evropský sociální fond v ČR
EVROPSKÁ UNIE
MINISTERSTVO ŠKOLSTVÍ, MLÁDEŽE A TĚLOVÝCHOVY
OP Vzdělávání pro konkurenceschopnost
INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Streamlining the Applied Mathematics Studies at Faculty of Science of Palacký University in Olomouc
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International Conference
Olomoucian Days of Applied Mathematics

ODAM 2013

Department of Mathematical analysis
and Applications of Mathematics
Faculty of Science
Palacký Univerzity Olomouc

Have psychology and mathematics anything in common?

Not much, but. . .

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Psychology as a quantifying science

- long-lasting tradition of attempts to measure psychological attributes
  - controversial
- psychometrics – test theory
  - exploratory and confirmatory factor analysis
  - Rasch models
  - item response theory models

Psychology as a science using qualitative methods

- Classification
  - e.g. well-grounded theory
- Diagramming
  - e.g. typical courses of behavior
- Analyses of text data
  - e.g. scoring of the verbal accounts
  - narrative analyses

Examples of the research paradigms

- Iowa Gambling Task
- Processes of Dyadic Interaction

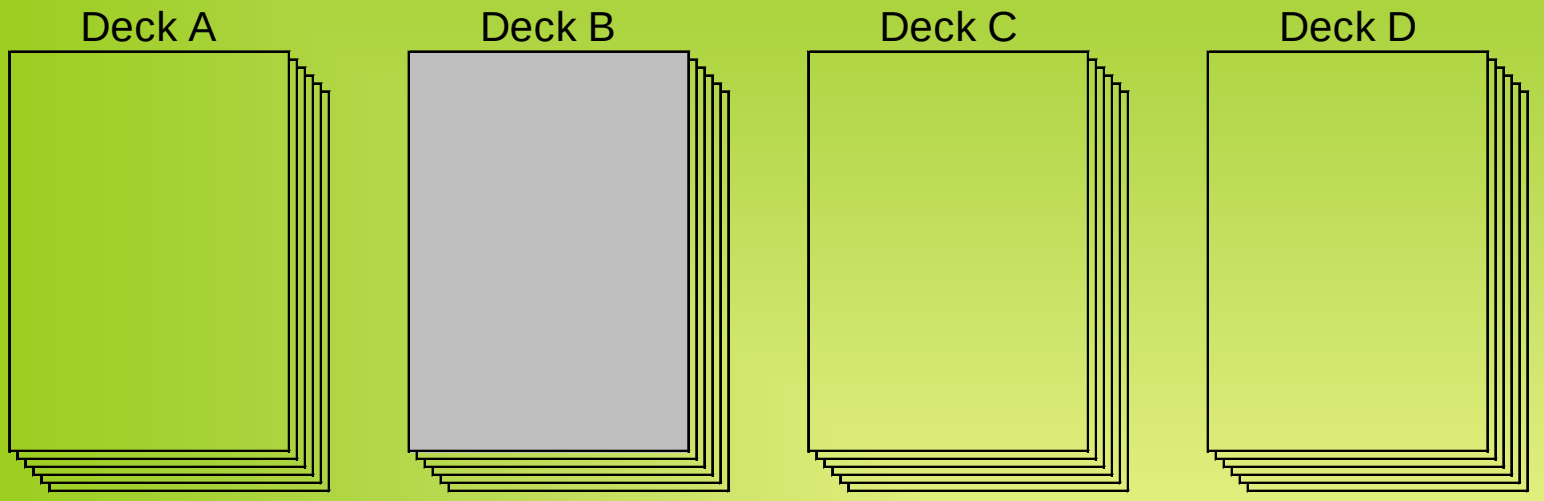
  – both suggest some application of
    - game theory
    - Markov decision processes
    - what else?

Iowa Gambling Task

- Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition*, 50, 7–15.

- simulation of the gambling card game
  - 4 decks 40 cards each
  - participant selects any card (100 times)
  - s/he knows that some decks are profitable

Iowa Gambling Task



Výhra: 100

Celkem: 550

Decks‘ characteristics

Average	Deck A	Deck B	Deck C	Deck D
Gain / Deck	$100	$100	$50	$50
Loss / 10 cards	$1250	$1250	$250	$250
Net / 10 cards	-$250	-$250	$250	$250
Reward / 10 cards	5	1	5	1

Traditional analysis

- too simple (simplistic) – just total score
  - (C + D) – (A + B)
  - both theoretical and methodological flaws

- need for more complex processing
  - expectancy-valence learning model
  - Bayesian-expected utility model
  - transition analysis

