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Date: August 5, 2001  
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## IS MULTITASKING MORE EFFICIENT? SHIFTING MENTAL GEARS COSTS TIME, ESPECIALLY WHEN SHIFTING TO LESS FAMILIAR TASKS

### Studying The "Inner CEO" Can Improve Interface Design, Personnel Training And Diagnosis Of Brain Damage

WASHINGTON - New scientific studies reveal the hidden costs of multitasking, key findings as technology increasingly tempts people to do more than one thing (and increasingly, more than one complicated thing) at a time. Joshua Rubinstein, Ph.D., of the Federal Aviation Administration, and David Meyer, Ph.D., and Jeffrey Evans, Ph.D., both at the University of Michigan, describe their research in the August issue of the *Journal of Experimental Psychology: Human Perception and Performance*, published by the American Psychological Association (APA).

Whether people toggle between browsing the Web and using other computer programs, talk on cell phones while driving, pilot jumbo jets or monitor air traffic, they're using their "executive control" processes – the mental CEO – found to be associated with the brain's prefrontal cortex and other key neural regions such as the parietal cortex. These interrelated cognitive processes establish priorities among tasks and allocate the mind's resources to them. "For each aspect of human performance – perceiving, thinking and acting – people have specific mental resources whose effective use requires supervision through executive mental control," says Meyer.

To better understand executive control, as well as the human capacity for multitasking and its limitations, Rubinstein, Meyer and Evans studied patterns in the amounts of time lost when people switched repeatedly between two tasks of varying complexity and familiarity. In four experiments, young adult subjects (in turn, 12, 36, 36 and 24 in number) switched between different tasks, such as solving math problems or classifying geometric objects. The researchers measured subjects' speed of performance as a function of whether the successive tasks were familiar or unfamiliar, and whether the rules for performing them were simple or complex.

The measurements revealed that for all types of tasks, subjects lost time when they had to switch from one task to another, and time costs increased with the complexity of the tasks, so it took significantly longer to switch between more complex tasks. Time costs also were greater when subjects switched to tasks that were relatively unfamiliar. They got "up to speed" faster when they switched to tasks they knew better, an observation that may lead to interfaces designed to help overcome people's innate cognitive limitations.

The researchers say their results suggest that executive control involves two distinct, complementary stages: goal shifting ("I want to do this now instead of that") and rule activation ("I'm turning off the rules for that and turning on the rules for this"). Both stages help people unconsciously switch between tasks.

Rule activation itself takes significant amounts of time, several tenths of a second – which can add up when people switch back and forth repeatedly between tasks. Thus, multitasking may seem more efficient on the surface, but may actually take more time in the end. According to the authors, this insight into executive control may help people choose strategies that maximize their efficiency when multitasking. The insight may also weigh against multitasking. For example, Meyer points out, a mere half second of time lost to task switching can mean the difference between life and death for a driver using a cell phone, because during the time that the car is not totally under control, it can travel far enough to crash into obstacles the driver might have otherwise avoided.

Understanding executive mental control may help solve "fundamental problems," says Meyer,

"associated with the design of equipment and human-computer interfaces for vehicle and aircraft operation, air traffic control, and many other activities in which people must monitor and manipulate the environment through technologically advanced devices." The research may also aid in personnel selection (given individual differences in executive control), training, assessment and diagnosis of brain-damaged patients (given advances in brain imaging and mapping), rehabilitation, and formulation of government and industrial regulations and standards. In addition, results from the study of executive control may foster a more general understanding of how the brain and human consciousness normally work.

**Article:** "Executive Control of Cognitive Processes in Task Switching," Joshua S. Rubinstein, U.S. Federal Aviation Administration, Atlantic City, N.J.; David E. Meyer and Jeffrey E. Evans, University of Michigan, Ann Arbor, Mich., *Journal of Experimental Psychology - Human Perception and Performance*, Vol 27. No.4

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**Full text of the article** is available from the APA Public Affairs Office and at [http://www.apa.org/journals/xhp/press\\_releases/august\\_2001/xhp274763.html](http://www.apa.org/journals/xhp/press_releases/august_2001/xhp274763.html).

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