu-ti amintesti, repeta decizia anterioara
  - Daca scorul este negativ, memoreaza decizia alternativa

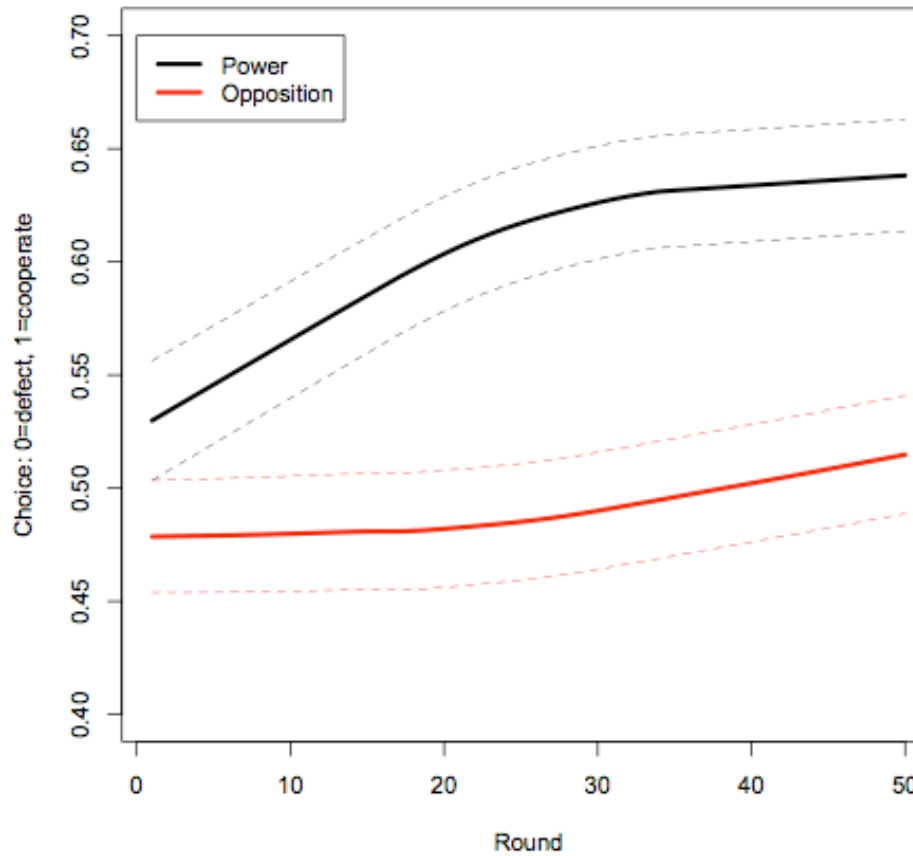