Expected valence model

(Busemeyer & Stout, 2002)

- Card selection ← interaction of 3 latent psychological processes
  - w – attention weight (to gains / losses) (0 ; 1)
    - different in normal / drug addicts
  - a – updating rate (rapid / slow forgeting) (0 ; 1)
    - memory deterioration
  - c – sensitivity (stability of reactions) (-5; 5)
    - fatigue, boredom, depletion

Equations

- $v_k(t) = (1 – w)\ W(t) + w\ L(t)$
  - valence of the deck *k* in time *t* with the reward W(t) and loss L(t)
- $Ev_k(t+1) = Ev_k(t) + a\ [v_k(t) – Ev_k(t)]$
  - expected valence of the deck *k* in time *t+1*
- $P[S_k(t+1)]=\exp[\theta(t)Ev_k] / \Sigma_{(i=1:4)}[\exp(\theta(t)Ev_i)]$
  - probability of the selection of the deck *k*
- $\theta(t)=(t/10)^c$

Transition analysis

Deck types

A	B	C	D	
		C	D	profitable
A	B			unprofitable
A		C		punitive
	B		D	nonpunitive

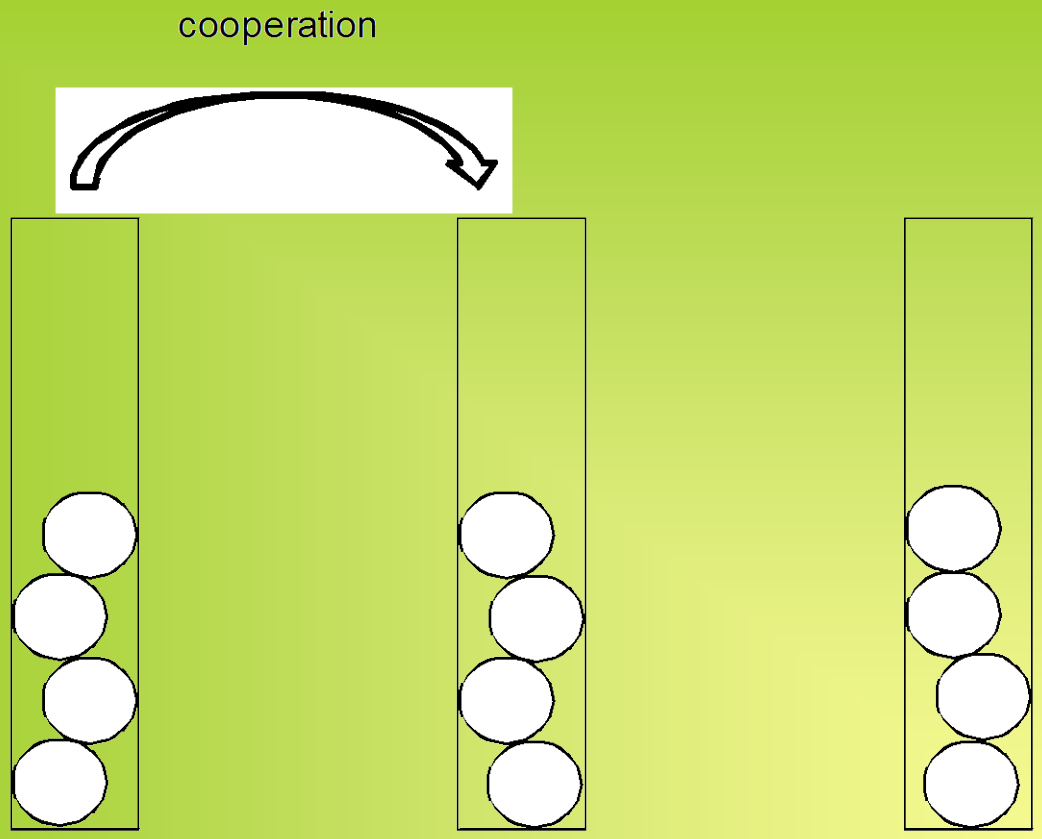
Transition matrix

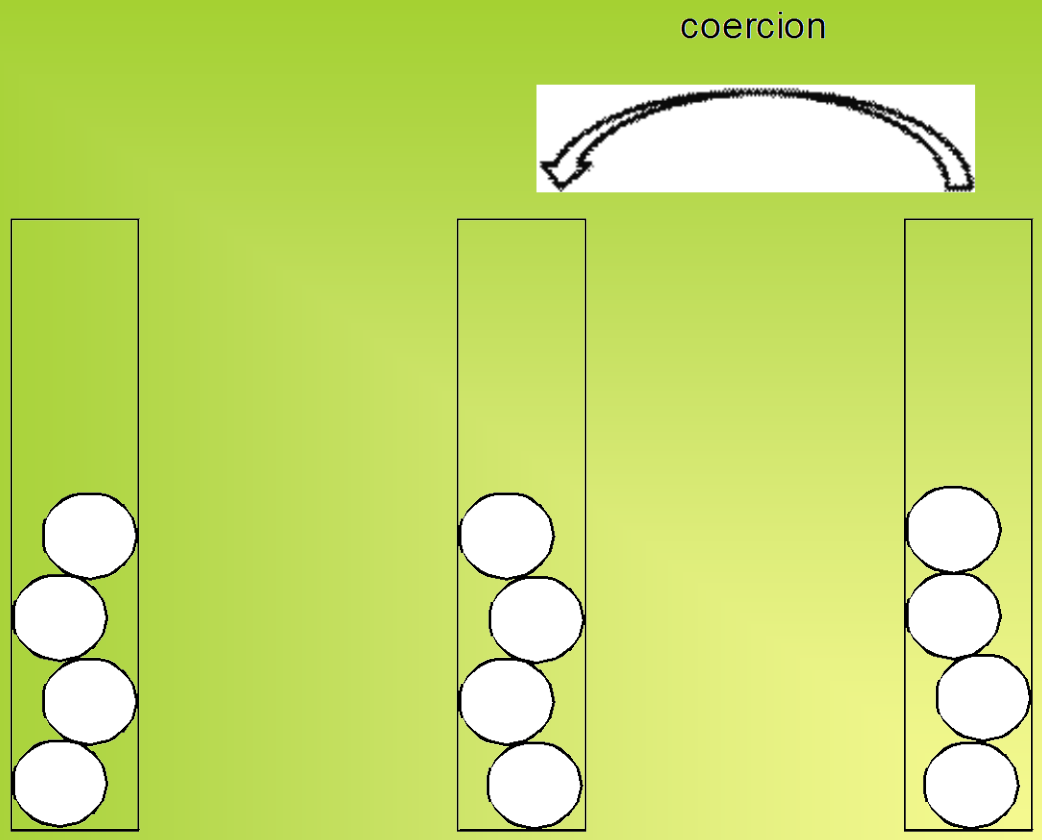
from \ to	A	B	C	D
A	transition frequencies / probabilities			
B				
C				
D				

