

SELECTED FINDINGS FROM THE INQUIRY
PROJECT: VOLUME & DISPLACEMENT,
MATTER & GRANULARITY

Treatment vs. Control Results

David W. Carraher

Carol L. Smith

May 27, 2009

TERC & Tufts University

Research design

- We use a comparative longitudinal research design suited for accompanying individual progress over time. Students take the same individual two-hour interview at multiple points in time: Treatment students (n=52) receive the Inquiry science curriculum for nine weeks in each of grades 3, 4, and 5. Control students (n=37) from the same schools receive the standard science classroom instruction in grades 3-5.
- To date we completed more than 250 interviews (before the curriculum in grade 3 for Treatment students as well as after the curriculum in grades 3 and 4; at the end of grade 3 and grade 4 for Control students).

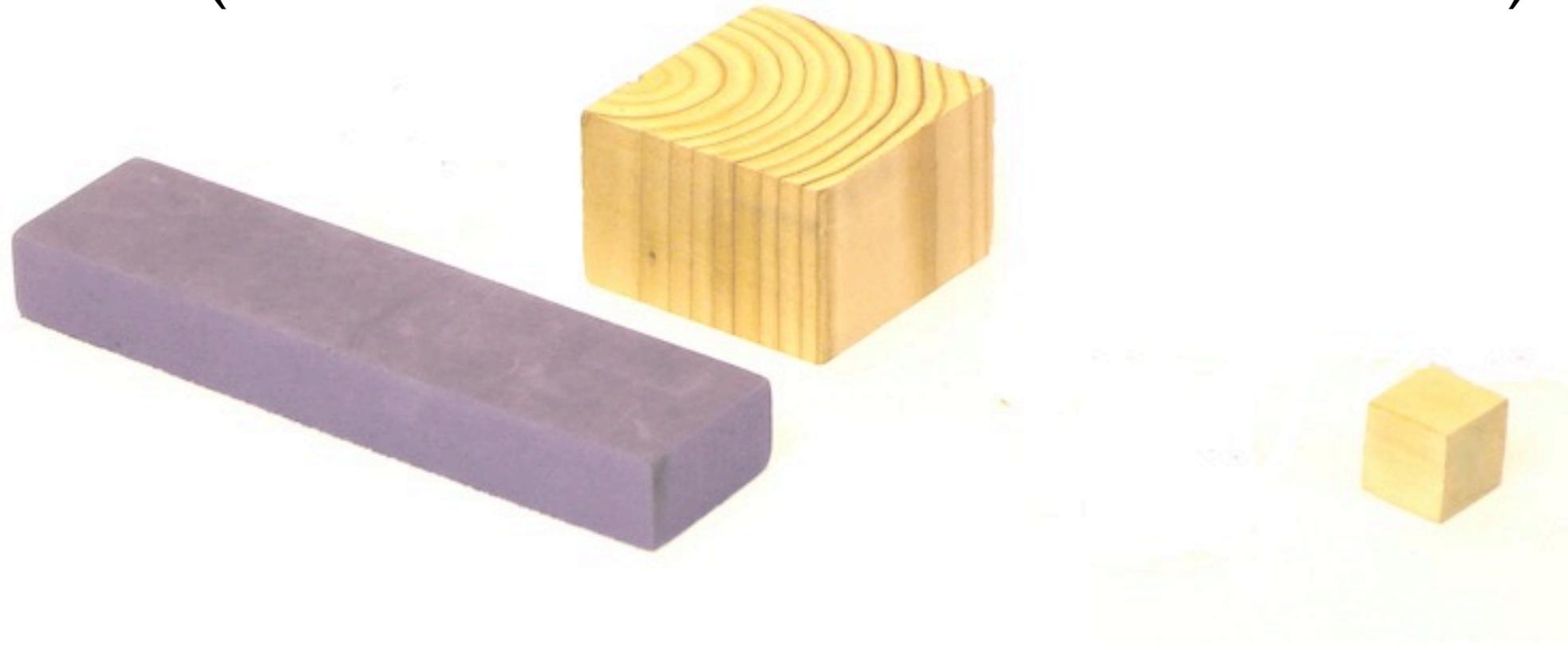
INTERVIEW TASKS ASSESSED CHILDREN'S UNDERSTANDING OF:

1. The divisibility and granularity of matter (clay)
2. Judgments about (and measurements of) length, area and volume
3. Weight, size, heaviness of material, and density
4. Water displacement
5. Constancy of volume of clay under re-shaping
6. Block rearrangements: what changes and remains invariant?
7. Sorting by matter / not matter as well as ideas about atoms and molecules (if children had heard of them);
8. Granularity of number and length
9. Transformations (beyond mechanical deformations) of materials
10. Ratio & proportion in natural contexts (mixtures)

