11th December 2017

Embodied Cognition

Yasamin Motamedi
Language and Cognition Lab
UCL Dept of Experimental Psychology
y.motamedi@ucl.ac.uk

Outline

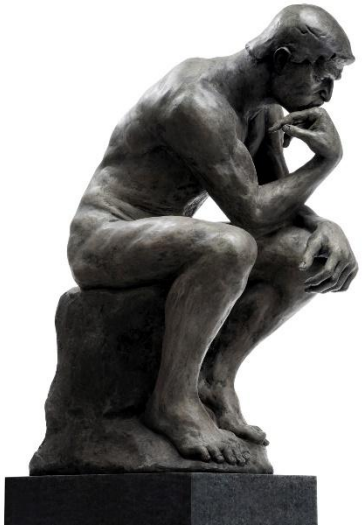
- What is embodied cognition?
- Background: why did the non-embodied viewpoint become dominant?
- Problematic evidence for non-embodied viewpoint
  (in emotion, action, perception)
  BUT failure to replicate many studies
- Limitations of embodied cognition theory

Embodied cognition

Hypothesis

Cognitive processes rooted in perception and action

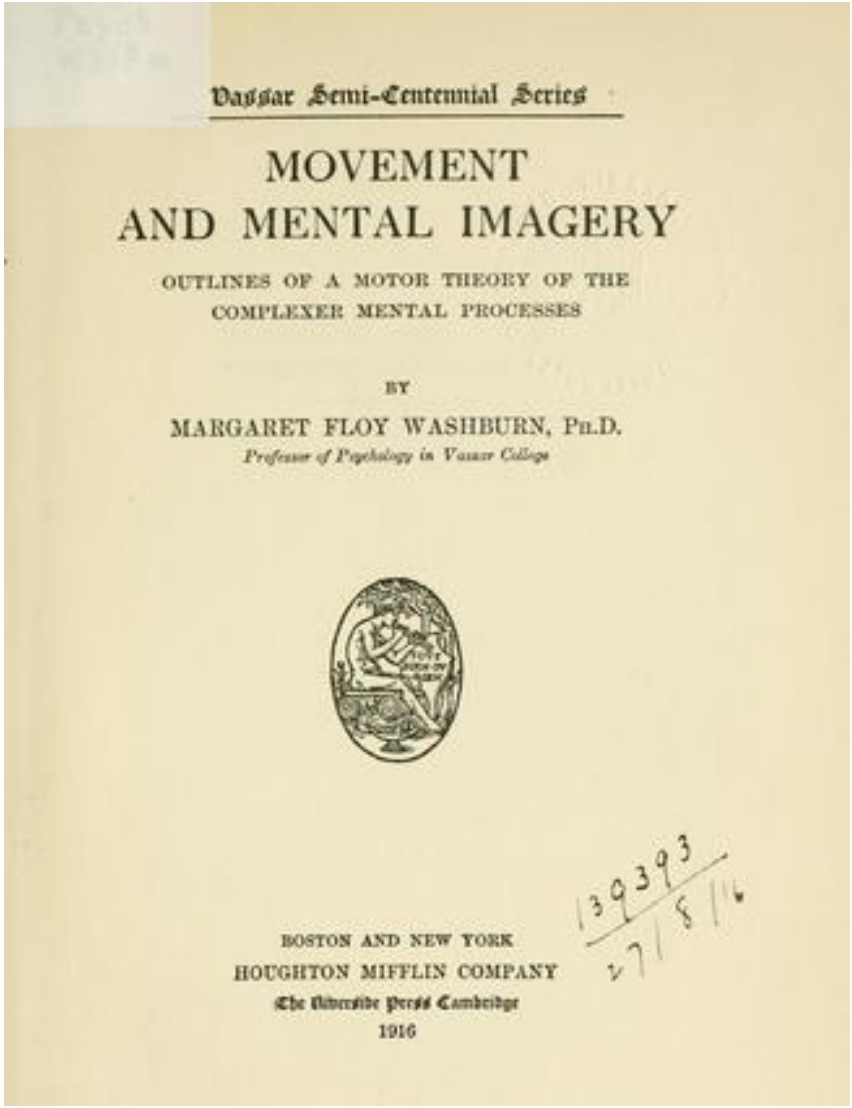
To properly understand cognition, we must consider its relation to the body, and how the body interacts with the world



"How we think depends upon the sorts of bodies we have"

Glenberg, A. M., Witt, J. K., & Metcalfe, J. (2013). From the Revolution to Embodiment. *Perspectives on Psychological Science*, *8*(5), 573–585.

Embodied cognition 100 years ago



Vassar Semi-Centennial Series

MOVEMENT
AND MENTAL IMAGERY

OUTLINES OF A MOTOR THEORY OF THE
COMPLEXER MENTAL PROCESSES

BY

MARGARET FLOY WASHBURN, PH.D.
Professor of Psychology in Vassar College

BOSTON AND NEW YORK
HOUGHTON MIFFLIN COMPANY
The Riverside Press Cambridge
1916

So what happened?

See Glenberg, A. M., Witt, J. K., & Metcalfe, J. (2013). From the Revolution to Embodiment. *Perspectives on Psychological Science*, *8*(5), 573–585

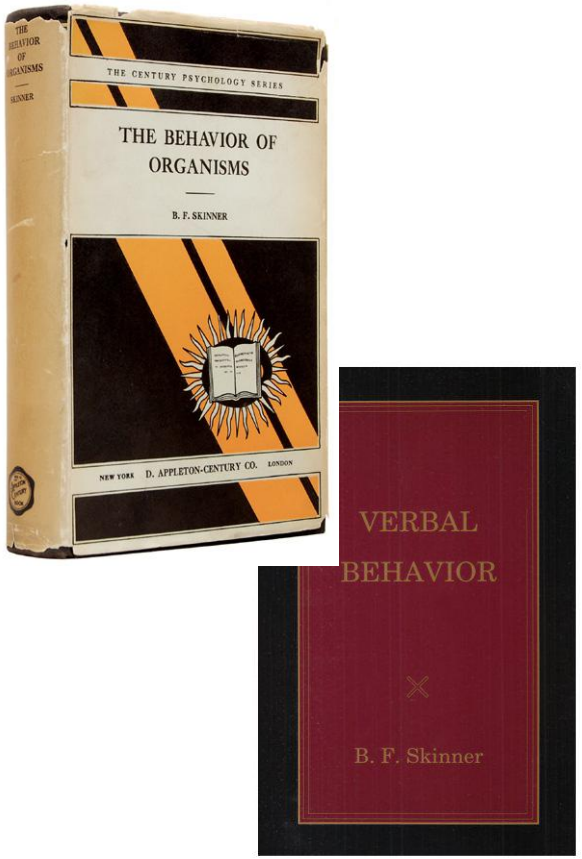
Behaviourism

PSYCHOLOGY AS THE BEHAVIORIST VIEWS IT

BY JOHN B. WATSON

The Johns Hopkins University

Psychology as the behaviorist views it is a purely objective experimental branch of natural science. Its theoretical goal is the prediction and control of behavior. Introspection forms no essential part of its methods, nor is the scientific value of its data dependent upon the readiness with which they lend themselves to interpretation in terms of consciousness. The behaviorist, in his efforts to get a unitary scheme of animal response, recognizes no dividing line between man and brute.

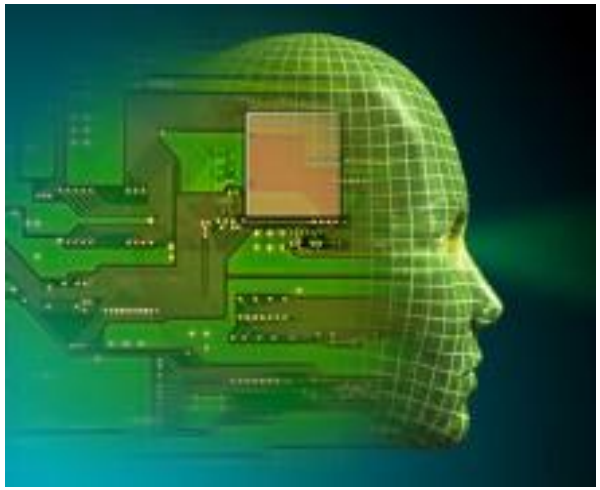


- Reaction to introspective methods
- Moves away from the mind/consciousness
- Focus on visible behaviour

Quote from Watson, J.B. (1913). Psychology as the behaviorist views it. *Psychological Review*, 20, 158-177.

The “Cognitive Revolution”

- Focus on mental processes, namely computation and feedback
- Began in 1950s, gained a lot of momentum by the 80s
- Heavily influenced by the development of computers, cybernetics, AI



The “Cognitive Revolution”

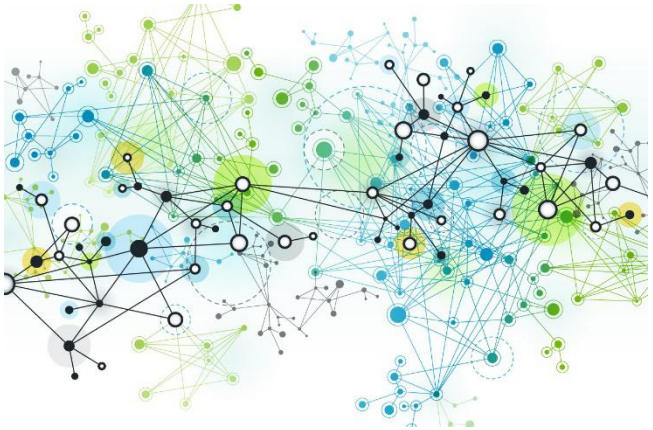
Defining psychology as the science of behaviour is like defining physics as the science of meter reading – Chomsky, 1971

The “Cognitive Revolution”

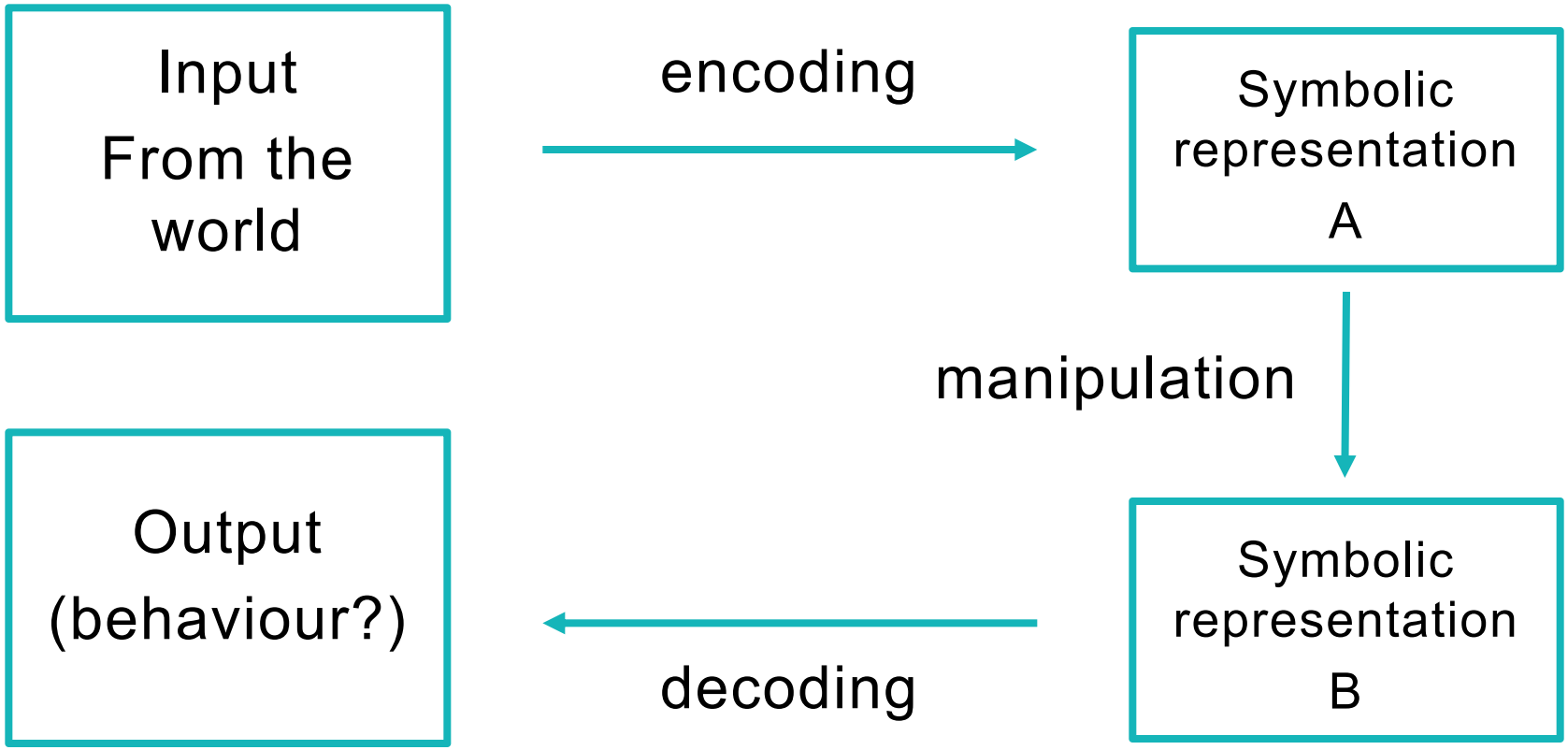
- Behaviourism explains what we *do*, not how we do it – the mechanism remains unexplained
- Relies on concepts of computation and information processing to explain cognition

The “Cognitive Revolution”

- Knowledge stored as networks of associated nodes
- Concepts are symbols
- Cognition works through symbol manipulation, i.e. computation



The “Cognitive Revolution”



Our poster child:

LANGUAGE

Language as purely symbolic

Word meaning is system internal

- It is the distribution or association of words in semantic networks that gives clues to meaning i.e. meaning is relative

- Word meaning learnt by the *linguistic* environment in which it occurs

“The meaning of a word is its use in language”

- Wittgenstein

Language as symbol manipulation

- Language can be thought of as a network of concepts (or symbols) that are manipulated through a set of rules (grammar)

The man waved at the woman

The woman waved at the man

- These rules explain all possible structures of language

Chomsky, N. (1959). A Review of B. F. Skinner's *Verbal Behavior*, *Language*, *35*, 26-58

Language as symbol manipulation

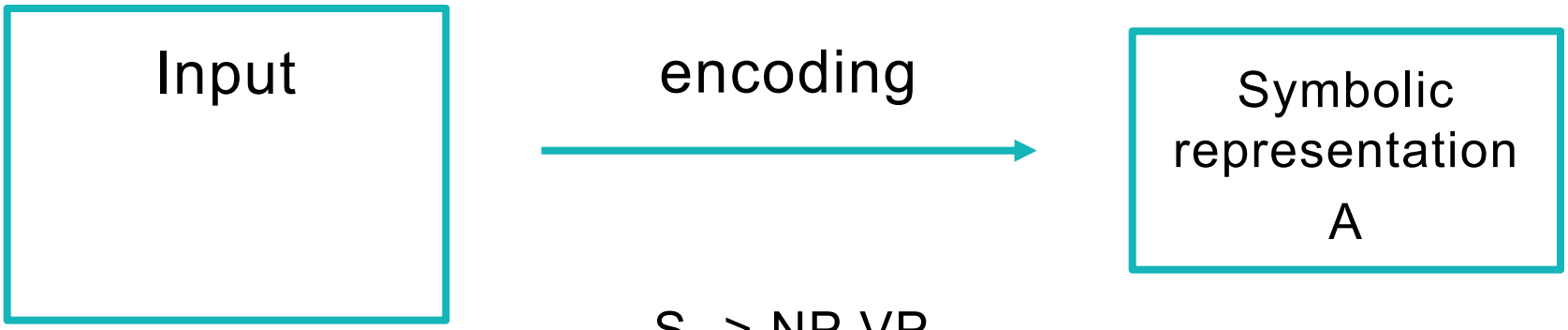
- Language can be thought of as a network of concepts (or symbols) that are manipulated through a set of rules (grammar)

The cow and the mermaid danced a beautiful samba

Chomsky, N. (1959). A Review of B. F. Skinner's *Verbal Behavior*, *Language*, *35*, 26-58

Language as symbol manipulation

The cat scratched the dog



S -> NP VP

NP -> Det, NP

VP -> V NP

Evidence for abstract representation

Speech errors suggest we do perceive linguistic units. E.g., phonemes, morphemes

Fromkin, V.A. (1971). The non-anomalous nature of anomalous utterances. *Language,* 47, 27-52.

