University of Maribor

How sixth graders' represent mathematics concepts with drawings

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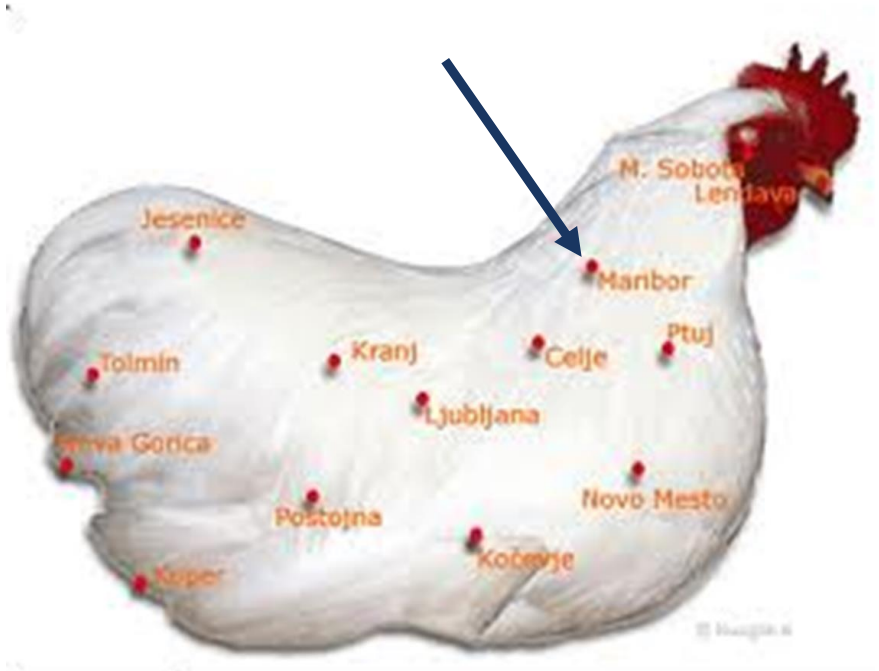
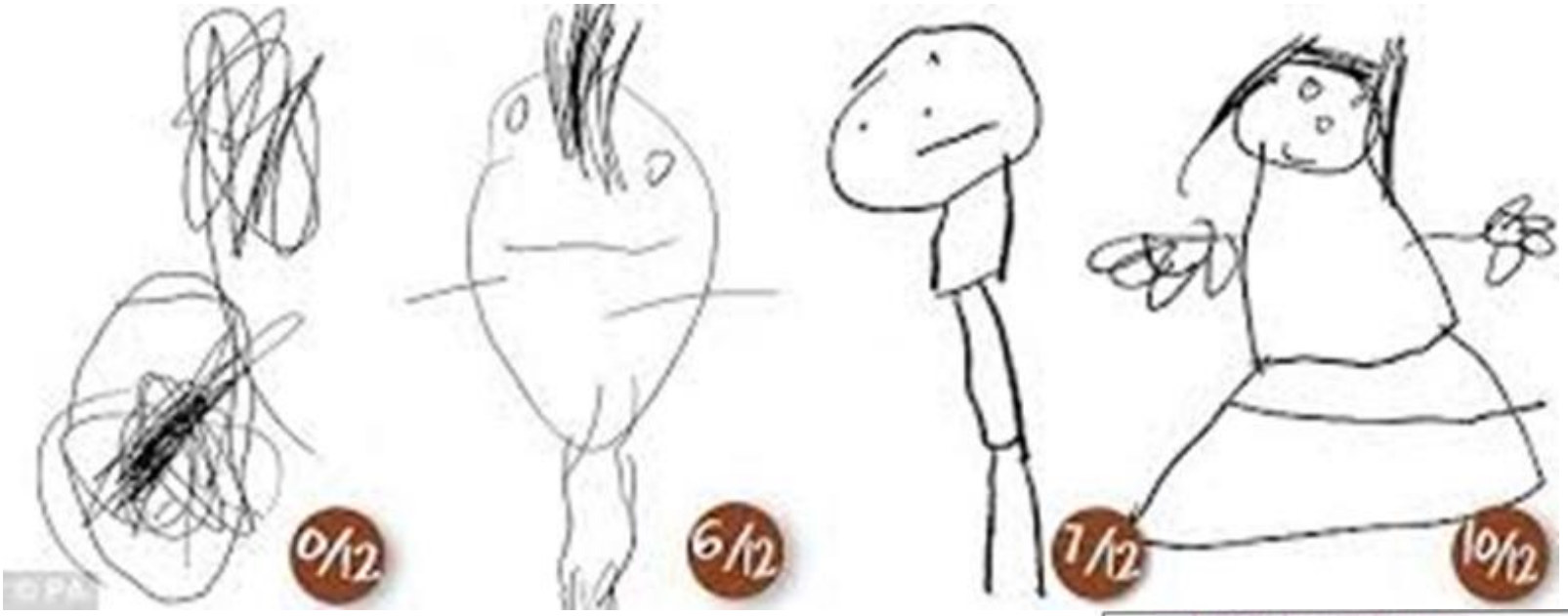
University of Maribor

