

Drawing and two-digit numeral learning: An exploration of recognition accuracy and the errors made by preschoolers

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Abstract

Numeral recognition is an important foundational math skill that children learn in preschool. Drawing can improve learning, as it leads to dual-encoding of novel concepts. To explore whether drawing could improve numeral recognition in preschoolers, we compared two groups of 3- and 4-year-olds: one group traced two-digit numerals and one group looked at two-digit numerals. We found that drawing led to higher numeral recognition than looking for both age groups. When we examined children's errors, we found that children in both conditions were more likely to choose the inverted version of the correct number than the single-digit number or the different target number at pre-test, post-test, and delayed post-test.

Background

- Differences in foundational math abilities, such as numeral recognition, can lead to lower math achievement in elementary and high school (Duncan et al., 2007).
- Drawing concepts can improve processing and retrieval of concepts through dual encoding. When concepts are drawn, this leads to the formation of verbal and non-verbal representations (Van Meter & Garner, 2005).
- Preschoolers that hand-wrote letters had higher letter recognition than preschoolers that searched for those letters on a keyboard, which suggests that drawing can be used to improve recognition in preschoolers (Longcamp et al., 2005).

Research Questions

- Can tracing be used to improve numeral recognition in preschoolers?
- When children choose the incorrect number, which one are they most likely to choose?

Participants

77 preschoolers aged 36-57 months ($M = 47.7$ months, $SD = 6.5$) participated.

There were 40 boys and 37 girls.

There were 33 three-year-olds and 44 four-year-olds.

Procedure

Pre-Test

All children were shown cards with four numerals and asked to point to the numeral being named (see *Figure 1*). Each card contained one of the nine target numerals (i.e. 63), the inverse of that numeral (i.e. 36), a different target numeral (i.e. 27), and a one-digit numeral (i.e. 5).

Drawing/Looking Task

Children in the **drawing condition** traced dotted versions of each numeral from the target set (see *Figure 2*).

Children in the **looking condition** looked at pieces of paper depicting each numeral from the target set.

Post-test/Delayed Post-test

All children completed the same numeral recognition task after drawing or looking, and a 48 hour delayed post-test.

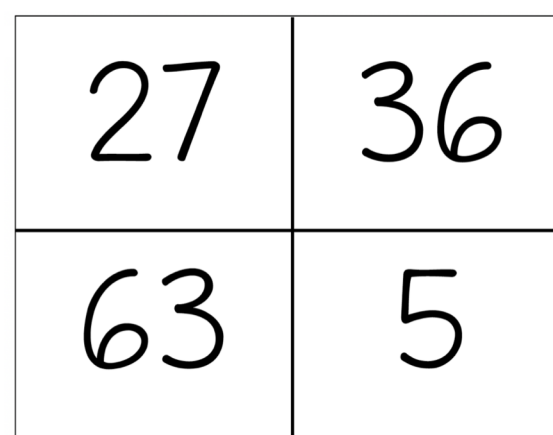


Figure 1. Example test card used in pre-test, post-test, and delayed post-test for target numeral 63.



Figure 2. A child's tracing of the numeral 63 from the drawing condition.

Analyses

Recognition Accuracy: The percentage of numbers identified correctly was calculated at pre-test, post-test, and delayed post-test

Errors: The percentage of each type of error (inverse of target, single digit, and different target) was calculated out of all errors made at pre-test, post-test, and delayed post-test

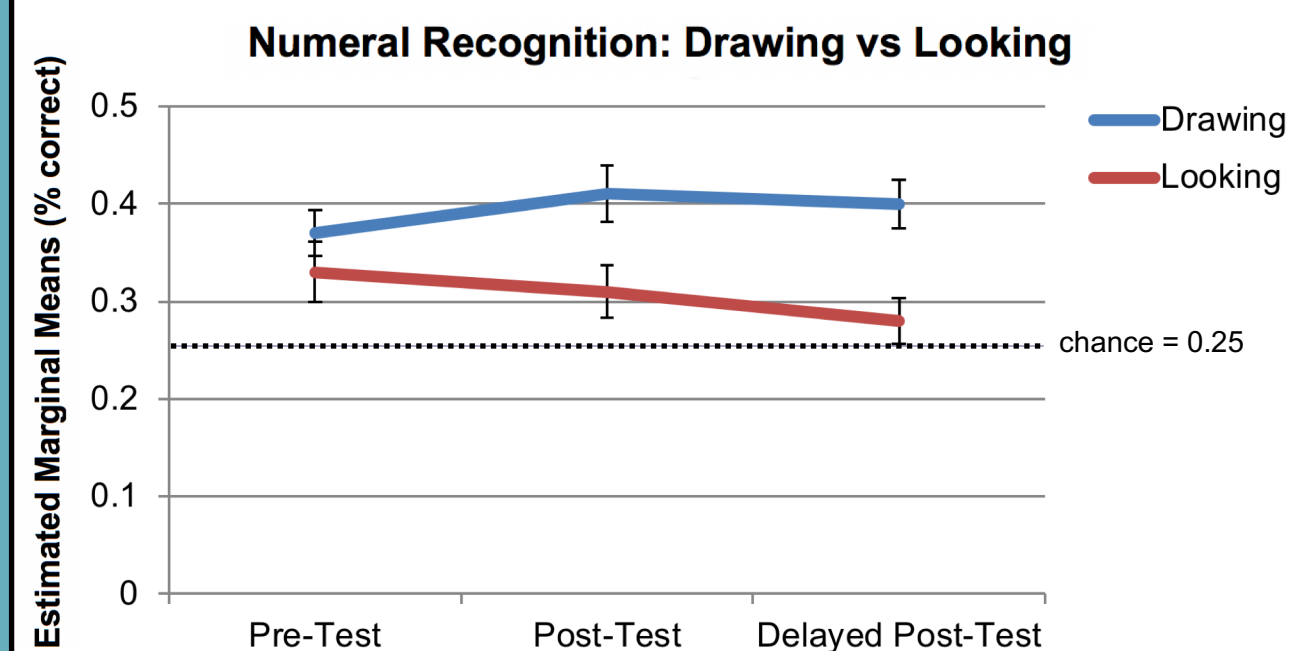
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Results

Recognition Accuracy

Children in the drawing condition had higher recognition accuracy than children in the looking condition at both the post-test ($p = .031$) and delayed post-test ($p = .032$).



Errors

Pre-test: Children were more likely to choose the inverse of the correct numeral than the single digit numeral ($p < .001$) or the different target numeral ($p < .001$). Three-year-olds were more likely to choose the single digit numerals than four-year-olds ($p = .009$).

Post-test: Children were more likely to choose the inverse of the correct numeral than the single digit numeral ($p < .001$) or the different target numeral ($p < .001$).

Delayed post-test: Children were more likely to choose the inverse of the correct numeral than the single digit numeral ($p < .001$) or the different target numeral ($p < .001$).

Conclusion

Tracing numerals led to higher numeral recognition than looking at numerals, but there were no differences in error types by condition. This indicates that tracing can affect processing and improve recognition and that drawing can be used to improve numeral recognition in preschoolers. Drawing could be used as a tool to improve STEM learning in preschool classrooms.

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