

# Study shows people capable of reading and solving math equations subconsciously

November 13 2012, by Bob Yirka

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This is a brain reading under the water surface -- a metaphor for unconscious recognition. Credit: Drawing by Rinat Laor

(Medical Xpress)—Researchers at Hebrew University in Jerusalem have found that contrary to popular thinking, people are capable of reading sentences and solving math problems without consciously thinking about them. The team describes their experiments and results in testing such abilities in their paper published in the *Proceedings of the National Academy of Sciences*.

Scientists have known for some time that people are capable of reading single words when their mind is elsewhere, but now, new research shows that they are also capable of reading entire [sentences](#) and grasping the content of them while their [conscious mind](#) is busy thinking about something else. They've also discovered that people are also capable of solving simple math problems subconsciously.

To come to these conclusions, the team used a technique known as Continuous Flash Suppression (CFS) to present target information to volunteer subjects subconsciously. The technique involves displaying target information to one eye while simultaneously displaying colorful images to the other. The colorful images demand so much attention that the target information is not noticed, at least in the conscious mind.

In the first exercise, volunteers were shown short word phrases during a CFS session; some of which made sense some of which were nonsensical. Afterwards, they were asked to recall the phrase. The researchers found that the volunteers were able to recall the nonsensical phrases faster than those that made sense, indicating they had been understood while still in a subconscious state.

In the second exercise, the researchers used CFS to flash a simple plus/minus type [mathematical equation](#), minus the answer, to one eye, while the other received the colorful images. Afterwards, each volunteer was asked to say out loud a number that was presented to them. The researchers found that [response times](#) were shorter when the number shown matched the answer to the math equation they had been shown.

Thus far, CFS is only able to distract the mind from perceiving information for just a couple of seconds, thus, the types of data that can be tested is limited by the amount of information (or its mathematical complexity) that could reasonably be expected to be absorbed in such a short time period. But the results suggest that people might be processing

a lot of information in their daily lives that they aren't aware of because their mind is elsewhere, a finding that the researchers suggest, means that views on subconscious awareness and thought processing, perhaps needs updating.

**More information:** Reading and doing arithmetic nonconsciously, *PNAS*, Published online before print November 12, 2012, [doi: 10.1073/pnas.1211645109](https://doi.org/10.1073/pnas.1211645109)

### **Abstract**

The modal view in the cognitive and neural sciences holds that consciousness is necessary for abstract, symbolic, and rule-following computations. Hence, semantic processing of multiple-word expressions, and performing of abstract mathematical computations, are widely believed to require consciousness. We report a series of experiments in which we show that multiple-word verbal expressions can be processed outside conscious awareness and that multistep, effortful arithmetic equations can be solved unconsciously. All experiments used Continuous Flash Suppression to render stimuli invisible for relatively long durations (up to 2,000 ms). Where appropriate, unawareness was verified using both objective and subjective measures. The results show that novel word combinations, in the form of expressions that contain semantic violations, become conscious before expressions that do not contain semantic violations, that the more negative a verbal expression is, the more quickly it becomes conscious, and that subliminal arithmetic equations prime their results. These findings call for a significant update of our view of conscious and unconscious processes.

[Press release](#)

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