Effects of playing with concrete objects on symbolic understanding of numbers

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Abstract

Concrete objects such as magnetic numbers and Cuisenaire rods are often assumed to facilitate children's mastery of the number system. Yet, this assumption remains largely untested and the available findings provide mixed evidence. To test when, how and why concrete objects contribute to children's symbolic development, we pre- and post-tested 36 children (46-50 and 52-56 months) on knowledge and understanding of numbers. In between the pre- and post-tests, the experimental group played games with concrete numbers and the control group played the same games with other materials. Our results show that "playing" with concrete objects doesn't offer any advantages in symbolic development. Yet, using concrete objects as symbols confers an advantage in symbol use.

Motivation

Mixed empirical evidence regarding manipulatives:

•Children can learn to solve arithmetic problems using manipulatives (Resnick and Omanson, 1987)

BUT…

• Meta-analyses fail to show a significant effect of manipulative use in the classroom (Sowell, 1989)

Divergent theoretical predictions:

• According to dual-representation hypothesis (DeLoache, 2000), playing with concrete objects wouldn't help because children would focus on the object in its own right and not on the referent

BUT…

•Symbolic knowledge can be transferred from one symbol to the other (Marzolf & DeLoache, 1994)

The Study

Participants:

• 36 children (21 female, 15 male)
• two age groups: 46-50 months and 52-56 months

Experimental Design:

Session 1 (day 1)	Pre-test
	Play
Child plays at home	
Session 2 (day 8)	Play
Child plays at home	
Session 3 (day 15)	Post-test

Measures:

• TEMA (Test of Early Mathematics Achievement)
• Tests of number knowledge:
  •number recognition task
  •counting task
• Various tests of symbolic understanding

The Study (cont'd)

Play Activities:

Children played 10 different games. Experimental group used toy numbers, control group used other materials.

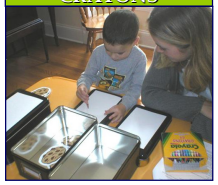
Sample play activities	
EXPERIMENTAL	CONTROL
Number Tower	Tower with blocks
Number Jewelry	Jewelry with beads
Play-Doh Numbers	Play-Doh shapes
Magnet Pictures	Pictures with magnets

Box Labeling Task:

• Our main symbolic task
• Children are asked to represent number of cookies in a box using crayons and magnets

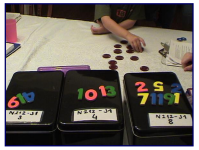
Box Labeling Task MAGNETS

Box Labeling Task CRAYONS



Results

CODING – BOX LABELING TASK

CATEGORY	MAGNETS	CRAYONS
Symbolic		
Analog		
Non-symbolic		

Results (cont'd)

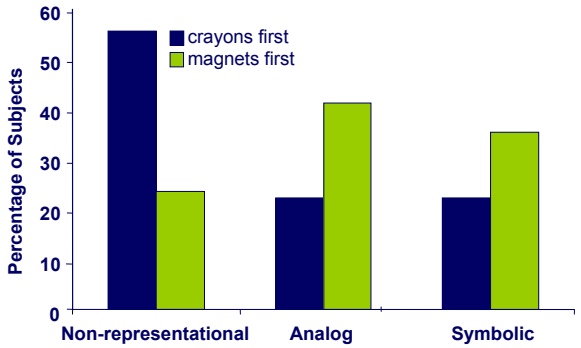
NO EFFECT OF PLAYING with numbers on:

• TEMA score
• numbers correctly recognized
• number up to which child can correctly count
• any symbolic task

BUT A TRANSFER EFFECT in the Box Labeling Task:

• Children who used magnets first were more successful with crayons:
  • they produced less non-symbolic representations with crayons
  • they produced more analog representations

GRAPH: Order Effect on Response Type in the Crayon Task



Conclusions and Implications

• Concrete objects can facilitate symbolic development by providing an inroad to representation when they are used as symbols
• But just playing with concrete objects doesn't seem to help (or hurt)
• Parents can play symbolic games with their children to help their children

References

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