

Background

- Drawing and copying can provide a window into the development of vision and visual-motor integration in childhood (refs).

- 'Project Prakash' is a humanitarian/scientific endeavour to treat children born blind, while exploring their brain development following visual deprivation in the first few years of life.

Goal

- Further developmental research on drawing ability as a window into internal representations by following the emergence of drawing from the onset of vision.

- Isolate the roles of visual- and motor- skill for contributing to the development of basic shape drawing.

- Determine if shape copying can develop past dogmatic critical periods (i.e. with late sight-onset).

- Map the developmental trajectory of shape production from visual versus haptic exploration, as visual experience is gained.

Method

Subjects

- 15 Patients:
treated for bilateral congenital cataracts when 7-22 years old.
No other co-occurring developmental issues.
Pre-operative acuities range ~20/500 to Light Perception only.
Post-operative acuities range ~20/150 to ~20/500.
Each child performed task at multiple, but not all, timepoints.

- 14 Controls:
With normal visual development and status.
Children attend orphanages in Delhi, India.
Matched for socio-economical background and location.
No other co-occurring developmental issues.
Approximately matched for gender and age.
Acuity matched: performed task with imposed 20/500 visual acuity.

Protocol

Tasks:

1. Tracing - trace outline of single and pairs of shapes.
2. Copying Vision - look at outline of shapes and reproduce.
3. Copying Tactile - with eyes closed, haptically explore embossed outline of shape, then reproduce by drawing on ipad with eyes open.

Conditions:

1. Single Shape: Primary, Secondary
2. Dual Shapes: Overlapped, Touching, Side-by-side

All tasks performed on ipad XX-inch, drawings made with finger, shape sizes kept consistent across conditions, shapes and subject drawings made in high contrast, subjects allowed to correct their shape production in real time.

Sampling:

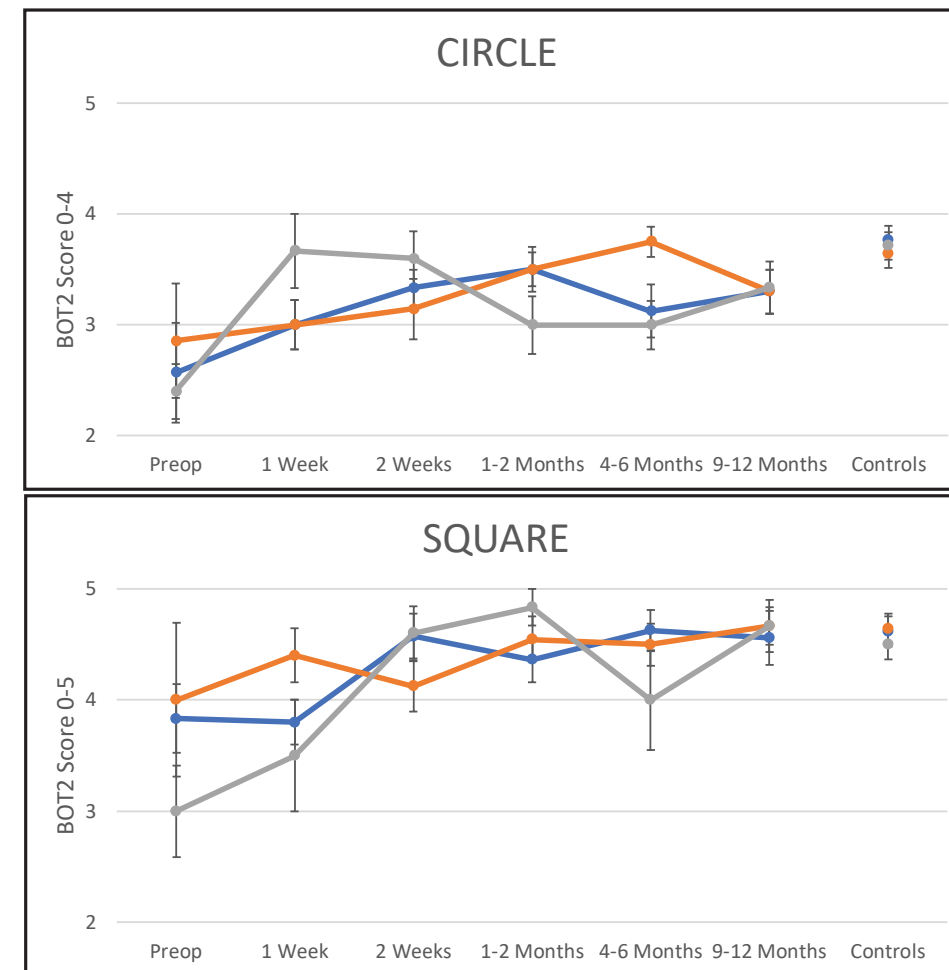
- Data collected at multiple timepoints before and after treatment, upto one year after treatment.
- Also recorded visual acuity, contrast sensitivity, age, education level.