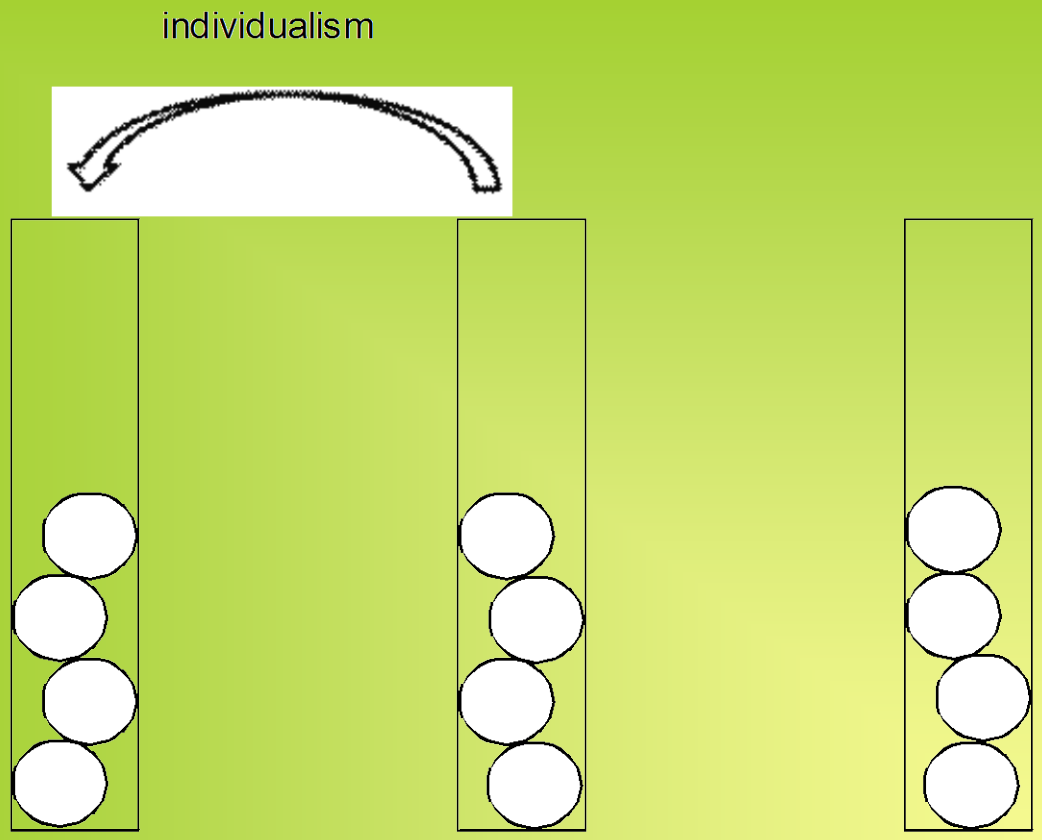
Processes of Dyadic Interaction

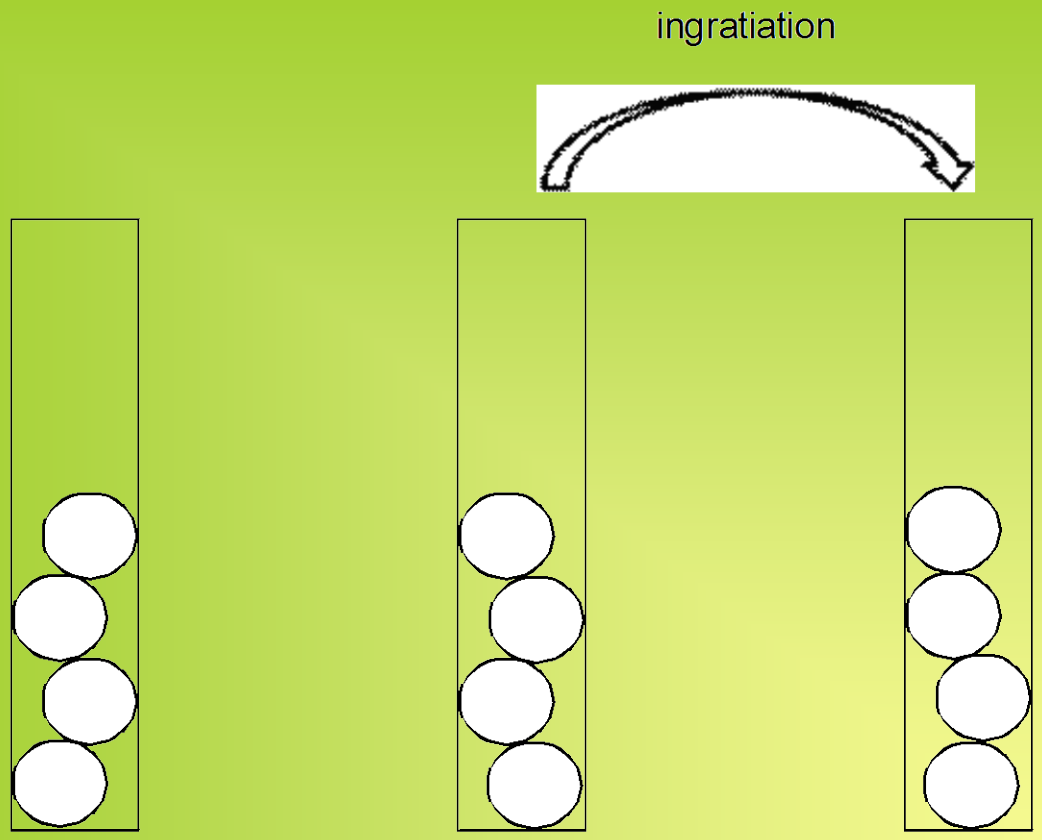
- Camillo García (Veracruz, Mexico)
- Game-like situation:
  - Start: 3 containers, some balls in each
  - two „players“ alternately take one ball from one container and put it to another
  - Goal: to fill one of the containers

