Multifractal analysis of developing map reading skills

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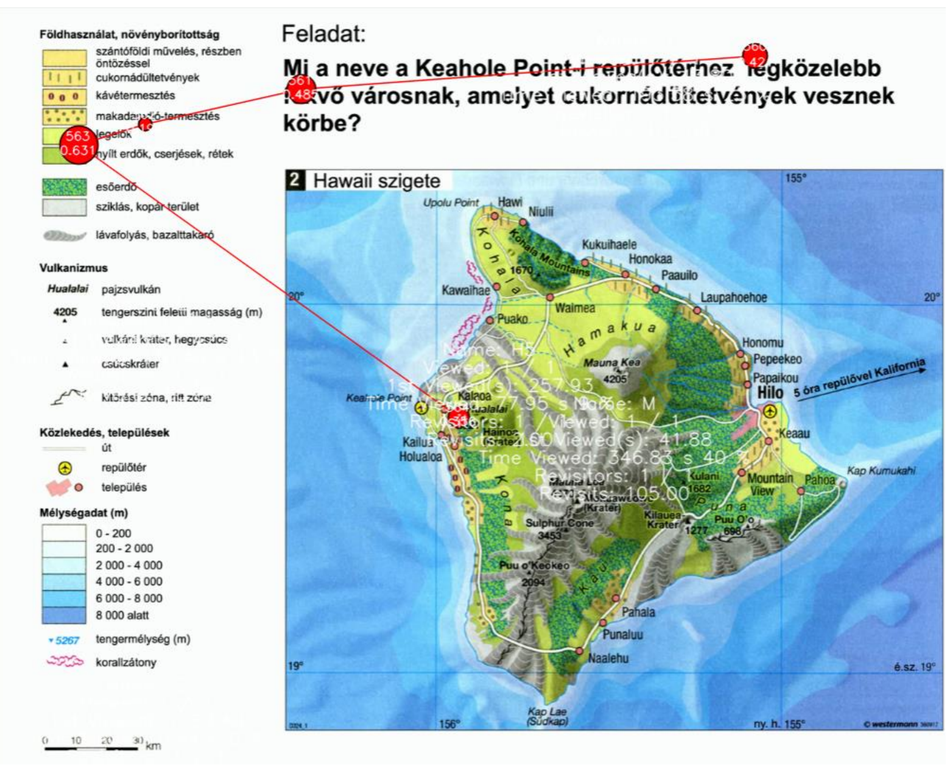
THE TASK

23 participants, age 13–16

2 maps, 12 questions to answer on each map (4 levels of difficulty)



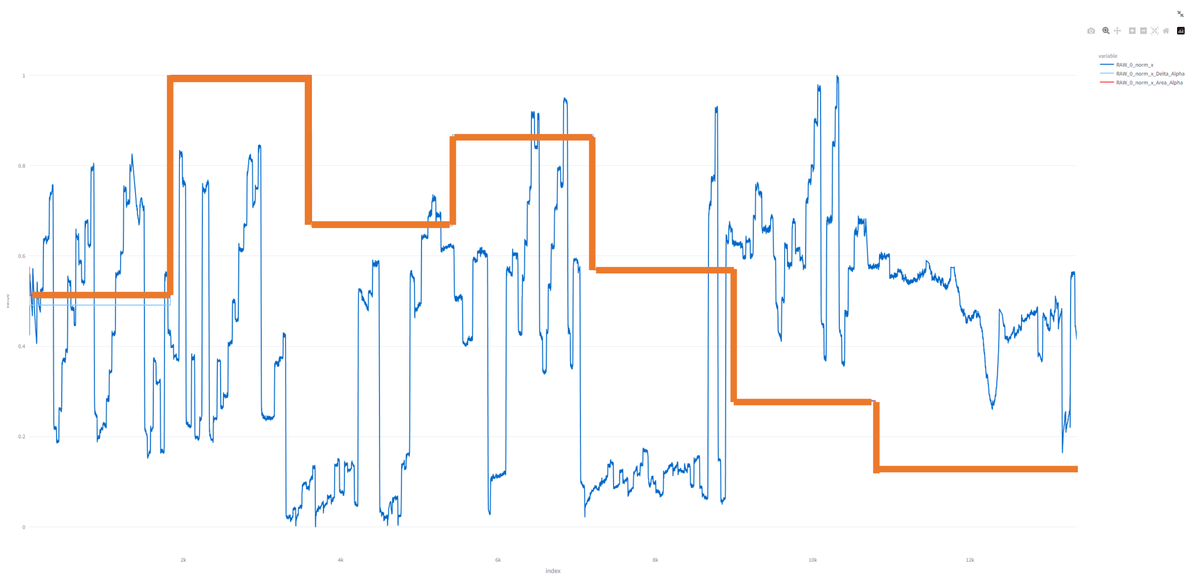
What is the name of the town that is closest to Keahole Point airport and is surrounded by sugarcane plantations?