STUDENTS' GRASP OF THE CONCEPT OF VOLUME

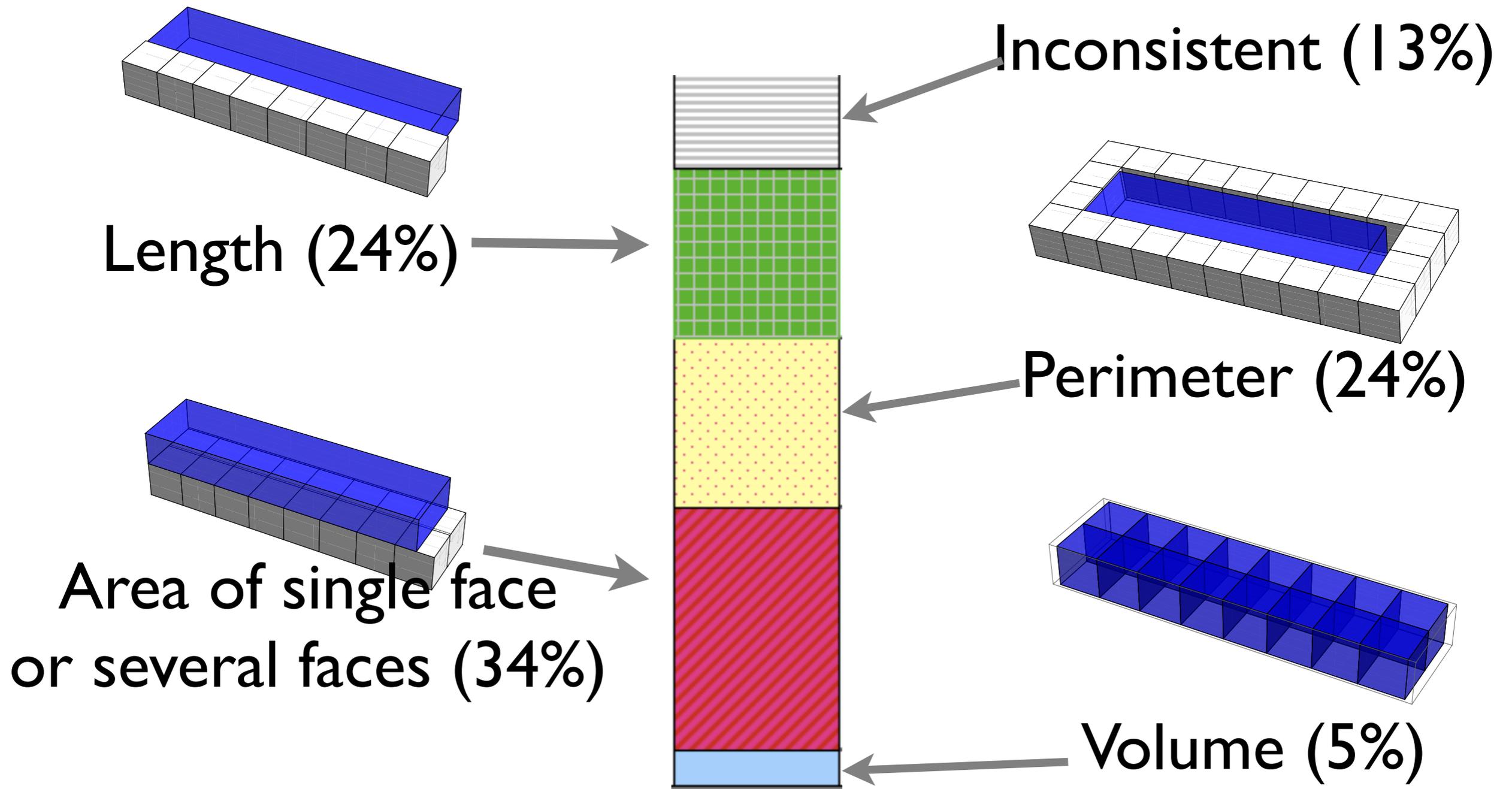
Which is bigger? Which takes up more space?

(The colored block or the wooden block?)