Six possible types of behavior

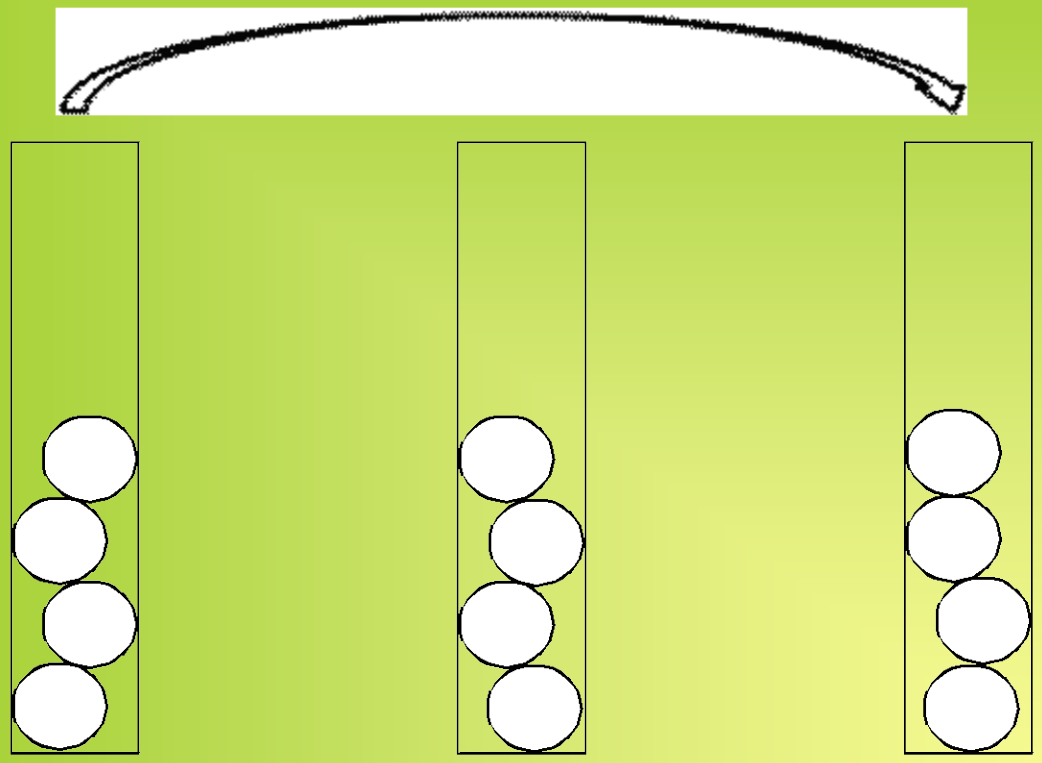



coercion

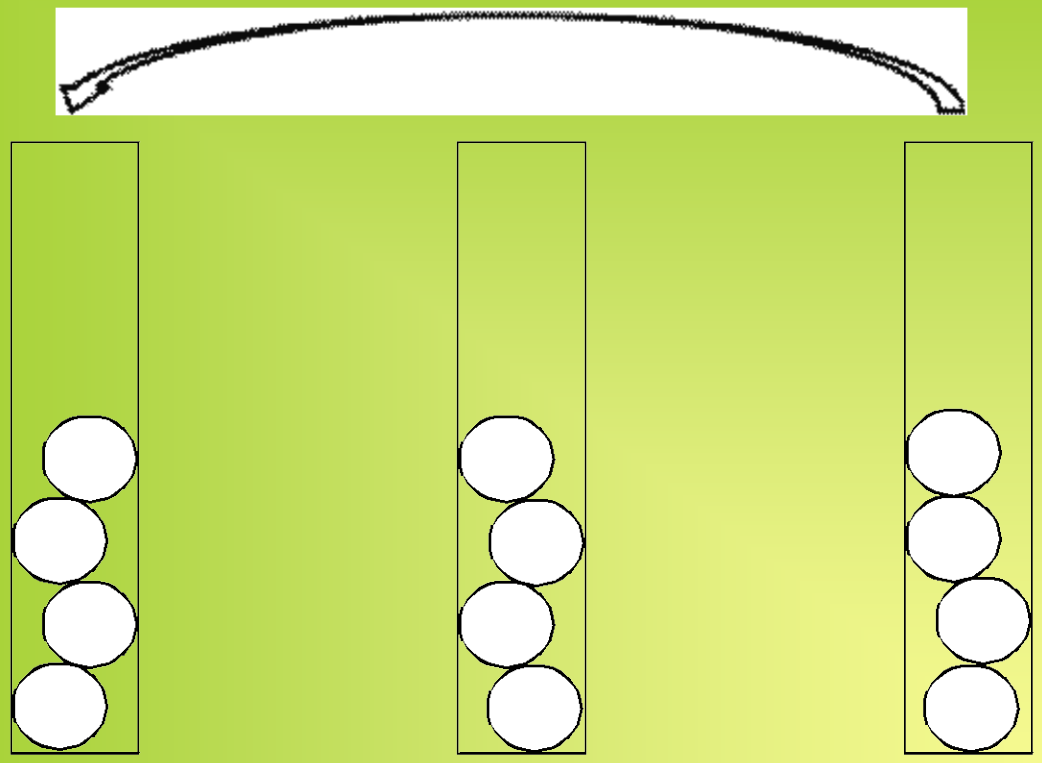

individualism


ingratiation

altruism



competition



Thank you

for your attention