Evidence for abstract representation

Evidence for abstract representation

Evidence for abstract representation

Evidence for abstract representation

Problems with language as symbol manipulation

Meaning is used to talk about the world – it has to link up somehow

How do we explain non-abstract features of language?

How do we explain context-specific language?

EMBODIED COGNITION

Embodied cognition

Knowledge is not stored as symbolic representation – possibly not ‘stored’ at all

Knowledge and cognition are rooted in perception and action – interaction with the physical world

Embodied cognition

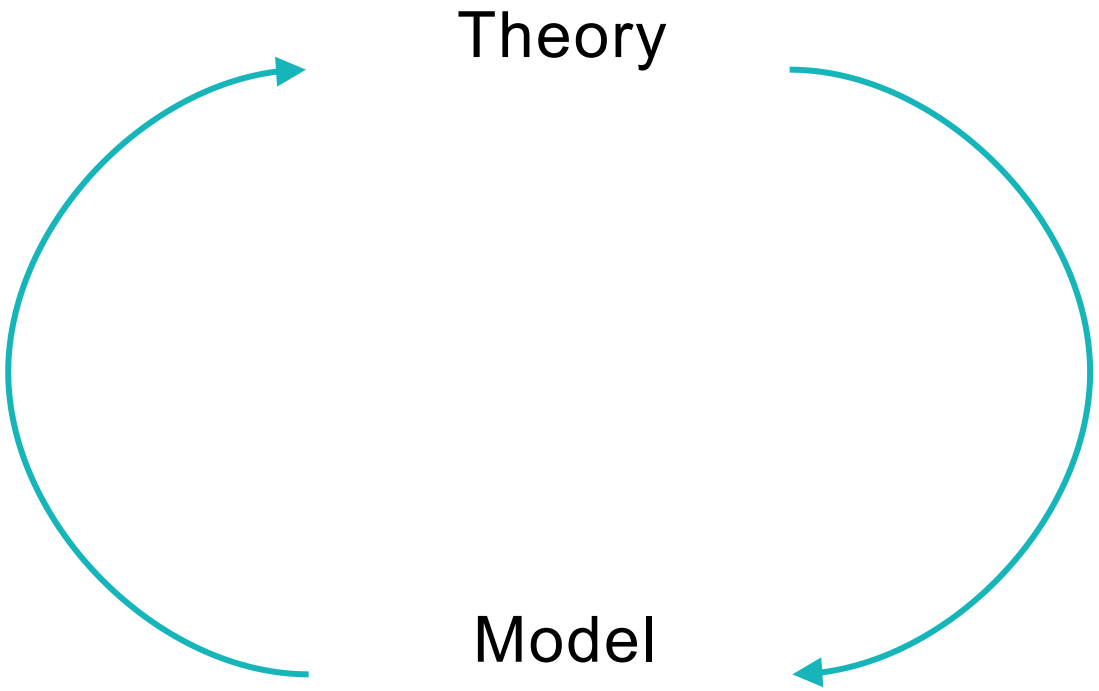
How do we get evidence for embodiment?

1. Demonstrate a link between cognition and perception/action

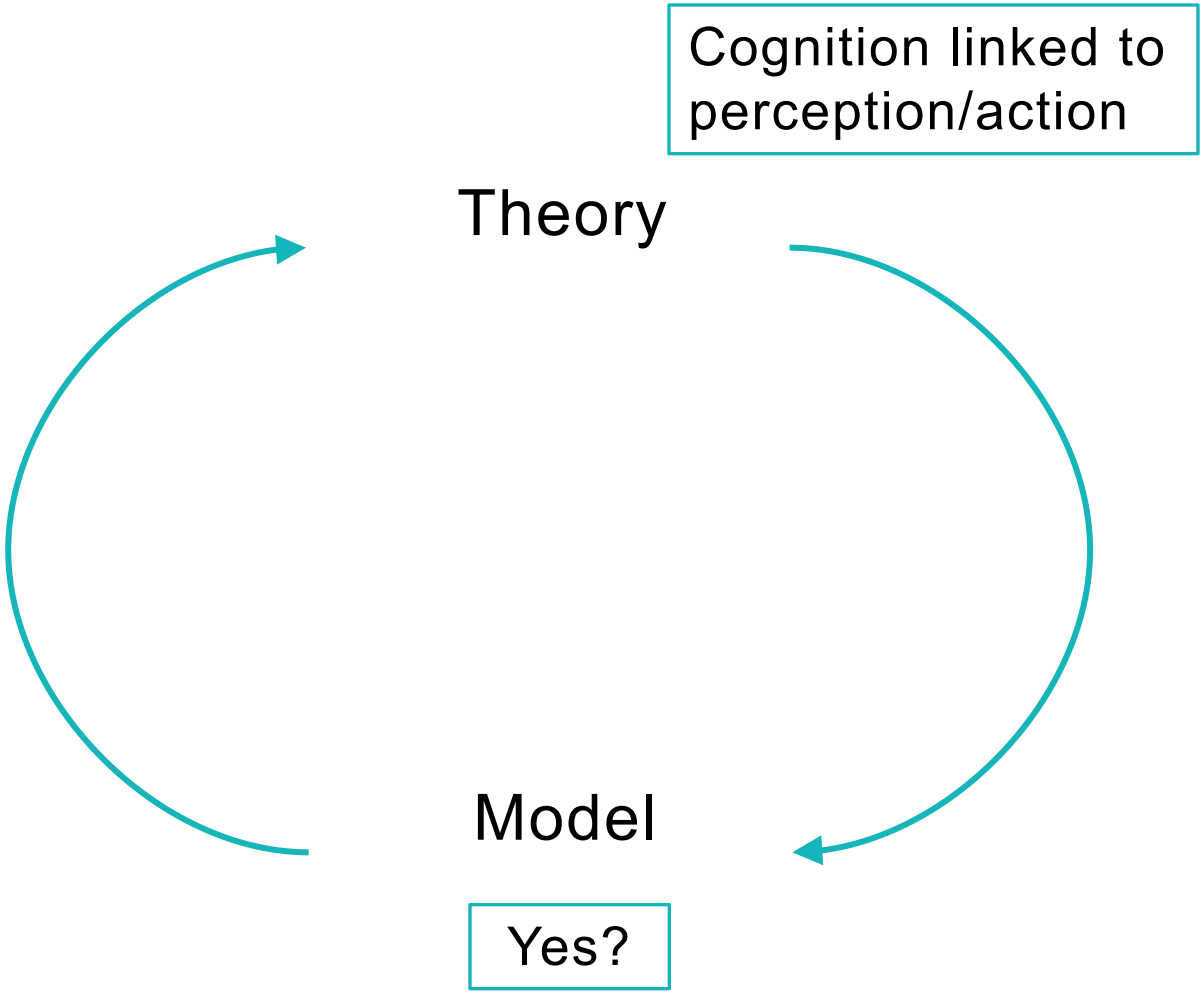
2. Investigate possible mechanisms of embodiment (i.e. how does this link operate?)

Embodied cognition

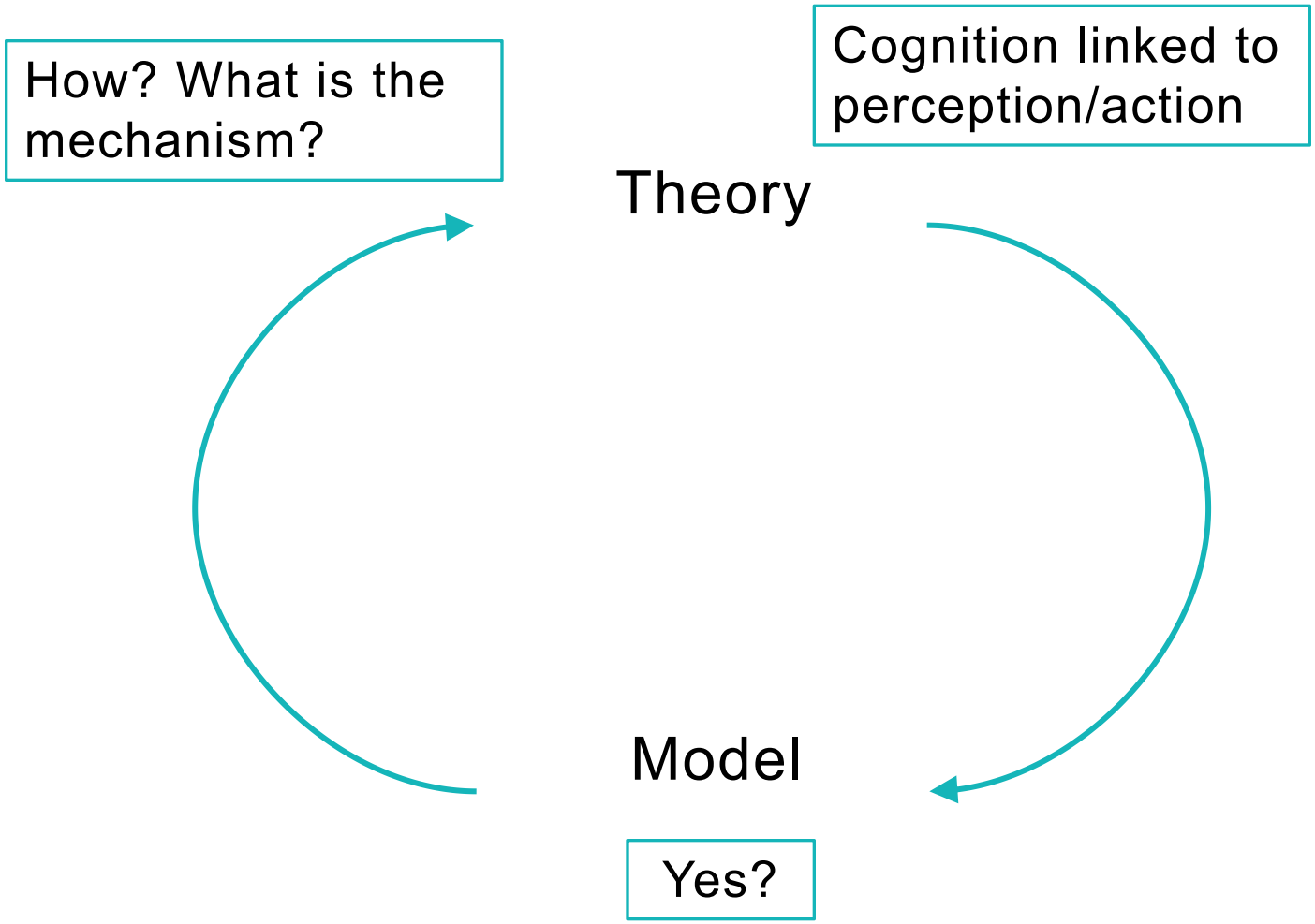
Cognition linked to perception/action



Embodied cognition

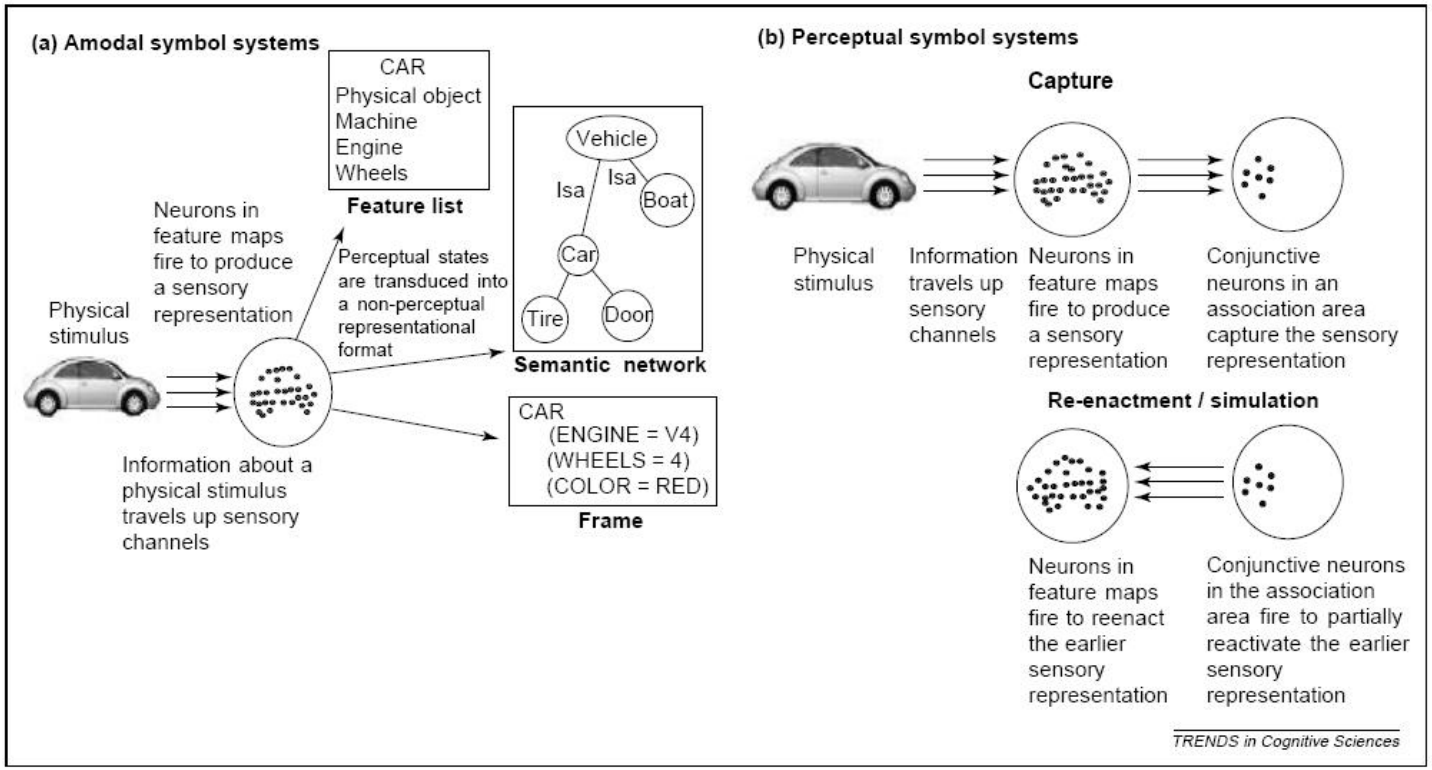


Embodied cognition



Mechanisms of embodiment

How might this work?



Barsalou, L.W., Simmons, W.K., Barbey, A., & Wilson, C.D. (2003). Grounding conceptual knowledge in modality-specific systems. *Trends in Cognitive Sciences*, 7, 84-91.