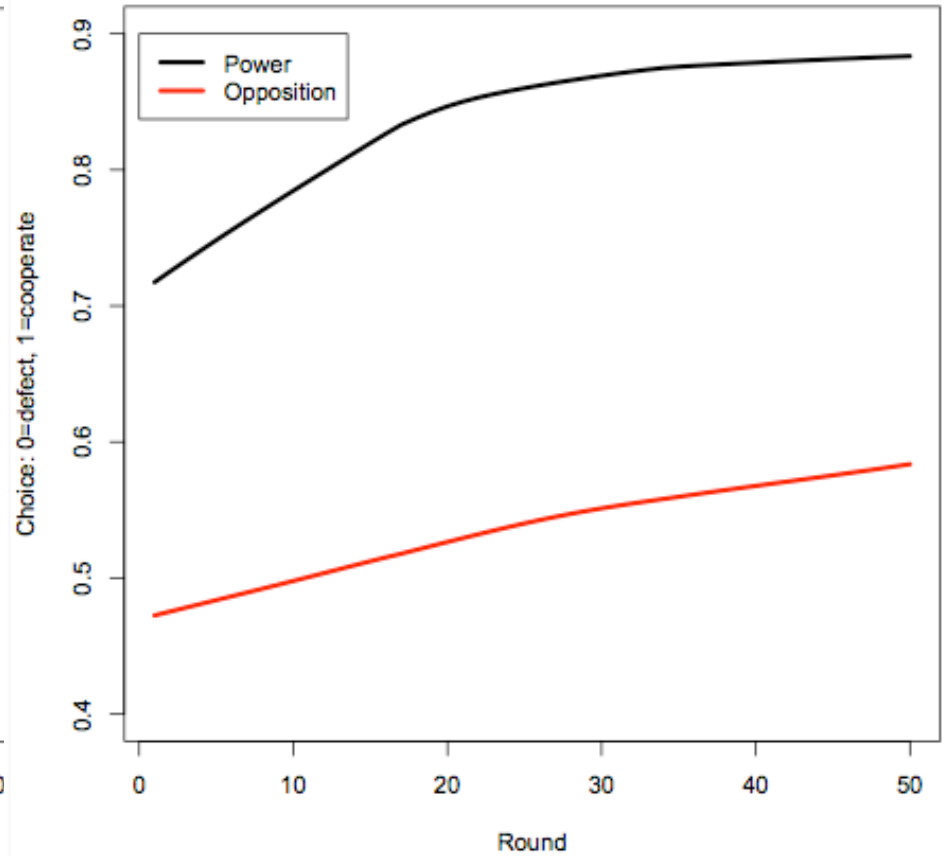


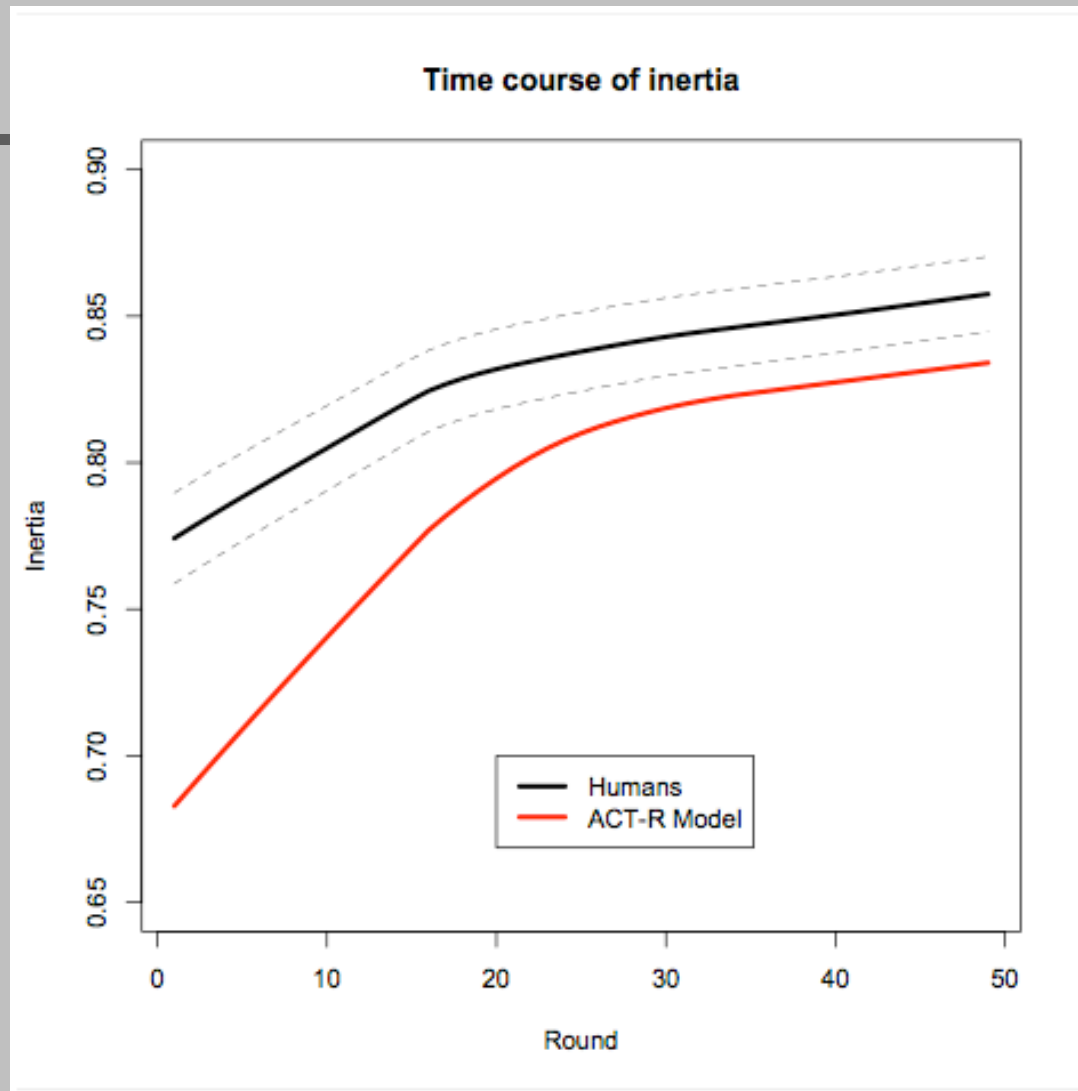
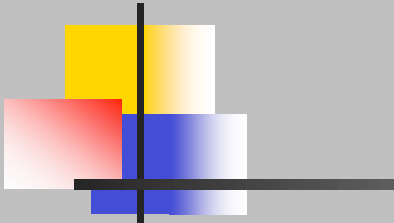