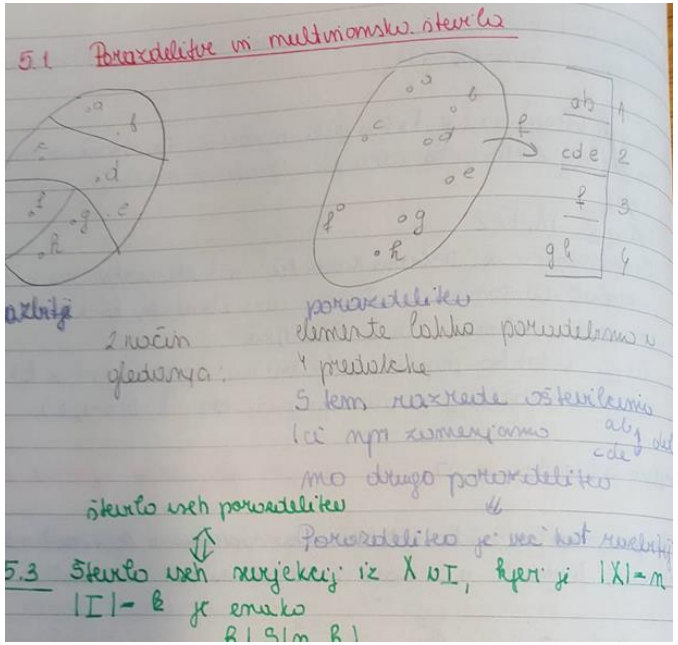


Drawings



External are the interesting ones!

Enactive/**iconic**/symbolic (Bruner, 1966)



$\sqrt{-1}$ 2^3 Σ π

and it was delicious!

Relevance for education

Very important (Bishop, 1973; Clements, 1981; Arcavi, 2003; …. Duval, 2014, …Presmeg, 2020)

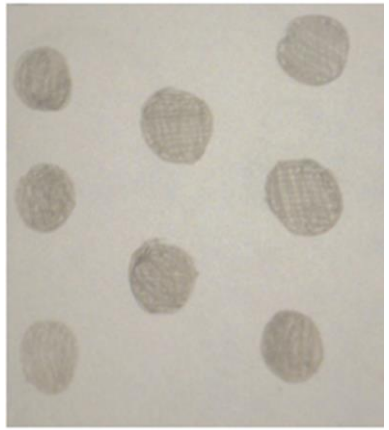
Positive effect on achievement, teachers should use them more often (Güler & Çiltaş, 2011; David & Tomaz, 2012; Ryve et al., 2013; …).. No influence on achievements (Sowel, 1989). Can have negative impact on achievments (De Bock et.al., 2007; Presmeg, 2014). ICT environments (Archer et al., 2014; Engelbrecht et al., 2020) Effect depends on students ablities (Gersten et al., 2009) ,content (Leikin et al,. 2014), age (English, 1993 vs. Beitzel et al., 2011), gender (Lowrie & Diezman, 2011)