Links to perception/action

How might cognition link to the body?

-Through visual perception
-Through action
-Through emotion

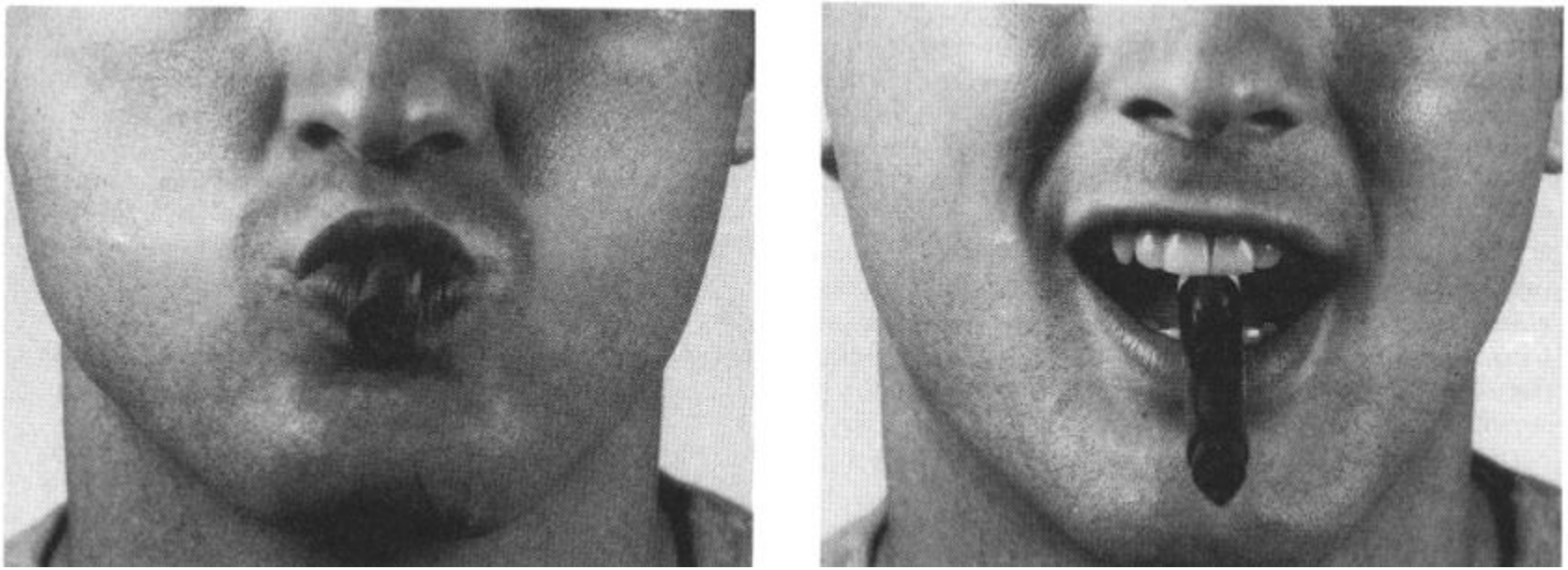
Example 1: facial feedback hypothesis

Hypothesis: facial activity influences affective responses

Does smiling or not smiling affect responses to funny cartoons?

Example 1: facial feedback hypothesis

Hypothesis: facial activity influences affective responses



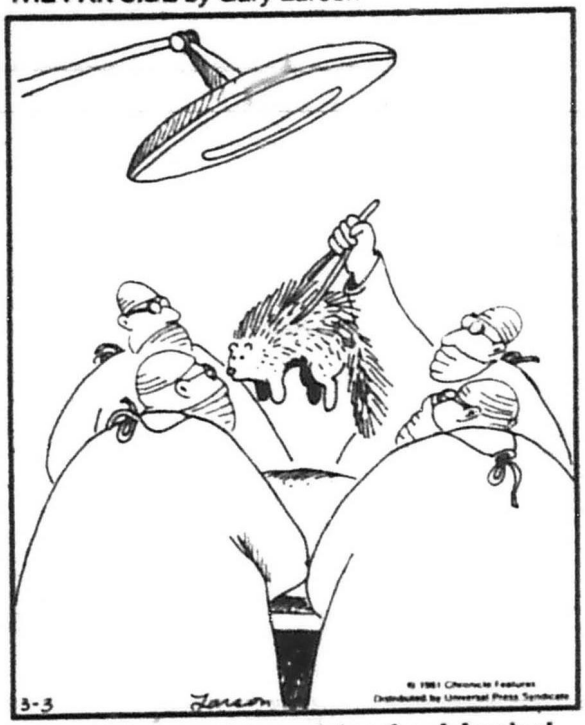
Strack, F., Martin, L. & Stepper, S. (1988). Inhibiting and facilitating conditions of the human smile: A nonobtrusive test of the facial feedback hypothesis. Journal of Personality and Social Psychology, 54, 768-777

Example 1: facial feedback hypothesis

Participants asked to rate cartoons

"The four cartoons were taken from Gary Larson's series *The Far Side* and had been prerated as being **moderately funny**"

Participants rated cartoons funnier when in the 'smiling' condition



"Well, I guess this explains the abdominal pains."

Strack, F., Martin, L. & Stepper, S. (1988). Inhibiting and facilitating conditions of the human smile: A nonobtrusive test of the facial feedback hypothesis. Journal of Personality and Social Psychology, 54, 768-777

Example 1: facial feedback hypothesis

Large-scale replication from 17 labs did not find the same effect

The British Psychological Society **Research Digest**

EMOTION, FACES, METHODS, REPLICATIONS

September 1,

No reason to smile – Another modern psychology classic has failed to replicate

E.-J. Wagenmakers et al. (2016). Registered replication report: Strack, Martin and Stepper (1988). *Perspectives on Psychological Science.* 11(6), 917-928

Example 2: action simulation and product preference

Hypothesis: visual handedness congruency will afford better mental simulation

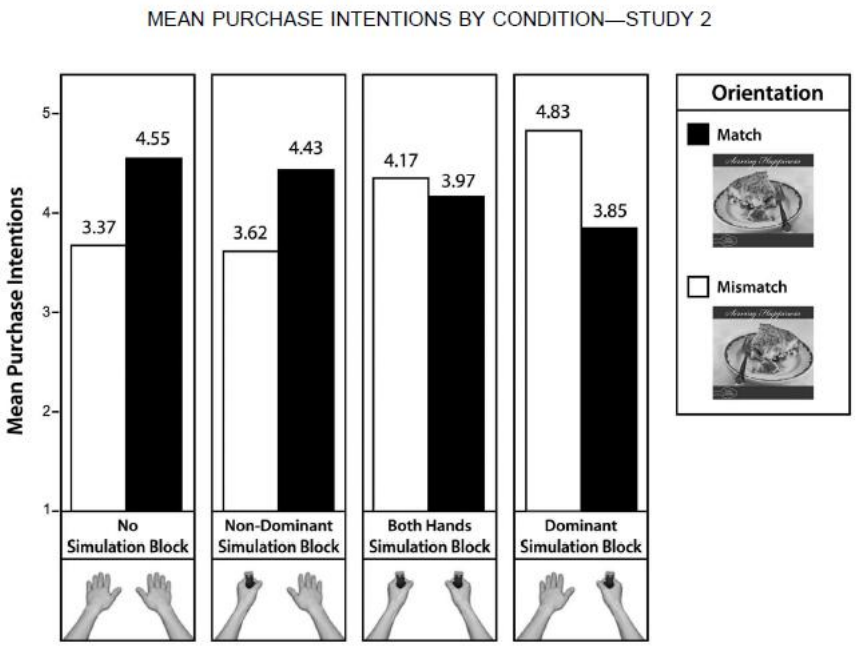
Elder, R. & Krishna, A.(2012), The "Visual Depiction Effect" in advertising: Facilitating embodied mental simulation through product orientation
J. Consumer Research 38(6): 988-1003

Example 2: action simulation and product preference

Greater purchasing preference when image handedness matched participant

Elder, R. & Krishna, A.(2012), The "Visual Depiction Effect" in advertising: Facilitating embodied mental simulation through product orientation
J. Consumer Research 38(6): 988-1003

Example 2: action simulation and product preference



The effect is reversed when dominant hand is blocked

Elder, R. & Krishna, A.(2012), The "Visual Depiction Effect" in advertising: Facilitating embodied mental simulation through product orientation
J. Consumer Research 38(6): 988-1003

Example 2: action simulation and product preference

International Journal of Research in Marketing

Available online 7 June 2016

In Press, Corrected Proof — Note to users

Replication

The role of action simulation on intentions to purchase products ☆

Diane Pecher[a], , , Saskia van Dantzig[b],

Show more

http://dx.doi.org/10.1016/j.ijresmar.2016.03.006

Abstract

Previous research suggested that consumers' intentions to purchase products are increased when the product's depiction affords an action with the dominant hand than with the non-dominant hand. In eight experiments the authors obtained no evidence that consumers have higher intentions to buy products that are shown oriented towards their dominant hand than towards their non-dominant hand. The absence of a dominant hand advantage questions the role of action simulations in consumers' evaluations of visually depicted products.

BUT

Effect did not replicate in 8 experiments

Now back to

LANGUAGE

The ACE effect: action sentence compatibility

Hypothesis: conflict between action and language can inhibit actions

Glenberg, A. M., & Kaschak, M. P. (2002). Grounding language in action. Psychonomic Bulletin & Review, 9, 558-565.

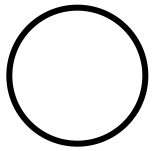
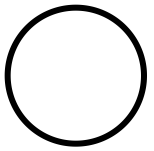
The ACE effect: action sentence compatibility

Participants presented with sentences have to say whether sentence makes sense or not

The ACE effect: action sentence compatibility

Participants presented with sentences have to say whether sentence makes sense or not

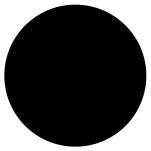
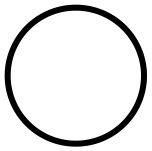
Open the drawer

YES   NO

The ACE effect: action sentence compatibility

Participants presented with sentences have to say whether sentence makes sense or not

Open the drawer

YES   NO

The ACE effect: action sentence compatibility

Participants presented with sentences have to say whether sentence makes sense or not

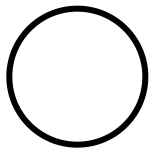
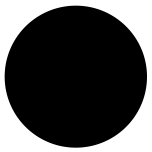
John sang the cards to you

YES ◯ ◯ NO

The ACE effect: action sentence compatibility

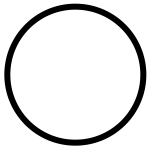
Participants presented with sentences have to say whether sentence makes sense or not

John sang the cards to you

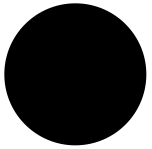
YES   NO

The ACE effect: action sentence compatibility

John sang the cards to you

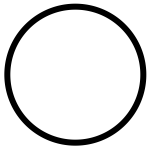
YES 

START

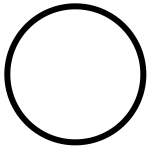
NO 

The ACE effect: action sentence compatibility

Open the drawer

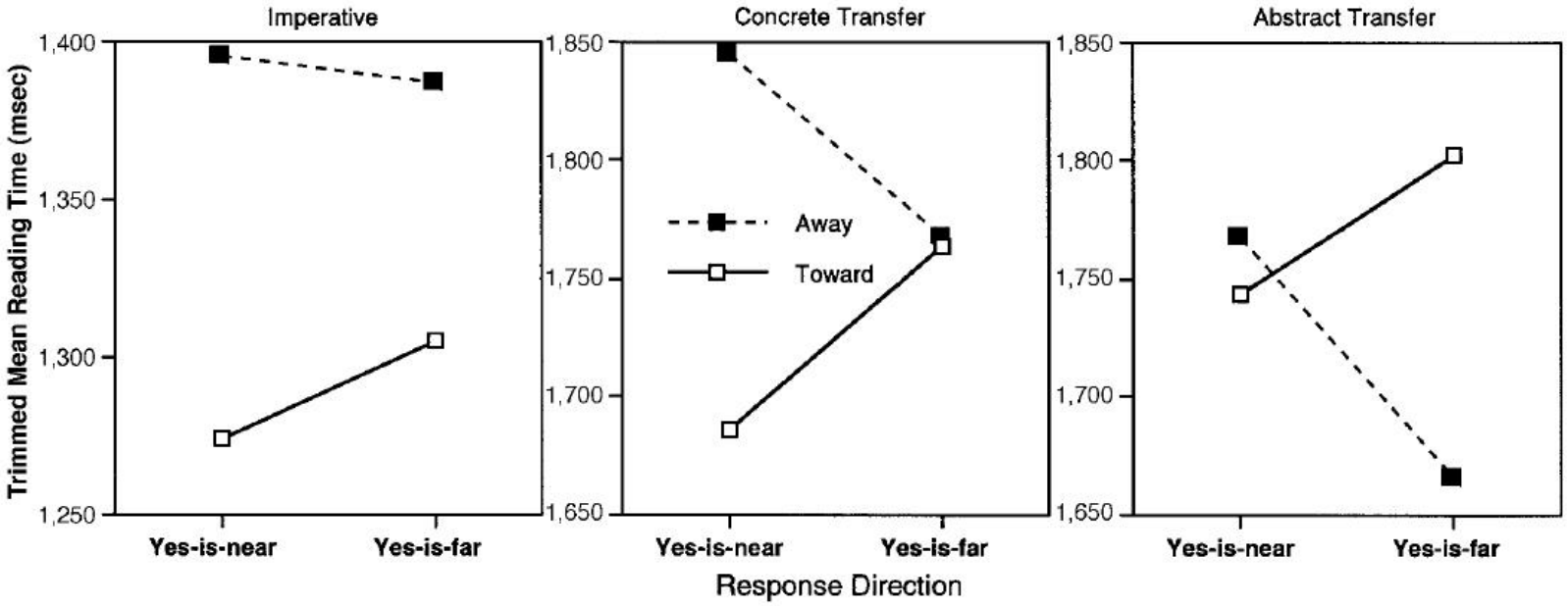
YES 

START

NO 

The ACE effect: action sentence compatibility

Judgements faster when sentence direction matched physical response direction

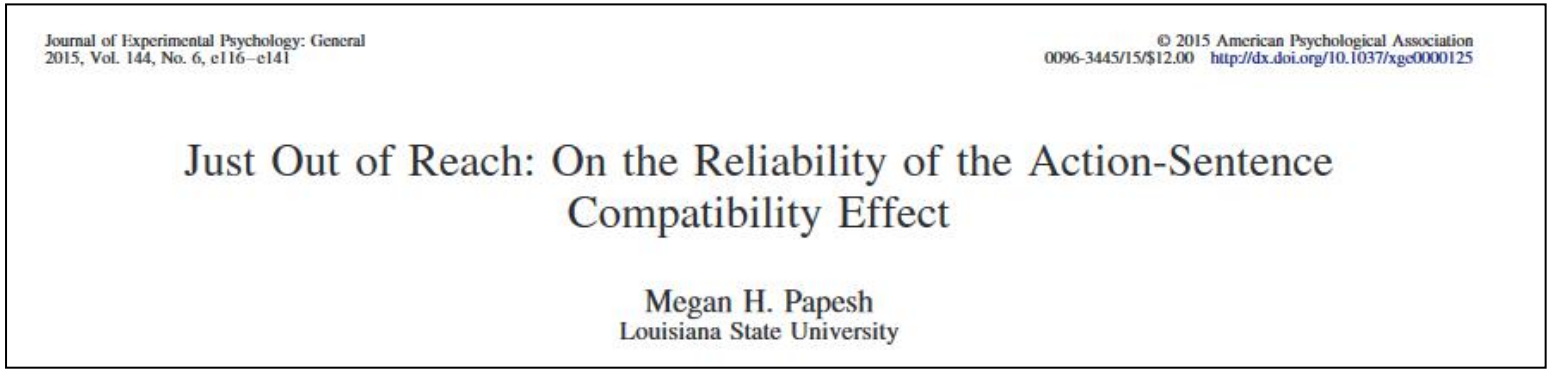


Glenberg, A. M., & Kaschak, M. P. (2002). Grounding language in action. Psychonomic Bulletin & Review, 9, 558-565.

