Embodied Language Processing: Desiderative Sentence Mood and Approach/Avoidance Actions

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I  Traditional view vs. embodied view of language comprehension

II  Experimental Study: Does comprehending desiderative-mood sentences interact with approach/avoidance actions?
Representation of described situation

- tokens standing for the entities that make up the described situations
- Representation of non-linguistic entities

A girl cut her finger when slicing lemons

How are representations of described situations related to representations that are constructed during perception and interaction with the world?
Two Possibilities

One \(\rightarrow\) separate-systems assumption
Representational format of representations of described situations is **different** from the representational format of representations that are constructed during direct experience.

Two \(\rightarrow\) common-systems assumption
Representations of described situations and representations constructed in action and perception share the **same** format and recruit the same mental subsystems.
Separate-systems assumption \rightarrow \text{traditional view}

Traditional view of language comprehension
(e.g., Fodor, 2000; Kintsch, 1988)
Language comprehension is based on the manipulation of amodal, abstract symbols
\rightarrow \text{amodal view}

e.g., sentence about the girl who cuts her finger is represented through a structure of arbitrary symbols
\rightarrow \text{representation is unrelated to representation that would be constructed when actually perceiving the cutting event}

Traditional amodal view suffers from two related problems
**Transduction problem**
Lack of an account as to how amodal symbols emerge in the mind
How are perceptual experiences transduced into arbitrary symbols?
(Barsalou, 1999; Brooks, 1987)

**Grounding problem**
How are amodal abstract symbols mapped back onto the world?
How is the meaning of the symbols grounded?
(Harnad, 1990 → Chinese/Chinese Dictionary-Go-Round)

Both problems: intimately related to the separate-systems assumption
Embodied view of language comprehension
(e.g., Barsalou, 1999; Glenberg, 1997, 2008; Zwaan, 2004)
(aka modal view aka simulation view)
Language comprehension involves embodied mental representations that are grounded in perception and action

Common-systems assumption ➔ embodied view
Representations of described situations are built in the same modality-specific mental subsystems as representations constructed during actual experience

➔ modal representations
composed of representations of features in different modalities and representations of motor programs
Embodied Simulations

Embodied view: linguistic input gives rise to a re-enactment of the modality-specific memory traces from past experiences with entities being denoted by the given words

*Kurt Vonnegut (1969): “to turn print into exciting situations in their skulls*

e.g., comprehending the sentence about the girl who cut her finger by mentally simulating the perception of the described situation

Note: simulations are not full-fledged even representations in perception are highly selective and incomplete simulations of described situations might even be sketchier: linguistic input hardly ever specifies every detail of the described situations
Neuroscientific studies

Overlap of pattern of brain activation when processing a linguistic expression and when actually perceiving the object or performing the activity denoted by the linguistic expression, e.g.:

González et al. (2006): Reading odor-related words (e.g., *cinnamon*) evokes activation in the olfactory cortex

Hauk et al. (2004): Reading action verbs (e.g., *kick*) activates areas in motor cortex that overlap with the areas that are activated when actually doing the actions
Behavioural studies

Action-sentence-compatibility effect
Comprehending a sentence describing an action in a particular direction facilitates performing an action in the same direction compared with the opposite direction
e.g., Zwaan & Taylor (2006): Processing John closed the water bottle (clockwise manual rotation) facilitates turning a knob in clockwise compared with counter clockwise direction; processing John opened the water bottle (counter clockwise manual rotation) facilitates turning a knob in counter clockwise compared with clockwise direction
Most of the evidence for the embodied view: from studies investigating the comprehension of content words referring to concrete situations

Present Study: Can the embodied view also handle abstract linguistic devices like desiderative sentence mood?

desiderative sentence mood
expressed by non-factual mood markers like want, wish, would like to
Example Antoine wants to marry a hairdresser.
Starting point: Distinction between two systems in accounts of the regulation of behaviour

- **Approach** → associated with desirable events
- **Avoidance** → associated with undesirable events

- Processing sentences in desiderative mood activates the approach system and facilitates approach actions compared with avoidance actions

**Approach/Avoidance Related Actions**

- **Approach** → e.g., pulling something toward you
- **Avoidance** → e.g., pushing something away from you
Experiment 1

