What is lumosity?

Lumosity is a web-based cognitive training platform that has grown to include over 600 million cognitive training task results from over 35 million individuals, comprising the largest existing dataset of human cognitive performance. As part of the Human Cognition Project.

Lumosity’s collaborative research program to understand the human mind, Lumos Labs researchers and external researchcollaborators have begun to explore this dataset in order uncover novel insights about the correlates of cognitive performance

Key questions?

- The first example focuses on replicating known findings relating lifestyle factors to baseline cognitive performance in a demographically diverse, healthy population at a much larger scale than has previously been available i.e alcohol consumption and sleep habit.
- The second example examines a question that would likely be very difficult to study in laboratory-based and existing online experimental research approaches at a large scale: specifically, how learning ability for different types of cognitive tasks changes with age

Experimental approach

- As of January 23, 2013, the dataset includes 36,140,947 users representing 231 distinct ISO3166 country codes. These users have trained on the cognitive exercises 609,017,147 times and taken online neuropsychological assessments 6,661,302 times.
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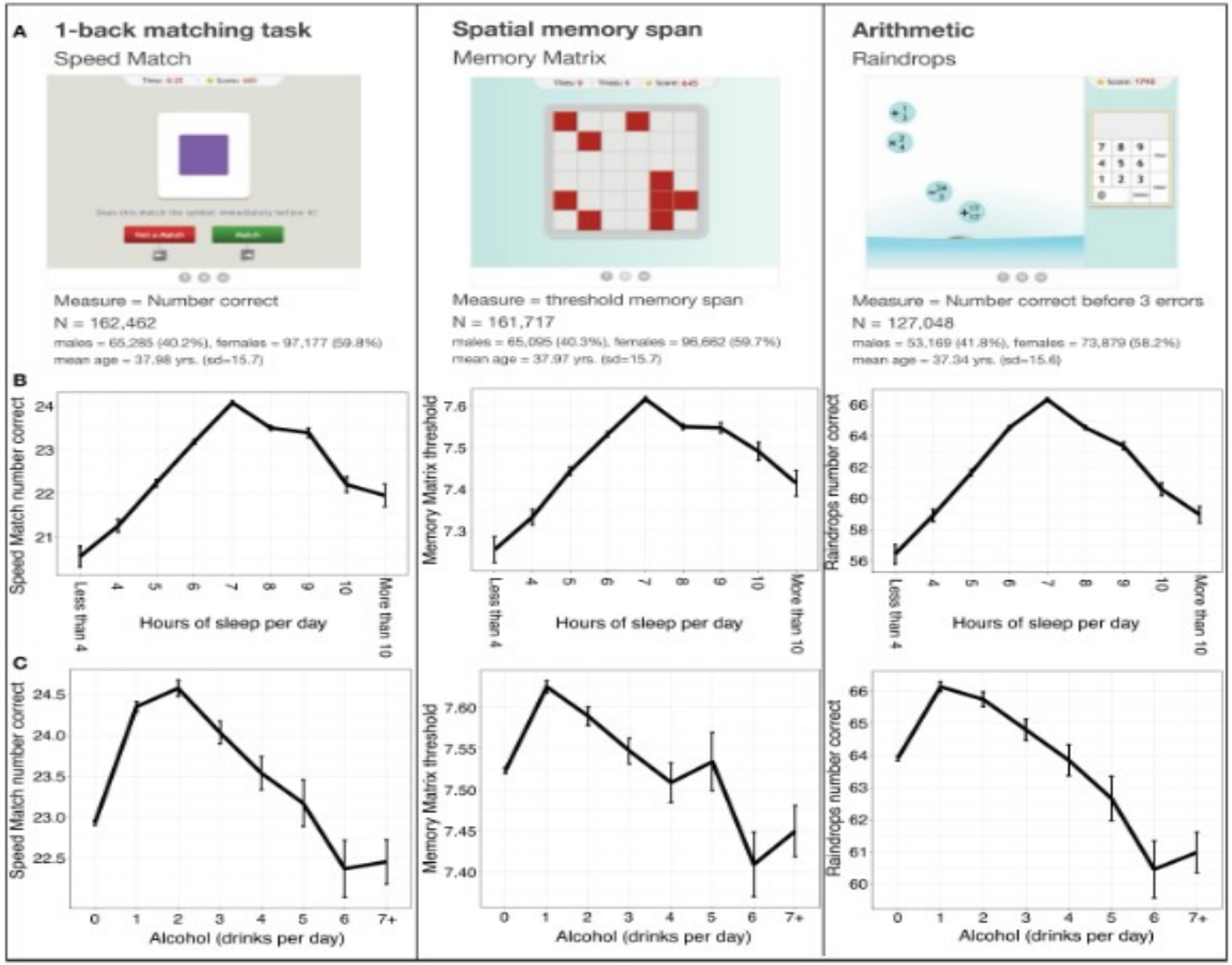
EXAMPLE 1: HEALTH, LIFESTYLE, AND COGNITIVE PERFORMANCE

- In order to examine this question, a survey was designed of health and lifestyle habits that has now been taken by millions of individuals across the world. This included deducing information about alcohol consumption and sleeping behaviour.
- 3 games were played; raindrop, memory matrix and speed match.