Oh but guess what?

The ACE effect: action sentence compatibility

"The present study began as an attempt to extend the ACE in a new direction, but eventually became a series of attempts to simply replicate the effect."



Journal of Experimental Psychology: General
2015, Vol. 144, No. 6, e116–e141

0096-3445/15/$12.00 http://dx.doi.org/10.1037/xge0000125

Just Out of Reach: On the Reliability of the Action-Sentence Compatibility Effect

Megan H. Papesh
Louisiana State University

The ACE effect: action sentence compatibility

8 experiments + Bayes Factor meta-analysis

"…the evidence for the ACE is generally weak"

Journal of Experimental Psychology: General
2015, Vol. 144, No. 6, e116–e141

0096-3445/15/$12.00 http://dx.doi.org/10.1037/xge0000125

Just Out of Reach: On the Reliability of the Action-Sentence Compatibility Effect

Megan H. Papesh
Louisiana State University

Facial expression and sentence processing

Hypothesis: involuntary facial expression plays a role in processing emotional language content

First time patients, receiving botox to the frown muscles

Havas, D. A., Glenberg, A. M., Gutowski, K. A., Lucarelli, M. J., & Davidson, R. J. (2010). Cosmetic use of botulinum toxin-A affects processing of emotional language. Psychological Science, 21, 895-900.

Facial expression and sentence processing

Does inhibition of frown muscles effect processing of emotional sentence content?

First time patients, receiving botox to the frown muscles

Havas, D. A., Glenberg, A. M., Gutowski, K. A., Lucarelli, M. J., & Davidson, R. J. (2010). Cosmetic use of botulinum toxin-A affects processing of emotional language. Psychological Science, 21, 895-900.

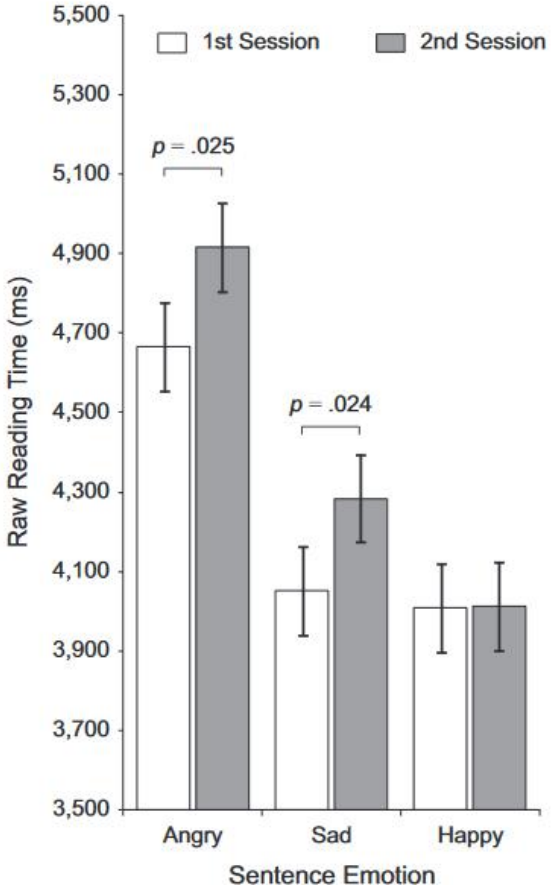
Facial expression and sentence processing

Presented with 3 types of sentences

Angry	*The workload from your pompous professor is unreasonable*
Sad	*You open your email inbox on your birthday to find no new emails*
Happy	*You spring up the stairs to your lover's apartment*

Havas, D. A., Glenberg, A. M., Gutowski, K. A., Lucarelli, M. J., & Davidson, R. J. (2010). Cosmetic use of botulinum toxin-A affects processing of emotional language. Psychological Science, 21, 895-900.

Facial expression and sentence processing



Participants slower to read angry and sad sentences after botox treatment

Inability to express specific facial expression interferes with processing of emotional content

Havas, D. A., Glenberg, A. M., Gutowski, K. A., Lucarelli, M. J., & Davidson, R. J. (2010). Cosmetic use of botulinum toxin-A affects processing of emotional language. Psychological Science, 21, 895-900.

Facial expression and sentence processing

Hypothesis: inhibiting facial expression affects the brain's response to emotional language

ERP study – participants read positive or negative sentences

\+ She reached inside her coat from last winter and found some cash

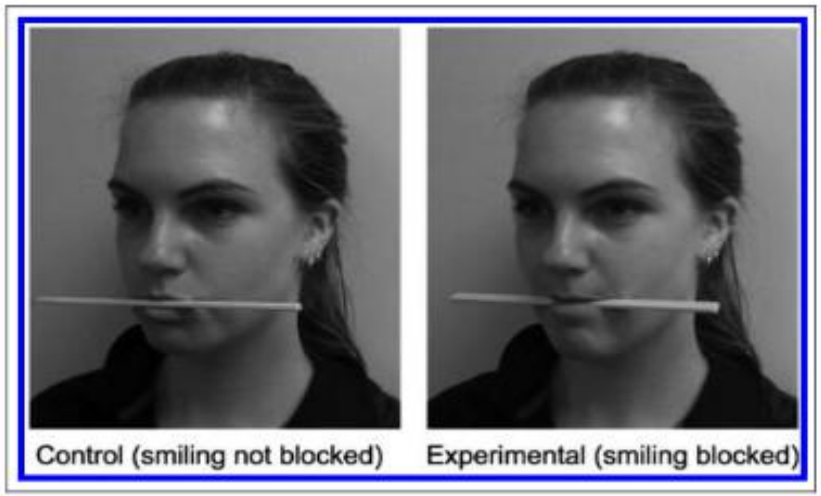
\- She reached inside her coat from last winter and found some bugs

Davis, J.D., Winkielman, P. and Coulson, S. (2015). Facial action and emotional language: ERP evidence that blocking facial feedback selectively impairs sentence comprehension. *Journal of Cognitive Neuroscience.* 27 (11) p. 2269-2280

Facial expression and sentence processing

Hypothesis: inhibiting facial expression affects the brain's response to emotional language

Facial expression manipulated with chopsticks

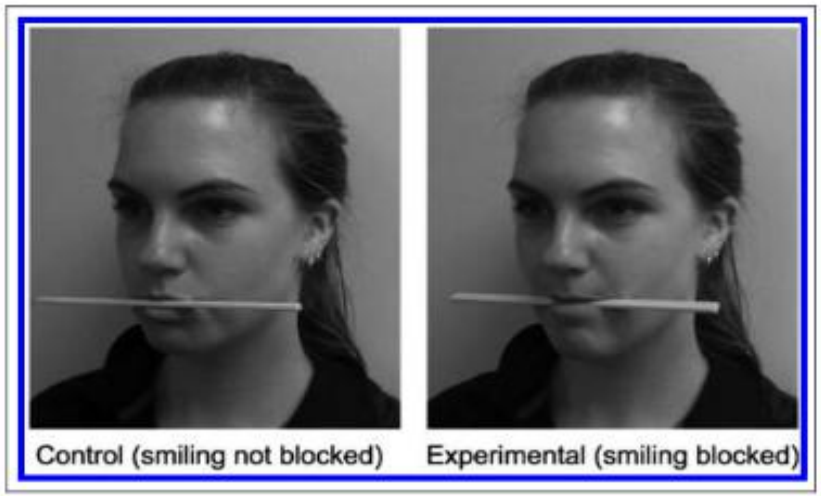


Davis, J.D., Winkielman, P. and Coulson, S. (2015). Facial action and emotional language: ERP evidence that blocking facial feedback selectively impairs sentence comprehension. *Journal of Cognitive Neuroscience.* 27 (11) p. 2269-2280

Facial expression and sentence processing

When smiling blocked, large N400 for positive ending sentences

i.e. inability to make congruent expression interferes with processing



Davis, J.D., Winkielman, P. and Coulson, S. (2015). Facial action and emotional language: ERP evidence that blocking facial feedback selectively impairs sentence comprehension. *Journal of Cognitive Neuroscience.* 27 (11) p. 2269-2280

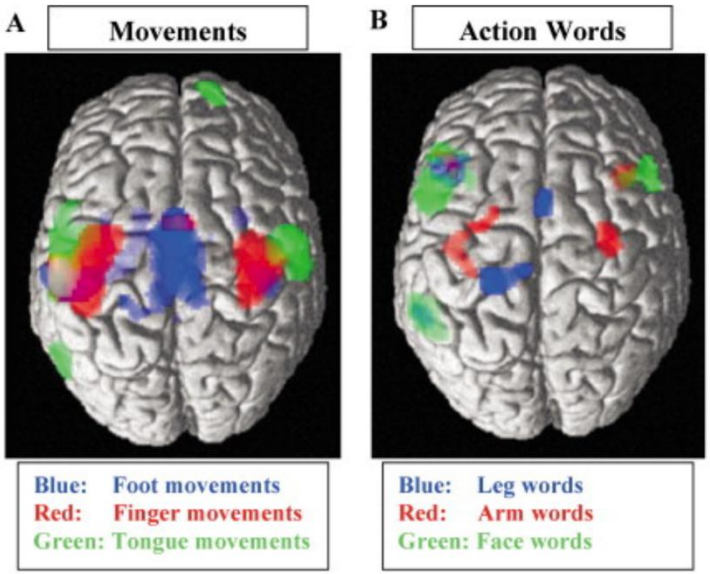
Word processing linked to motor control

Hypothesis: words are directly linked to real-world perception and action

Hauk, Johnsrude and Pulvermuller (2004). Somatotopic representation of action words in human motor and premotor cortex. *Neuron.* 41(2). p. 301-307.

Word processing linked to motor control

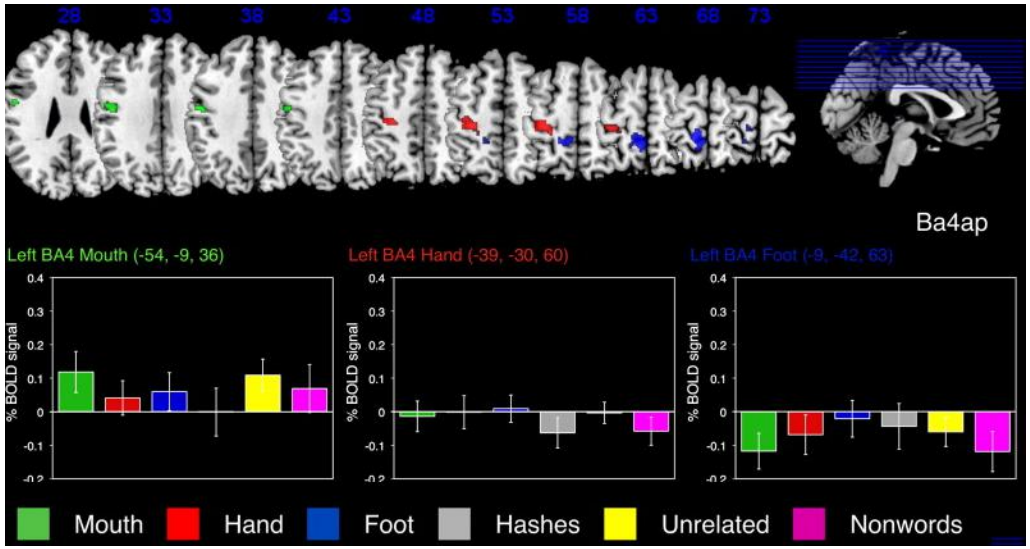
Hearing words associated with different articulators (legs, arms, face) activates parts of the brains associated with motor control of those articulators



Hauk, Johnsrude and Pulvermuller (2004). Somatotopic representation of action words in human motor and premotor cortex. *Neuron.* 41(2). p. 301-307.

Word processing linked to motor control

BUT possible failure to replicate...



No evidence for linkage in specific brain regions

Postle, N., et al. (2008). Action word meaning representations in cytoarchitectonically defined primary and premotor cortices. *NeuroImage* 43(4), 634-644.

Visual imagery and sentence processing

Hypothesis: people activate perceptual representations during language comprehension and processing

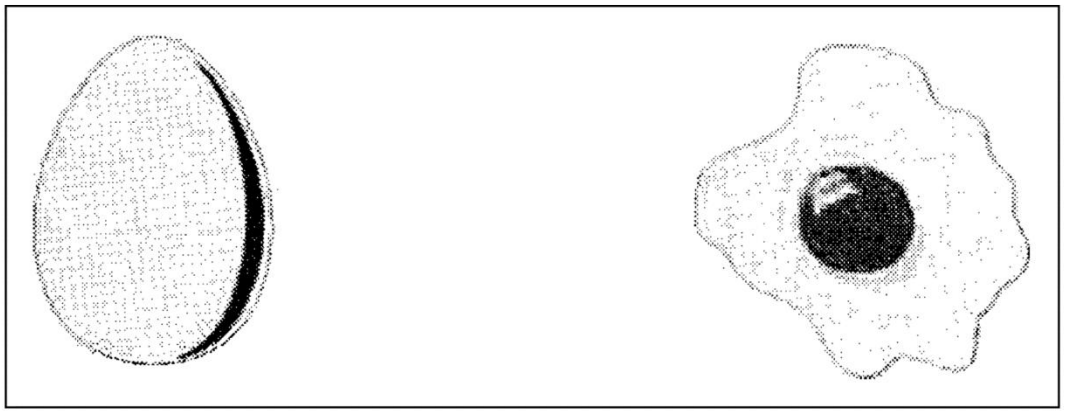
She took the egg out of the refrigerator

She took the egg out of the pan

Zwaan, R. A., Stanfield, R. A., & Yaxley, R. H. (2002). Language comprehenders mentally represent the shape of objects. Psychological Science, 13, 168-171.

Visual imagery and sentence processing

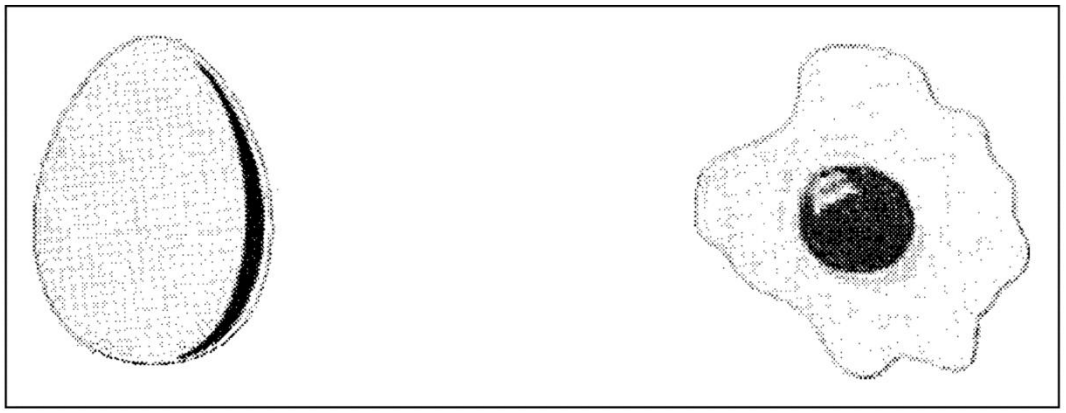
Hypothesis: people activate perceptual representations during language comprehension and processing



Zwaan, R. A., Stanfield, R. A., & Yaxley, R. H. (2002). Language comprehenders mentally represent the shape of objects. Psychological Science, 13, 168-171.

