

# A NEW TEST FOR PATTERN MATCHING INTELLIGENCE FOR SCHOOL CHILDREN AND PERFORMANCE ANALYSIS WITH ACADEMIC GRADE POINT

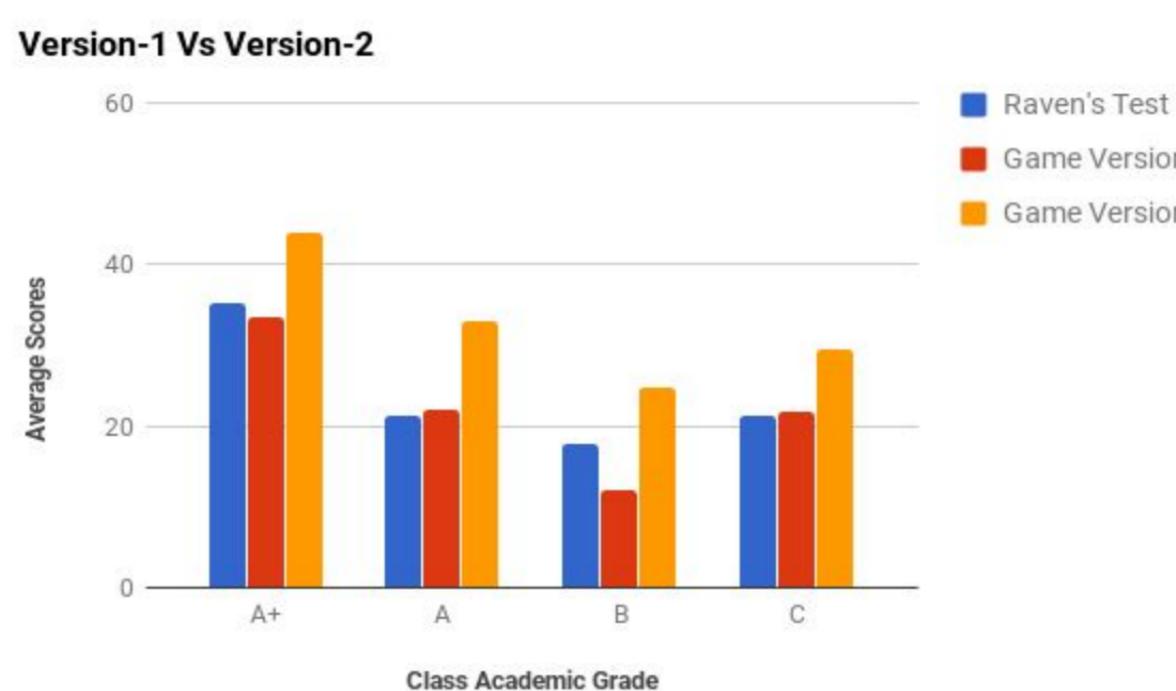
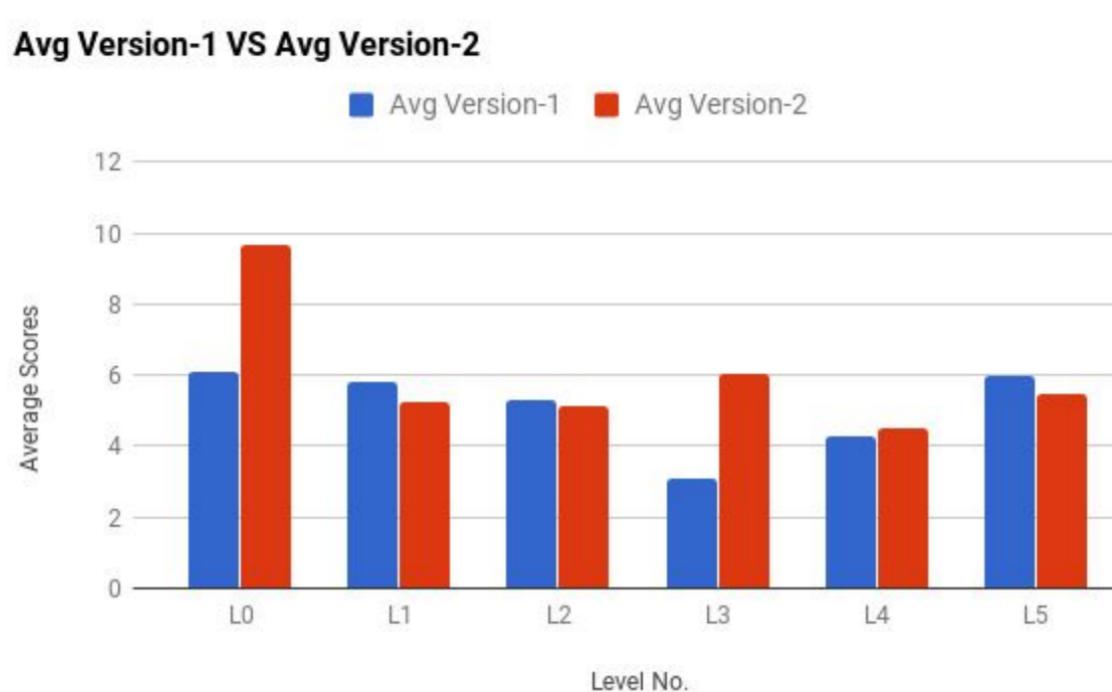
## AIM

