Goal for today

Imagine your honours thesis addresses the following topic:

You are carrying out an experiment to establish that mental simulation is not the same as mental imagery.

Produce a plan for the first 2 paragraphs of your Introduction.
The plan should be an outline of the content you will write, establishing the logical flow of the ideas that will open your introduction.

**It should take the following form, as if you were giving someone a blueprint of the logical structure of the first two paragraphs.**

1) Begin with a statement about X. You need to complete X.
2) Next introduce the idea of Y. What is Y?
3) Then talk about Z.
4) ........
Meaning involves “mental simulation”

compare with

Meaning involves “mental imagery”

Example: John opened the door in a hurry and rushed from the room.

Imagery versus simulation?  
a) Yes  
b) No

Is simulation just mental imagery?  
a) Yes  
b) No
One major weakness of reaction time studies like these is that they present a perceptual stimulus or require a physical action that matches the linguistic content or not.

This raises the concern that it might only be this feature of the experimental apparatus that induces simulation effects.

That is, perhaps people only think about the orientation of toothbrushes in the context of an experiment that systematically presents visual depictions of objects in different orientations. Perhaps the experiment induces the effects.
One way to methodologically circumvent this concern is with the use of eye-tracking. Several groups have used eye-tracking during passive listening as a way to make inferences about perceptual processes during language processing. For instance, Spivey and Geng (2001) had participants listen to narratives that described motion in one direction or another while looking at a blank screen, and while the participants believed the eye-tracker was not recording data. The researchers found that the participants’ eyes were most likely to move in the direction of the described motion, even though they had been told that this was a rest period between the blocks of the real experiment. Another study (Johansson at al. 2006) first presented people with visual scenes and then had them listen to descriptions of those scenes while looking at the same scene, looking at nothing, or looking at nothing in the dark. They found that people’s eye movements tracked with the locations of the mentioned parts of the scene. Both studies suggest that even in the absence of experimental demands to attend to specific aspects of described objects, actions, and scenes, people engage perceptual processes. This is consistent with the idea that they perform simulations of described linguistic content, even when unprompted by task demands.
<table>
<thead>
<tr>
<th>Story Type</th>
<th>Description</th>
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<tbody>
<tr>
<td>Upward</td>
<td>&quot;Imagine that you are standing across the street from a 40 story apartment building. At the bottom there is a doorman in blue. On the 10th floor, a woman is hanging her laundry out the window. On the 29th floor, two kids are sitting on the fire escape smoking cigarettes. On the very top floor, two people are screaming.&quot;</td>
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<tr>
<td>Downward</td>
<td>&quot;Imagine you are standing at the top of a canyon. Several people are preparing to rappel down the far canyon wall across from you. The first person descends 10 feet before she is brought back to the wall. She jumps again and falls 12 feet. She jumps another 15 feet. And the last jump, of 8 feet, takes her to the canyon floor.&quot;</td>
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<td>Leftward</td>
<td>&quot;Imagine a train extending outwards to the left. It is pointed to the right, and you are facing the side of the engine. It is not moving. Five cars down is a cargo holder with pink graffiti sprayed on its side. Another six cars down is a flat car. The train begins to move. Further down the train you see the caboose coming around a corner.&quot;</td>
</tr>
<tr>
<td>Rightward</td>
<td>&quot;Imagine a fishing boat floating on the ocean. It's facing leftward from your perspective. At the back of the boat is a fisherman with a fishing pole. The pole extends about 10 feet to the right beyond the edge of the boat. And from the end of the pole, the fishing line extends another 50 feet off to the right before finally dipping into the water.&quot;</td>
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<tr>
<td>Control</td>
<td>&quot;Imagine you are on a hill looking at a city through a telescope. Pressing a single button zooms a specific block into view. Another button brings a gray apartment building into focus. Finally a third button zooms in on a single window. Inside you see a family having breakfast together. A puppy appears and begs for a piece of French toast.&quot;</td>
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You will soon hear a pre-recorded, spoken description. The description will describe a two-dimensional picture. We want you to listen to the description as carefully as possible and to imagine it as thoroughly as possible. During this description we will measure your pupil size. It is important that you do not close your eyes, but you may look wherever you want on the white board.
When people are processing language about motor actions, there’s an increased signal in motor areas, as compared with language not about motor actions. This signal in the motor system observed during motor language processing is weaker than when people are actually moving their bodies, and overlaps but may not be fully co-extensive with the area in which a signal is observed while people are performing intentional imagery of motor actions. But the signal is present even when people are not asked to think deeply about the meanings of the sentences they’re presented with.
Reliability of evidence?

Relevant evidence

Action-sentence compatibility effect (ACE)

For example, processing a sentence about moving one’s hand toward one’s body (like *Scratch your nose!*) leads to faster reactions to press a button close to the body. Conversely, sentences about action away from the body (like *Ring the doorbell!* ) lead to faster responses away from the body (Glenberg and Kaschak 2002).