Visual imagery and sentence processing

Participants faster to recognise objects when specific details of picture matched the sentence



Zwaan, R. A., Stanfield, R. A., & Yaxley, R. H. (2002). Language comprehenders mentally represent the shape of objects. Psychological Science, 13, 168-171.

Visual imagery and sentence processing

Hypothesis: real-world expertise influences how perceptual representations are used

2 populations: experts (hockey players, football players)
novices (non-sport playing university students)

Holt, L.E., & Beilock, S.L. (2006). Expertise and its embodiment: Examining the impact of sensorimotor skill expertise on the representation of action-related text. Psychonomic Bulletin & Review, 13(4), 694-701.

Visual imagery and sentence processing

Hypothesis: real-world expertise influences how perceptual representations are used

Exp 1:

A. The child saw the balloon in the air. (A)

B. The child saw the balloon in the bag. (B)

Holt, L.E., & Beilock, S.L. (2006). Expertise and its embodiment: Examining the impact of sensorimotor skill expertise on the representation of action-related text. Psychonomic Bulletin & Review, 13(4), 694-701.

Visual imagery and sentence processing

Hypothesis: real-world expertise influences how perceptual representations are used

Exp 1:

A. The referee saw the hockey helmet on the player. (A)

B. The referee saw the hockey helmet on the bench. (B)

Holt, L.E., & Beilock, S.L. (2006). Expertise and its embodiment: Examining the impact of sensorimotor skill expertise on the representation of action-related text. Psychonomic Bulletin & Review, 13(4), 694-701.

Visual imagery and sentence processing

Hypothesis: real-world expertise influences how perceptual representations are used

Exp 1:

both groups faster for congruent images in everyday object set

only hockey players faster for congruent images in hockey set

Holt, L.E., & Beilock, S.L. (2006). Expertise and its embodiment: Examining the impact of sensorimotor skill expertise on the representation of action-related text. Psychonomic Bulletin & Review, 13(4), 694-701.

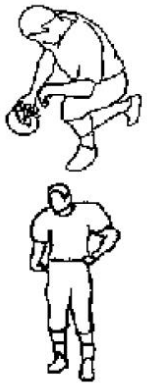
Visual imagery and sentence processing

Hypothesis: real-world expertise influences how perceptual representations are used

Exp 2:

A. The coach saw the football defenseman during the team prayer.

B. The coach saw the football defenseman during the coin toss.



Holt, L.E., & Beilock, S.L. (2006). Expertise and its embodiment: Examining the impact of sensorimotor skill expertise on the representation of action-related text. Psychonomic Bulletin & Review, 13(4), 694-701.

Visual imagery and sentence processing

Hypothesis: real-world expertise influences how perceptual representations are used

Exp 2:

A. The trainer saw the offensive lineman protect the quarterback.

B. The trainer saw the offensive lineman protect the ball.

Holt, L.E., & Beilock, S.L. (2006). Expertise and its embodiment: Examining the impact of sensorimotor skill expertise on the representation of action-related text. Psychonomic Bulletin & Review, 13(4), 694-701.

Visual imagery and sentence processing

Hypothesis: real-world expertise influences how perceptual representations are used

Exp 2:

A. The trainer saw the offensive lineman protect the quarterback.

B. The trainer saw the offensive lineman protect the ball.

Holt, L.E., & Beilock, S.L. (2006). Expertise and its embodiment: Examining the impact of sensorimotor skill expertise on the representation of action-related text. Psychonomic Bulletin & Review, 13(4), 694-701.

Visual imagery and the link to language

Hypothesis: real-world spatial associations with word meanings interfere in an irrelevant task

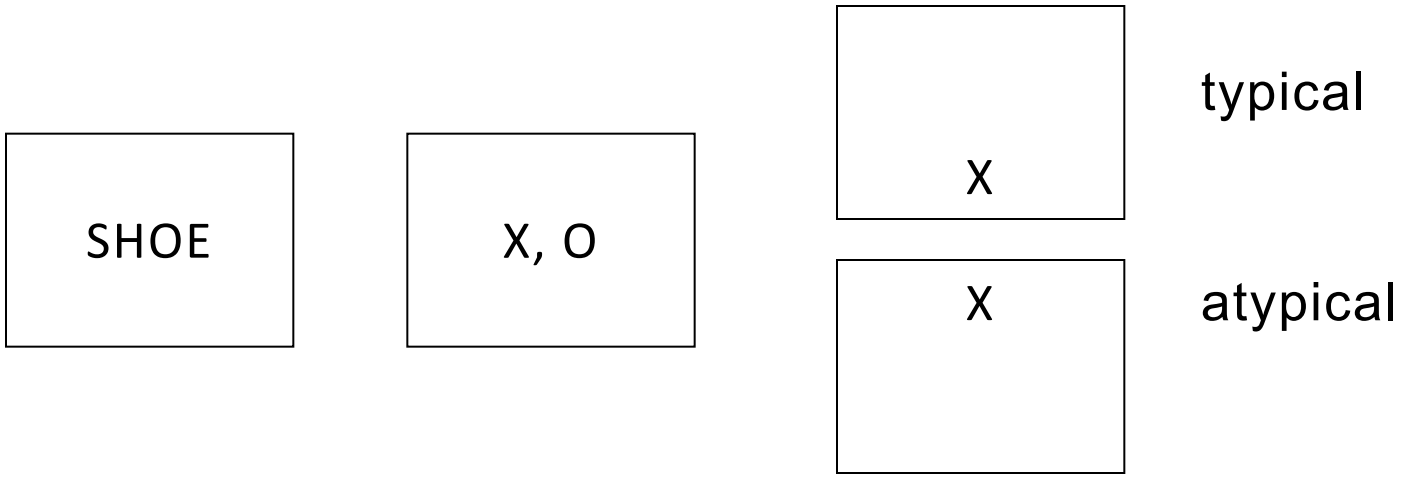
Words can be associated with locations (e.g. body parts, animals, clothes)

Do these associated location interfere with visual processing?

Estes, Z., Verges, M. & Barsalou, L.W. (2008). Head up, foot down: Object words orient attention to the objects' typical location. Psychological Science.

Visual imagery and the link to language

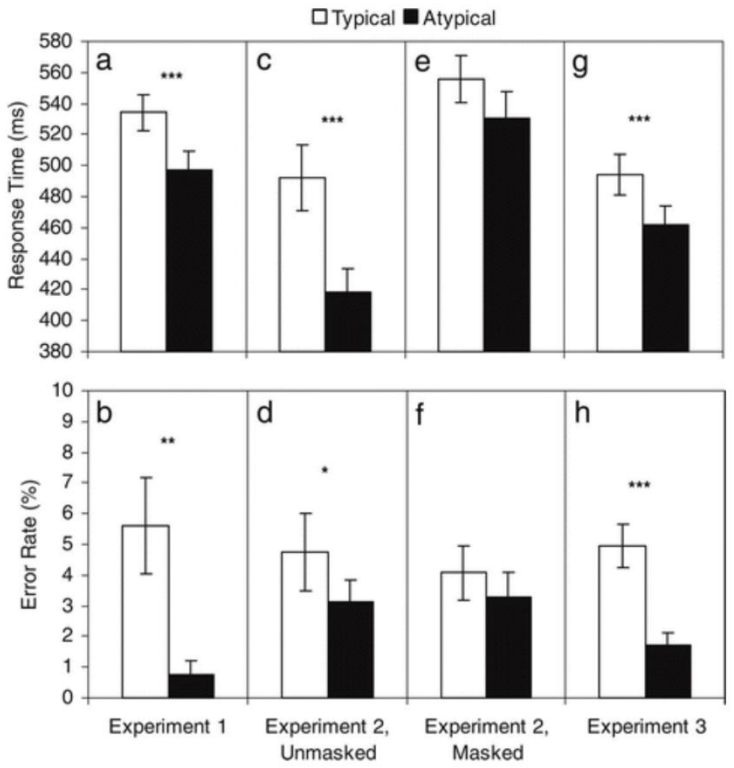
Hypothesis: real-world spatial associations with word meanings interfere in an irrelevant task



Estes, Z., Verges, M. & Barsalou, L.W. (2008). Head up, foot down: Object words orient attention to the objects' typical location. Psychological Science.

Visual imagery and the link to language

Participants slower and less accurate when letter is in typically-associated location

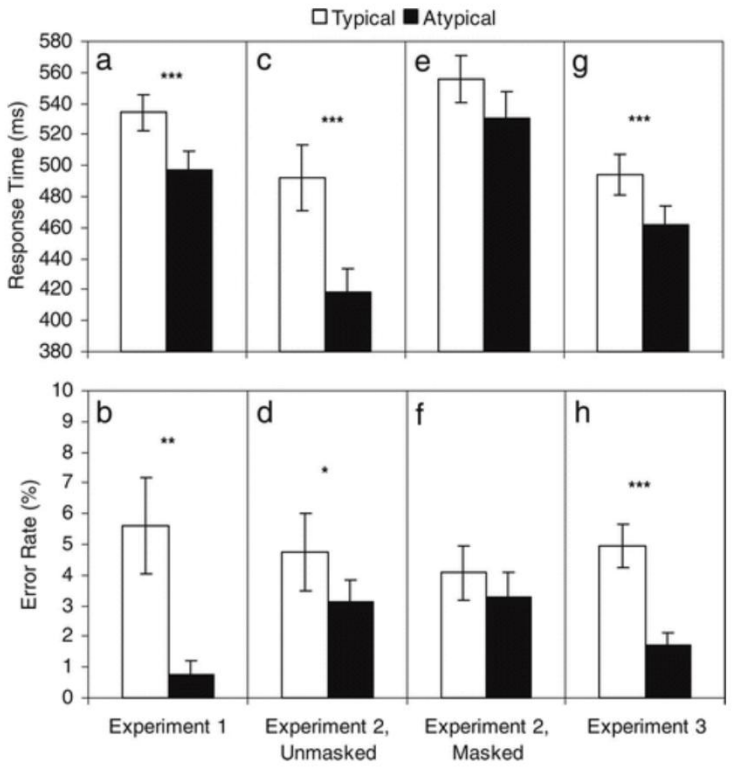


Estes, Z., Verges, M. & Barsalou, L.W. (2008). Head up, foot down: Object words orient attention to the objects' typical location. Psychological Science.

Visual imagery and the link to language

Participants slower and less accurate when letter is in typically-associated location

WHY?

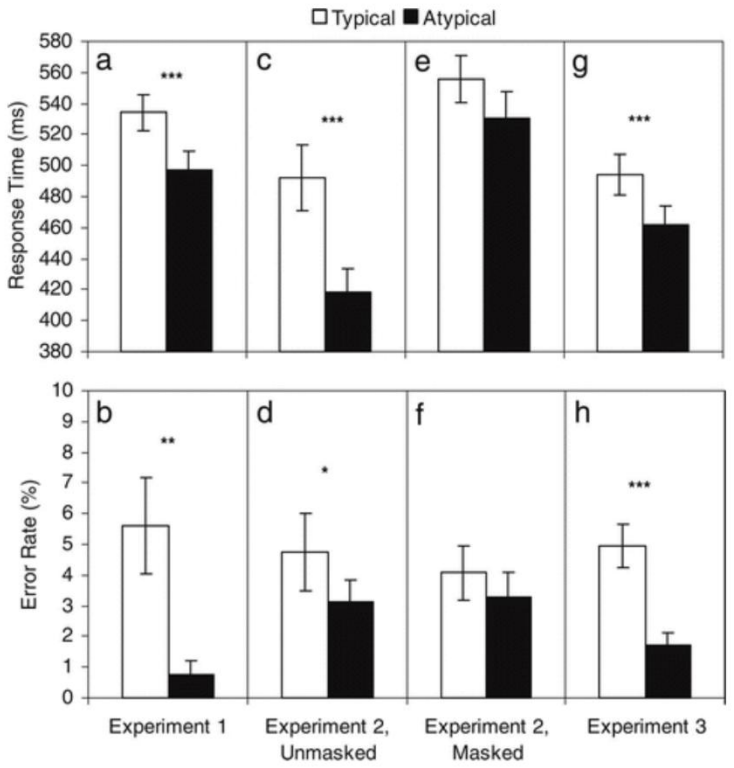


Estes, Z., Verges, M. & Barsalou, L.W. (2008). Head up, foot down: Object words orient attention to the objects' typical location. Psychological Science.

Visual imagery and the link to language

Participants slower and less accurate when letter is in typically-associated location

Object and target share few features, perception of target requires inhibition of mental imagery



Estes, Z., Verges, M. & Barsalou, L.W. (2008). Head up, foot down: Object words orient attention to the objects' typical location. Psychological Science.

Visual imagery and the link to language

Similar effects found by other researchers (Bergen, Lindsay, Matlock, & Narayanan, 2007
Gozli, Chasteen, & Pratt, 2013)

BUT

One failed replication attempt by Renkewitz and Muller (https://osf.io/b7zek/)

Response from original authors: https://osf.io/g3qt5/

Visual imagery and the link to language

Similar effects found by other researchers (Bergen, Lindsay, Matlock, & Narayanan, 2007
Gozli, Chasteen, & Pratt, 2013)

BUT

One failed replication attempt by Renkewitz and Muller (https://osf.io/b7zek/)

Response from original authors: https://osf.io/g3qt5/

“Testing a language effect in a different language is not a replication”

Visual imagery and the link to language

Similar effects found by other researchers (Bergen, Lindsay, Matlock, & Narayanan, 2007
Gozli, Chasteen, & Pratt, 2013)

BUT

One failed replication attempt by Renkewitz and Muller (https://osf.io/b7zek/)

“In our judgment, many of the German cue words do not have a strong association with a specific (upper or lower) location”

The story so far

A lot of classic embodiment studies fail to replicate

The story so far

A lot of classic embodiment studies fail to replicate

facial feedback hypothesis
action simulation and product preference
action sentence compatibility
facial expression and sentence processing
link between language and motor control
visual imagery and language processing
visual imagery and task interference

The story so far

A lot of classic embodiment studies fail to replicate

facial feedback hypothesis

action simulation and product preference

action sentence compatibility

facial expression and sentence processing

link between language and motor control

visual imagery and language processing

visual imagery and task interference

The story so far

A lot of classic embodiment studies fail to replicate

facial feedback hypothesis

action simulation and product preference

action sentence compatibility

facial expression and sentence processing

link between language and motor control

visual imagery and language processing

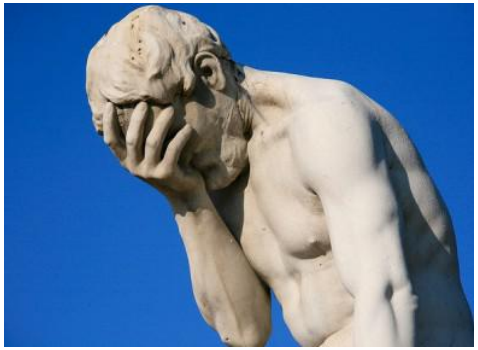
visual imagery and task interference

The story so far

What do this mean for theories of embodied cognition?

How do researchers studying embodied cognition go forward?

