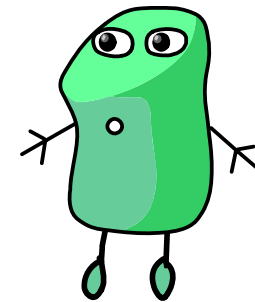


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# **Simulating speech behaviour of artificial agents in emotional situations**

(Linguistic approaches to human-robot emotional speech interaction)



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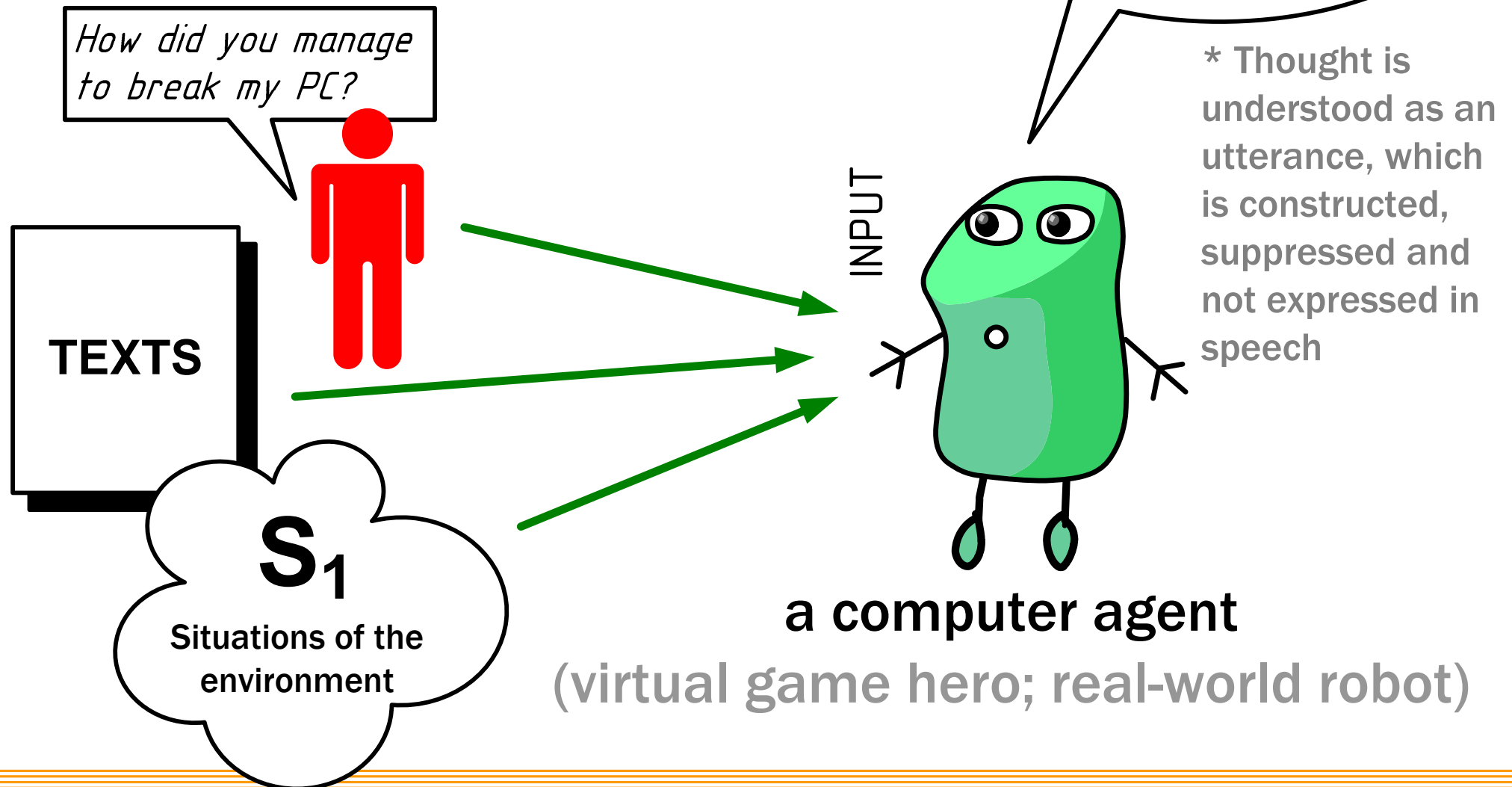
e-mail: [kotov@harpia.ru](mailto:kotov@harpia.ru)

<http://www.harpia.ru/english.html>

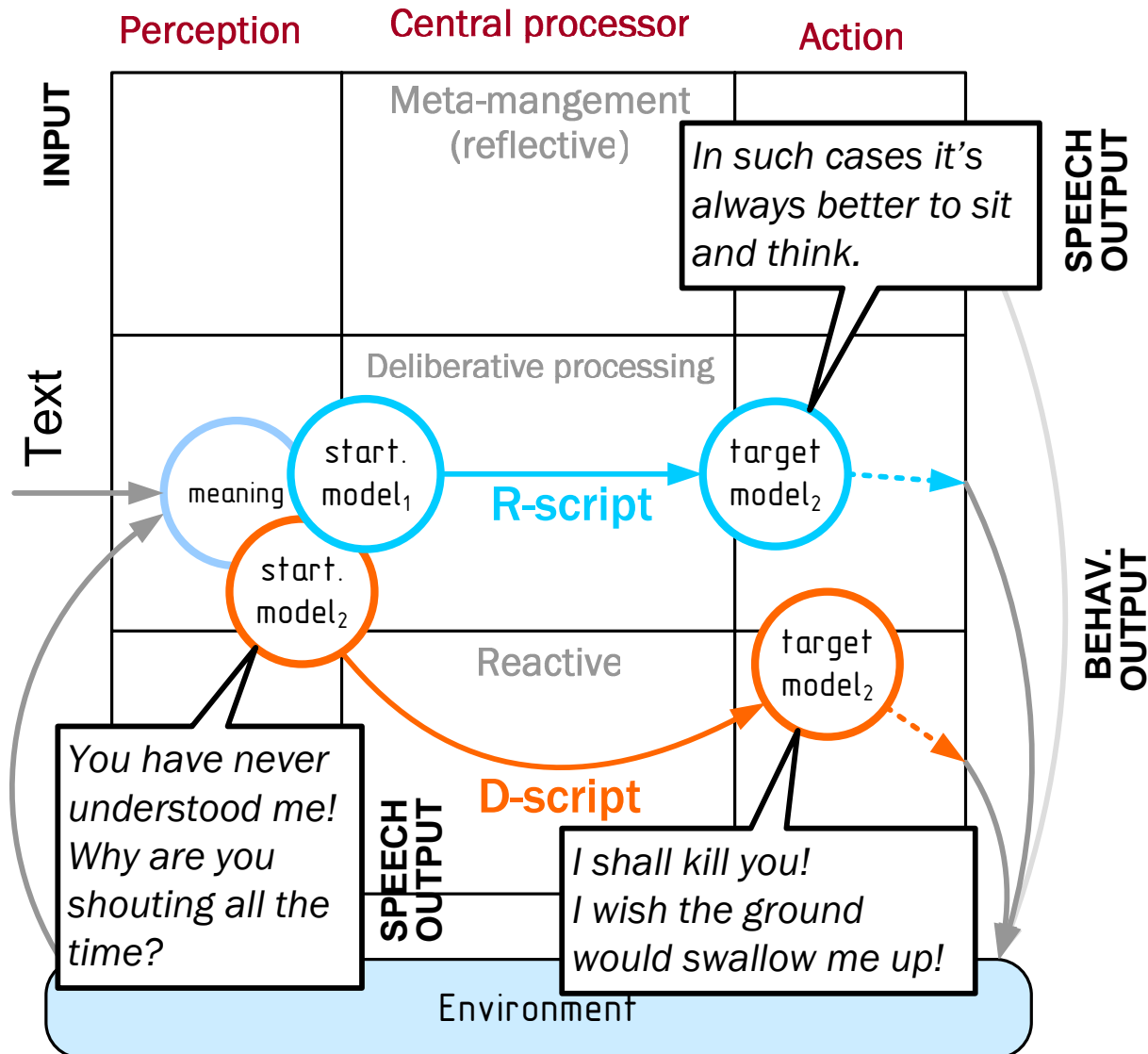


## Main question: what to say / think in a particular situation?

A computer agent meets different situations, like: verbal / behavioural interaction with humans, input texts, environmental situations. In all the situations the agent might react with an utterance.