Time course of choice per power status (Humans)

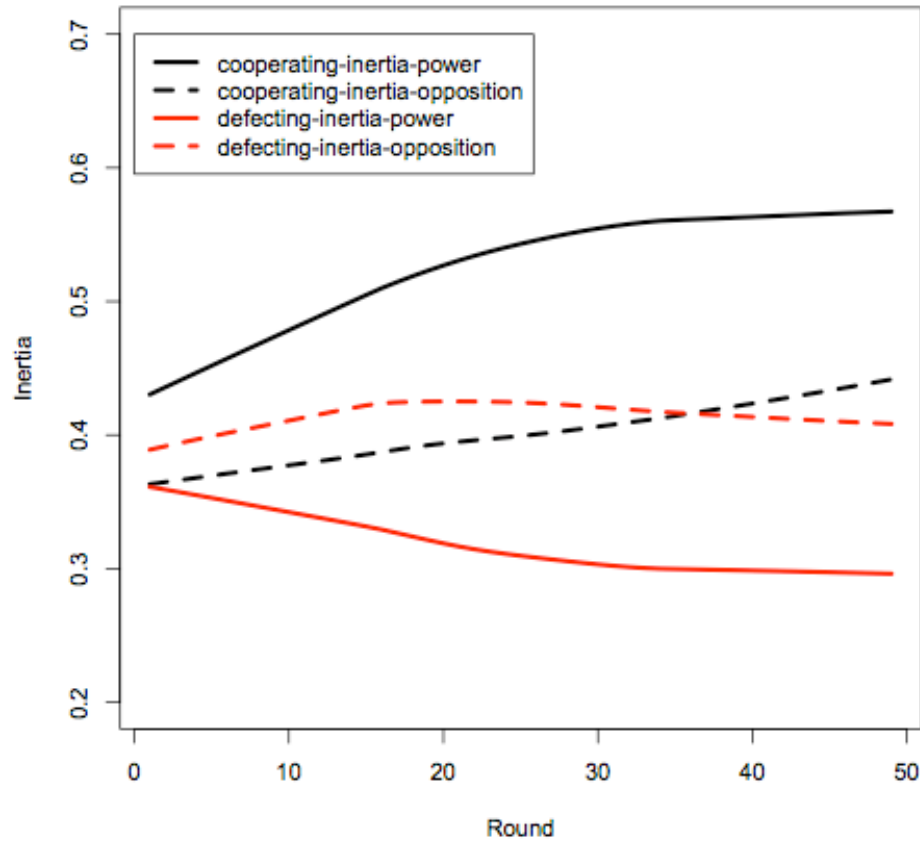


Time course of choice per power status (Model)