A
1-back matching task
Speed Match
Measure = Number correct
N = 162,462
males = 65,285 (40.2%), females = 97,177 (59.8%)
mean age = 37.98 yrs. (sd=15.7)
Spatial memory span
Memory Matrix
Measure = threshold memory span
N = 161,717
males = 65,095 (40.3%), females = 96,662 (59.7%)
mean age = 37.97 yrs. (sd=15.7)
Arithmetic
Raindrops
Measure = Number correct before 3 errors
N = 127,048
males = 53,169 (41.8%), females = 73,879 (58.2%)
mean age = 37.34 yrs. (sd=15.6)
B
Speed Match number correct
Memory Matrix threshold
Raindrops number correct
Less than 4
More than 10
Hours of sleep per day
C
Alcohol (drinks per day)

Results

- 1 unit a day increased performance over total abstinence however there was a decrease in trend for any levels above that.
- There was increased cognitive performance as sleep was increased from 4 hours to 7 hours (peak) and each additional hour after decreased performance.

What the results show?

- The associations between sleep, alcohol intake, and cognitive function observed here are comparable to previous findings from the Whitehall II study.
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EXAMPLE 2: COGNITIVE TASK IMPROVEMENTS AND AGING

- Exploring this question using standard laboratory-based approaches would require recruiting a large number of participants across a wide range of ages and bringing them into the lab to perform multiple tasks many times over the course of weeks or months
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- This type of data may be difficult to obtain via other webbased platforms in part because, while it is relatively simple to use small payments to individuals and/or online advertising to quickly obtain baseline cognitive performance data from a large number of individuals, there is little incentive for participants to return on a regular basis. In contrast, Lumosity users are specifically interested in cognitive training and are able to train on a large variety of cognitive tasks as often as they would like. As a result, they commonlyreturn regularlyoverthe courseofmonths and years

- As a preliminary demonstration of the ability to measure these differences in this data set, we looked at how a user’s age influences how much he or she improves over the course of the first 25 sessions of a cognitive task, and compared tasks that rely on abilities linked to fluid intelligence, such as working memory tasks, vs. those that rely more on crystallized knowledge, such as verbal fluency and basic arithmetic

Working memory 2-back

Memory Match

Measure = n correct in 45 seconds

N = 22,718

males = 11,294 (48.7%), females = 11,855 (51.3%)

mean age = 44.59 yrs (sd=15.4) range = 18-74

Spatial memory span

Memory Matrix

Measure = threshold memory span

N = 23,109

males = 11,156 (49.1%), females = 11,562 (50.9%)

mean age = 44.63 yrs. (sd=15.5) range = 18-74

Verbal fluency

Word Bubbles

Measure = n words correct in 3 minutes

N = 107,478

males = 34,339 (31.9%), females = 73,139 (68.1%)

mean age = 38.82 yrs. (sd=14.7) range = 18-74

Arithmetic

Raindrops

Measure = n correct before 3 errors

N = 41,338

males = 19,444 (47.0%), females = 21,894 (53.0%)

mean age = 41.21 yrs. (sd=15.3) range = 18-74

What the results showed?

- We observed negative age-related differences in performance on all tasks.
- performance on the tasks that rely on fluid intelligence decreased with increasing age at a faster rate than the tasks that rely on crystallized intelligence
- In general, users improved with training,
- The amount of improvement between sessions decreased as age increased, and this negative effect of aging on learning was greater for the tasks that relied on fluid intelligence than those that relied on crystallized knowledge

- This finding also runs counter to the theory that individuals who have more initial difficulty with a particular type of task should show greater improvementwith training atthat task compared to ones that they find easier
- We found instead that older individuals, who start with lower performance on fluid intelligence tasks, also show slower rates of improvement with training compared to those that rely to a greater degree on crystallized knowledge

Conclusion

- Minimal amount of alcohol may improve cognitive function.
- 7 hours sleep seems to be the ideal amount of time
- However this is a correlative effect, not necessarily a causative.
- Fluid and crystallised memory decreased with age. Fluid memory decreases at a faster rate however.

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- This is very unrefined bulked data!
- However its very useful in developing more refined hypotheses about cognitive patterns.