## Some cognitive architectures (like CogAff) distinguish units for rational and emotional processing of input

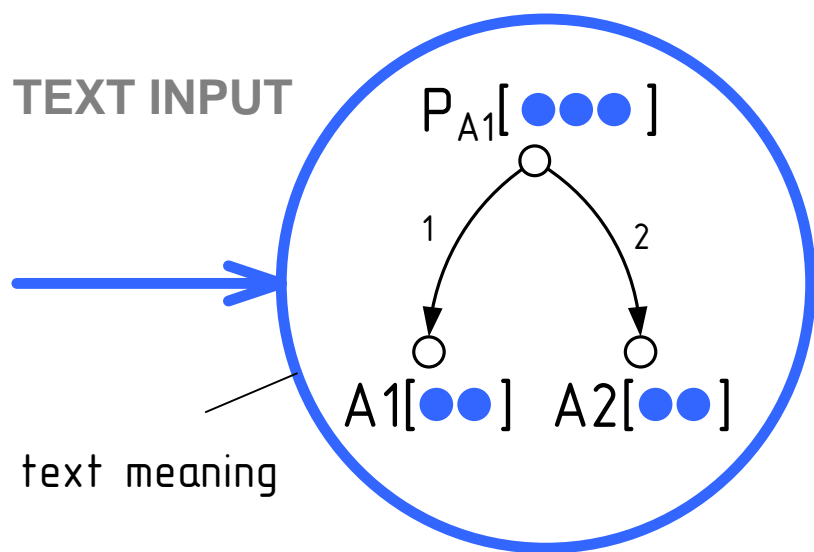


<http://www.cs.bham.ac.uk/research/cogaff/>

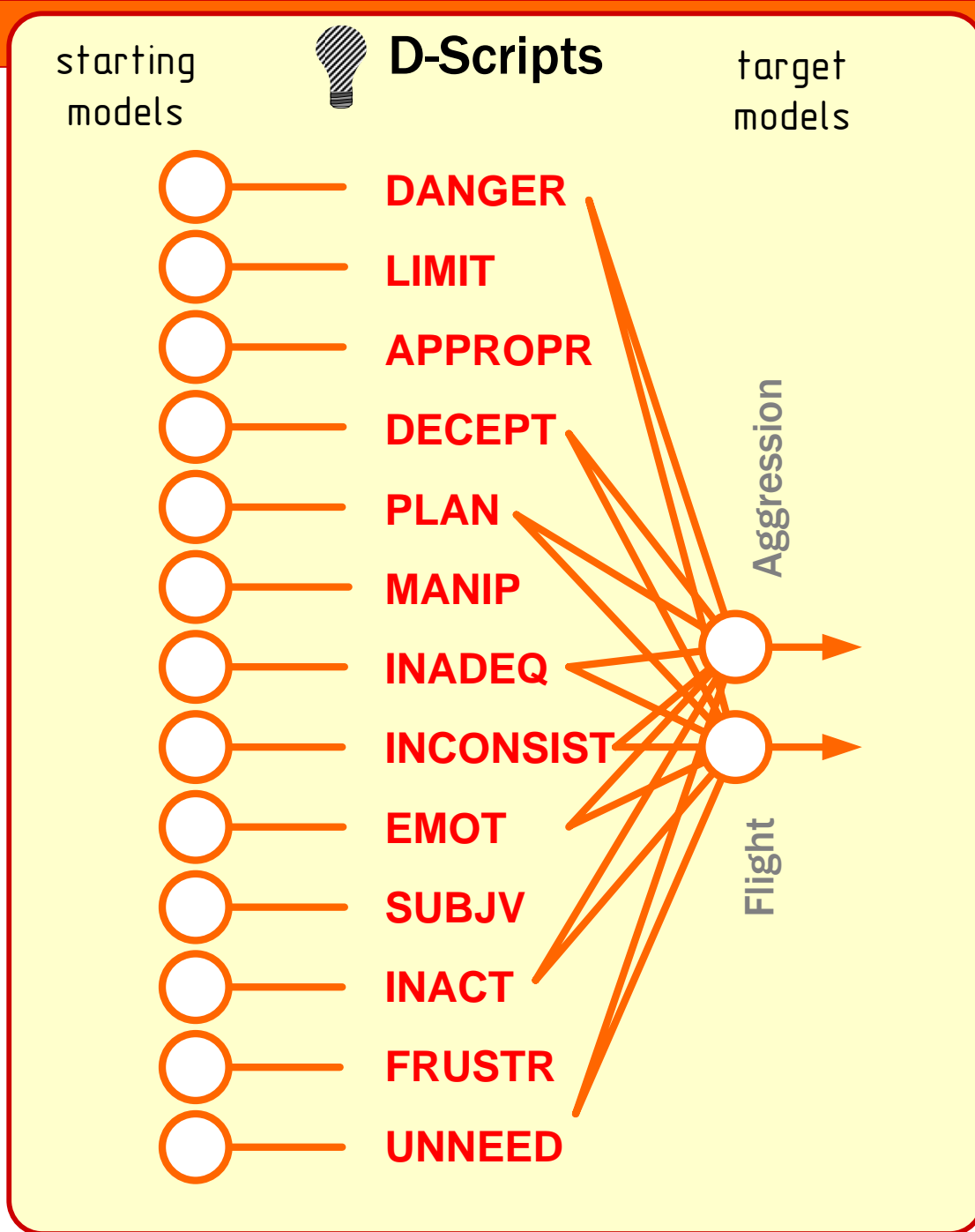
CogAff (H-CogAff) architecture is designed for emotional computer agents and autonomous robots. The model includes **alarms** component, which gets priority and control in critical situations. Activation of alarms correspond to emotional processing.

CogAff model can be appended by **d-scripts (dominant)** and **r-scripts (rational)** to execute processing of incoming texts and synthesis of emotional speech

# Linguistic model, interaction of incoming meaning with d-scripts



(A) - *On this week the government is discussing the budget.*



"Negative" D-Scripts are responsible for emotional processing of incoming texts and are represented with a list of 13 units, see: [www.harpia.ru/d-scripts-en.html](http://www.harpia.ru/d-scripts-en.html)

## "Negative" d-scripts (examples)

**DANGER** ("Danger"): *It is dangerous to go outside nowadays! I'm going to kill you! Terrorists are everywhere!*

**LIMIT** ("Limitation"): *The government doesn't let us go outside the city without permission - soon, they won't let us breathe!*

**DECEPT** ("Deception"): *The government is lying to you!*

**PLAN** ("Plan, planning"): *The government was working for a long time on a plan of how to take money from the people!*

(+APPROPR)

