General Event Knowledge during Single Word Comprehension

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Method

Participants

The participants in the present study were a sample of 26 undergraduate students from the University of Western Ontario, all of whom were native speakers of English with normal (or corrected to normal) visual acuity. Participants were compensated with course credit for their participation.

Materials

Participants were shown 60 sets of four images in random order, 20 of which were critical sets (i.e. they contained target and related images), and 40 of which were filler sets (i.e. they contained 4 images that were neither normatively nor semantically related to one another). More specifically, critical sets contained one target image, one related image (relatedness as given by word pairs used in Hare, Jones, Thomson, Kelly, & McRae, 2009), and two additional images that were semantically unrelated to any other image in the set. An example critical set is a bowl (target), cereal (related), a stapler (unrelated), and a moth (unrelated) (for a full list of critical sets see Appendix A). All image sets were presented with a fixation dot at the centre of the screen (with the four images spaced evenly in the surrounding white background) and were created prior to testing to ensure that no sets contained accidentally related images. Images in all sets were drawn from a commercial collection.

The sound files used to indicate the target image were voiced by a male speaker, and had an average duration of 640ms.

Procedure

Stimuli were presented on a 21-inch CRT monitor (running at 100Hz with a resolution of

1280x1024 pixels). Image selection responses were made using a computer mouse. Eye movement was tracked in the dominant eye only (as determined by a simple parallax test), using a SR-Research EyeLink 2000 desk-mounted eye-tracker (spatial resolution of 0.01 degrees, 1000Hz sampling rate). The apparatus included a chin rest to reduce head movement and keep the viewing distance constant (approximately 70cm from centre of screen).

Each participant's session began with the administration of a simple parallax test (to determine their dominant eye used for tracking), and a 9 point calibration/validation of the eye-tracker (this calibration was also repeated every 25 trials, and after any changes in the participant's posture). Two practice trials were administered, followed by 60 experimental trials in random order. Each trial began with fixation on a central fixation dot, followed by a 2 second presentation of an image set, after which a sound file (presented over stereo computer speakers) indicated the target image in the set (the timer began after the sound file finished playing). Each trial ended when the participant selected an image by clicking on it with the computer mouse. Participation in the entire study took less than 30 minutes to complete.

Design

In the present study, the availability of general event knowledge during single word comprehension was investigated using a visual world paradigm. If general event knowledge was present during single word comprehension, it was expected that the percentage of fixations on related images in critical sets would be greater than the percentage of fixations on unrelated images (due to the semantic similarity of the target and related images). If there was no general event knowledge present, however, it was expected that the percentage of fixations on related images and unrelated images would not differ. Based on the theory that many semantic relations, including event-based relations, are encoded in semantic memory it was hypothesized that there

would be a greater percentage of fixations on an image semantically related to the target image than on unrelated images. To test this hypothesis, the effects of image relatedness and time on fixation percentages were analyzed within 26 participants (F_1) and within 20 critical sets (F_2) using two separate repeated measures analyses of variance.

Image relatedness had 2 levels, namely related or unrelated. Fixations on both unrelated images were summed to produce the total 'unrelated' fixation percentage. (Fixations on the target image in the critical sets were excluded from the analysis – this percentage rose quickly and dominated the other two levels, and as such is of little theoretical interest.)

Time had 17 levels, given by 50ms wide bins from 200ms to 1049ms inclusively after the target was identified. Data from 0-49ms was discarded, and the following 3 time bins (50-99ms, 100-149ms, 150-199ms) were excluded from the analysis because it takes a minimum of 180ms to execute a saccade.

Results

The effect of relatedness on fixation percentage within participants was significant ($F_1(1, 25) = 39.73$, $p < .00001$), in that related images contributed a higher percentage of fixations than unrelated images. Secondly, the effect of time on fixation percentage within participants was significant ($F_1(16, 400) = 19.34$, $p < .00001$), indicating related and unrelated images contributed a higher percentage of fixations more closely following the target word.

The effect of relatedness on fixation percentage within critical sets was significant ($F_2(1, 19) = 26.84$, $p < .0002$), in that related images again contributed a higher percentage of fixations than unrelated images. The effect of time on fixation percentage within critical sets was also significant ($F_2(16, 304) = 17.48$, $p < .00001$), again indicating a significant effect of time.

The mean percentages of image fixations over time (collapsed across participants and

critical sets) are presented in Figure 1. The interaction between image relatedness and time was not significant within participants ($F_1(16, 400) = 1.46$, $p > .1$), nor within critical sets ($F_2(16, 304) = 1.31$, $p > .1$).

In conclusion, the degree of image relatedness had a significant effect on the distribution of fixation percentages both within participants and within critical sets. Furthermore, time had a significant effect on the distribution of fixation percentages both within participants and within critical sets. No significant interaction between image relatedness and time was found.

Demonstrating support for the hypothesis, these findings indicate that there was a greater percentage of fixations on images semantically related to the target image than on unrelated images. The significant effect of time on fixation percentages indicates that as time goes on, the target image fixations account for a greater percentage of the total fixations, implying that the effects of semantic relatedness on fixations are more focused shortly after the target is indicated. Finally, the absence of a significant interaction between image relatedness and time implies that the image sets selected for the present experiment were theoretically valid, insofar as the perceived interrelatedness of images did not change over time.