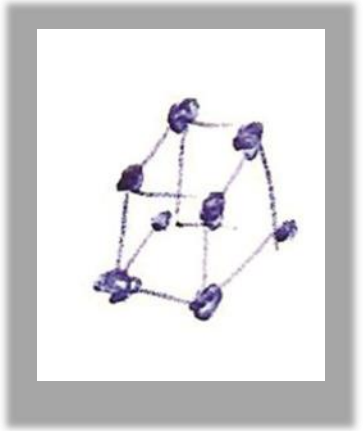
Strongly researched field, but mostly: a) picture as a medium for teaching and b) drawing as a problem-solving tool.

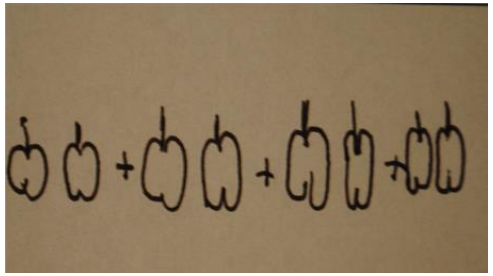
Can children's‘ *self-designed drawing* serve as a research tool for insight into child's *mathematical understanding*?

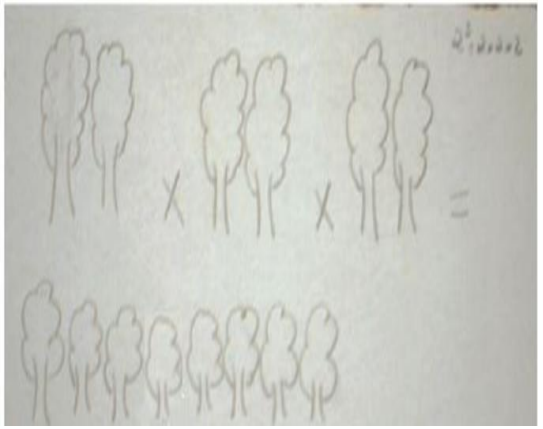
Draw a picture representing