**MANIP** ("Manipulation"): *TV programs control our consciousness!*

**INADEQ** ("Inadequacy"): *You are not thinking enough about what you are saying!*

**INCONSIST** ("Inconsistency"): *How can you say we are going, and immediately say we aren't going!?*

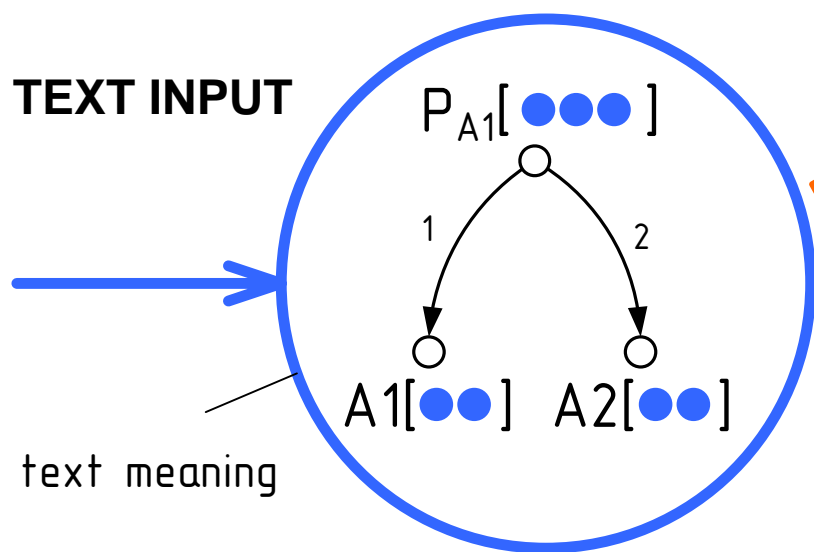
**EMOT** ("Emotionality"): *Why are you shouting all the time?*

**SUBJV** ("Subjectivity"): *All he thinks about is his football! He only thinks about himself!*

**INACT** ("Inactivity"): *He doesn't care, even if I die!*

**13 negative + 20 (+2) positive d-scripts**

## Interaction between incoming meanings and d-scripts



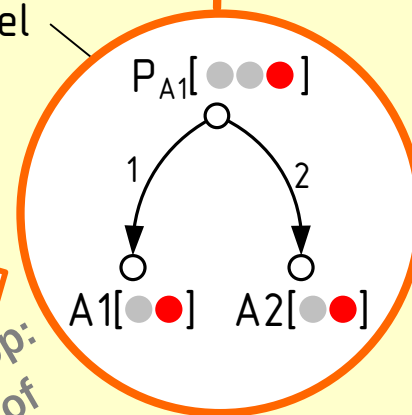
**(A) – On this week the government is discussing the budget.**



## D-Scripts

d-scr. starting model

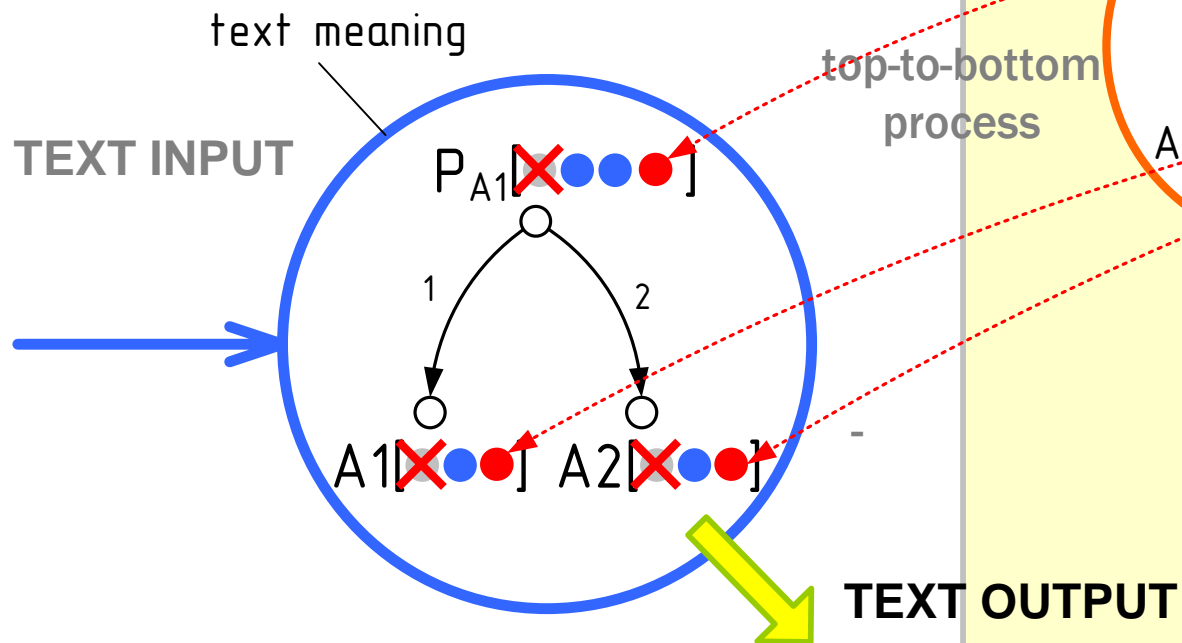
bottom-to-top:  
selection of  
a d-script



Агрессия/  
Aggression  
Бегство/ Flight

Incoming meaning is represented as a semantic graph. Starting models (if-conditions) of d-scripts are defined in the same way. For the list of d-scripts we check, if the incoming meaning corresponds to any of the d-scripts. If we find a match, we activate the d-script.

## Interaction between incoming meanings and d-scripts



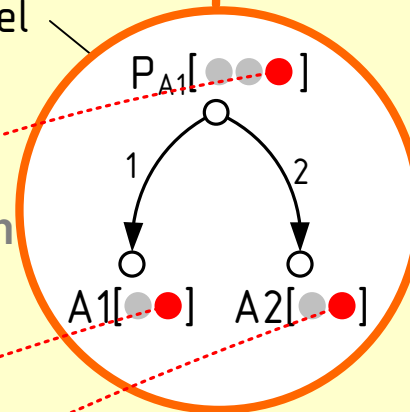
(A) - *On this week the government is discussing the budget.*