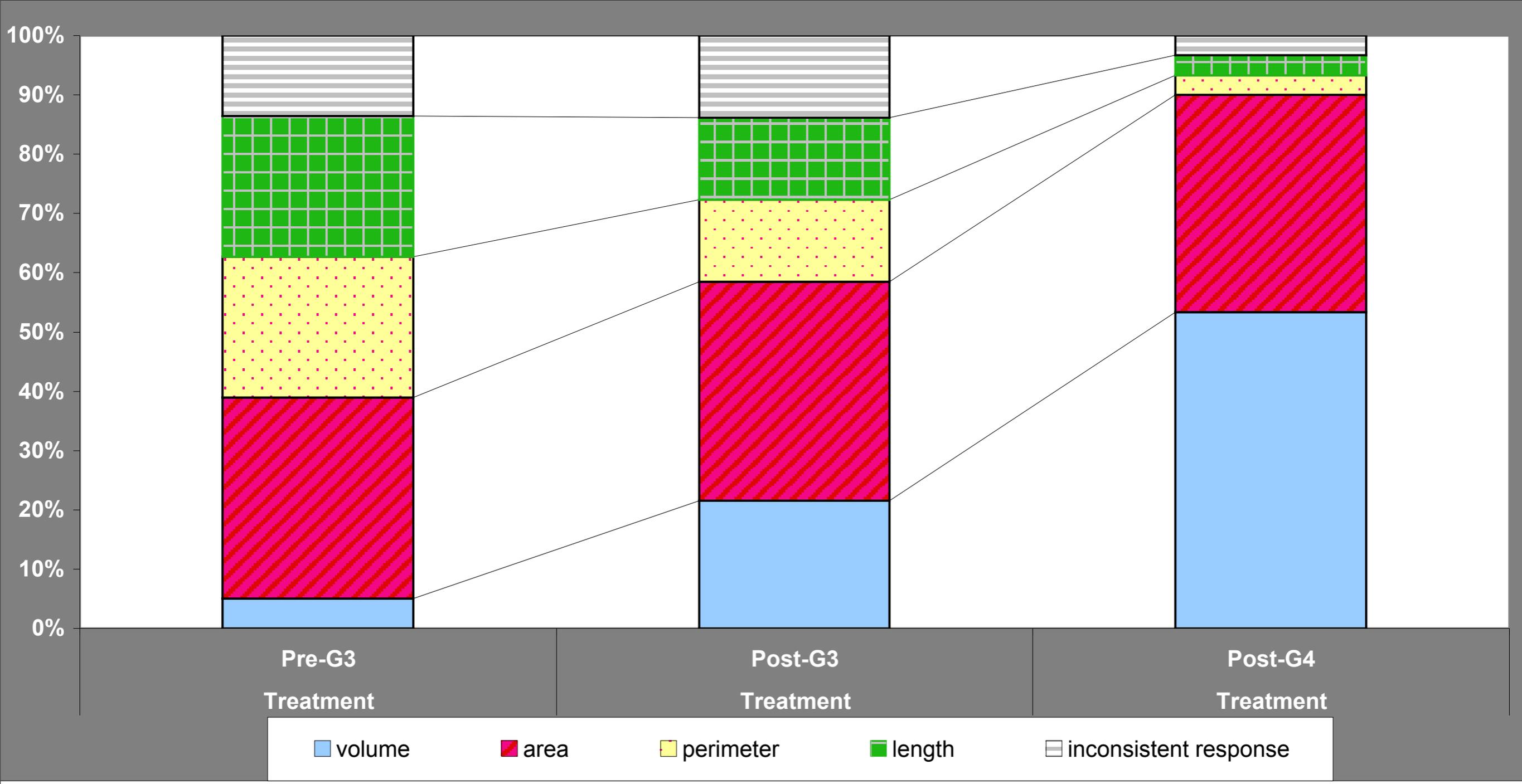


You may use the white cube to help you decide

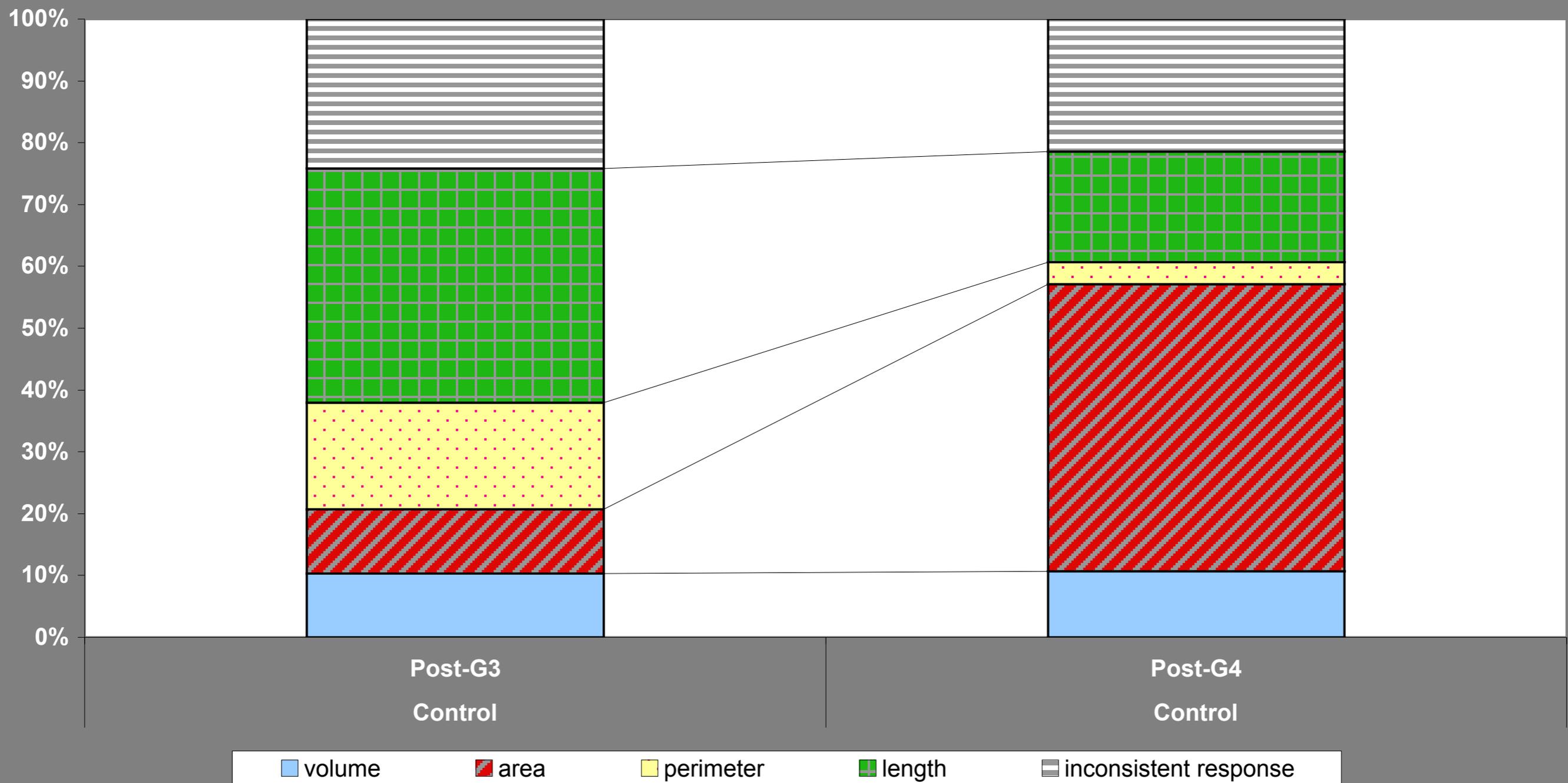
Beginning Third Grade Students base their



