

P74 - VR SPATIAL SKILLS TESTING

Understanding the effectiveness of testing spatial ability in a virtual reality environment compared to traditional, 2D spatial skills tests.

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WHAT IS SPATIAL INTELLIGENCE?

Spatial abilities embody the ability to produce, transform, and interpret mental images.

Spatial skills can be split into 4 different sections:

- Spatial/visuospatial perception
- Mental rotation
- Spatial Visualisation
- Spatial Working Memory

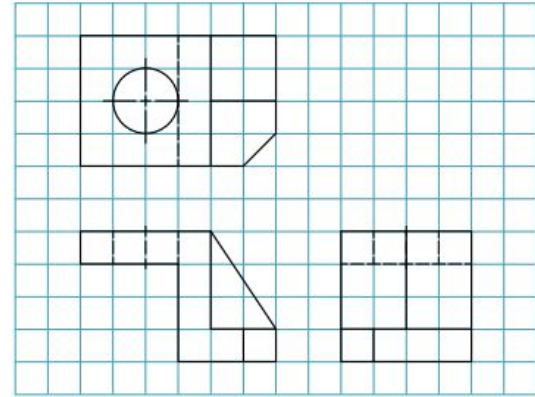


REMEMBER THIS?

Completing tasks like these requires the use of spatial skills!

- b In this case, this questions tests the ability to mentally visualise and draw a 3D object based on the 2D schematics.

Draw the isometric view for the object shown below.



LINKS TO PROFICIENCY IN STEM AREAS

High Spatial Intelligence has shown to have a direct correlation to higher proficiency in Science, Technology, Engineering and Medical (STEM) fields.

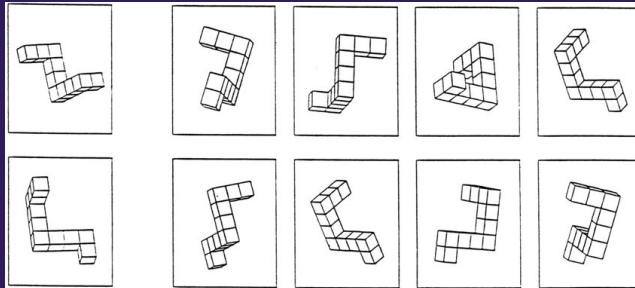
From “The Hidden Stem Economy” (2011)

- In the United States, 20% of all jobs require a high level of knowledge and proficiency in any one STEM field.
- STEM-oriented metropolitan economies perform strongly on a wide variety of economic indicators, from innovation to employment.

THE IMPORTANCE OF TESTING

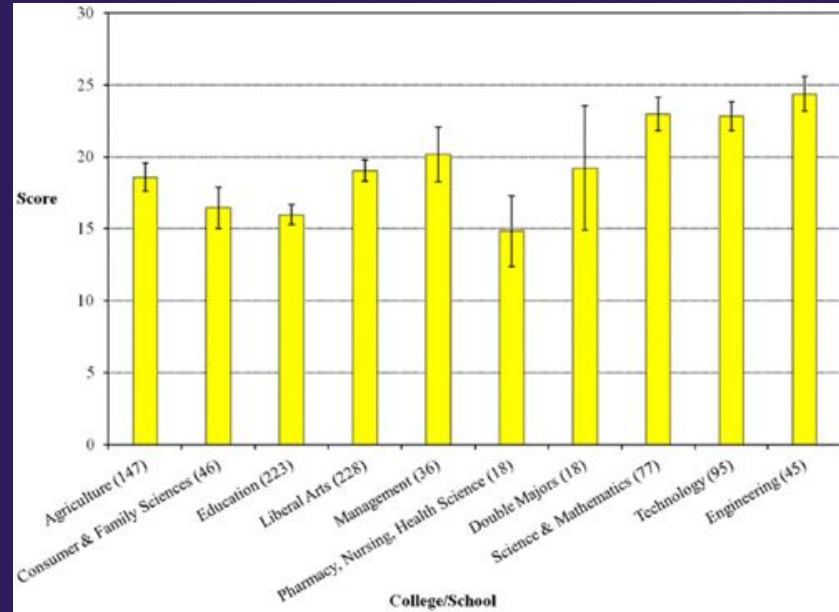
Provides students with an early indication of whether or not they could be suited for a profession in STEM.

Offers opportunities to understand where an individual's spatial skills are lacking or are well developed.



2D TESTING

- Yoon and Mann (2017) found that students in STEM majors showed significantly better performance in spatial tests compared to those in non-STEM majors, even when normalising for general intelligence.