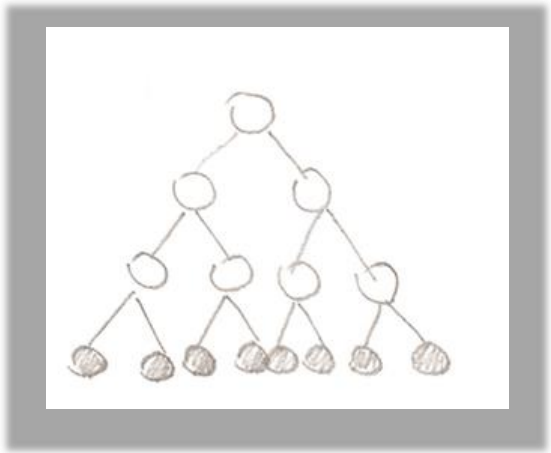
$$2^3$$

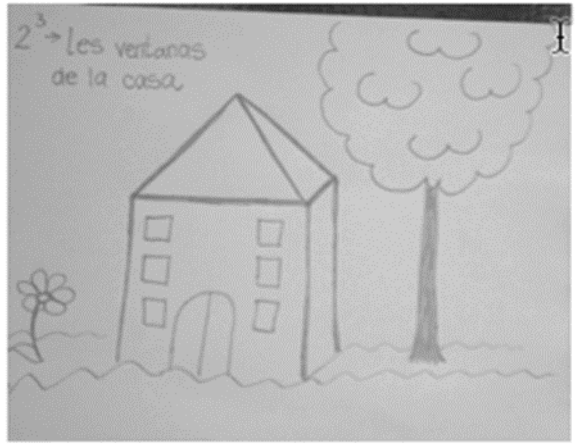


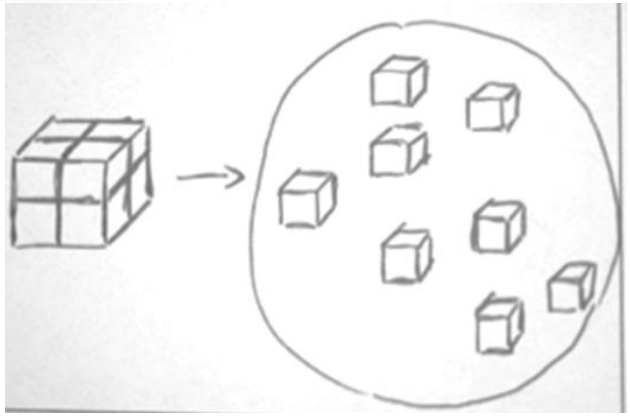


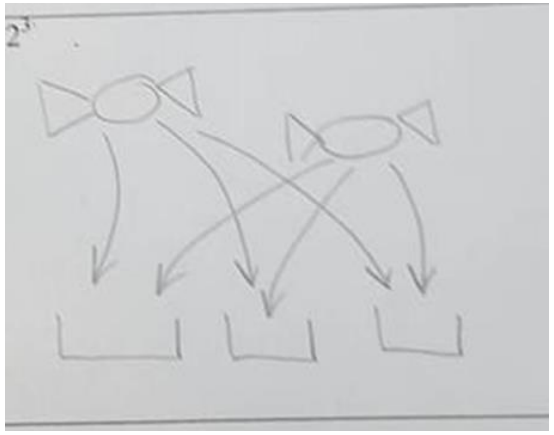


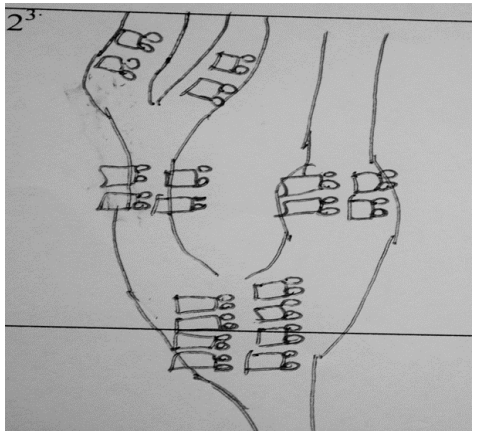

2³ árboles

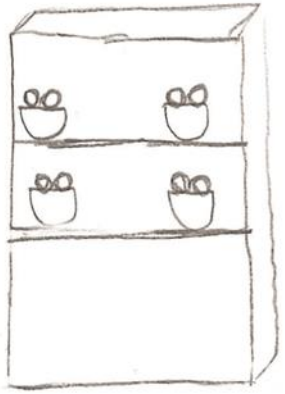


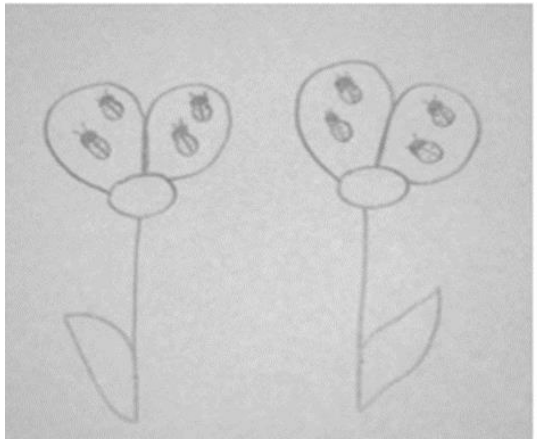

2³ → les ventanas
de la casa



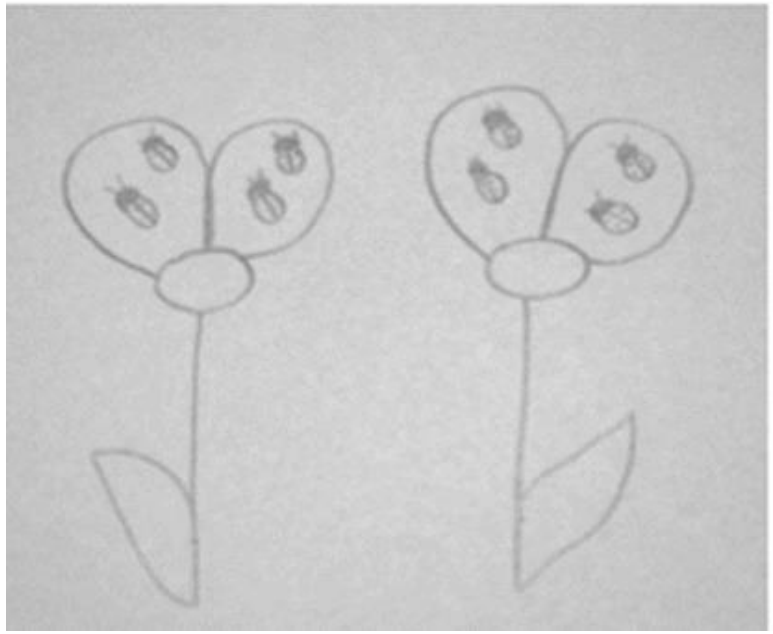