Reliability of evidence?
Abstract
The action-sentence compatibility effect (ACE; Glenberg & Kaschak, 2002), a hallmark finding in Embodied Cognition, implicates the motor system in language comprehension. In the ACE, people process sentences implying movement toward or away from themselves, responding with actions toward or away from their bodies. These processes interact, implying a linkage between linguistic and motor systems. From a theoretical perspective, the ACE has been extremely influential, being widely cited evidence in favor of embodied cognition. 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. Across 8 experiments, I tested whether the ACE extends to a novel mouse-tracking method and/or is susceptible to higher-order cognitive influences. In 3 experiments, attempts were made to “disembodied” the ACE by presenting participants’ names on the computer screen (as in Markman & Brendi, 2005). In each experiment, the ACE could not be disembodied, because the ACE did not occur. In further experiments, the ACE was not observed in reading times, regardless of response mode (mouse movements vs. button-presses) or stimuli, including those from the original research. Similarly, no ACE was observed in physical movement times. Bayes Factor analyses of the current experiments, and the previous ACE literature, suggest that the evidence for the ACE is generally weak: Many studies considered as positive evidence actually support the null hypothesis, and very few published results offer strong evidence for the ACE. Implications for the embodiment hypothesis are discussed. (c) 2015 APA, all rights reserved).
One of the most interesting features of this literature is that there are various experiments in which the priming effect appears—superficially—to reverse itself.

Seeing, Acting, Understanding: Motor Resonance in Language Comprehension

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EXAMPLE SENTENCES

Counter-clockwise

While driving/to work/he/approached/the/intersection/and/turned left/onto the/street.

When/the annual/time change/in the/fall/occurred/he/set back/the/clock.

After/lighting/the candles/for the/romantic/evening/he/dimmed/the/lights.

Clockwise

Before/the/big race/the driver/took out/his key/and/started/the/car.

To attach/the boards/he/took out/his/screwdriver/and/screwed in/the/screw.

The lamp/was off/and he/wanted/to read/so/he/turned on/the/lamp.
visual stimulus while at the same time presenting words and recording response times for several frames per sentence. We therefore decided to use an illusory rotation stimulus (see Figure 2), which created the percept of visual rotation but is stationary. It could therefore be presented as the background for the reading task, with the words being presented centrally on the screen.

Method

Subjects. Sixty students (42 female) enrolled in introductory psychology courses participated for course credit. The subjects' mean age was 18.8 (range 18–20) years.

Stimuli and design. The same sentences that were used in Experiment 4 were visually presented in a subject-paced reading paradigm. The visual stimulus depicted 12 shaded half ovals that were situated in a circle such that they resulted in illusory visual rotation around a center point. Each word was left justified two characters to the left of that center point. This was judged by the experimenters to create the strongest visual illusion during normal reading. Figure 2 presents a sample image–text pairing used in this experiment.

The direction of rotation implied by the visual stimulus was manipulated within subjects and between items. Implied rotation direction of the sentences was manipulated within subjects and between items. List (groups of items appearing under the same condition) was manipulated between subjects and between items.

Procedure. The experiment began with the subject seated in front of a computer monitor and a keyboard. At the beginning of each trial, subjects were instructed to press the spacebar to continue. After the first spacebar press, the first block of text was presented. Each subsequent spacebar press resulted in the presentation of the next block of text until the sentence was finished. On one third of the trials, the subject answered a yes–no question regarding the content of the immediately preceding sentence. After each trial, subjects pressed the spacebar again to begin the next sentence. Subjects read sentences by pressing the spacebar between blocks of text during the concurrent presentation of a visual stimulus. For the first half of the experiment, the visual stimulus depicted illusory rotation in one direction, whereas in the second half, it depicted illusory rotation in the opposite direction. Order was counterbalanced across subjects. Each subject read 48 sentences (16 experimental, 32 filler) during the experiment. Implied rotation direction was counterbalanced across subjects. A yes–no comprehension question pertaining to the content of the immediately preceding sentence followed half of the filler items. Each subject completed nine practice items before the experiment began.