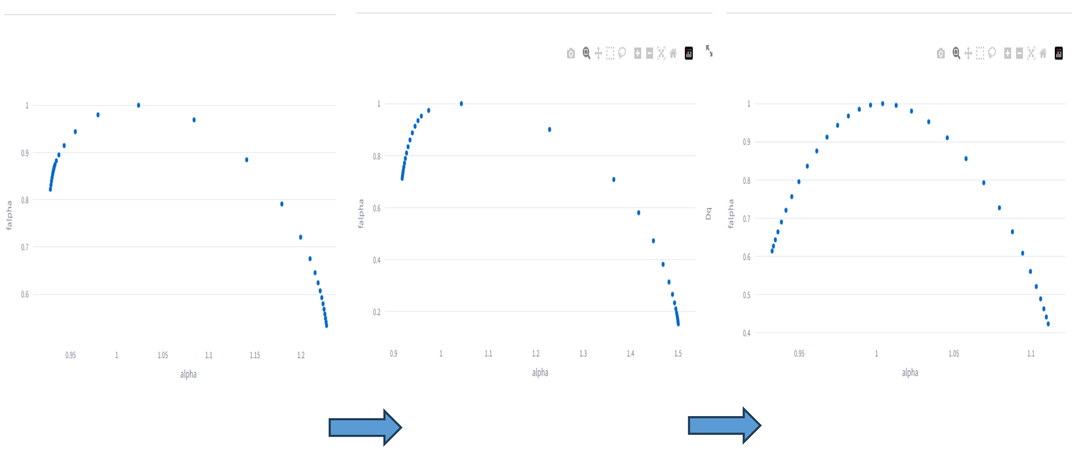
OBJECTIVES

Can we see different multifractal patterns in eye movements:

- for different levels of task difficulty?
- for high vs low performing individuals?



Evolution of multifractal spectrum width (Chaabra & Jensen, 1998) in the first 60 seconds



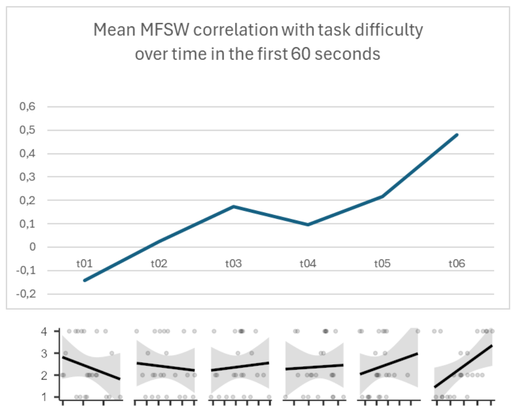
MFSW for 10 seconds long non-overlapping segments

THE IDEA

Cognitive performance dynamics follow a fractal (power-law) pattern in relation to both size and time scale. These fluctuations, which exhibit fractal properties, represent the flow of energy governing cognition across all scales (Dixon et al, 2012). Rather than a single power-law relationship, the cognitive system displays multiple power-law relationships, whether observed over time or space. This multifractality sheds light on how energy flows through the cognitive system. Looking at the short scale time-evolution in the multifractal spectrum important aspects of cognitive performance are revealed.

RESULTS

MFSW relation to task difficulty gets stronger by the end of the first minute

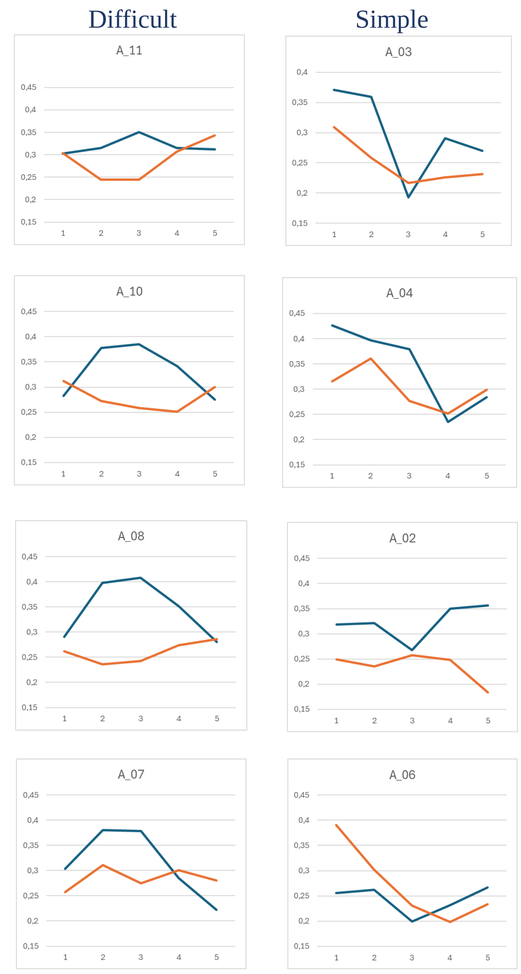


By the end of the first minute: Spearman's rho = 0.492, p=0.015

Overall performance appears to be related to reverse u shape of the changes in MFSW of the eye movements, especially in the more complex tasks.

Our pilot suggests that the proposed measurement may support the development of learner specific education systems.

Different patterns in performance and in task difficulty



References

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