BREAK



What have we learnt about embodied cognition

1. Is there a link between cognition and the body?

Lots of studies support and embodied account to some degree

Lack of replication for quite a few studies

Varied replication for some studies show that effects of embodiment not observed under all conditions

What have we learnt about embodied cognition

2. How does this mechanism work?

How plausible is a fully embodied account of cognition?

i.e. Do we always activate sensory and motor systems when processing language, or *anything?*

Do the conflicting experimental results support this account?

Limitations of embodied cognition – how does it work?

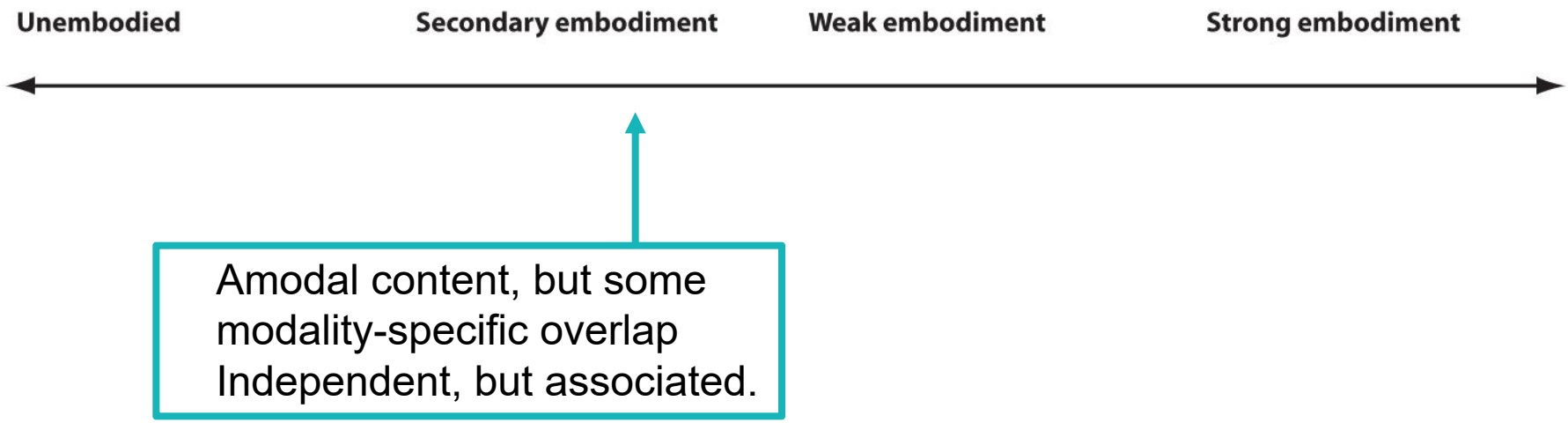
Meteyard, L., Rodriguez Cuadrado, S., Bahrami, B. & Vigliocco, G. (2012) Coming of age: a review of embodiment and the neuroscience of semantics. Cortex, 48(7), 788-804.

Limitations of embodied cognition – how does it work?

Semantic regions have no overlap with sensory/motor areas.
The two are completely independent.

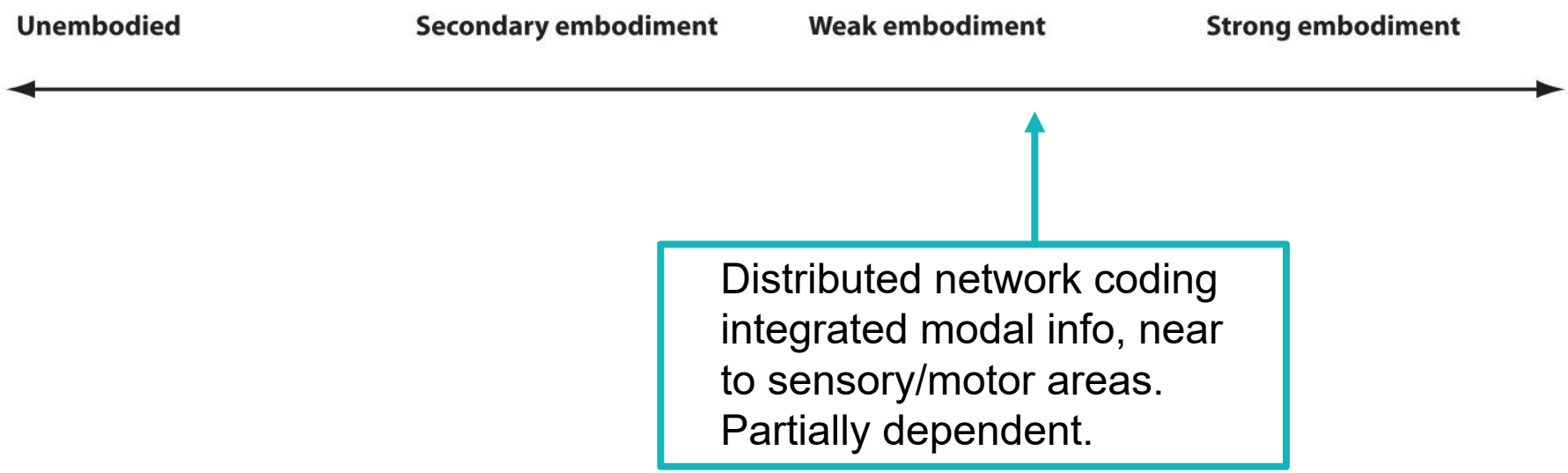
Meteyard, L., Rodriguez Cuadrado, S., Bahrami, B. & Vigliocco, G. (2012) Coming of age: a review of embodiment and the neuroscience of semantics. Cortex, 48(7), 788-804.

Limitations of embodied cognition – how does it work?



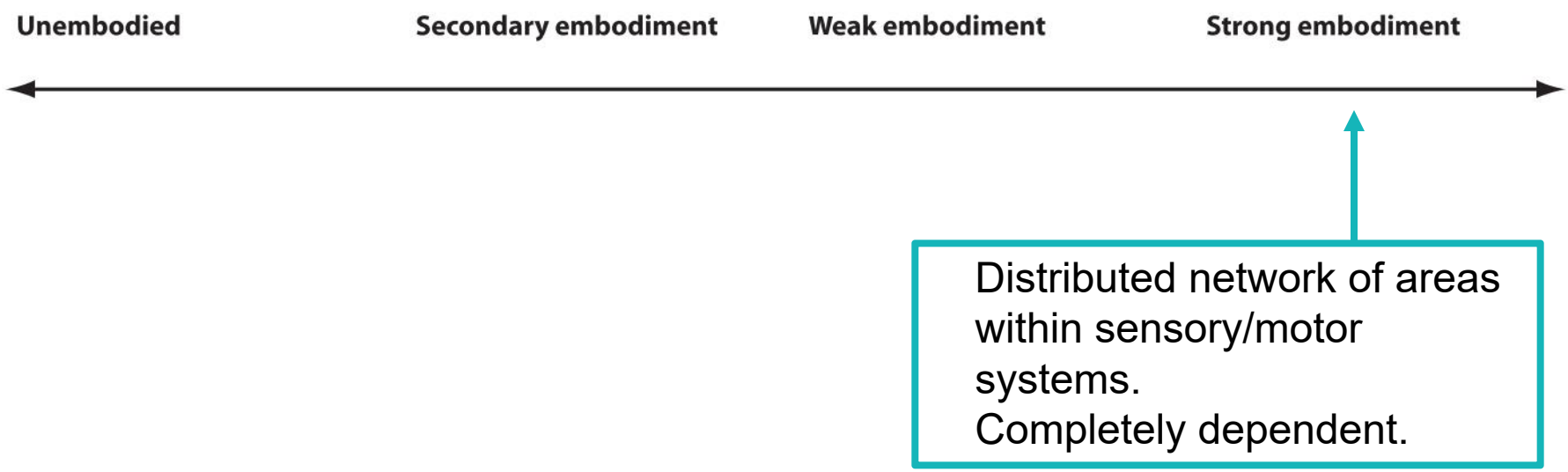
Meteyard, L., Rodriguez Cuadrado, S., Bahrami, B. & Vigliocco, G. (2012) Coming of age: a review of embodiment and the neuroscience of semantics. Cortex, 48(7), 788-804.

Limitations of embodied cognition – how does it work?



Meteyard, L., Rodriguez Cuadrado, S., Bahrami, B. & Vigliocco, G. (2012) Coming of age: a review of embodiment and the neuroscience of semantics. Cortex, 48(7), 788-804.

Limitations of embodied cognition – how does it work?



Meteyard, L., Rodriguez Cuadrado, S., Bahrami, B. & Vigliocco, G. (2012) Coming of age: a review of embodiment and the neuroscience of semantics. Cortex, 48(7), 788-804.

Limitations of embodied cognition – how does it work?

Meteyard, L., Rodriguez Cuadrado, S., Bahrami, B. & Vigliocco, G. (2012) Coming of age: a review of embodiment and the neuroscience of semantics. Cortex, 48(7), 788-804.

Limitations of embodied cognition – how does it work?

- Zwaan (2014) calls for a “pluralist view of cognition”
- Mahon and Caramazza (2008) propose a middle ground; abstract symbols activated by sensory-motor info

Limitations of embodied cognition – how does it work?

Why are these distinctions important?

- They allow us to create better models to test more specific hypotheses
- i.e. better theory about how the link works allows us to test whether the link is there

Limitations of embodied cognition – is cognition related to the body?

- Models of embodiment underspecified
- Any effect of the body on thought taken as evidence for embodiment without understanding of how embodiment *works*
- We should be able to explain the pattern of results, not just whether embodiment is there or not

Limitations of embodied cognition – is cognition related to the body?

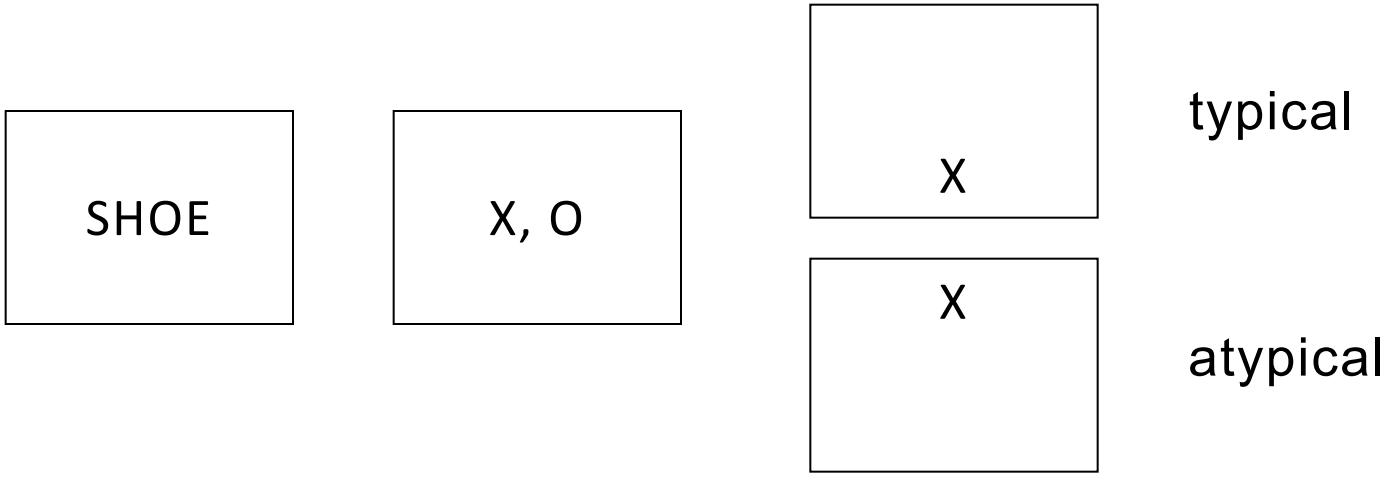
This means that lack of replication actually tells us very little

SO

We need better models, better predictions of when embodiment occurs, when it doesn't

Gozli et al. (2013)

Replication and extension of Estes et al. (2008)

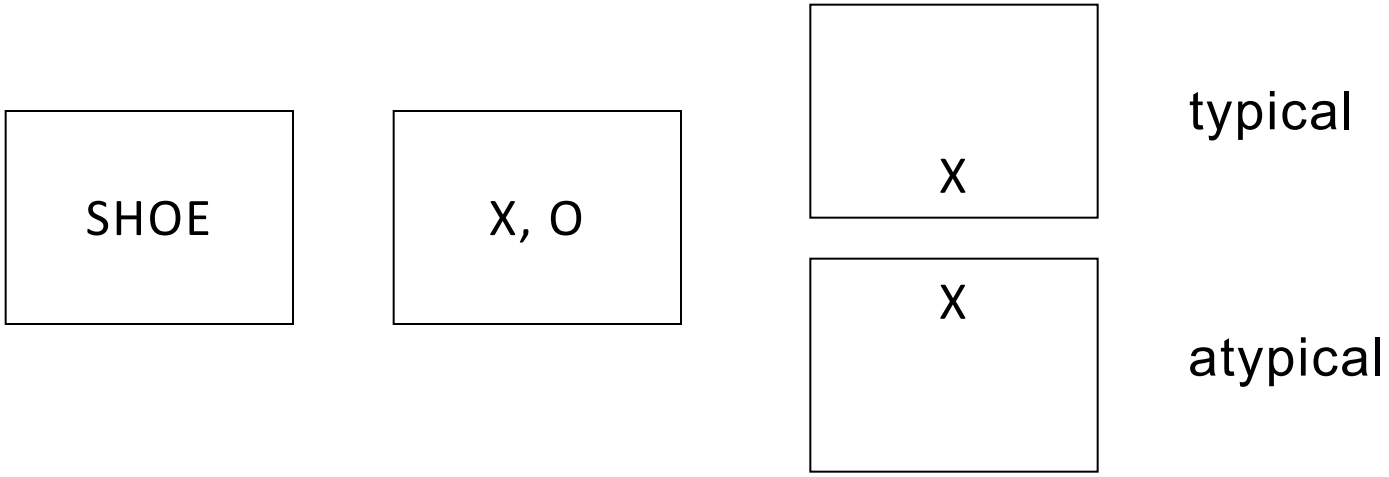


"The cost and benefit of implicit spatial skills for visual attention"

Gozli, D.G., Chasteen, A.L. & Pratt, J. (2013). The cost and benefit of implicit spatial skills for visual attention. *Journal of Experimental Psychology: General*

Gozli et al. (2013)

Replication and extension of Estes et al. (2008)



"The cost and benefit of implicit spatial skills for visual attention"

Gozli, D.G., Chasteen, A.L. & Pratt, J. (2013). The cost and benefit of implicit spatial skills for visual attention. *Journal of Experimental Psychology: General*

Gozli et al. (2013)

Estes et al. (2008) found slower responses when word association and letter location matched – others have found faster responses!

Table 1
Task Characteristics in Reports of Interference and Facilitation Resulting From Cue–Target Compatibility

Characteristic	Inhibition	Facilitation
Representative report	Estes et al. (2008)	Chasteen et al. (2010)
Cue type	concrete concepts	abstract concepts
Cue–target SOA	short (150–350 ms)	long (800–1,200 ms)
Visual task	discrimination (choice RT)	detection (simple RT)
Cue treatment	passive viewing	categorization

Note. SOA = stimulus onset asynchrony; RT = response time.