- ❖ The goal of the project is to test the visual pattern detection and matching intelligence of school children with the Raven Progressive Matrices standard test and a specially designed set of tests with patterns prevalent in nature.
- ❖ Hypothesis: Human's identify patterns in nature from complete visual sensory information. Visual intelligence tests with abstract patterns fall short in explaining our ability to detect patterns in nature. .

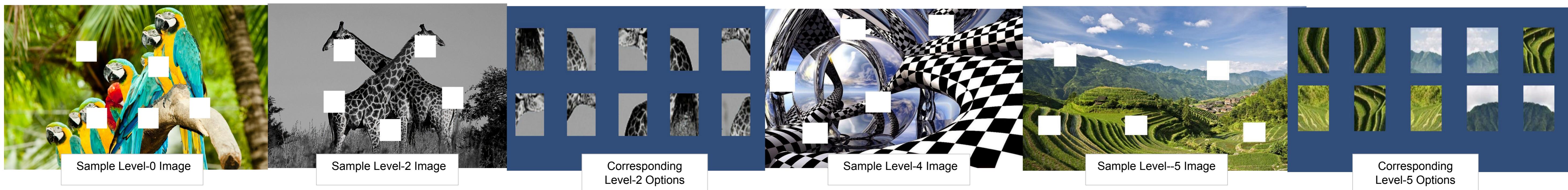
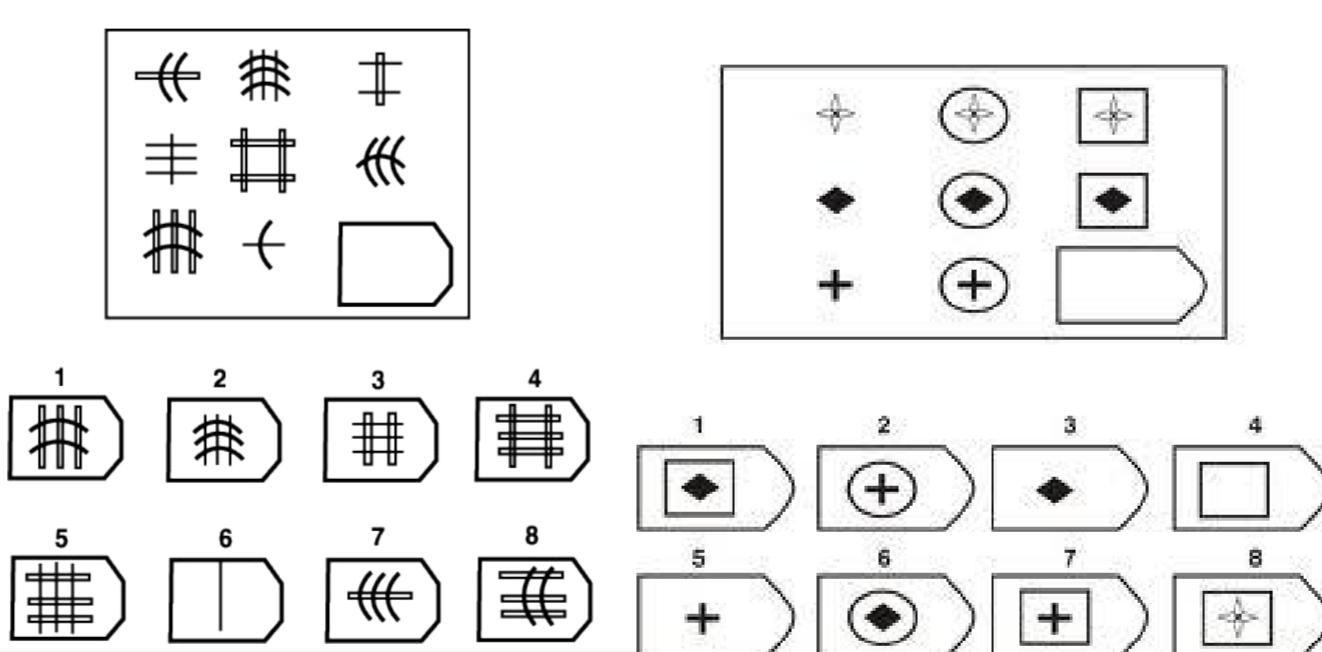
## METHOD