(B) - *They all are always shouting only about this budget/  
such trifles!*

## D-Scripts

d-scr. starting model

top-to-bottom process

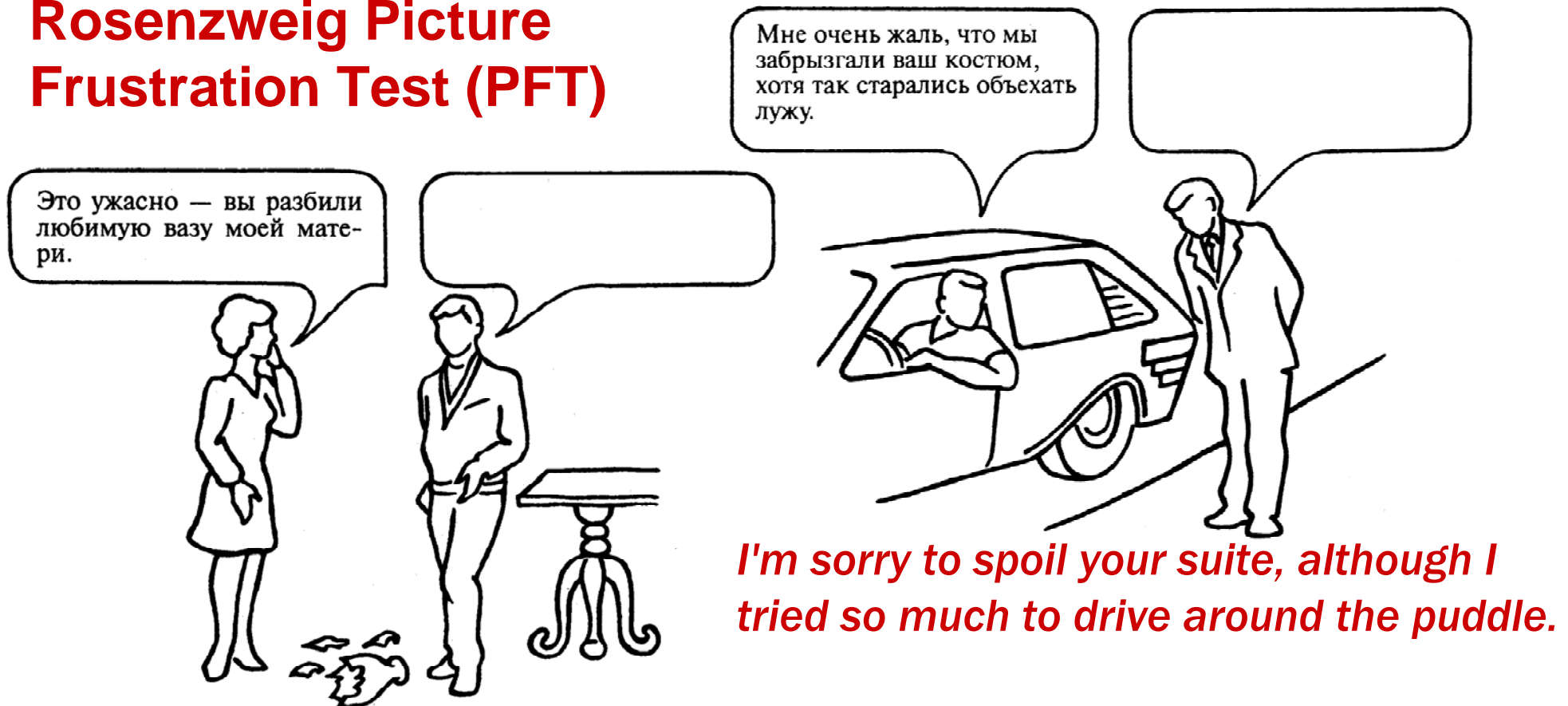


**SUBJV  
D-SCRIPT**

Following the activation some semantic markers in the incoming meaning are deleted and others - appended from the definition of the d-script.

These markers are also important to distinguish emotional and non-emotional texts (in linguistic expertise).

## Rosenzweig Picture Frustration Test (PFT)



*It's terrible, you broke the favourite vase of my mother.*

*I'm sorry to spoil your suite, although I tried so much to drive around the puddle.*

We have collected answers of 450 respondents to the following questions:

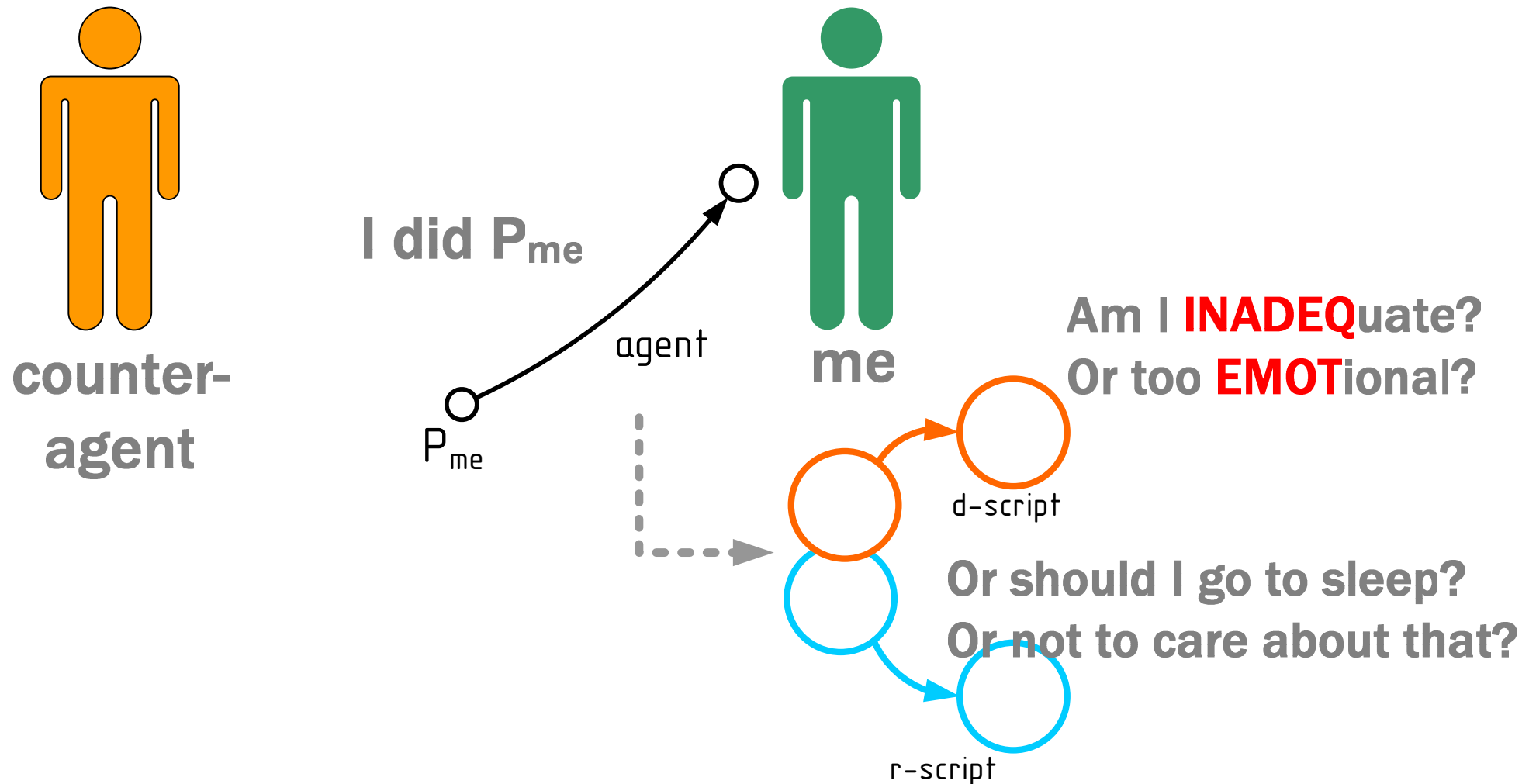
- What would you say in this situation? (WWYS)
- What would you think in this situation? (WWYT)
- What would you do if you wouldn't have to limit yourself? (WWYD)
- Describe a real situation, where a person feels the same. <conceptualization>

We have marked up the answers and formed a database.

# How to select a semantic graph in a situation (where there is no a priori representation)?

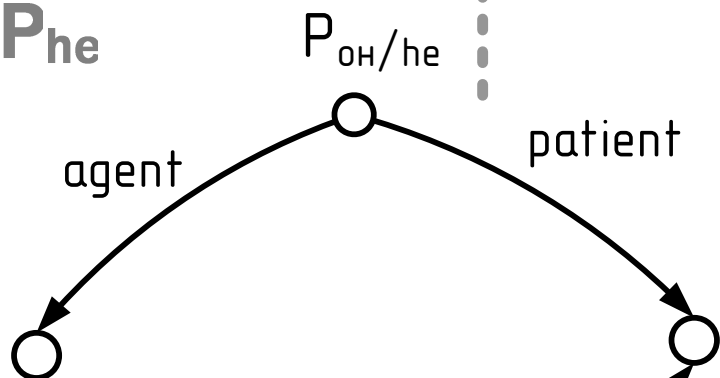
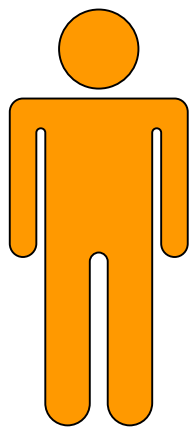
This can be done in different (8) ways.