Gozli, D.G., Chasteen, A.L. & Pratt, J. (2013). The cost and benefit of implicit spatial skills for visual attention. *Journal of Experimental Psychology: General*

Gozli et al. (2013)

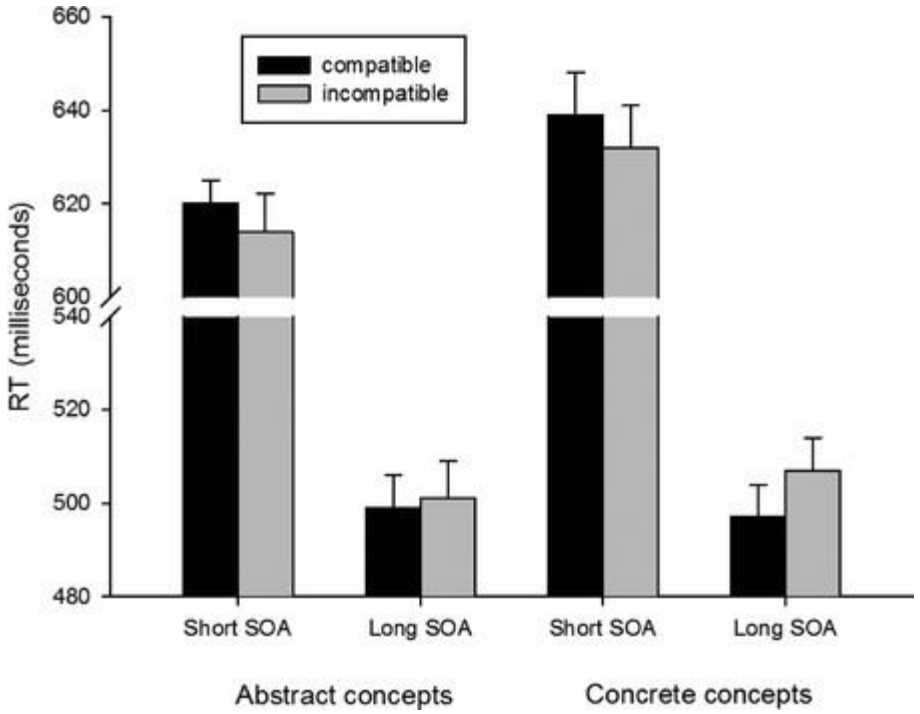
Gozli et al. (2013) ask: under what conditions do we see interference (slow responses) and under what conditions do we see facilitation (faster responses)?

Gozli, D.G., Chasteen, A.L. & Pratt, J. (2013). The cost and benefit of implicit spatial skills for visual attention. *Journal of Experimental Psychology: General*

Gozli et al. (2013)

Authors replicate both results:

Under some conditions, prime-target compatibility facilitates recognition

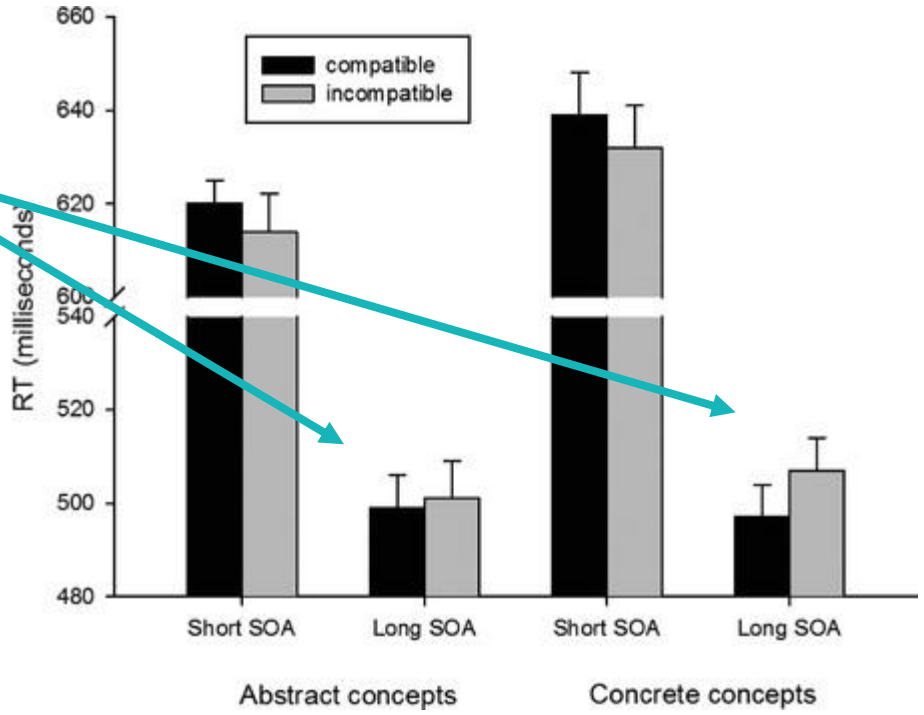


Gozli, D.G., Chasteen, A.L. & Pratt, J. (2013). The cost and benefit of implicit spatial skills for visual attention. *Journal of Experimental Psychology: General*

Gozli et al. (2013)

Authors replicate both results:

Under some conditions, prime-target compatibility facilitates recognition



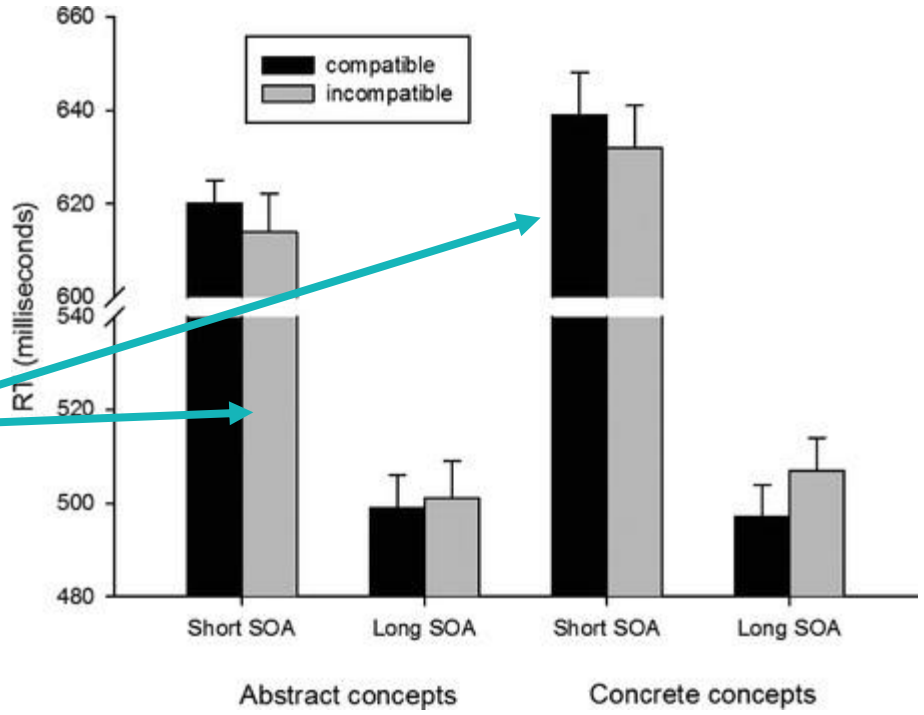
Gozli, D.G., Chasteen, A.L. & Pratt, J. (2013). The cost and benefit of implicit spatial skills for visual attention. *Journal of Experimental Psychology: General*

Gozli et al. (2013)

Authors replicate both results:

Under some conditions, prime-target compatibility facilitates recognition

Under others, it inhibits it

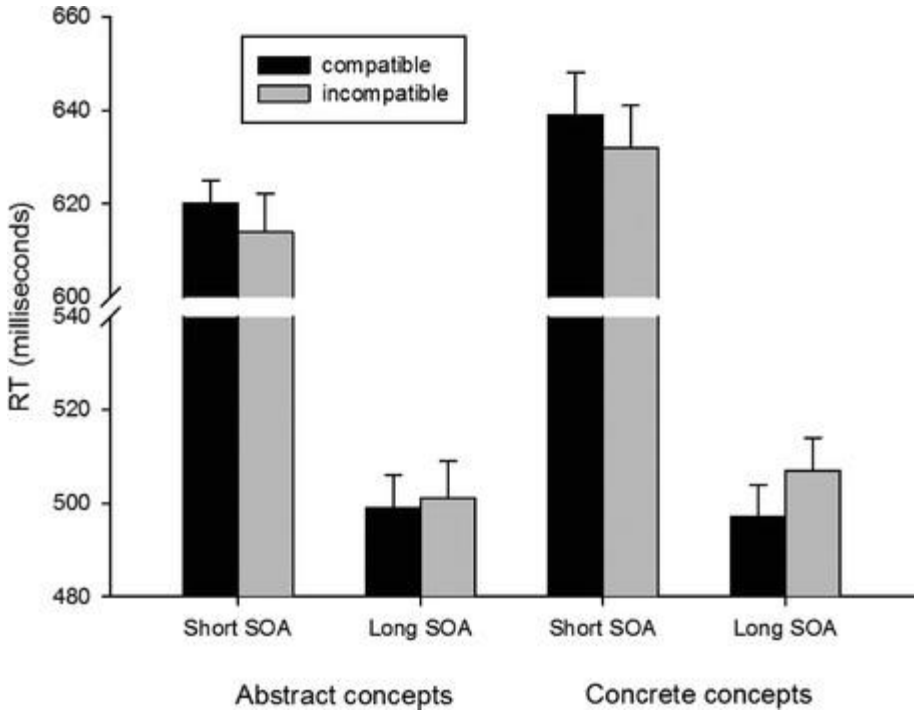


Gozli, D.G., Chasteen, A.L. & Pratt, J. (2013). The cost and benefit of implicit spatial skills for visual attention. *Journal of Experimental Psychology: General*

Gozli et al. (2013)

Authors replicate both results:

Visual imagery gets in the way…but only temporarily



Gozli, D.G., Chasteen, A.L. & Pratt, J. (2013). The cost and benefit of implicit spatial skills for visual attention. *Journal of Experimental Psychology: General*

One more (big) barrier: embodying abstract concepts

How can embodied cognition account for abstract thought?

One more (big) barrier: embodying abstract concepts

How can embodied cognition account for abstract thought?

There is an intuitive understanding of how motor responses can influence thoughts about actions

One more (big) barrier: embodying abstract concepts

How can embodied cognition account for abstract thought?

But what about things that cannot be acted upon?

Truth, freedom, justice, beauty?

One more (big) barrier: embodying abstract concepts

How can embodied cognition account for abstract thought?

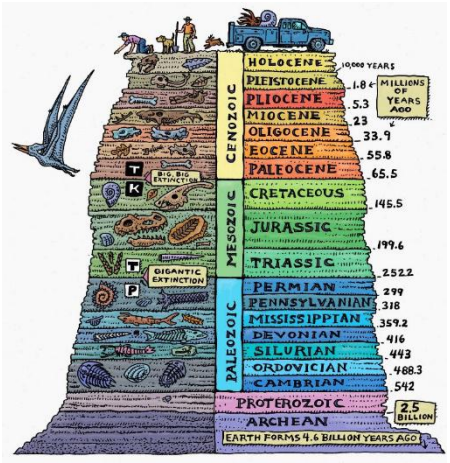
But what about things that cannot be acted upon?

Truth, freedom, justice, beauty?

Unicorns, Nessie, *meringues?*

One more (big) barrier: embodying abstract concepts

Time?



KimKierkegaardashian @KimKierkegaard 13 Jul
Each individual fights for himself, with himself, within himself, in order to free himself before God. I'm gonna be sooo sore tomorrow!
Expand

KimKierkegaardashian @KimKierkegaard 12 Jul
The unhappy person is one for whom the content of life lies outside the self. Can't wait to go to Miami this weekend!
Expand

KimKierkegaardashian @KimKierkegaard 11 Jul
No filter. No photoshop. The highest and most beautiful things are not to read about or seen, but to be lived. Bikini summertime yoga!
Expand

KimKierkegaardashian @KimKierkegaard 11 Jul
Bootcamp & pilates by 9am! Beast mode day 2! I feel good! The defiant self is its own master, but he is a king without a country.
Expand

KimKierkegaardashian @KimKierkegaard 10 Jul
A little makeup lesson for a friend: Tears do not quench the gleam in your eyes; pallid cheeks are all the more soulful.
Expand

KimKierkegaardashian @KimKierkegaard 10 Jul
What distinguishes the unhappiest person? Smoky eyes and chic up-do. Evening glam.
Expand

KimKierkegaardashian @KimKierkegaard 10 Jul
One is furthest from being conscious of himself as spirit when he is ignorant of being in despair. Fun memories watching this episode!
Expand

Embodying abstract concepts

How might this work?

1. Developmental trajectory
2. Simulations from specific events
3. Conceptual metaphor

NOTE: These theories are not mutually exclusive!

Embodying abstract concepts

How might this work?

1. Developmental trajectory

Sensory-motor info learnt first in development, allowing us to create links between the world and the mind

Understanding of abstract concepts can develop from this

Developmental trajectory

The syntactic-bootstrapping hypothesis

Concrete words learnt early, via link to world

Concrete words in syntactic structure help us learn regularities about word meaning and distribution

We can then use those distributional regularities to learn more abstract concepts

Gleitman, L.R., Cassidy, K., Nappa, R., Papafragou, A., & Trueswell, J.C. (2005). Hard words. Language Learning and Development, 1, 23-64.

Developmental trajectory

The syntactic-bootstrapping hypothesis

Embodiment could provide the groundwork for learning abstract concepts

But doesn't necessarily have direct role in abstract-concept learning

Gleitman, L.R., Cassidy, K., Nappa, R., Papafragou, A., & Trueswell, J.C. (2005). Hard words. Language Learning and Development, 1, 23-64.

Embodying abstract concepts

2. Specific simulations

Abstract concepts are not fully independent of their exemplars (e.g. experiences of these concepts)

Create a representation of these concepts based on simulated experience

Barsalou & Wiemer-Hastings. (2005). Situating abstract concepts. In Pecher & Zwaan (Eds.), Grounding cognition: The role of perception and action in memory, language and thinking.

Specific simulations

The ‘idea’ of FREEDOM is hard to link to the real world

But if we use experiences or instances of freedom, then we have a link, through our own bodies and experiences, to the real world

We can rely on past experience to ‘simulate’ abstract concepts

Barsalou & Wiemer-Hastings. (2005). Situating abstract concepts. In Pecher & Zwaan (Eds.), Grounding cognition: The role of perception and action in memory, language and thinking.

Embodying abstract concepts

How might this work?

3. Conceptual metaphor

Abstract concepts are related to the concrete via metaphor

Embodying abstract concepts

How might this work?