Drawing as a Window into Visual Learning and Plasticity Following Treatment for Congenital Bilateral Blindness

Sharon Gilad-Gutnick et al



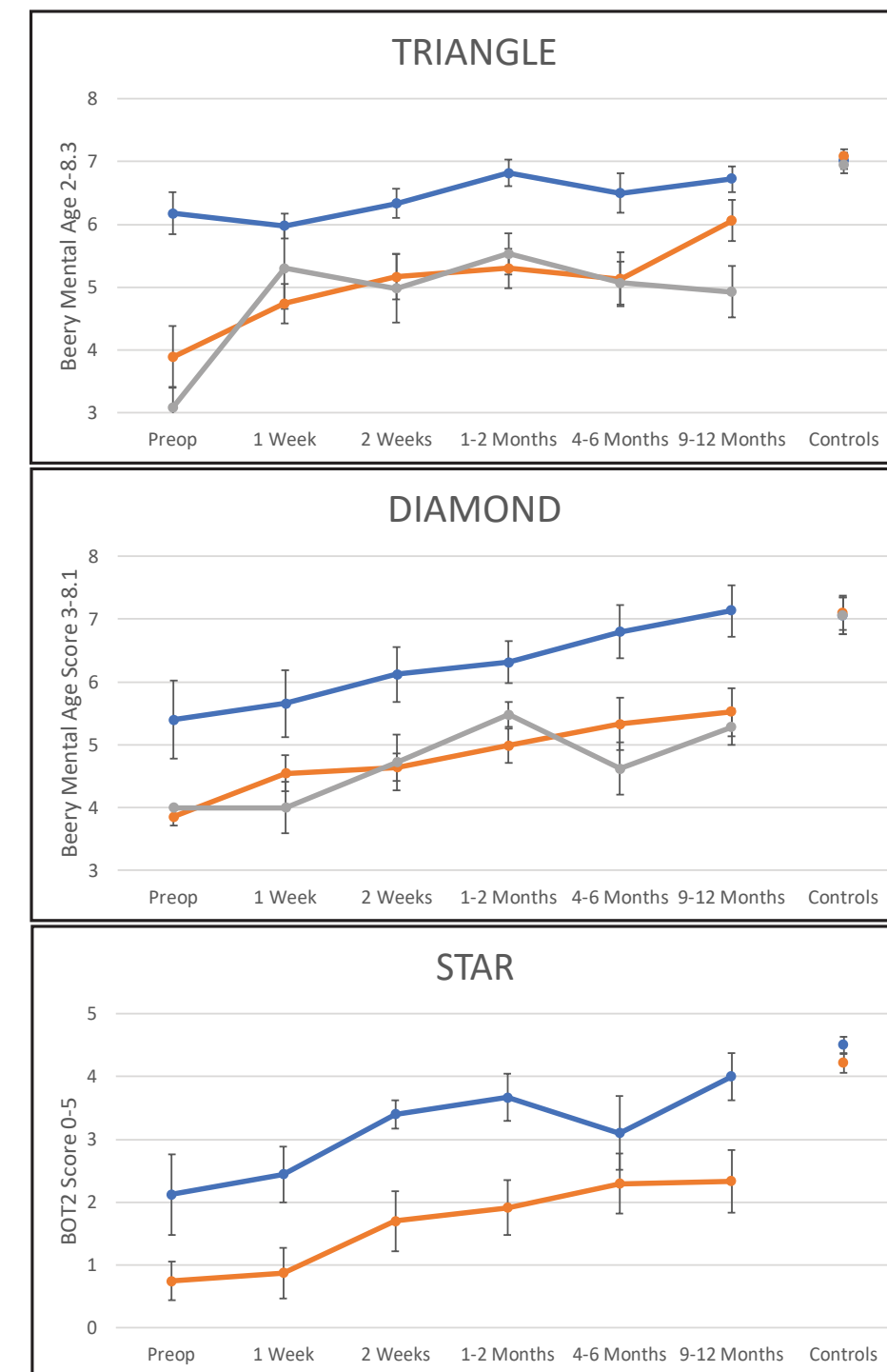
Primary Shape



1. Patient group begins w/ lower than control performance, and much lower than children their biological age on all 3 tasks.
2. However, they improve rapidly w/ only 2 wks of visual experience to the level of controls on all stats.
3. Increased visual experience results in decrease in "between subject variability" for tracing & vision copying only.