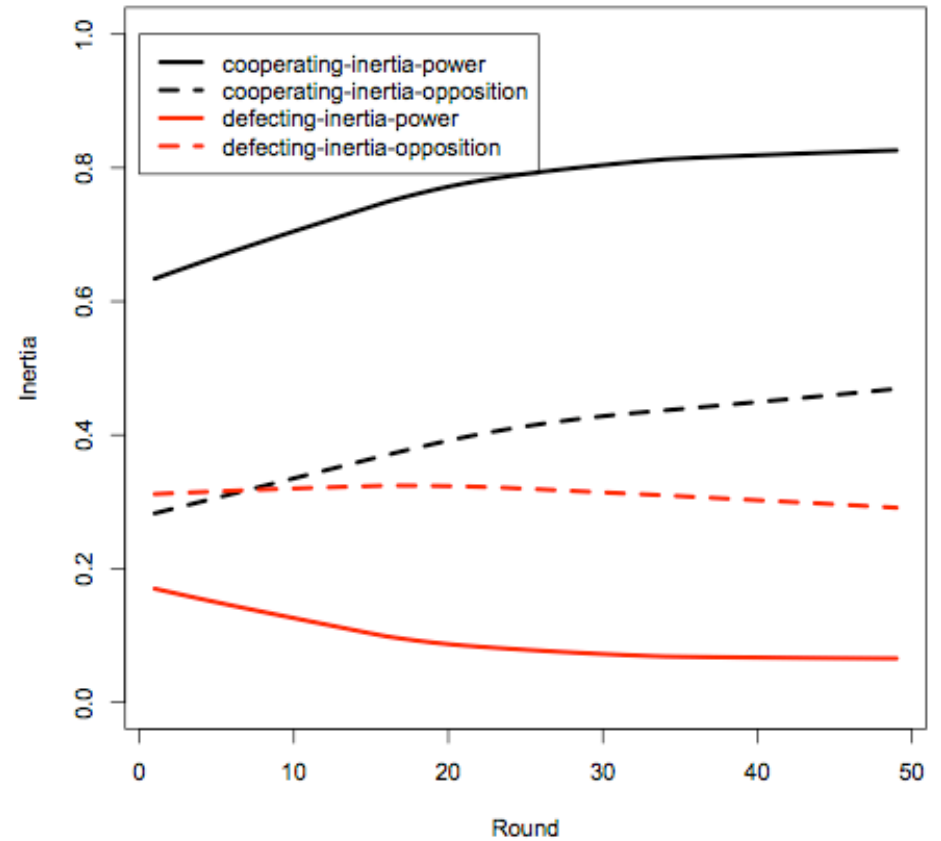




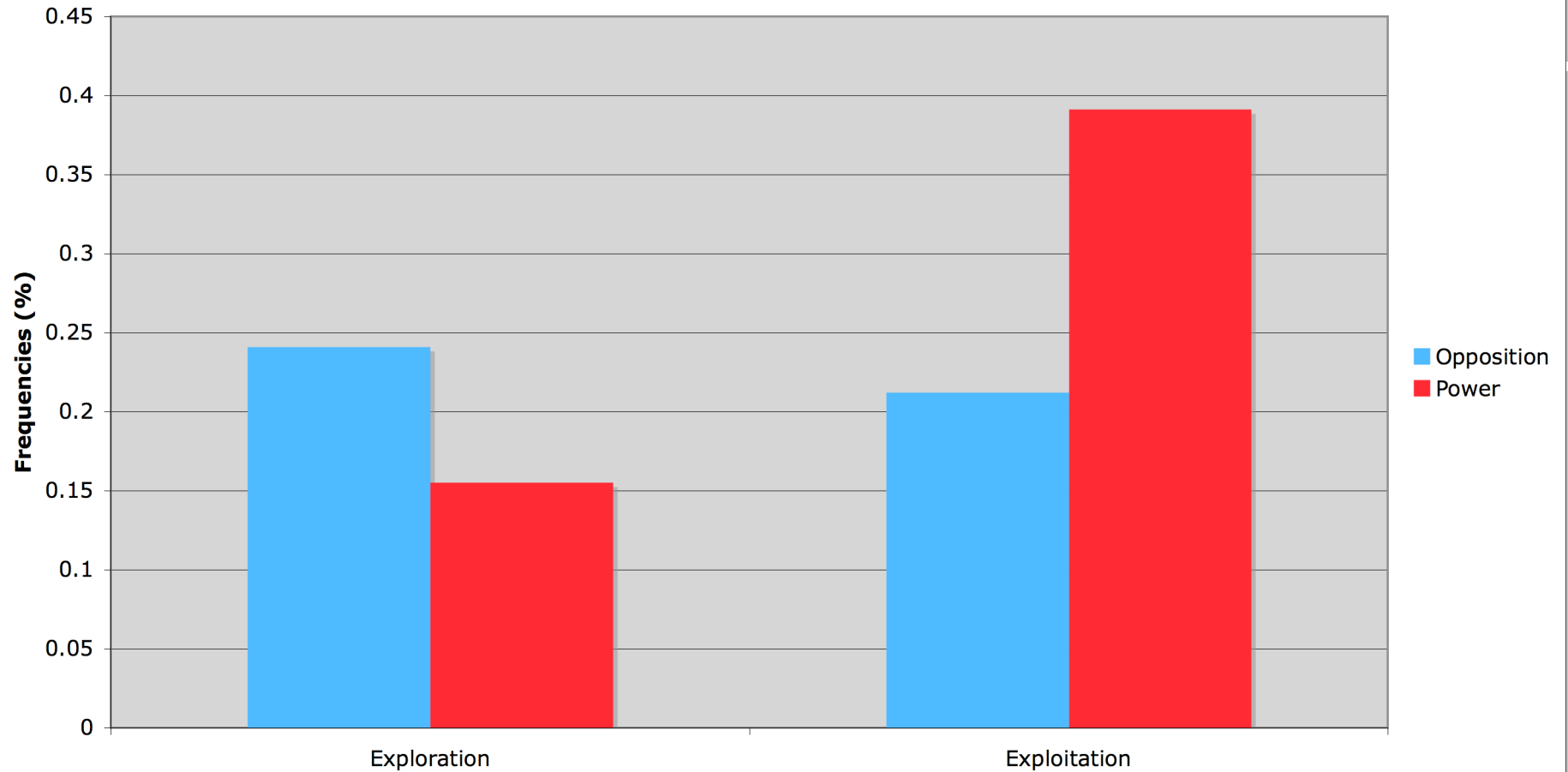
Time course of inertia: HUMANS



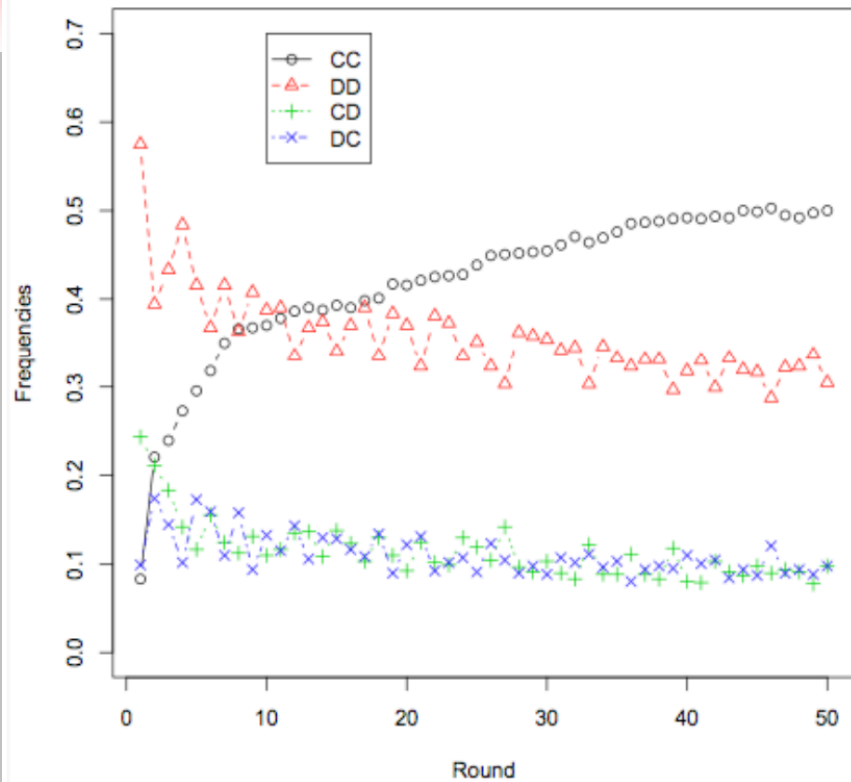
Time course of inertia: MODEL



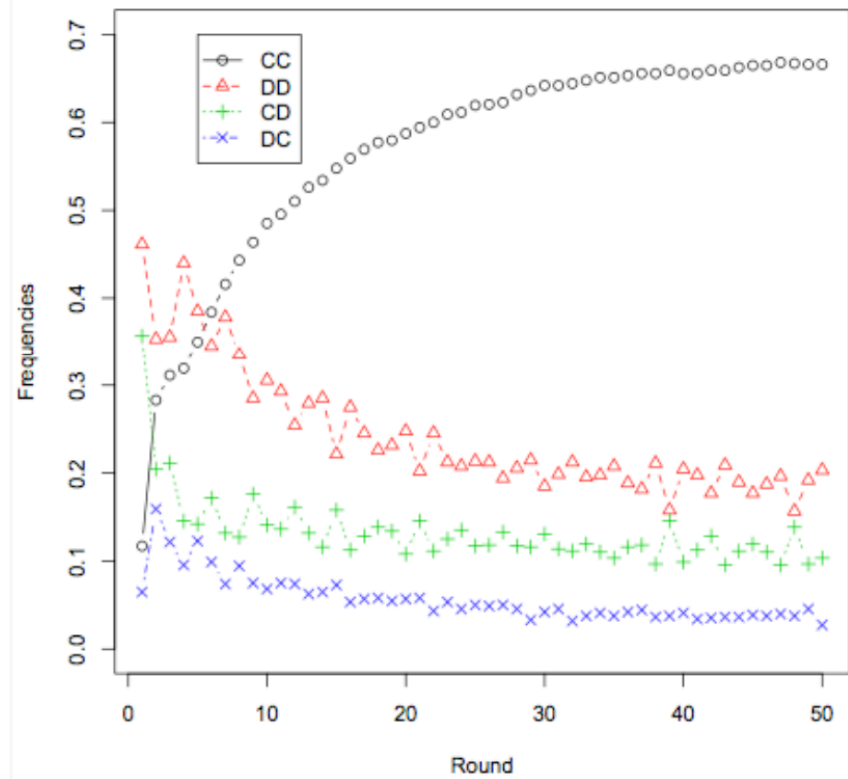
Exploration-Exploitation per power status

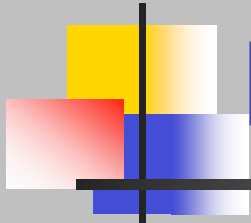


Time course of various outcomes (Humans)



Time course of various outcomes (Model)

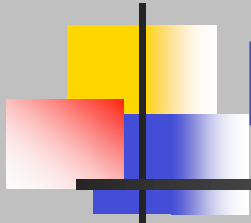




# Diferente inter-individuale

	Factor 1	Factor 2
Decizie in opozitie	-0.213	
Altruism	-0.198	-0.168
Extraversie	-0.128	-0.295
Agreabilitate	-0.334	
Constiinciozitate	-0.327	
Stabilitate Emotionala	-0.304	-0.228
Deschidere	-0.440	