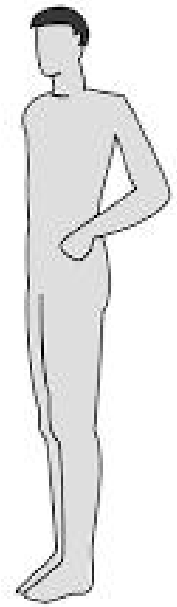
3. Conceptual metaphor

e.g. life is a journey
knowledge is ‘stuff’ in the head
time as a pathway

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by. Chicago: Chicago University Press.*
Lakoff, G., & Johnson, M. (1999). *Philosophy in the flesh: The embodied mind and its challenge to western thought. New York: Basic Books.*

Conceptual metaphors

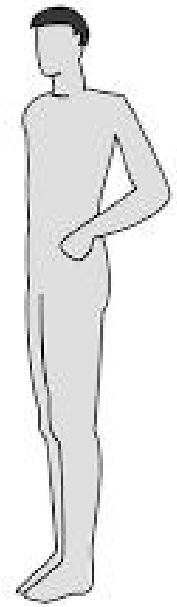
Future



Past

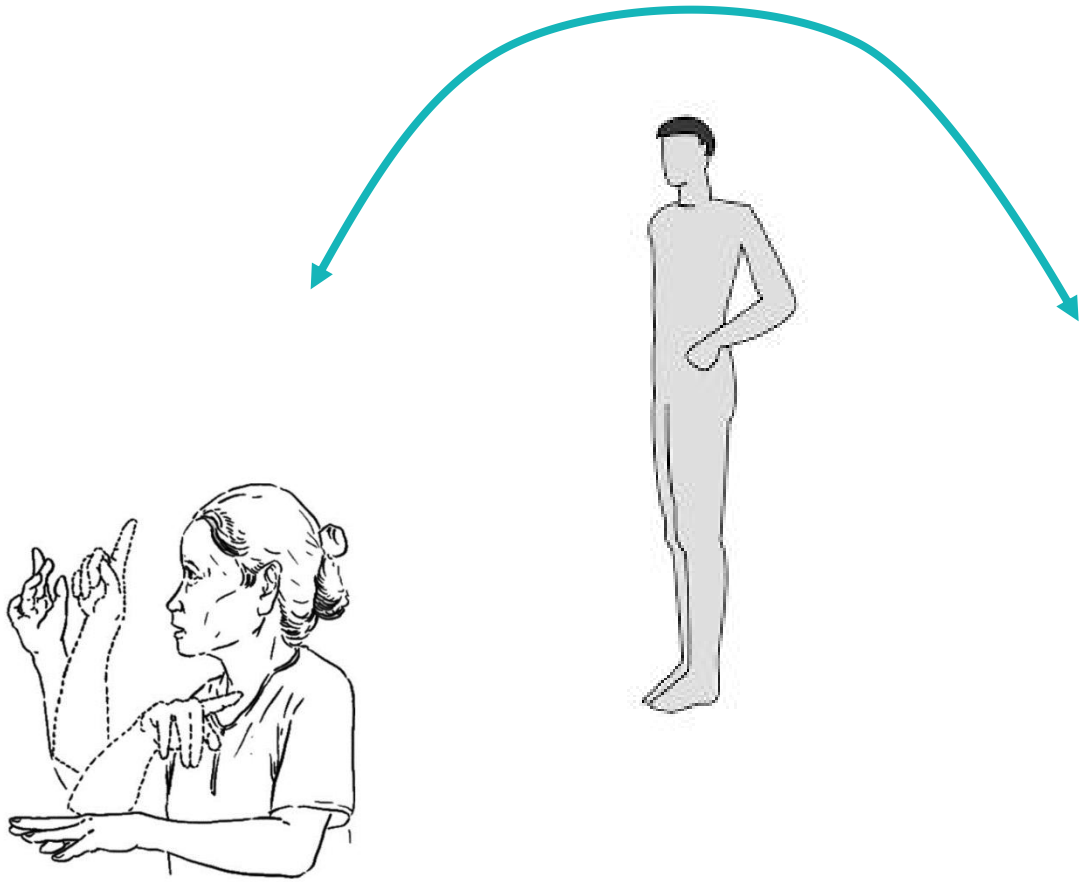
Conceptual metaphors

Past



Future

Conceptual metaphors



de Vos, C. (2014). The Kata Kolok Pointing System: Morphemization and Syntactic Integration. *Topics in Cognitive Science*, 1–19.

Conceptual metaphors

Santiago et al. (2006): conceptual metaphors affect language processing

Spanish words referring to past or future

e.g. tensed words (*dijo*)

temporal adverbs (mañana)

Words presented either on left or right of screen

Left/right response keys = past or future

Santiago, J., Lupáñez, J., Pérez, E. & Funes, M. (2007). Time (also) flies from left to right. *Psychonomic Bulletin & Review, 14,* 512-516

Conceptual metaphors

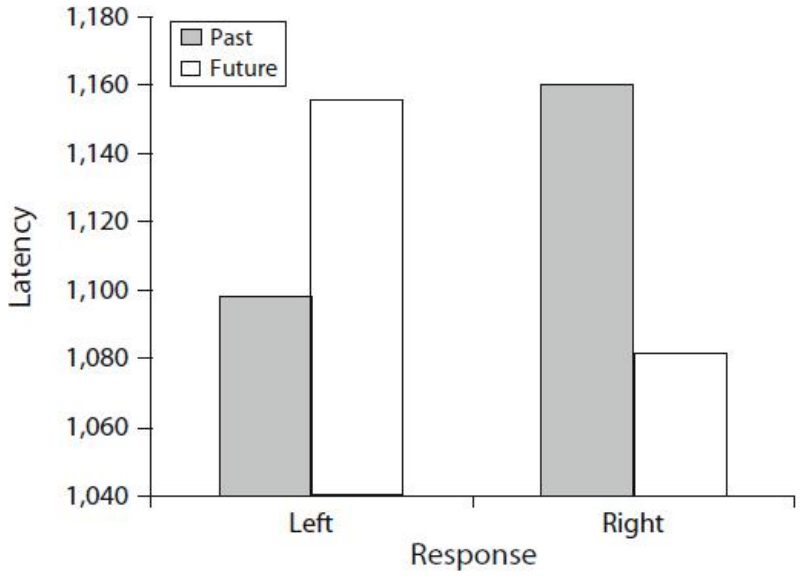
Test: Does the word refer to the past or the future?

Santiago, J., Lupáñez, J., Pérez, E. & Funes, M. (2007). Time (also) flies from left to right. *Psychonomic Bulletin & Review, 14,* 512-516

Conceptual metaphors

Test: Does the word refer to the past or the future?

Participants faster when left/right keys match past/future mapping



Santiago, J., Lupáñez, J., Pérez, E. & Funes, M. (2007). Time (also) flies from left to right. *Psychonomic Bulletin & Review, 14,* 512-516

Conceptual metaphors

Mental time line linked to physical action response

Similar effect found for numerical timeline (Dehaene et al. (1993)

AND

Also found to reverse for users of right-to-left writing systems - e.g. Farsi, Hebrew, Arabic (Fuhrman and Boroditsky, 2010; Zebian, 2005)

Conceptual metaphors: emotion

Embodiment could allow link to abstract concepts through emotion

How we feel about experiences can help us to conceptualise them

Vigliocco, G., Meteyard, L., Andrews, M., & Kousta, S. (2009). Toward a theory of semantic representation. Language and Cognition, 1(2), 215–244

Conceptual metaphors: emotion

Embodiment could allow link to abstract concepts through emotion

Abstract words tend to be more emotionally loaded than concrete words: LOVE, TRUTH, JUSTICE

More emotional abstract words learnt earlier than neutral abstract words

Vigliocco, G., Meteyard, L., Andrews, M., & Kousta, S. (2009). Toward a theory of semantic representation. Language and Cognition, 1(2), 215–244

Conceptual metaphors: gesture

Gestures are prevalent in human communication and problem-solving

Kita, S. and Alibali, M. (2017). How Do Gestures Influence Thinking and Speaking? The Gesture-for-Conceptualization Hypothesis. *Psychological Review.* 124 (3) p.245-266

Conceptual metaphors: gesture

Often rely on conceptual metaphor in the same way as speech (Cienki and Muller 2008)

Allow users to understand abstract concepts by physicalizing them (e.g. comparisons, arithmetic)

See Goldin-Meadow, S. (1999). The role of gesture in communication and thinking. Trends in Cognitive Sciences, 3, 419-429.

Conceptual metaphors: gesture

e.g. arithmetic equalizing

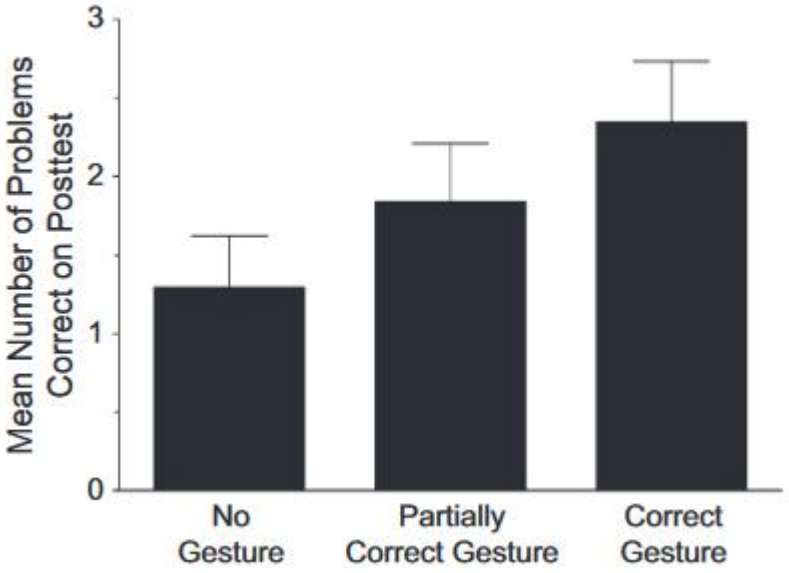
$$4 + 3 + 6 = \_\_\_\_ + 6$$

Goldin-Meadow, S., Cook, S. W., & Mitchell, Z. A. Gesturing gives children new ideas about math. *Psychological Science,* 2009, *20(3)*, 267-272

Conceptual metaphors: gesture

Children using gestures able to get more problems correct than children who didn't produce a gesture

Gesture provides *grounding* for an abstract problem



Goldin-Meadow, S., Cook, S. W., & Mitchell, Z. A. Gesturing gives children new ideas about math. *Psychological Science,* 2009, *20(3)*, 267-272

Where do we stand?

We have looked at:

- What is embodied cognition?
- What is the historical/cultural context of embodied cognition
- How do we study embodied cognition?

Where do we stand?

We have seen:

- There is evidence for a link between cognition and the body
- But that evidence is mixed

N.B. issues with embodied cognition research reflect larger issues in scientific research

Where do we stand?

Steps forward for the field fall into two categories:

1. Methodological

How does embodied research deal with replicability (or lack thereof)

How do we further understand how embodiment works?

Where do we stand?

Steps forward for the field fall into two categories:

1. Methodological

Better specified models to understand *under what conditions* embodied effects pop up

Where do we stand?

Steps forward for the field fall into two categories:

2. Theoretical

How much of cognition can embodiment explain?

a) Is it operating at all times?
b) Is it operating across all domains?

Where do we stand?

Steps forward for the field fall into two categories:

2. Theoretical

More nuanced, middle-ground theories of cognition
Theories of linkage – from the concrete to the abstract

References

Barsalou & Wiemer-Hastings. (2005). Situating abstract concepts. In Pecher & Zwaan (Eds.), Grounding cognition: The role of perception and action in memory, language and thinking.

Barsalou, L.W., Simmons, W.K., Barbey, A., & Wilson, C.D. (2003). Grounding conceptual knowledge in modality-specific systems. *Trends in Cognitive Sciences*, 7, 84-91.

Chomsky, N. (1959). A Review of B. F. Skinner's *Verbal Behavior*, *Language*, *35*, 26-58.

Davis, J.D., Winkielman, P. and Coulson, S. (2015). Facial action and emotional language: ERP evidence that blocking facial feedback selectively impairs sentence comprehension. *Journal of Cognitive Neuroscience.* 27 (11) p. 2269-2280.

de Vos, C. (2014). The Kata Kolok Pointing System: Morphemization and Syntactic Integration. *Topics in Cognitive Science*, 1–19.

Elder, R. & Krishna, A.(2012), The "Visual Depiction Effect" in advertising: Facilitating embodied mental simulation through product orientation
J. Consumer Research 38(6): 988-1003.

Estes, Z., Verges, M. & Barsalou, L.W. (2008). Head up, foot down: Object words orient attention to the objects' typical location. Psychological Science.

Fromkin, V.A. (1971). The non-anomalous nature of anomalous utterances. *Language,* 47*,* 27-52.
), 168–171.

References

Gleitman, L.R., Cassidy, K., Nappa, R., Papafragou, A., & Trueswell, J.C. (2005). Hard words. Language Learning and Development, 1, 23-64.

Glenberg, A. M., Witt, J. K. J., & Metcalfe, J. (2013). From the Revolution to Embodiment. *Perspectives on Psychological Science*, *8*(5), 573–585.

Glenberg, A. M., & Kaschak, M. P. (2002). Grounding language in action. Psychonomic Bulletin & Review, 9, 558-565.

Goldin-Meadow, S. (1999). The role of gesture in communication and thinking. Trends in Cognitive Sciences, 3, 419-429.

Goldin-Meadow, S., Cook, S. W., & Mitchell, Z. A. Gesturing gives children new ideas about math. *Psychological Science,* 2009, *20(3)*, 267-272.

Gozli, D.G., Chasteen, A.L. & Pratt, J. (2013). The cost and benefit of implicit spatial skills for visual attention. *Journal of Experimental Psychology: General*

Hauk, Johnsrude and Pulvermuller (2004). Somatotopic representation of action words in human motor and premotor cortex. *Neuron.* 41(2). p. 301-307.

Havas, D. A., Glenberg, A. M., Gutowski, K. A., Lucarelli, M. J., & Davidson, R. J. (2010). Cosmetic use of botulinum toxin-A affects processing of emotional language. Psychological Science, 21, 895-900.

References

Holt, L. E., & Beilock, S. L. (2006). Expertise and its embodiment: Examining the impact of sensorimotor skill expertise on the representation of action-related text. *Psychonomic Bulletin & Review*, *13*(4), 694–701.

Kita, S. and Alibali, M. (2017). How Do Gestures Influence Thinking and Speaking? The Gesture-for-Conceptualization Hypothesis. *Psychological Review.* 124 (3) p.245-266.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by. Chicago: Chicago University Press.*

Lakoff, G., & Johnson, M. (1999). *Philosophy in the flesh: The embodied mind and its challenge to western thought. New York: Basic Books.*

Mahon, B & Caramazza, A. (2008). A critical look at the embodied cognition hypothesis and a new proposal for grounding conceptual content. *Journal of Physiology-Paris*, Volume 102, Issues 1–3, 2008, Pages 59-70.

Meteyard, L., Rodriguez Cuadrado, S., Bahrami, B. & Vigliocco, G. (2012) Coming of age: a review of embodiment and the neuroscience of semantics. Cortex, 48(7), 788-804.

Papesh, M. H. (2015). Just out of reach: On the reliability of the action-sentence compatibility effect. Journal of Experimental Psychology: General, 144, e116-e141.

Pecher, D. and van Dantzig, S. (2016). The role of action simulation on intentions to purchase products. International Journal of Research in Marketing, 33(4), pp. 971-974.

References

Postle, N., et al. (2008). Action word meaning representations in cytoarchitectonically defined primary and premotor cortices. *NeuroImage* 43(4), 634-644.

Santiago, J., Lupáñez, J., Pérez, E. & Funes, M. (2007). Time (also) flies from left to right. *Psychonomic Bulletin & Review, 14,* 512-516.

Strack, F., Martin, L. & Stepper, S. (1988). Inhibiting and facilitating conditions of the human smile: A nonobtrusive test of the facial feedback hypothesis. Journal of Personality and Social Psychology, 54, 768-777.

Vigliocco, G., Meteyard, L., Andrews, M., & Kousta, S. (2009). Toward a theory of semantic representation. Language and Cognition, 1(2), 215–244.

E.-J. Wagenmakers et al. (2016). Registered replication report: Strack, Martin and Stepper (1988). *Perspectives on Psychological Science.* 11(6), 917-928.

Zwaan, R. A. (2014). Embodiment and language comprehension: Reframing the discussion. *Trends in Cognitive Sciences*, *18*(5), 229–234.

Zwaan, R. A., Stanfield, R. A., & Yaxley, R. H. (2002). Language Comprehenders Mentally Represent the Shapes of Objects. *Psychological Science*, *13*(2), 168–171.