2³


2³





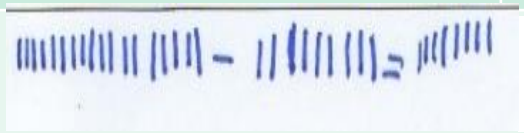
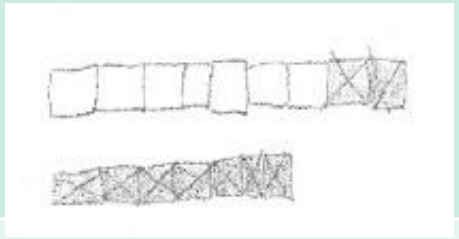
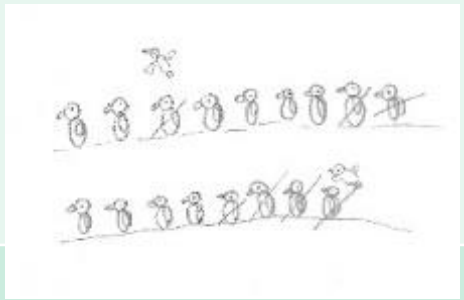
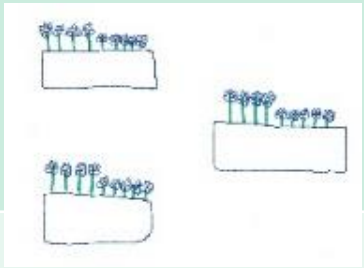
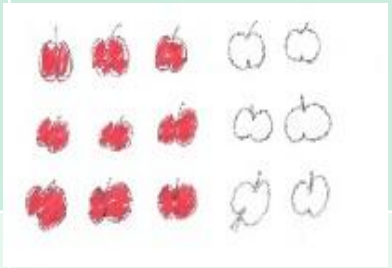
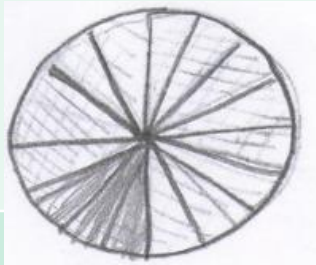
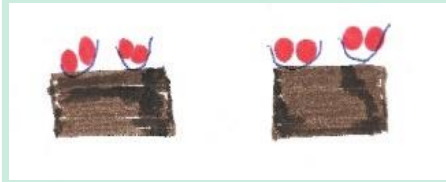
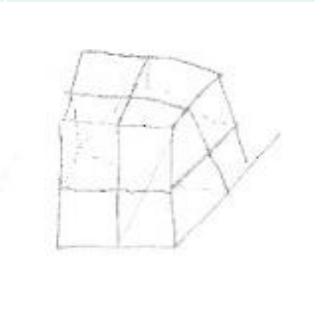
Research problem