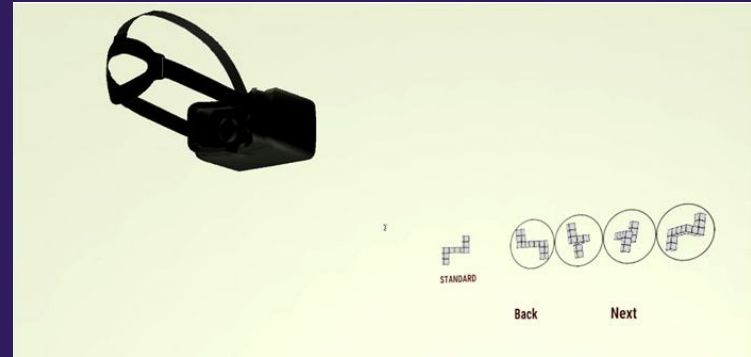


ENDEAVOURS IN VR

Weiner and Sanchez (2020) found partial support that the VR spatial skills test results would converge on the traditional spatial skills tests scores. Used ThrounneIVR as the game to test spatial skills.

Main Findings

- Unwanted testing of other skills
- Existing games are not purpose built for testing spatial ability
- Some VR tests are just basic ports.



GENDER DIFFERENCES IN RESULTS

- Gender differences in spatial ability tasks are less prominent when moving to a VR environment.
- Parsons (2004) states that this is one piece of evidence suggesting that solving these tasks in virtual reality may be a more appropriate medium.

AUTOMATIC QUESTION GENERATION (AQG)

Kurdi et al (2020) analysed publications over the course of 50 years, finding that within the last 10 years, the interest in AQG as a testing tool has grown exponentially.

AQG allows for the same test to be repeated by the same participant, with minimal training effect.

Currently AQG has not been implemented at all in spatial skills testing in both VR and 2D environments.

RESEARCH GAPS

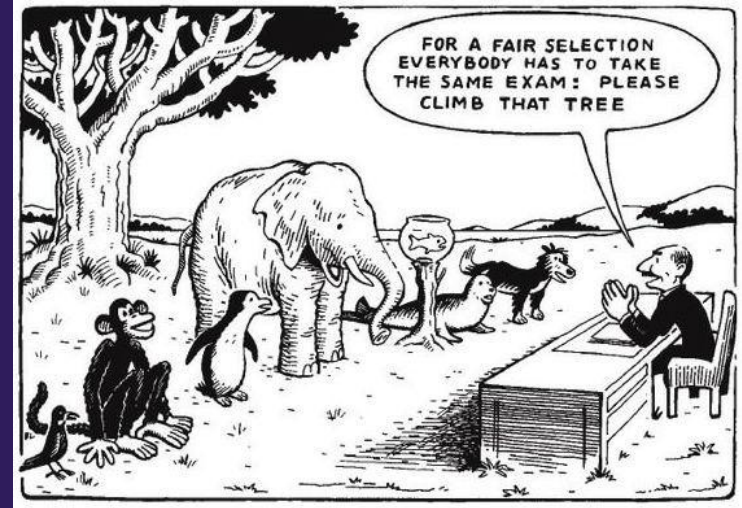
- Lack of Virtual Reality programs which test spatial skills specifically, leading to uncertainty in whether or not it is a good environment for testing all spatial skills.
- Whilst research exists into the evaluation of spatial ability in VR, many only focus on one component.
- Tests have shown to be biased towards questions that participants from STEM backgrounds will identify with better.

WHAT WE WILL ADD TO THE RESEARCH

- Can a VR spatial skills test provide a better testing environment than current screen or paper based tests
- Investigate whether having different difficulty levels of questions can provide a better indication of a person's spatial skills

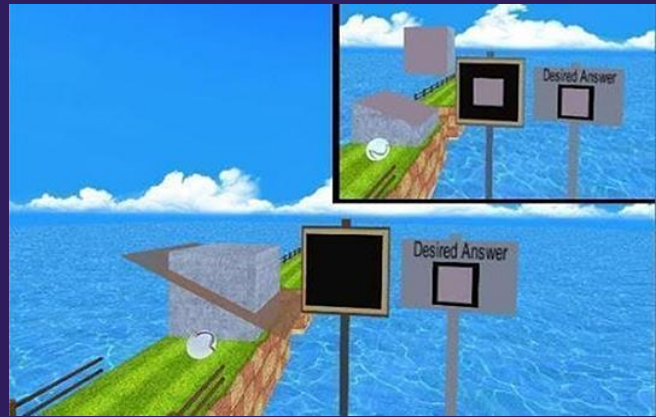
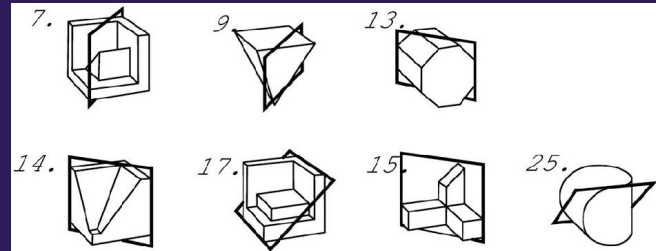
TESTING BIAS