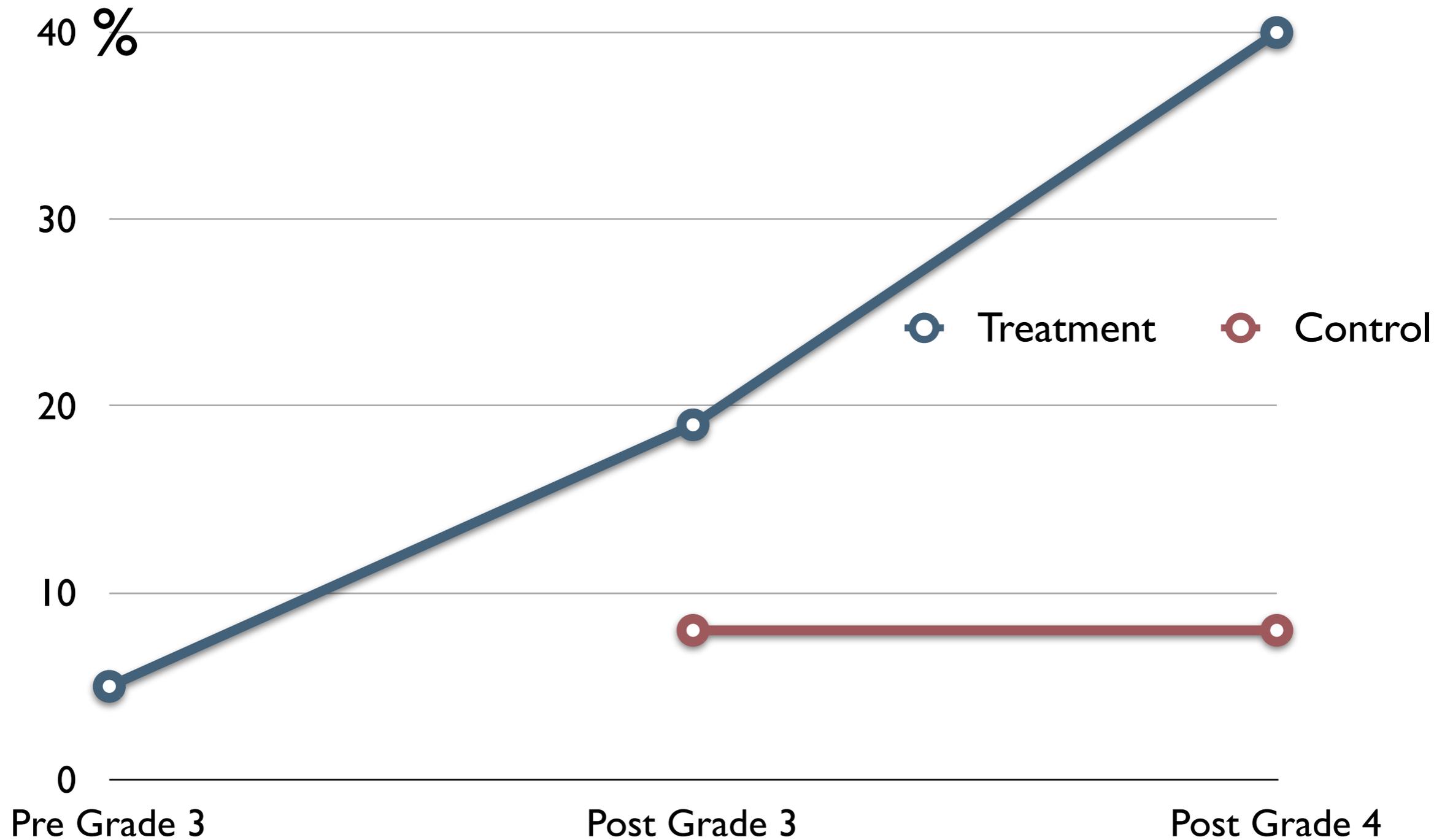
Inquiry Students Make Great Progress by the End of Grade 4



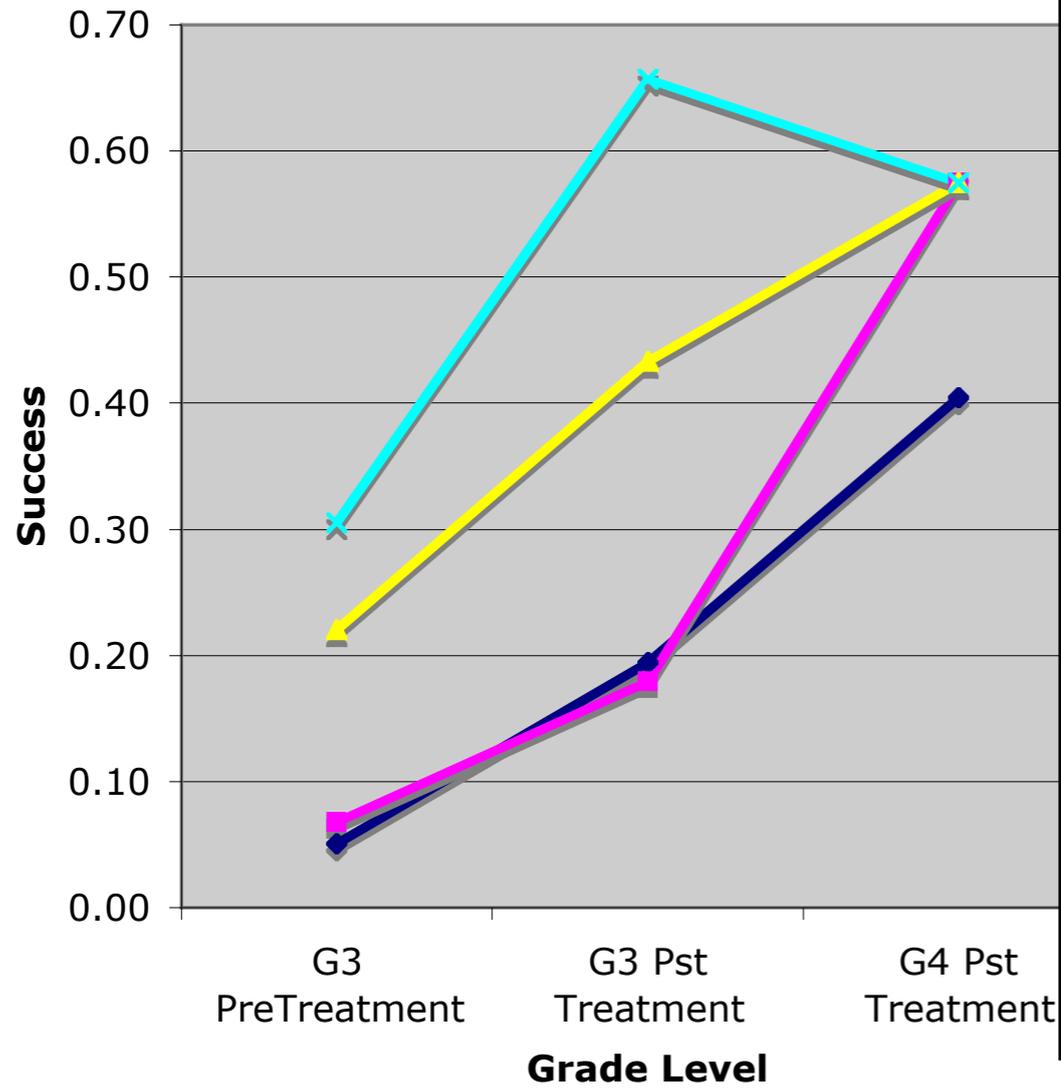
Control Group Students Make Comparatively Little Progress