‘For a math teacher, there is no real difference between a visual representation of a concept and the visualisation process of making sense of that concept. For students, however, there is a gap that some are unable to bridge. **Students simply do not see what the teacher sees.'** (Duval, 2014, p. 160).

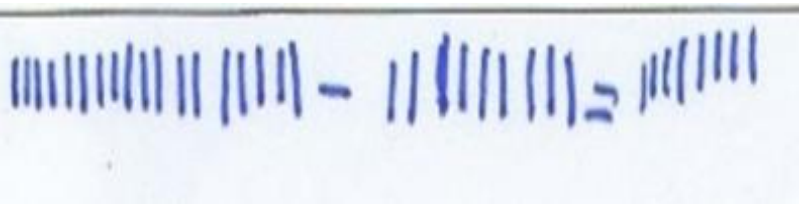
$17 - 9$ $3 \cdot (4 + 5)$ $\frac{3}{5}$ of 15 2^3

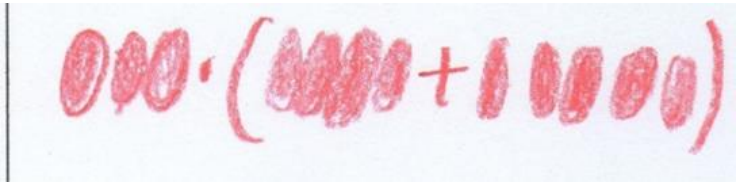
Future teachers, elementary	Slovenia Slovakia Spain	N = 288
16-17 years, gymnasium	Slovenia	N = 147
11-13 years	Slovenia	N =1595
5-7 years	Slovenia	N = 192

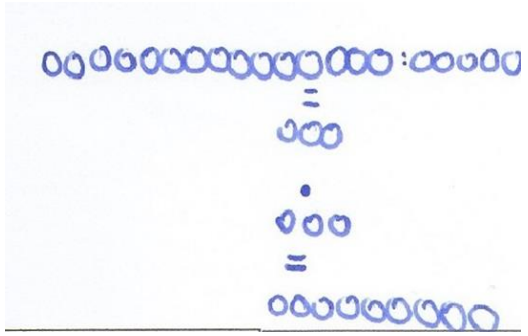
Theme 12-13 years	categories	codes			
		subtraction	paranthesis	fractions	power
Procedural	Result-symbol	8	27	9	8
	Result-picture	8 objects	27 objects	9 objects	8 objects
	interplay				
conceptual	relations	 	 	 	  
Not known	ilustration				

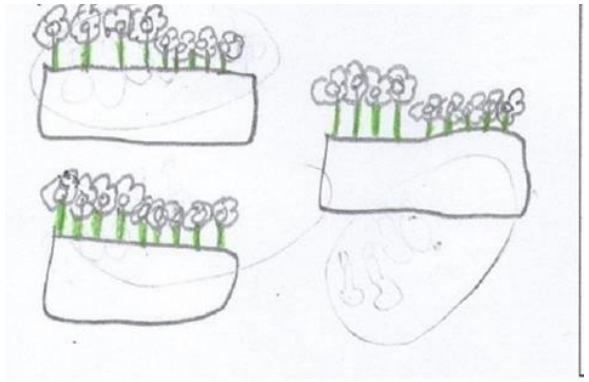
Instrumental /relational understandng (Skemp, 1976)