Familiarity can play a big part in the results of spatial ability tests.



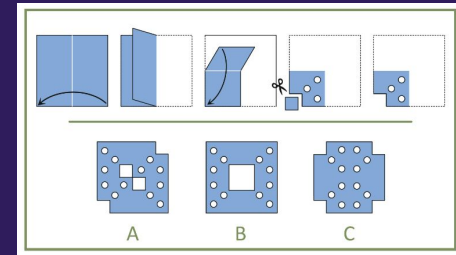
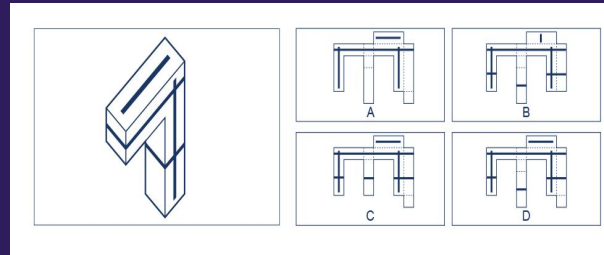
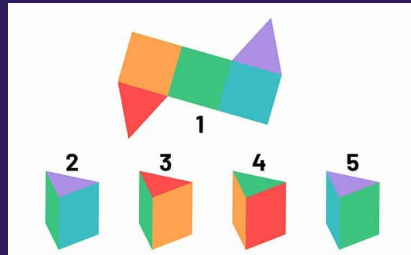
VR ENVIRONMENT

A more recognisable environment
can help to level the playing field



TEST DIFFICULTY

Can adding difficulty to the test give a better indication of someones spatial abilities?



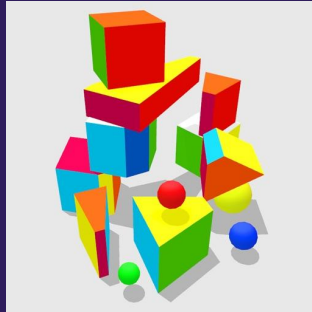
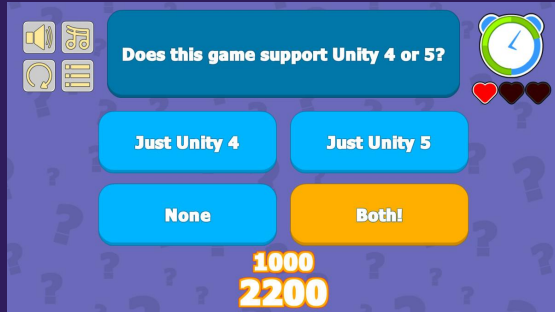
OUR PLAN

Step 1: Create a 2D quiz

Step 2: Make a VR spatial skills test

Step 3: ...

Step 4: Profit!



TOOLS

- Unity is our development platform and game engine
- Blender for creating our 3D assets
- Oculus Rift as our VR headset of choice



Unity®



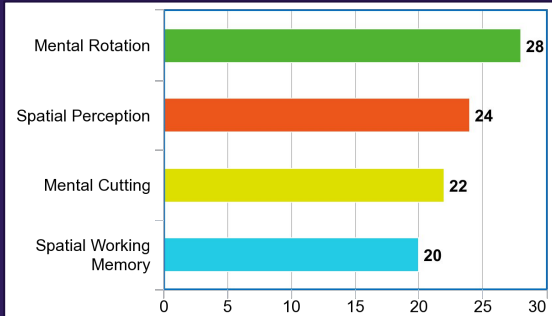
blender®



oculus

MEASURING RESULTS

Comparing test results from the 2D quiz and the virtual reality test



Mental rotation:	Level 8	Top 10%
Spatial Perception:	Level 6	Top 25%
Mental Cutting:	Level 5	Top 50%
Spatial Working Memory:	Level 2	Below Average

THANK YOU

Thank you for listening to our presentation!

We are now open to questions on our project

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