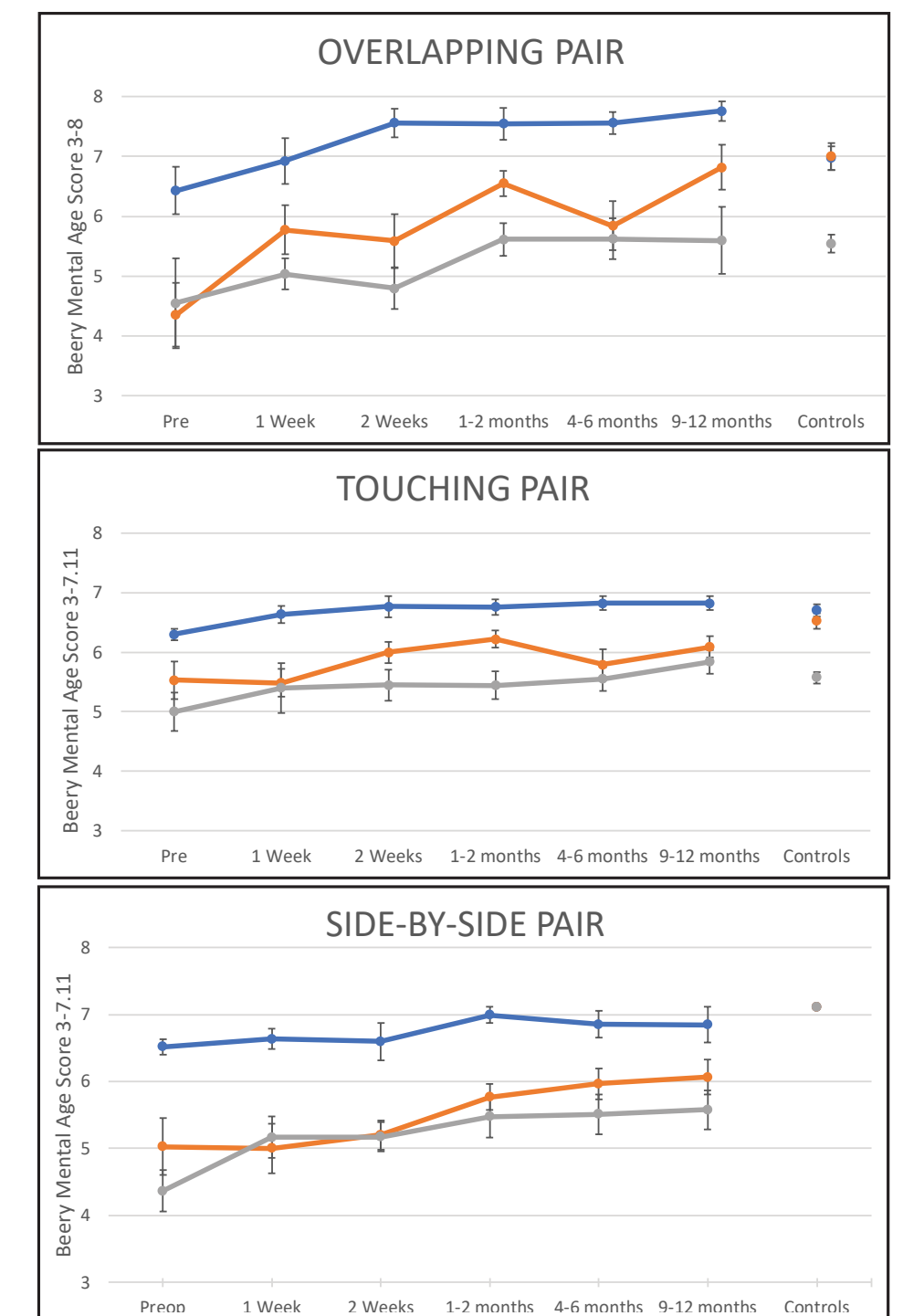
Controls

Secondary Shape



1. Tracing performance begins high and rapidly reaches NT level:
Possibly reflects reliance on component-based strategies, which remain effective for tracing even with minimal vision.
Indicates that their drawing skills are not limited by fine motor control.
2. Reproduction of shapes (ie copying) begins worse than tracing, regardless of modality of input, but improve rapidly with just 1yr of visual experience.
3. Improved performance does not correlate with improvement or absolute visual acuity.

Paired Shapes



1. When shapes are overlapped (ie have a clear interaction) patients experience huge improvements over the first year of recovery, ending up with the same profile as controls, i.e copying & tracing > tactile.
2. When shapes are side-by-side (ie no interaction) patients also show huge improvements, but their performance still falls short of controls after one year.
3. When shapes are just touching (ie 1-point of interaction) patients' performance begins similar to controls' impaired tactile performance, and does not improve much, reflecting sustained difficulties in judging correct relationship between shapes in both the visual and tactile tasks.