## Way #1:

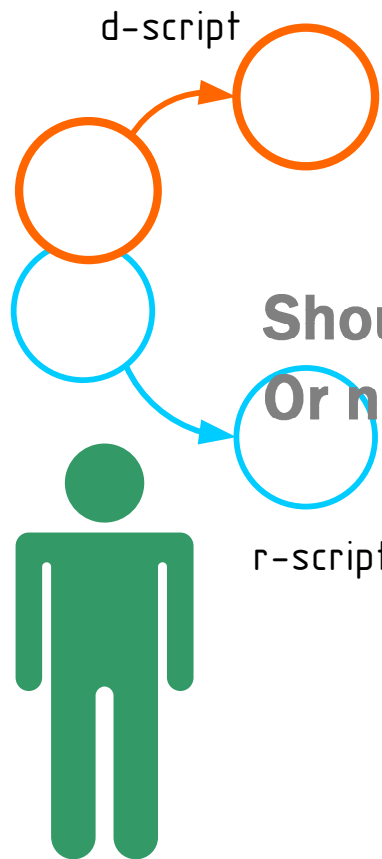
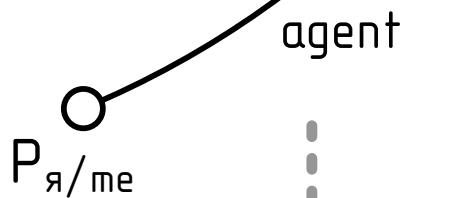


### Way #2:

He did with me  $P_{he}$



I did  $P_{me}$



Is it **DANGER**ous?  
Did he **LIMIT** my freedom?

Should I break with him?  
Or not to care about that?

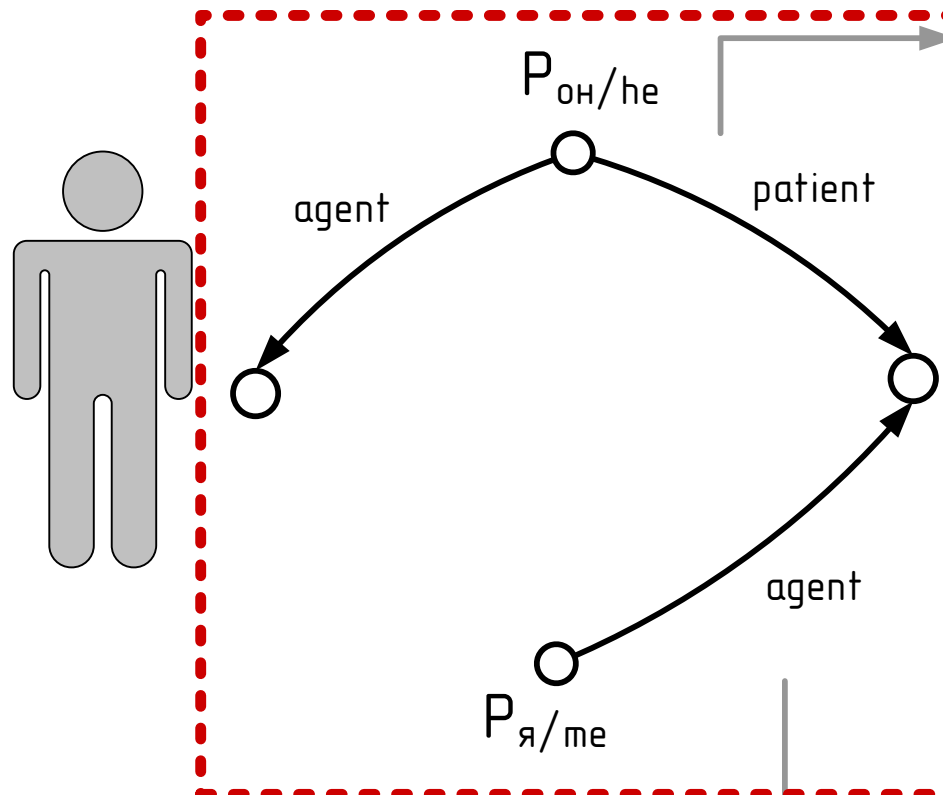
Am I **INADEQ**uate?  
Or too **EMOT**ional?

Or should I go to sleep?  
Or not to care about that?

Selection of segments is combined with activation of scripts.



For each of 8 segments of segmentation model we may start the activation model (d/r-scripts)



Segmentation unit (8 segments)

Is it **DANGER**ous?  
Did he **LIMIT** my freedom?

Should I break with him?  
Or not to care about that?

Activation units

Am I **INADEQ**uate?  
Or too **EMOT**ional?

Or should I go to sleep?  
Or not to care about that?

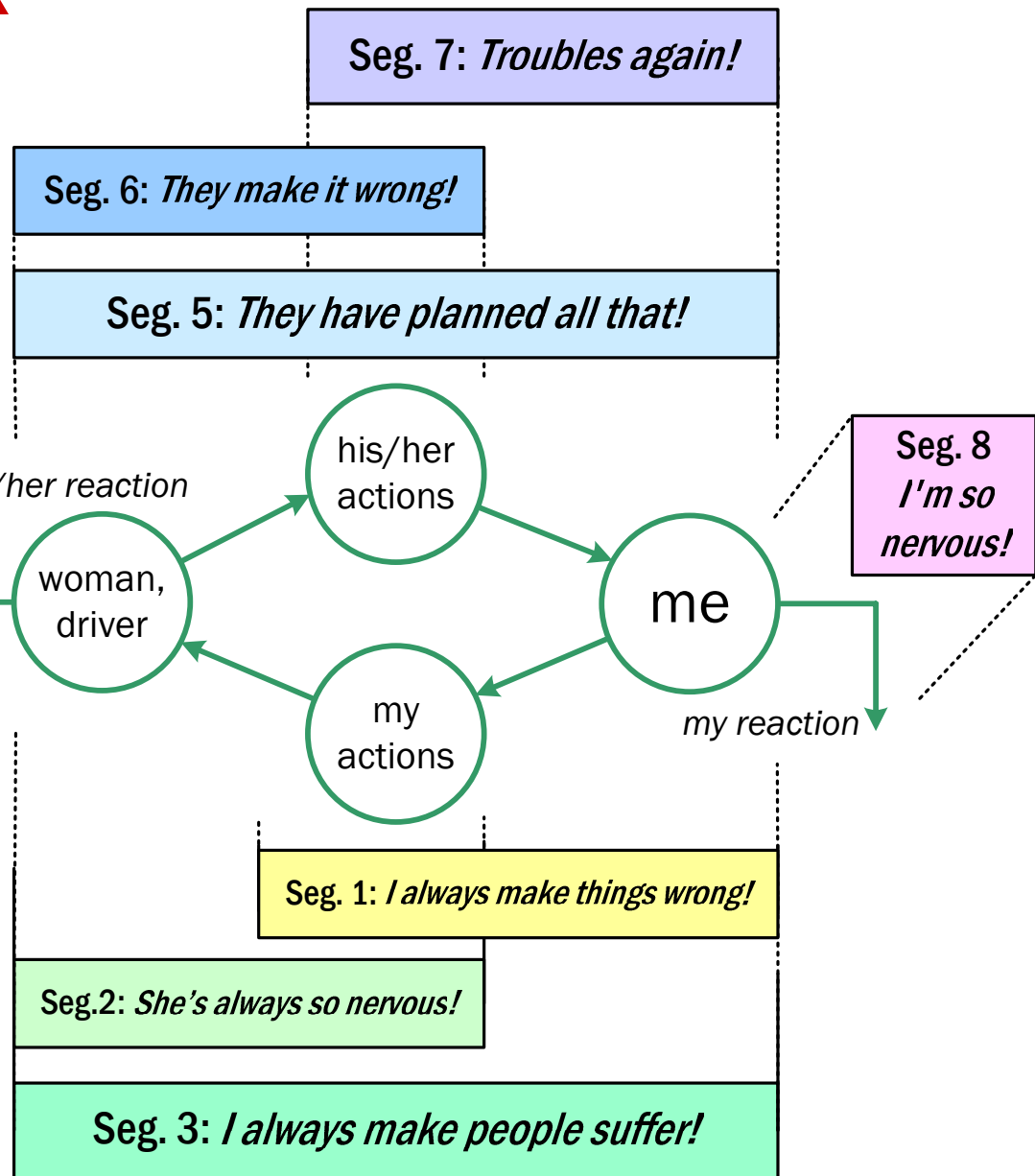
# Segmentation framework (all 8 segments)

