A Cognitive Training Quiz Application



Computer Integrated Surgery II

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Introduction

- We created a web application for the assessment of visuospatial cognitive deficits based on existing pen-and-paper exercises.
- This web application increases the accessibility of the exercises, by allowing patients to take the exercises from any device with an internet connection, and increases the amount of data which can be collected.
- Conversion of assessments of cognitive visuospatial ability to electronic format has been done in the past, is supported by efficacy research.

Problem

• Current method of assessing visuospatial deficit involves a penciland-paper test and must be administered by a clinician.

Results

- Complete transcription of modules, albeit without all images (dependency resolution still in progress).
- All core features built to completion: able to complete exercises, submit results, and view scores.
- Conducted UX/UI review, applied some insights to user ۲ interface design.

Mo	View Que	stion			×
Tra Cc 2 3 4 6 7 8	At yo	corner 5, would you ti ur right?	y Left My Right		
9		single-select	Correct	1324 ms	
10	1	single-select	Incorrect	1253 ms	
11		single-select	Correct	1526 ms	
12	2	single-select	Correct	1236 ms	
				(700	

Patients cannot do these exercises at home or track their own performance.

Solution

- We built a platform-agnostic single-page Angular web application, using Bootstrap as a front-end framework for responsive design.
- This application is supported by a RESTful API back-end, served by a Ruby on Rails application.



The Stack

- Three types of users: patient, physician, administrator
 - Patients are able to take the exercises and view their own results.
 - Physicians are able to view their patients' results.

14	single-select	Correct	1645 ms
15	single-select	Incorrect	1721 ms
16	single-select	Correct	2139 ms

UI Insight: Modal windows for viewing questions in results view

Future Work

- Both team members graduating, Ran will bring the project to completion.
- Planned work: •
 - Results digest, generate summaries of score report
 - Allow physicians to export patient data (excel, csv, etc.)
 - Additional UI Polish
 - Integration of artwork for modules 4, 5
- Current research surrounds the duration of benefits from cognitive training and the effects that training in a specific skill has on daily function.

Lessons Learned

- Ruby on Windows is a recipe for disaster. Development switched to Linux after two weeks of hitting our heads against the wall.
- Refactor early. You'll regret it if you don't, and you need to make a fundamental redesign or add a feature which you didn't plan for.
- You can stack Angular dependency resolution in order to create sequential asynchronous callback/resolve chains and avoid race conditions.

Credits

• Administrators manage user accounts.

FORMING MENTAL IMAGES	Cognitive Training Application	patient -	Refineme
There are several steps involved in solving spatial problems. The first step is to form a mental image of an object or drawing. A second step involves mentally rotating or turning this mental image.	Dashboard Home Exit	Kennen	
In this exercise we will practice on the first stepforming mental images. Look at EXAMPLE A. Look at the picture on the left. Which picture on the right looks like the picture on the left? Yes, it is Answer C. In order to solve this type of problem, you must remember (form a mental image) of the drawing on the left. Then you must decide	Cempleted: 38/86 Forming Mental Images There are several steps involved in solving		Publication
which drawing on the right is like this mental image. Now, circle the answer to EXAMPLE B.	spatial problems. The first step is to form a mental image of an object or drawing. A second step involves mentally rotating or turning this mental image. Look at the picture on the right. Which picture below looks like the picture on the right?	,	 Bigelow, R Visuospati
A B C D			Journal of \
			• Willis, She

Side-by-side comparison of paper test and the web application

- Serialization of the paper exercises was done by classifying each \bullet exercise, creating a template that could be populated with the essential data of the question, and then digitizing the assets.
- Assets served by CDN (in practice, just an Apache instance)
 - Prompt images
 - Prompt text and layout

- Ran: Front-end development, back-end development, UI Design \bullet
- Nick: Front-end development, Module transcription, UI Design, UI ent

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- RT, Agrawal, Y. "Vestibular involvement in cognition: ial ability, attention, executive function, and memory". Vestibular Research 25 (2015).
- erry L., et al. "Long-term effects of cognitive training on everyday functional outcomes in older adults". Jama 296.23 (2006).

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