Does processing sentences in desiderative mood facilitate an approach action compared with an avoidance action?
Exp 1: Method

Participants listened to sentences
and had to judge whether the sentences were sensible

Material
sensible and non-sensical sentences

Experimental sentences (all sensible)
two versions → ‘desired’ / ‘factual’ (control)
Lea wants to rest in a hammock. [Lea will in einer Hängematte liegen.]
Lea has rested in a hammock. [Lea hat in einer Hängematte gelegen.]
Two response conditions
Responding to the sensibility-judgment task via moving a joystick
→ 2 conditions
  yes-is-pulling (approach)
    → indicate a yes, sensible-response by pulling the joystick
       (and a no, non-sensical-response by pushing)

yes-is-pushing (avoidance)
→ indicate a yes, sensible-response by pushing the joystick
   (and a no, non-sensical-response by pulling)
Exp 1: Design and Prediction

Each participant was initially randomly assigned to one of the two joystick-direction conditions (yes-is-pulling / yes-is-pushing)

Halfway through the experiment, the assignment of response to joystick direction was reversed

Half of the experimental sentence in ‘desired’ version, the other half in ‘factual’ version

**Dependent variable:** Response times for correct responses to the (sensible) experimental sentences

**Prediction**

‘desired’ sentences: Response Time pulling < Response Time pushing

‘factual’ sentences: No effect of joystick direction on response times
Exp 1: Result

Mean Response Times (in ms)

Pull (approach) | Push (avoidance) | Pull (approach) | Push (avoidance)

Factual (control)
Exp 2: Action → Comprehension

Do approach/avoidance related actions affect processing sentences in desiderative mood?
Exp 2: Method

Participants had to perform an approach or avoidance action while listening to sentences

**Approach**  pressing one palm against the bottom of a table and maintain arm tension

**Avoidance**  pressing one palm on top of a table and maintain arm tension

(adopting a procedure from studies on affective processing, e.g., Neumann & Strack, 2000)

same material as in Experiment 1 (*Lea wants to rest / has rested in a hammock*) → two versions of experimental sentences: ‘desired’ / ‘factual’

judging the sensibility of the sentences by pressing either of two keys (!not by moving a joystick)
Exp 2: Design and Prediction

Each participant was initially randomly assigned to one of the two action conditions (table bottom / table top)

Halfway through the experiment, the action condition was changed

Half of the experimental sentence in ‘desired’ version, the other half in ‘factual’ version

**Dependent variable:** Response times for correct responses to the (sensible) experimental sentences

**Prediction**

‘desired’ sentences: Response Time \(_{\text{bottom}}\) < Response Time \(_{\text{top}}\)

‘factual’ sentences: No effect of action on response times
Exp 2: Result

Mean Response Times (in ms)

- Desired:
  - Bottom (Approach): 300 ms
  - Top (Avoidance): 400 ms

- Factual (Control):
  - Bottom (Approach): 350 ms
  - Top (Avoidance): 500 ms
Conclusion

Results of two experiments ➔ Comprehending desiderative mood sentences interacts with approach/avoidance related motor actions

Exp 1: Comprehending ➔ Action
Processing desiderative mood sentences facilitates approach-related actions compared with avoidance-related actions

Exp 2: Action ➔ Comprehending
Performing an approach action facilitates processing desiderative mood sentences compared with performing an avoidance action

➔ Preliminary evidence that the embodied view can handle even abstract information like desiderative sentence mood
Using a different control condition

Exp 1 and 2: Control condition (e.g., *Lea has rested in a hammock*) and desiderative-mood condition (e.g., *Lea wants to rest in a hammock*) did not only differ wrt to sentence mood; control condition described an event that did take place

**alternative control condition:** sentences in future tense, e.g., *Lea will rest in a hammock*
Location and time course of the effect

→ Where does the effect of desiderative-mood on pushing/pulling occur? Already at the desiderative mood marker or later?

Exp: Word-by-word presentation of the sentences; participants advance through a sentence by either pulling or pushing a joystick

(results from pilot experiment: effect at mood marker: 
Lea | will | in | einer | Hängematte | liegen )

→ Does negation reverse the effect? 
e.g., Lea | will | nicht | in | einer | Hängematte | liegen  
(Lea does not want to rest in a hammock)
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