

Media Release: European College of Neuropsychopharmacology (ECNP)

“For the science and treatment of disorders of the brain”

Systematic review shows ‘smart drug’ modafinil does enhance cognition

Embargo until: 00.05 British Summer Time, Thursday 20th August 2015

The drug modafinil was developed to treat narcolepsy (excessive sleeping), but it is widely used off-licence as a ‘smart drug’ to promote cognitive enhancement, where qualities such as alertness and concentration are desired to assist someone with, for example, exam preparation. Past studies on sleep-deprived individuals have shown a strong positive effect of modafinil on these functions, but there has been less attention and scientific consensus on the drug’s overall effectiveness as a cognitive enhancer in people that are not sleep-deprived – presumably the majority of people taking it. Now, a new systematic review, published online in the peer-reviewed journal *European Neuropsychopharmacology** shows that modafinil does indeed confer significant cognitive benefits in this group, at least on a particular subset of tasks.

Dr Ruairidh Battleday and Dr Anna-Katharine Brem from the University of Oxford and Harvard Medical School evaluated all research papers on cognitive enhancement with modafinil from January 1990 to December 2014. They found 24 studies dealing with different benefits associated with taking modafinil, including planning and decision making, flexibility, learning and memory, and creativity.

Unsurprisingly, they found that the performance-enhancing capacity of modafinil varied according to the task. What emerged was that the longer and more complex the task tested, the more consistently modafinil conferred cognitive benefits.

Modafinil made no difference to working memory, or flexibility of thought, but did improve decision-making and planning. Very encouragingly, the 70% of studies that looked at the effects of modafinil on mood and side effects showed very little overall effect, although a couple reported insomnia, headache, stomach ache or nausea (which were also reported in the placebo group).

According to Ruairidh McLennan Battleday (University of Oxford):

“This is the first overview of modafinil’s actions in non-sleep-deprived individuals since 2008, and so we were able to include a lot of recent data. Interestingly, we found that the type of test used to assess modafinil’s cognitive benefits has changed over the last few decades. In the past, people were using very basic tests of cognition, developed for neurologically-impaired individuals. In contrast, more recent studies have, in general, used more complex tests: when these are used, it appears that modafinil more reliably enhances cognition: in particular ‘higher’ brain functions that rely on contribution from multiple simple cognitive processes.”

According to Anna-Katharine Brem (University of Oxford and Harvard Medical School):

“So, we ended up having two main conclusions: first, that, in the face of vanishingly few side effects in these controlled environments, modafinil can be considered a cognitive enhancer; and, second that we need to figure out better ways of testing normal or even supra-normal cognition in a reliable

Website: www.ecnp.eu

* Modafinil for cognitive neuroenhancement in healthy non-sleep-deprived subjects: a systematic review

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European Neuropsychopharmacology doi: 10.1016/j.euroneuro.2015.07.028

The accepted manuscript will be published online on 20th August, <http://www.journals.elsevier.com/european-neuropsychopharmacology/>. **Accepted manuscripts** are Articles in Press that have been peer reviewed and accepted for publication by the Editorial Board of this publication. They have not yet been copy edited and/or formatted in the publication house style, and may not yet have the full ScienceDirect functionality, e.g., supplementary files may still need to be added, links to references may not resolve yet etc. The text could still change before final publication. Although accepted manuscripts do not have all bibliographic details available yet, they can already be cited using the year of online publication and the DOI, as follows: author(s), article title, Publication (year), DOI. Please consult the journal's reference style for the exact appearance of these elements, abbreviation of journal names and use of punctuation

Abstract:

Modafinil is an FDA-approved eugeroic that directly increases cortical catecholamine levels, indirectly upregulates cerebral serotonin, glutamate, orexin, and histamine levels, and indirectly decreases cerebral gamma-amino-butyric acid levels. In addition to its approved use treating excessive somnolence, modafinil is thought to be used widely off-prescription for cognitive enhancement.

However, despite this popularity, there has been little consensus on the extent and nature of the cognitive effects of modafinil in healthy, non-sleep-deprived humans. This problem is compounded by methodological discrepancies within the literature, and reliance on psychometric tests designed to detect cognitive effects in ill rather than healthy populations.

In order to provide an up-to-date systematic evaluation that addresses these concerns, we searched MEDLINE with the terms "modafinil" and "cognitive", and reviewed all resultant primary studies in English from January 1990 until December 2014 investigating the cognitive actions of modafinil in healthy non-sleep-deprived humans.

We found that whilst most studies employing basic testing paradigms show that modafinil intake enhances executive function, only half show improvements in attention and learning and memory, and a few even report impairments in divergent creative thinking. In contrast, when more complex assessments are used, modafinil appears to consistently engender enhancement of attention, executive functions, and learning.

Importantly, we did not observe any preponderances for side effects or mood changes. Finally, in light of the methodological discrepancies encountered within this literature, we conclude with a series of recommendations on how to optimally detect valid, robust, and consistent effects in healthy populations that should aid future assessment of neuroenhancement.