Results

Five subjects were removed and replaced for having comprehension accuracy below 80%. We removed reading time outliers in two stages. First, latencies shorter than 100 ms and longer than 1,500 ms were eliminated. Next, latencies more than 2 SDs from a subject's condition mean were eliminated. In all, 2.6% of the data were eliminated. The remaining latencies were submitted to a 4 (sentence region) × 2 (match) × 2 (direction) ANOVA. The average reading times per region are displayed in Figure 1. Most relevant to our prediction, there was a significant interaction between sentence region and match, \( F(3, 168) = 2.69, \text{MSE}=2,031, p = .046 \). The matching sentences were read significantly faster in the verb region than the mismatching sentence, \( F(1, 56) = 7.65, p = .120 \), whereas there was no match effect in any of the other three regions (\( F_s < 1.06 \)). Not relevant to our predictions, there...
Verb gapping: An action-gap compatibility study

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Setting: working at a petrol station | Christian opens/closes a petrol cap on a car and Martin a petrol can next to the car wash facility. (Christian öffnet/schließt einen Tankdeckel an einem Auto und Martin einen Benzinkanister neben der Waschanlage.)
Analyses were performed on the reading times per frame of the gapping sentences and were based on residual reading times, adjusted for frame length in terms of number of characters.
Eagle

Kite

Mountain

Submarine

Worm

Tunnel
could not consciously identify the words. For each participant, Analysis of the prime visibility test showed that participants indicated in a forced-choice task whether or not the words were identical by pressing the upper- or lower-button, respectively. Identical by-items analysis (1,23) was calculated. Mean $d^*$ was displayed on the screen and the next trial started.

In summary, these findings suggest that briefly presented words that cannot be identified by the participants influence subsequent actions.
Fig. 3 – Mean reaction times in Experiment 2 for down- and up-responses and down- and up-words. Error bars represent the 95% confidence interval according to Loftus and Masson (1994).
A sensitivity index (d)
could not consciously identify the words. For each participant,
Analysis of the prime visibility test showed that participants
indicate in a forced-choice task whether or not the words were
word was either identical to the masked word (50% of the tri-
These trials were identical to the test-trials, with the difference
in a second
pressing the upper- or lower-button, respectively
als), or a different word (50% of the trials). Participants had to
that instead of a colored rectangle a word was displayed. This
The phase, a conservative prime visibility test was conducted. This
test consisted of 16 practice trials and 160 experimental trials.
sponses was balanced between participants. In a second
the fixation cross. Participants were instructed to fixate to-
were held pressed for 1 sec, the trial started with the onset of
the fixation cross and keep their eyes in the middle of the
the right or left hands on a self-constructed response apparatus
wards the fixation cross and keep their eyes in the middle of the
the right and left hands. Downward responses involved releasing
upward or downward responses. Mapping of colors to response direction
action verbs, object pictures or symbolic cues on responding
Previous studies investigating the effects of briefly presented
language and sensorimotor processes (Barsalou, 2008; Glenberg
reversal compatibility effect was found, suggesting that even masked direction-associated words can
influence subsequent actions. Such findings support grounded models
in language understanding, proposing a tight coupling of
results. Importantly, there was an interaction between
interaction was due to compatible responses being slower
response direction and word direction,
outliers (fast guesses) and were excluded from RT analysis
Subsequently, RTs were analyzed with a 2
response direction and word direction,
outliers (deviating at least 2SD from the mean d)
hand assignment (left
response direction and word direction,
outliers (deviating at least 2SD from the mean d)
response direction and word direction,
outliers (deviating at least 2SD from the mean d)
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Word is unconscious

Fig. 2 – Mean reaction times in Experiment 1 for down- and up-responses and down- and up-words. Error bars represent the 95% confidence interval according to Loftus and Masson (1994).

Word is conscious

Fig. 3 – Mean reaction times in Experiment 2 for down- and up-responses and down- and up-words. Error bars represent the 95% confidence interval according to Loftus and Masson (1994).
Word is unconscious

Moving **up** primed by a word like *EAGLE* is slower than moving **down**.

Moving **down** primed by a word like *SUBMARINE* is slower than moving **up**.

**Fig. 2** – Mean reaction times in Experiment 1 for down- and up-responses and down- and up-words. Error bars represent the 95% confidence interval according to Loftus and Masson (1994).
Analysis of the prime visibility test showed that participants indicate in a forced-choice task whether or not the words were als), or a different word (50% of the trials). Participants had to respond with their dominant hand (left or right) to upward or downward responses. Mapping of colors to response direction was balanced between participants. At the start of each trial, a blank screen was displayed on the screen and the next trial started.

These trials were identical to the test-trials, with the difference that none of the participants could consciously process the order of the words. The test consisted of 16 practice trials and 160 experimental trials. Upward responses involved releasing a central key and pressing an upper key with the right hand. Downward responses involved releasing a central key and pressing an upper key with the left hand. Action times (RTs) faster than 200 msec were classified as outliers (fast guesses) and were excluded from RT analysis.

Specifically, in line with the studies mentioned above, a reversed compatibility effect was found, suggesting that even masked direction-associated words can influence subsequent actions. A sensitivity index (d') was calculated. Mean d' did not significantly differ across response direction and word direction, with d' exceeding .5 in all conditions. This indicates that masked direction-associated words can affect behavior even when participants are not consciously aware of their presence.