This segmentation type is more typical for "driver" situations



**Seg. 4**  
*She is not correct!*

This segmentation type is more typical for "vase" situations



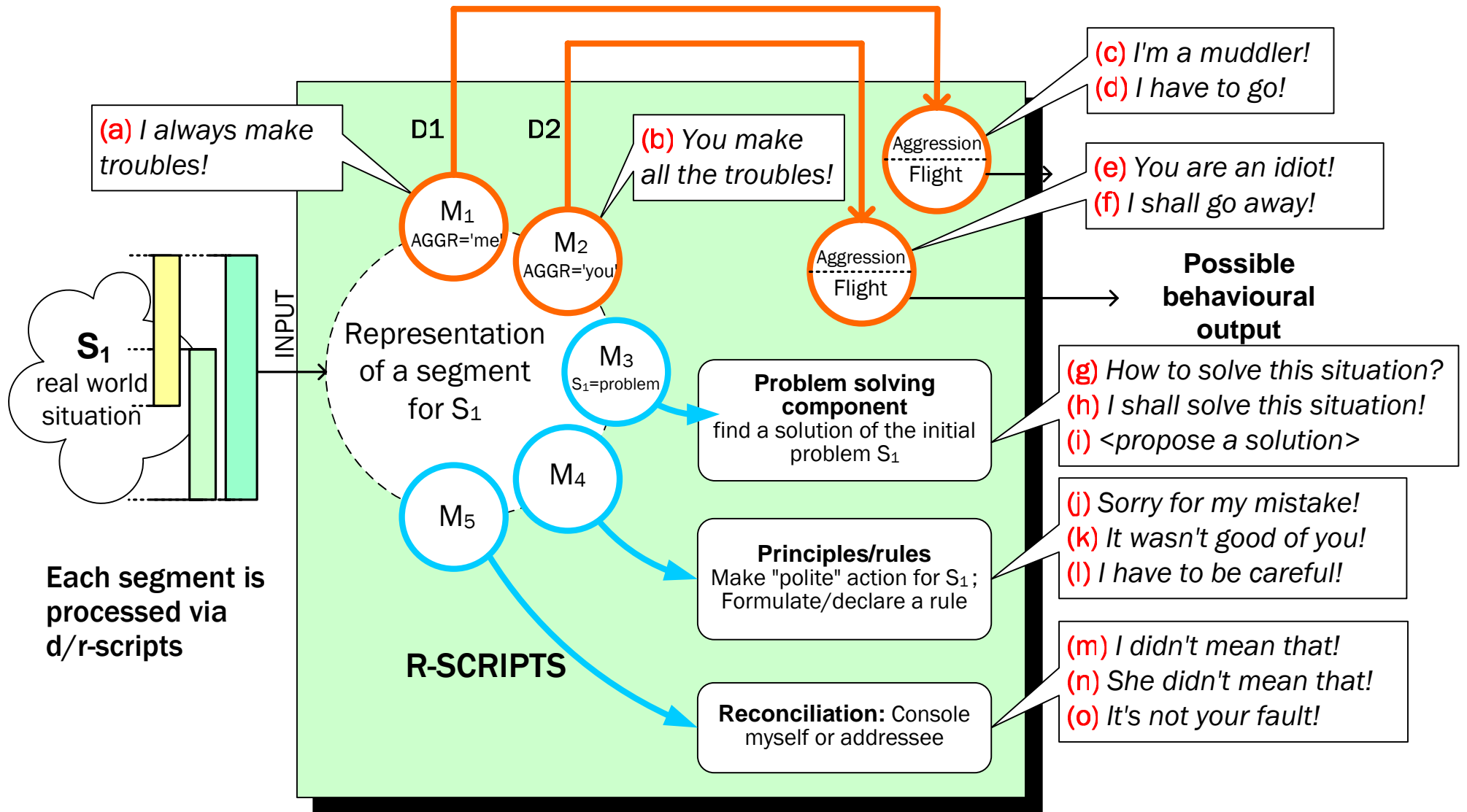
# Activation unit (Processing a single segment)

Segments arrive at the input, activate d/r-scripts, which result in synthesis of a text reply.

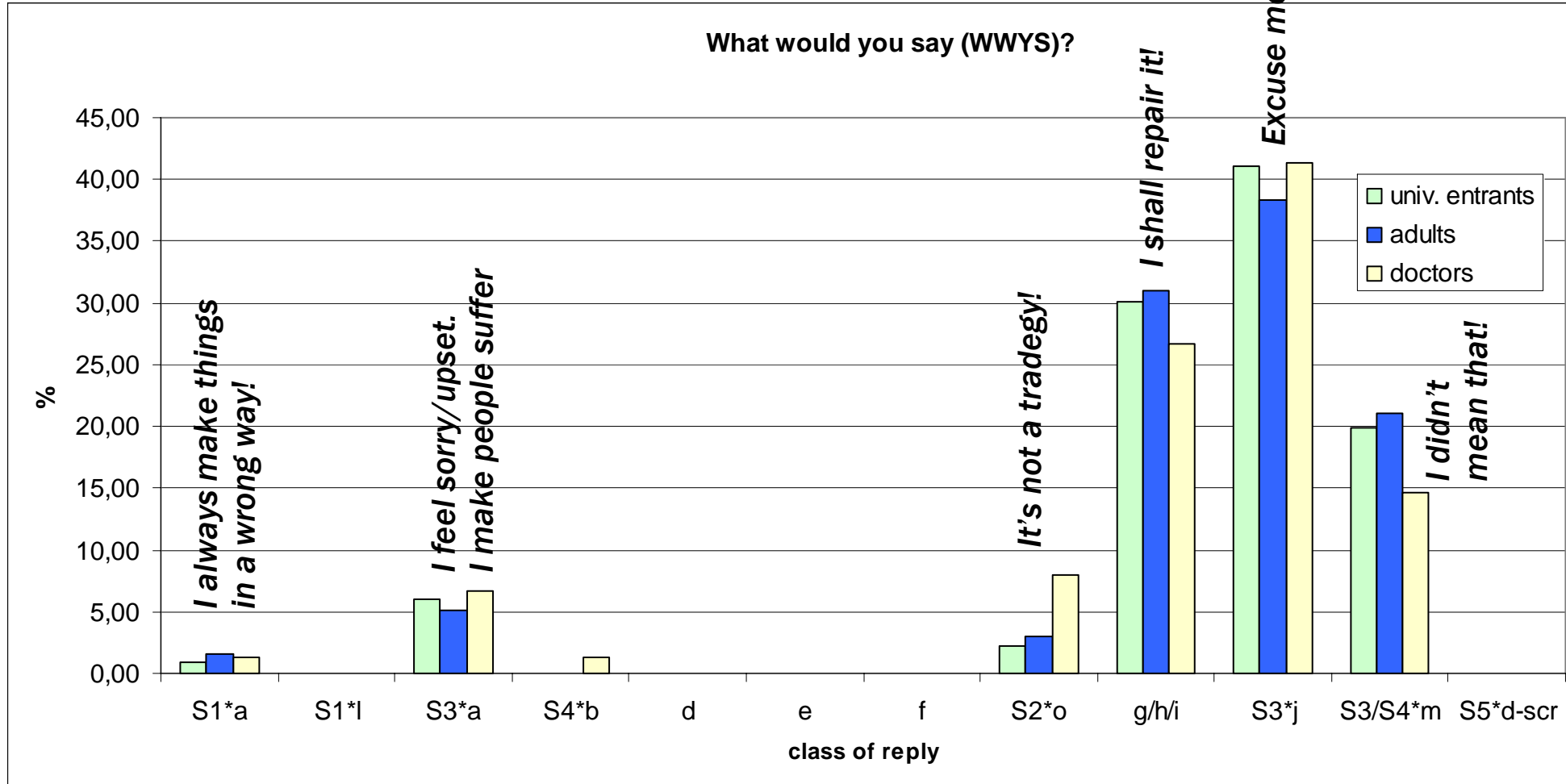
Activation model applies to each segment (is multiplied by the number of segments - x8)

As a result of Segmentation x Activation = sum total we get 30 classes.