References

Hare, M., Jones, M., Thomson, C., Kelly, S., & McRae, K. (2009). Activating event knowledge. *Cognition*, *111*, 151-167.

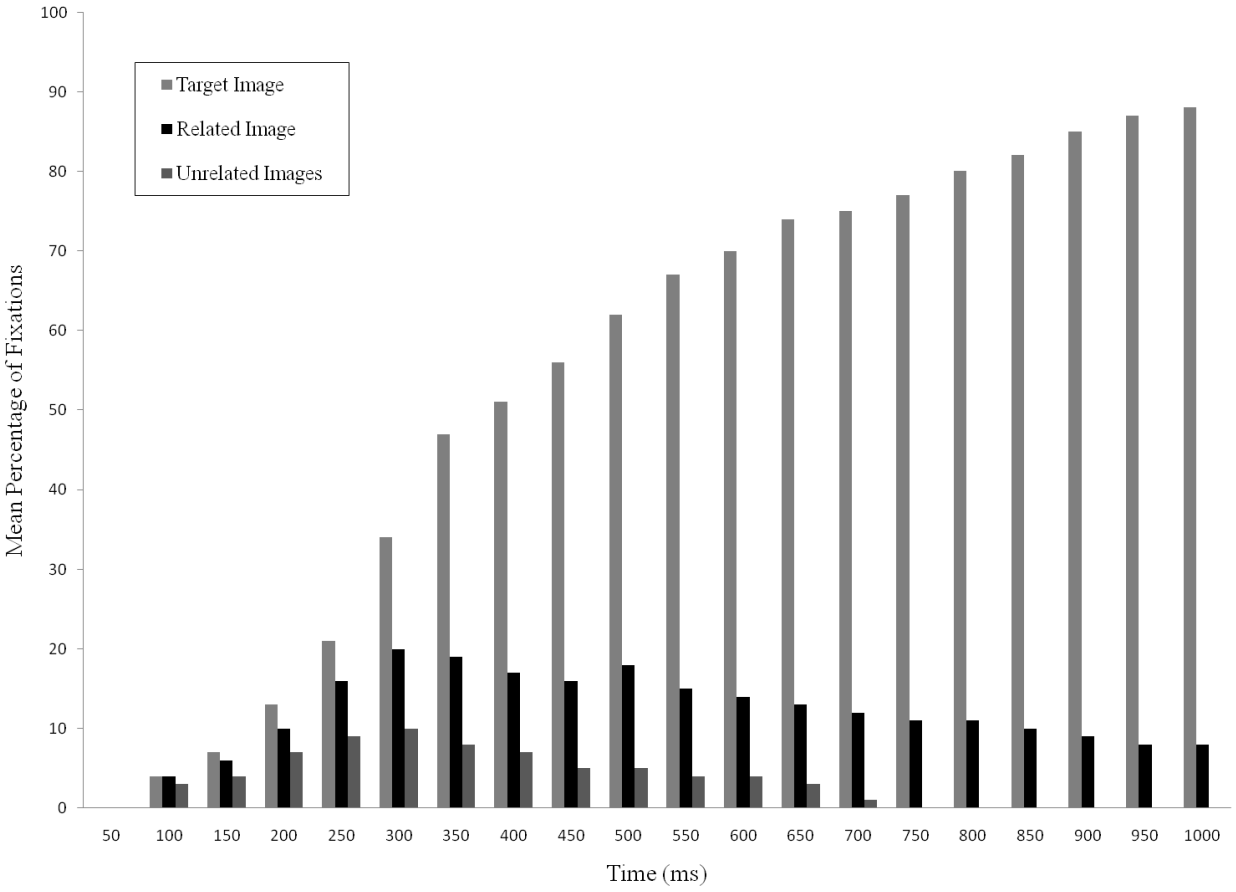

Figure 1. Mean percentages of image fixations over time from target indication. Unrelated Images is the sum of fixation percentages on both unrelated images. (Percentages do not sum to 100 at each time interval because participants sometimes look elsewhere.)

Appendix A: List of Critical Image Sets

Target Instrument	Related Object	Unrelated 1	Unrelated 2
Battery	Car	Kettle	Grape
Bowl	Cereal	Stapler	Moth
Briefcase	Papers	Cabbage	Spoon
Crayon	Pictures	Lantern	Umbrella
Detergent	Clothes	Cigarette	Potato
Fridge	Food	Fox	Flute
Furnace	House	Celery	Book
Hoe	Garden	Bongo	Button
Key	Door	Peach	Corn
Ladle	Soup	Donkey	Ring
Mug	Coffee	Scalpel	Tongs
Net	Fish	Guitar	Dice
Oven	Cookies	Screwdriver	Tie
Pump	Tires	Candle	Whistle
Razor	Face	Boots	Apple
Scissors	Hair	Truck	Banana
Spatula	Pancakes	Ruler	Maracas
Strainer	Water	Banjo	Pliers
Tweezers	Eyebrow	Pencil	Baseball
Wrench	Bolt	Garlic	shoe