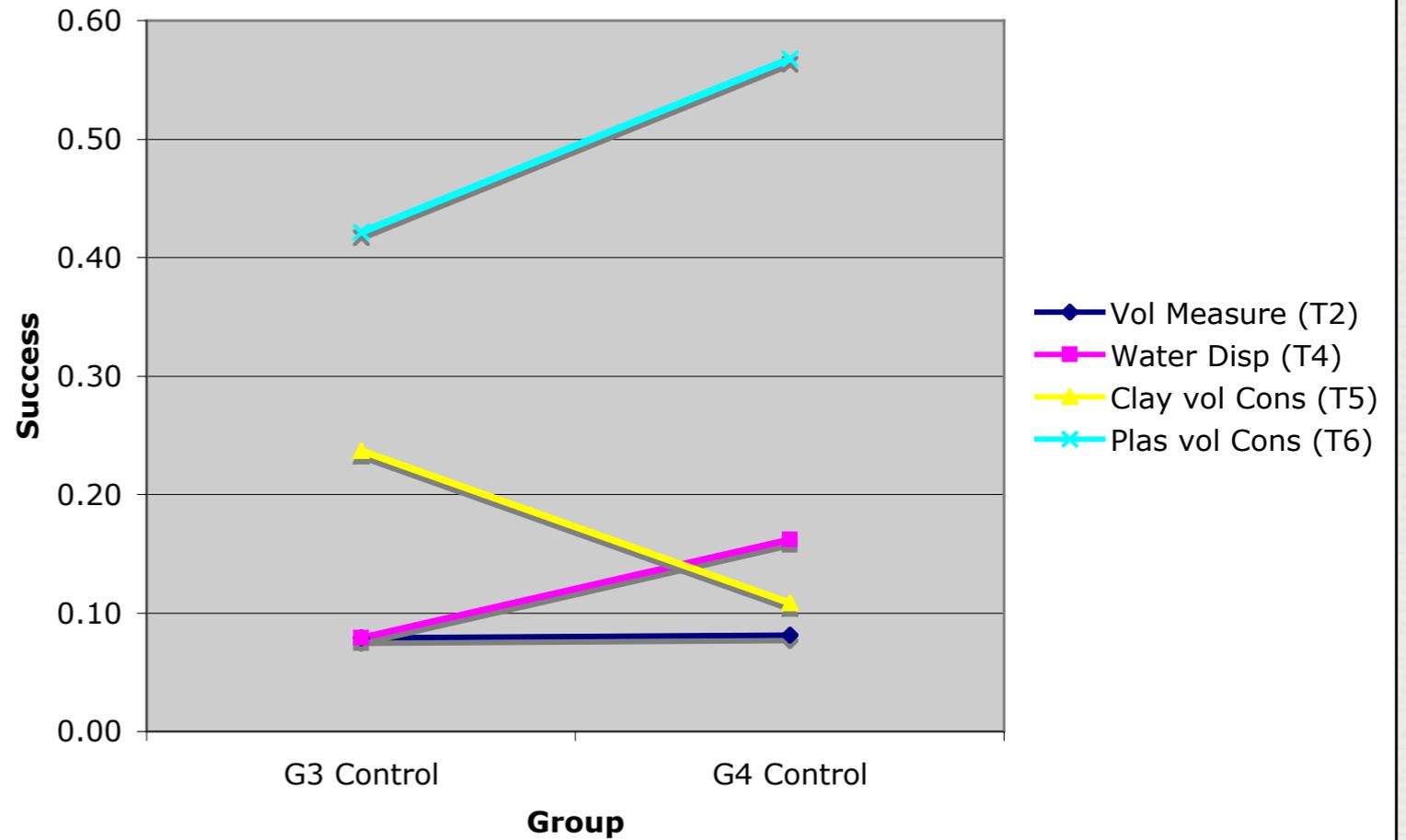
% Students Who Focus On Volume



Treatment: Volume Measures Over Time



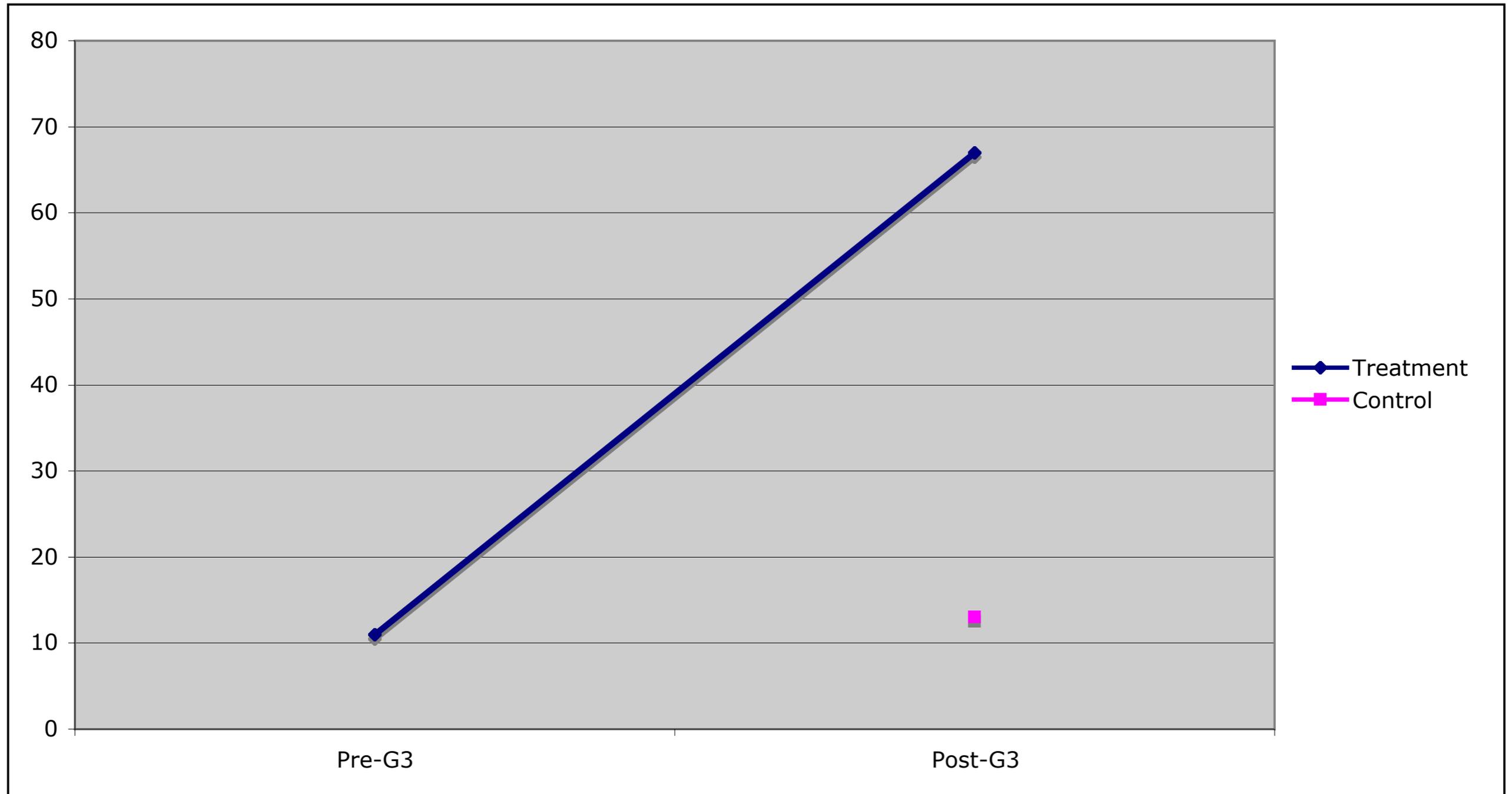
