Using quantitative labels to promote children’s patterning skills
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Introduction
This study investigated how the labels used to describe patterns affect children’s understanding of pattern structure.

Background
Early patterning skills have been shown to relate to formal math and reading achievement (see Burgoyne et al, 2017 for review).

Research is needed to identify factors of the environment that improve patterning skills.

Previous research suggests a critical role of language.

Providing abstract letter labels (e.g., calling square-square-circle ‘A-A-B’) increased children’s performance on pattern tasks relative to using concrete labels (e.g., red-red-blue; Fyfe et al, 2015).

Here, we investigate several different abstract labels.

Pattern Abstraction
Children are shown model patterns made with one set of materials (here, black shapes printed on strips of paper) and asked to recreate the structure of each pattern using a different set of materials (here, colored wooden tiles).

Method
Participants: 90 children (M age = 5.4 years; 52% female) participated in a one-on-one session.

Design: Using a between-subjects design, children were taught pattern abstraction in one of four conditions that differed in how the experimenter labeled the model patterns.

Procedure: Children were shown three examples and asked to solve ten pattern abstraction problems (one baseline, seven training, and two posttest) and asked “how is your pattern like my pattern?”

Results
Performance by Condition

No Labels Grouping Letters Numbers

Training Items

Posttest Items

Training performance favored all label conditions.

Posttest performance favored grouping condition.

Children’s use of grouping labels and grouping gestures positively correlated with performance on the training items (rs = .31 and .32, ps < .005).

Types of Labels

The part that repeats in my pattern is...

No Labels Grouping Letters Numbers

this part two-one A-A-B 1-1-2

…because it has two that are the same and then one other that is different.

Examples of correct pattern abstraction:

Frequency of Label Use by Condition

Letters Numbers

No Labels Grouping Letters Numbers

Training:

Correct

Correct

Correct

Correct

Correct

Correct

Correct

Correct

Correct

Posttest:

Pointing

Grouping

Other

Frequency of Gesture Use by Condition

No Labels Grouping Letters Numbers

Pointing

Grouping

Other

Frequency of Gesture Use by Condition

No Labels Grouping Letters Numbers

Pointing

Grouping

Other

Conclusions
Abstract labels aided performance on training problems and grouping labels aided performance on posttest problems on which no labels were provided. Across conditions, evidence from children’s speech and gestures suggests that mentally “grouping” similar elements together (e.g., thinking of a small circle and a big circle as the same) was positively related to patterning performance.

This could be because grouping labels draw children’s attention to quantitative information and reduce cognitive load. Children have also previously been observed to use grouping labels spontaneously (unlike letters and numbers labels), indicating that grouping labels may align better with their intuitive representations of patterns.

The benefits of grouping labels may have practical implications for early mathematics education and interventions.

References