- ❖ Forty primary school students (25 boys, 15 girls) participated in this experiment. All participants were in the age group of 9-12 years, had never taken Standard Raven's Progressive Matrices (RPM) test before, were well acquainted with English language and had basic computer usage skill.
- ❖ The Experiment consisted of 2 tests - the standard Raven Progressive Matrices (hardcopy) and a game-like application of patterns observed in nature presented on a laptop screen. The game-app was designed by us.
- ❖ The game-app had 6 levels and each level consisted of 5 questions. An image (examples below) was presented with correct number options of patches in a side panel (Version-1). The player had to select each of these patches and move it to the gap in the image. A correct pattern matching is given a score while time taken to complete the task is recorded. In some levels the patches were inverted patterns and had multiple incorrect choices (Version-2).
- ❖ The timer is set according to the complexity of a particular level. If the participant is not able to complete the question in the given time, the game automatically navigates to the next question.
- ❖ Each level of the game was designed to assess different abilities of participants.
  - Level-0 is the basic level allows the players to familiarize themselves with the game user-interface.
  - Level-1 tests the ability of players to recognize the symmetry in skins of animals.
  - Level-2 is designed to test the ability of the players to recognize continuity and symmetry in black and white images.
  - Level-3 is designed to check the ability to recognize continuity in nature's landscape photographs.
  - Level-4 tests the ability to recognize continuity in optical illusions.
  - Level-5 is motivated from Standard RPM test. Each question in this level is correlated to a difficult questions (section E) in Standard Raven Progressive Matrices test.
- ❖ The game was played in 2 iterations. The first iteration (version -1) had five options to the corresponding five missing pieces whereas in the second iteration (version-2) ten options corresponding to the missing pieces are provided. The options in the second iteration are flipped/rotated to increase complexity.
- ❖ The class teacher provided the grade (A+,A,B,C) position of each participant based on regular class performance over the school year.

## RESULTS



- The toppers (A+ grade) in academics also scored high in the intelligence tests administered
  - There is no significant variance in the scores of Raven's and game-app for Version-1, whereas in the Version-2 the scores were higher.
  - The subset of students in the lowest academic grade scored similar to the top A graders while the B grades were significantly lower.
  - Comparing between the levels in the pattern matching game, it was observed that landscapes with rich colors and complex textures scored lower (Level -3), though in the Version-2, the score was higher.



## ANALYSIS

- ❖ The scores for the Raven's test were marked as per the instructions provided by the tests.
- ❖ For the game-app, the average score for each level across all the participants was calculated.
- ❖ The scores of the players were grouped into the regular grades division as provided by the teacher.
- ❖ Comparative analysis was conducted to examine for correlation between class grade and the two tests on visual intelligence.
- ❖ A second analysis examined the scores from the two levels of the game-app. This step was to determine pattern matching when multiple similar choices were presented.
- ❖ As the number of subjects for the preliminary study were only 40, statistical analysis like T-tests was not attempted.

## DISCUSSIONS

- ❖ The preliminary raw data analysis highlights an important parameter, that the students who fall at the bottom of the class grade have visual/pattern intelligence comparable with the top graders.
- ❖ This is an interesting proposition as most of these children are not given an opportunity for higher studies as cut-offs for admissions are based on academic grades.
- ❖ Another important data point is the higher scores for Version-2. This needs to be re-examined by counterbalancing the presentation of version-1 and 2, to remove familiarity bias, though the images were completely different.
- ❖ But, if one considers the findings (point 3 above), then it could mean that humans pattern match by elimination strategy similar to observations in human speech recognition.
- ❖ The game-app requires standardization to be an accepted measure for visual pattern matching with concrete natural images.

## LIMITATIONS AND FUTURE WORK

- ❖ The participants sample size was too small to make strong inferences.
- ❖ The images selected for the game-app have to be standardised for visual balance, color hue sensitivity, light/retinal illuminance and many other human visual system factors that might influence the matching.
- ❖ Participants have to be tested for color blindness using Ishihara color tests.
- ❖ The role of timer related stress should also be weighted to the score.
- ❖ The studies are being extended post analysis of each image's features and balancing the same to reduce 'noise' from these factors in the data.