Control: Volume over Time



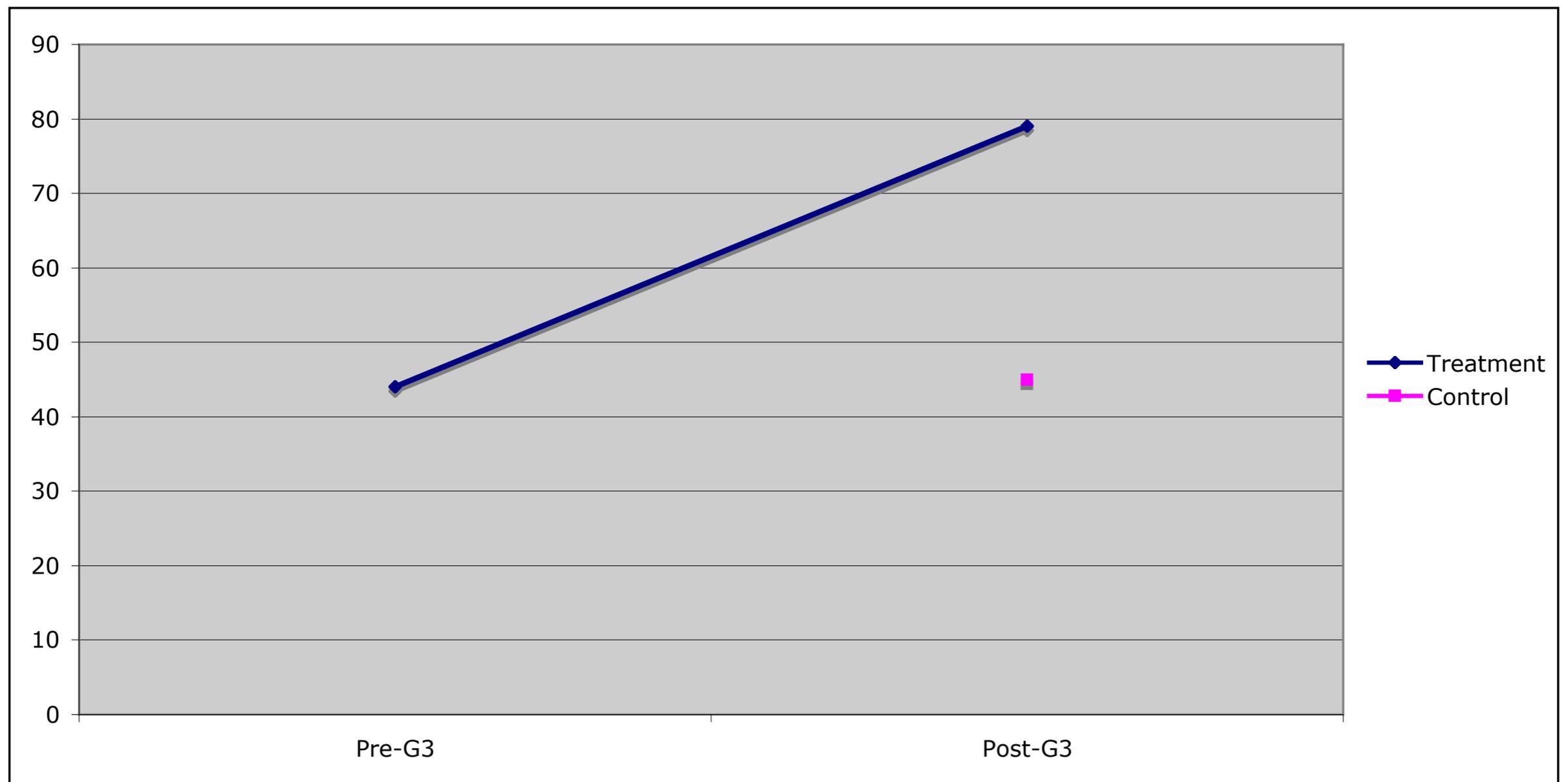
- Vol Measure (T2)
- Water Disp (T4)
- Clay vol Cons (T5)
- Plas vol Cons (T6)