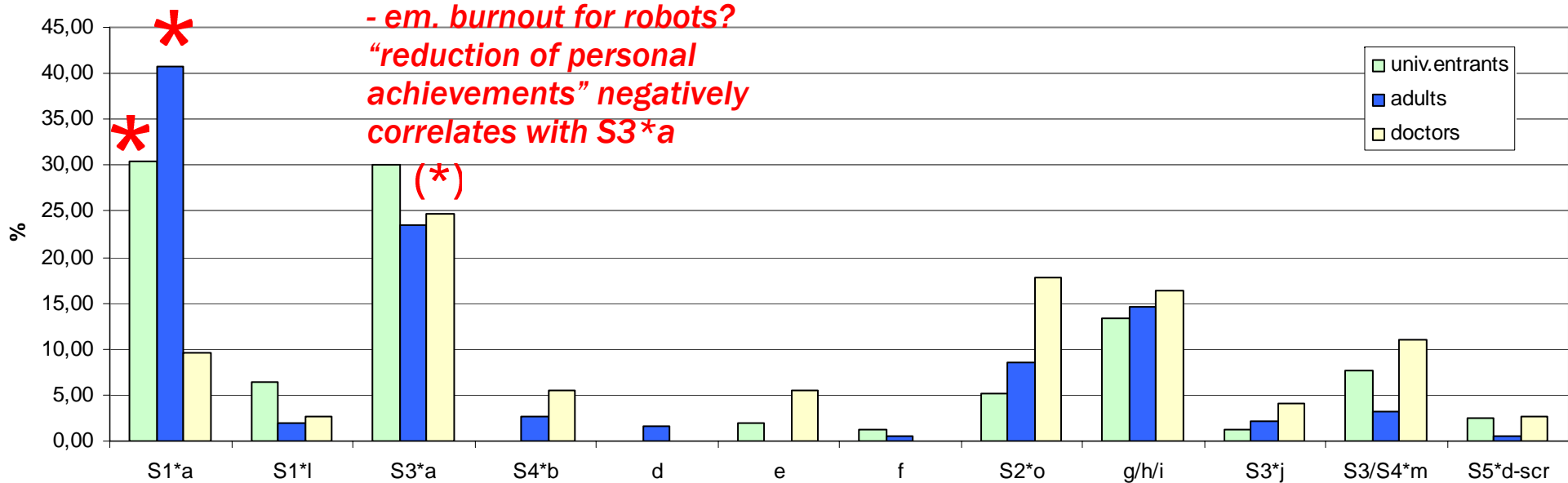
 **D-SCRIPTS**



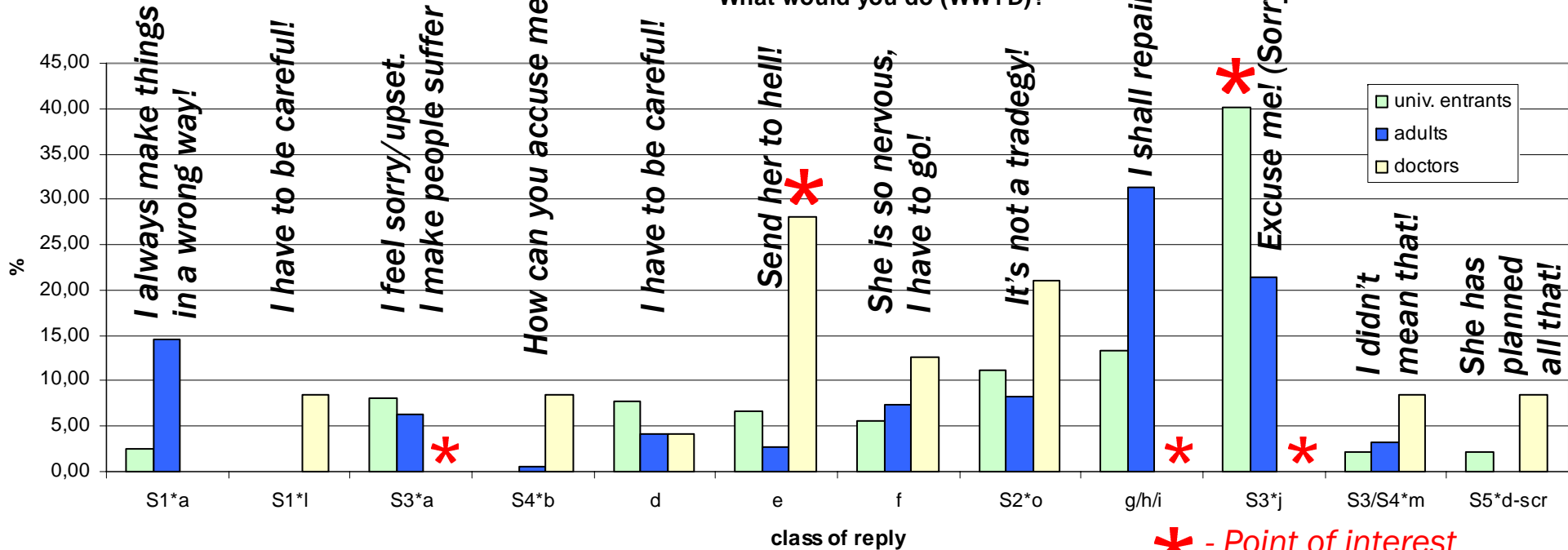
# Shallow results – "vase" situation



What would you think (WWYT)?



What would you do (WWYD)?



## Example: correlations between personal characteristics and replies (marked up by d/r-scripts)

Univerisity entrants (145 probes)  
4 sit. Rosenz. PFT + Big 5 test

Big 5	D/R-scripts mark up	p
Neuroticism	+ speech emotionality (d-scripts)	p=0,014
Openness Conscientiousness	- speech aggression	p=0,017 p=0,003
Extraversion	- speech flight	p=0,011
Openness	+orientation on the addressee	p=0,015
Openness	+ rationality (r-scripts)	p=0,034

If we want the computer agent to simulate these characteristics...

...then we have to prefer / suppress these groups of answers

## Emotional speech reactions of a computer game agent

A game hero (agent) may get frustrated

We try to simulate a list of [all] possible utterances for a give situation

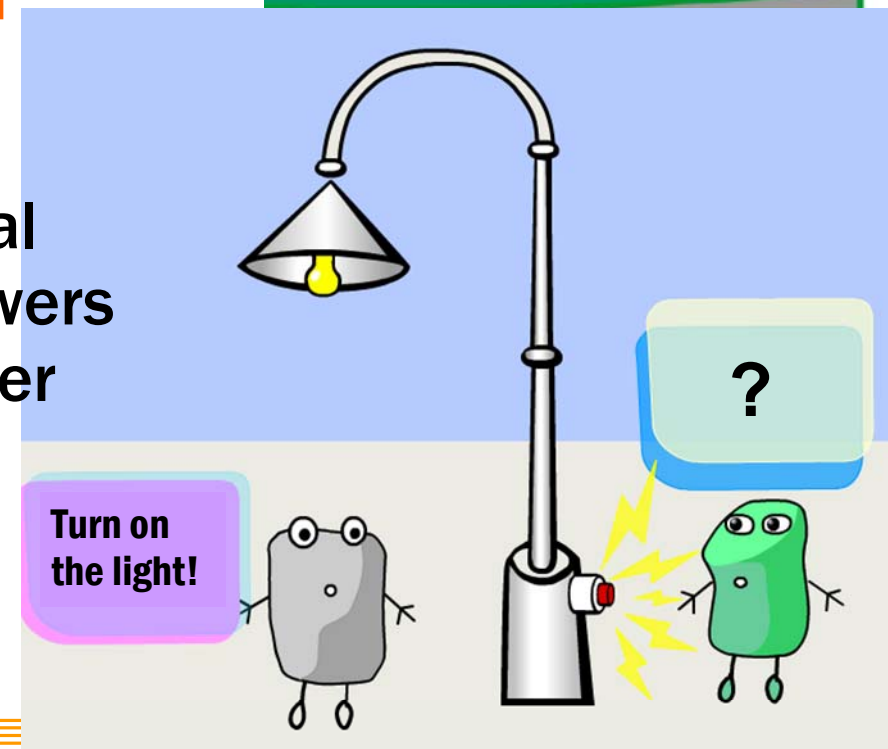
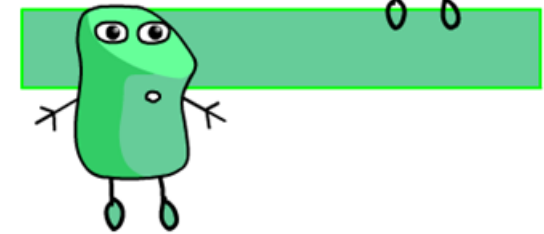
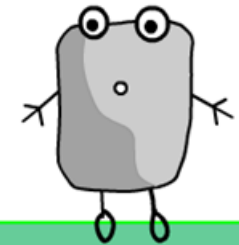
Method:

- define segmentation;
- enumerate d/r-scripts for each segment.

Correspondences between personal characteristics and classes of answers help to simulate a specific character



Selection of a character



## One phrase is not enough to support communication; what are the perspectives?

1

Detect and change communicative distance:

sincere agents

Changes of initiative:

authoritative / infantile agents

2

Semantic shifts in aggressive / friendly-ironic dialogue:  
agents to scoff or joke at the addressee

3

Dynamics of mood in time: an agent may simulate  
changes of several states after the emotional event (it  
“plays” for 10-20 sec.)

- Integration with existing dynamic emotional models;

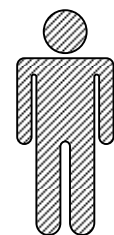
Management of emotional texts (2-10 sentences)

Emotional texts can be represented as standard  
transitions from one d-script to another

**1**

**Sincere artificial interlocutors?  
(Kotov, 2005)**

A speaker may suppose, that an argument to his utterance shall satisfy his positive d-scripts

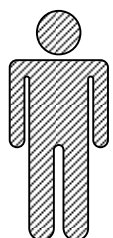


addressee N°1

*We all are. This is because of our government wants us to be!*

Confirm his VICT

"Com. of victims"




speaker

***I am so stupid!***  
AGGR/VICT='myself'



addressee N°2

***Me too!*** Confirm his AGGR/VICT



***Not at all: you are very clever and kind!***

addressee N°4

Confront his AGGR/VICT

Conflict



addressee N°3

***Yes, you are! I always tell you that!***

**straightforward computer:  
New information on the user accepted.**

Confirm his AGGR

## Sincere artificial interlocutors?

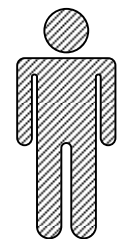
In other texts "self-accusation" helps to construct dialogue atmosphere

"Communication of victims"



addressee N°1

*Our life makes us hard-hearted. We see happiness in advertising and grief in evening news.* Confirm his VICT



speaker

*I feel that I'm becoming so callous to other's grief. When I see beggars or stray dogs at the street I feel that I'm incapable and unwilling to help them.*

AGGR/VICT='myself'



addressee N°2

sincerity

*And I got so stressed with my work, so I guess, I have tormented all my relatives. They are such kind people but it's so difficult for them to live with me.*

Confirm his AGGR/VICT

Conflict



addressee N°3

*You have no soul!*

*straightforward computer: I record: now you are callous.*

Confirm his AGGR

*Mutual storytelling, even in the form of an argument, can make the storytellers feel closer to each other (Schank, 1990)*



## Semantic shifts in dialogue and Mass Media

(Kotov, 2003, Ph.D thesis)

### Mysterious transfer of municipal funds to the Bank of New York

City government assigns 20 mln \$ for development of city infrastructure. Where do they transfer the funds? To **Menatep-bank**. Any citizen may confirm, that **it** is not in NY, **it** is on the central street, next to the Opera building.

(Adapted TV example)

A: Is there any **water** in the refrigerator?

B: Yes.

a: Where? I don't see **it**.

B: [**It** is] In the cells of the eggplant.

(Winograd, Flores, 1987)

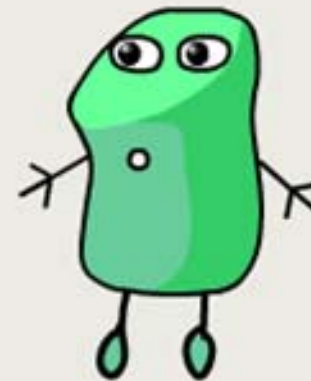
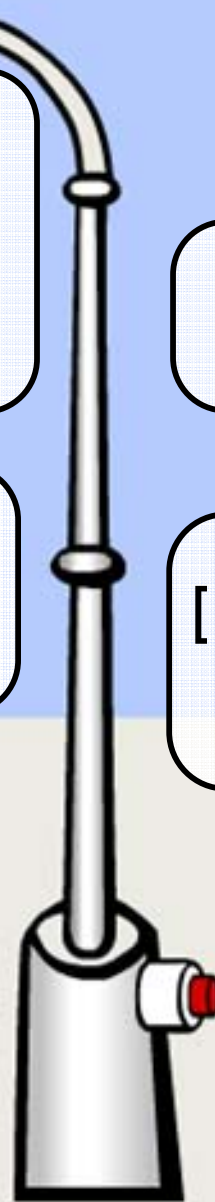
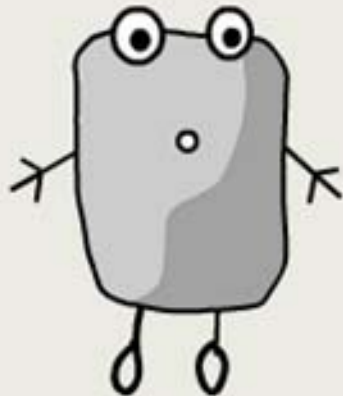
## Semantic shifts can be used to joke (in a friendly dialogue) or to scoff (in a tense dialogue)

Is there any **water** in the refrigerator?

Yes.

Where? I don't see **it**.

[**It** is] In the cells of the eggplant.

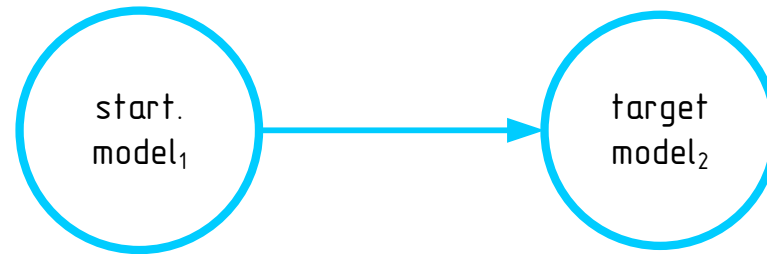


I may joke  
(as a friend)

or scoff  
(as an enemy)

## Towards a taxonomy of semantic shifts

A “known” shift is a script



If you find an ambiguous segment...

...represent is as if the speaker used the other meaning (was **INADEQ**uate)

**Current classification** (extension of Kotov 2003)

Each class represents a specific type of a meaning shift.

Classes are organized in 4 groups:

- A. Nomination: 17 classes (“**water**” is here – class **A-6**)
- B. R-Scripts (inferences): 13 classes
- C. Irony and 3<sup>rd</sup> party plans: 7 classes
- D. Communication: 11 classes

List of classes and mass media texts with mutual links.  
Available online in russian at [www.harpia.ru/methods/](http://www.harpia.ru/methods/)

**Thank you for your attention!**

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[www.harpia.ru/english.html](http://www.harpia.ru/english.html)