Maximizare	-0.398	
Nevoia de Cognitione	-0.329	
Incredere		-0.302
Asumare riscuri	-0.226	0.174
Varsta		-0.462
Educatie		-0.295
Sex		0.491
Orientare politica	-0.232	0.368





# Diferente inter-individuale

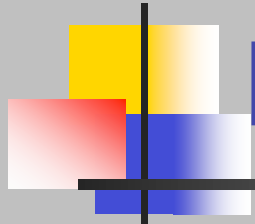
- Factor 1: Jucator emotional / impulsiv
- Factor 2: Jucator curajos si increzator

Dependent	Independent	Estimate	Std.Error	t.value	Pr(> t )
Putere	Factor 1	0.0025589	0.0025405	1.007	0.319
	Factor 2	-0.0007591	0.0028682	-0.265	0.792
Scor	Factor 1	0.0006417	0.0025080	0.256	0.799
	Factor 2	0.0063671	0.0028315	2.249	0.029 *
Decizie	Factor 1	-0.028434	0.012047	-2.360	0.0222 *
	Factor 2	-0.004097	0.013601	-0.301	0.7645
Decizie in opozitie	Factor 1	-0.03476	0.01257	-2.766	0.00793 **
	Factor 2	0.01263	0.01419	0.890	0.37780



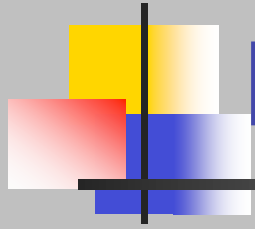
# Discutie

- Jucatorii umani se apropie de optimalitatea Pareto
- Totusi tendinta de a nu coopera (mai ales cand sunt in opozitie) este mai mare decat cea prezisa de modelul cognitiv
  - Posibile cauze:
    - Comportament explorativ
    - Instabilitate emotionala



## Posibile aplicatii

- Formare si optimizare a comportamentului prosocial
- Diagnoza a tendintelor asociale



# Mulumesc pentru atentie! :)

- Intrebari?
- ...
- ...
- ...
- Esti interesat de colaborare?
  - Email: [ijuvina@cmu.edu](mailto:ijuvina@cmu.edu)