THE PROPERTIES OF TINY THINGS

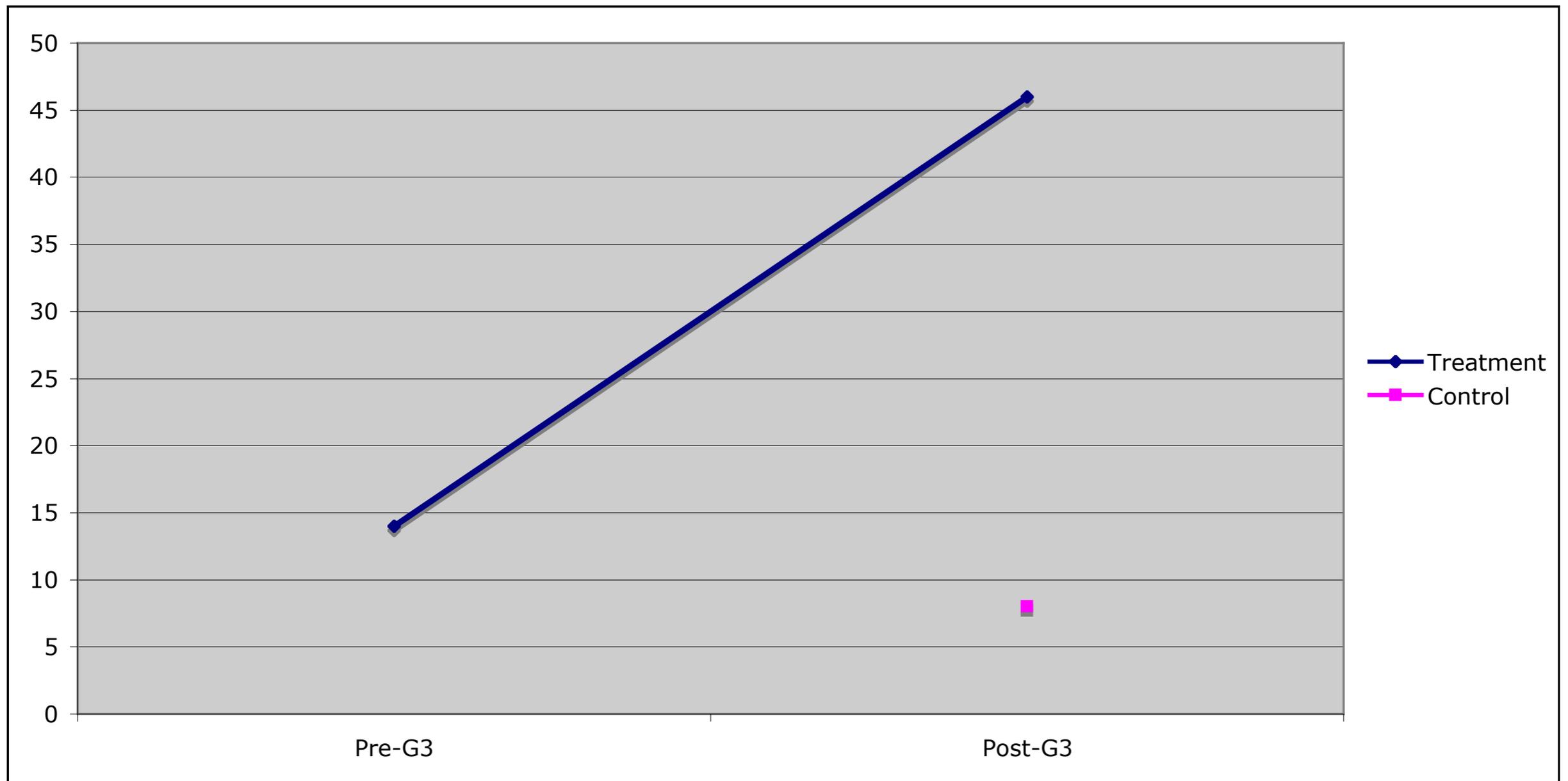
% Students Who Believe a Tiny (Visible) Speck Has Weight



% Students Who Believe a Tiny (Visible) Speck Takes Up Space



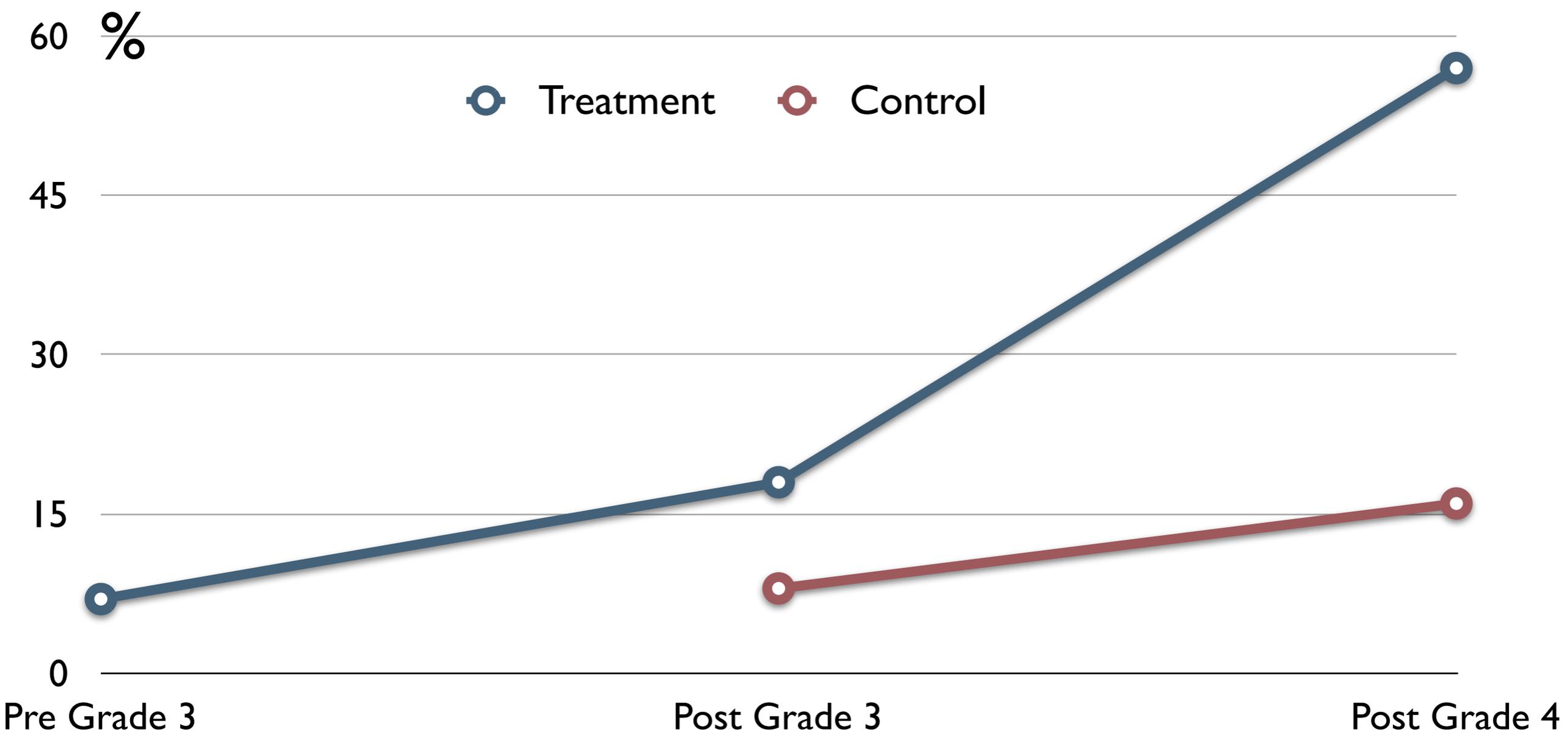
% Students Who Believe an Invisible Speck Weighs Something



IMPROVEMENT IN UNDERSTANDING OF WATER DISPLACEMENT

An Aluminum Cylinder Will Raise Water Level as High as a Brass One*

(% students)

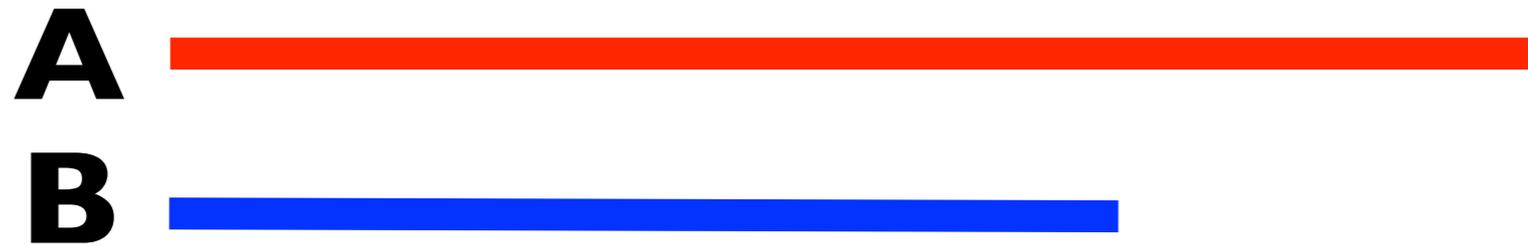


THE GRANULARITY OF NUMBER, WEIGHT & LENGTH

How Many Numbers Are There Between 4 and 5?

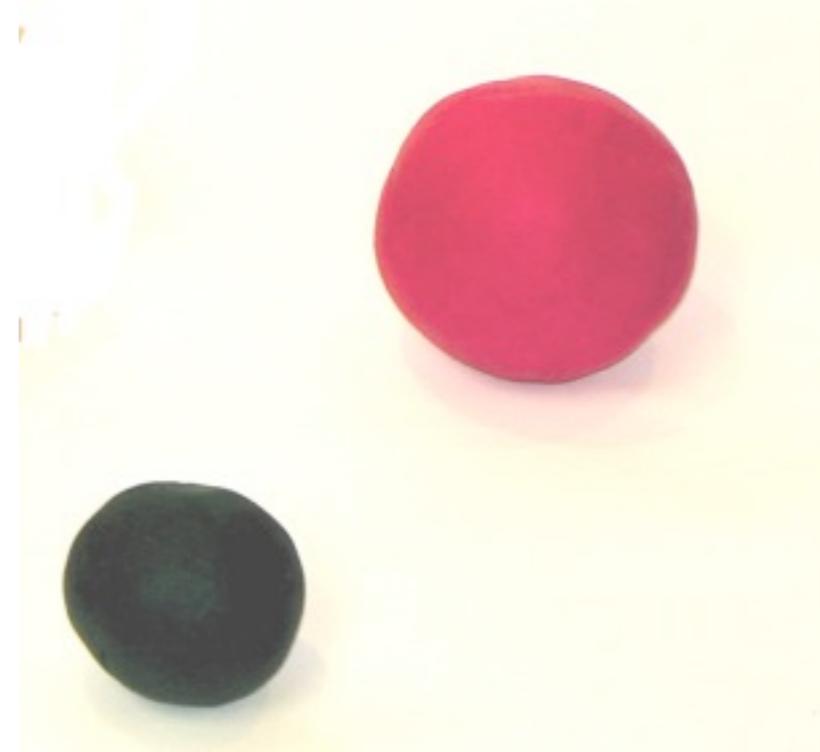
- Many third grade students believe there are no numbers between 4 and 5.
- Almost all others believe there are only a few numbers (e.g $4\frac{1}{4}$, $4\frac{1}{2}$, $4\frac{3}{4}$) in that interval.
- We are currently analyzing the results for grade 4.

How many lines can exist having lengths between A and B?



- The vast majority of third graders believe that very few lengths exist that are shorter than A and longer than B.
- For them, length seems to be a “sparsely populated continuum”.
- We are currently analyzing the data for grade 4.

How many weights exist between the weight of the larger and smaller ball of clay?



- Almost all third graders believe very few weights lie between A and B (even though A happens to be three times as great as B).
- They seem to believe that for objects to have different weights, they must feel noticeably different.
- We are currently analyzing data from grade 4.