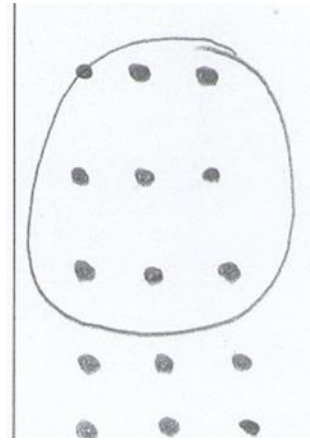
→ Procedural /conceptual type of knowledge (Rittle-Johnson & Siegler); critique (Ainley et al., t, & Hansen, 2006)

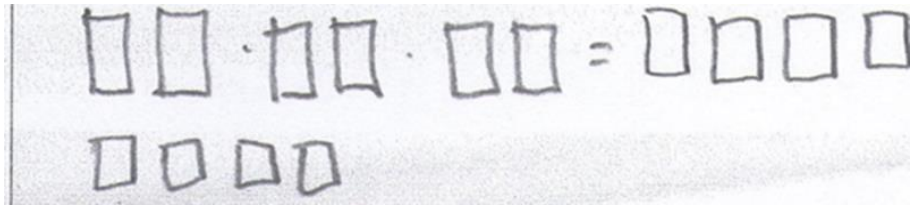




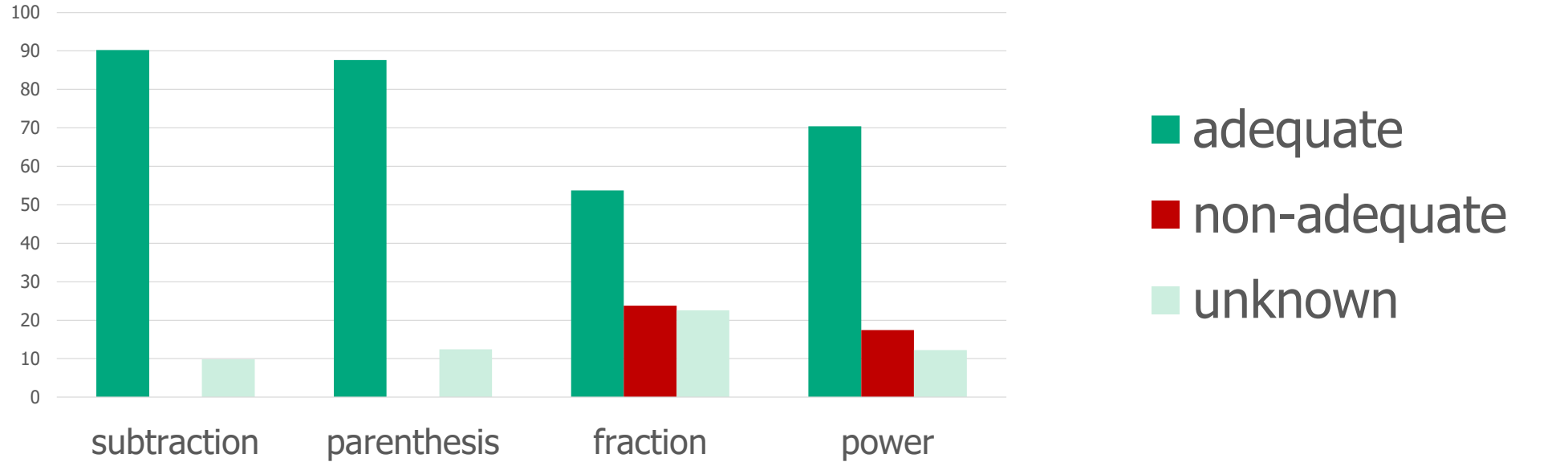


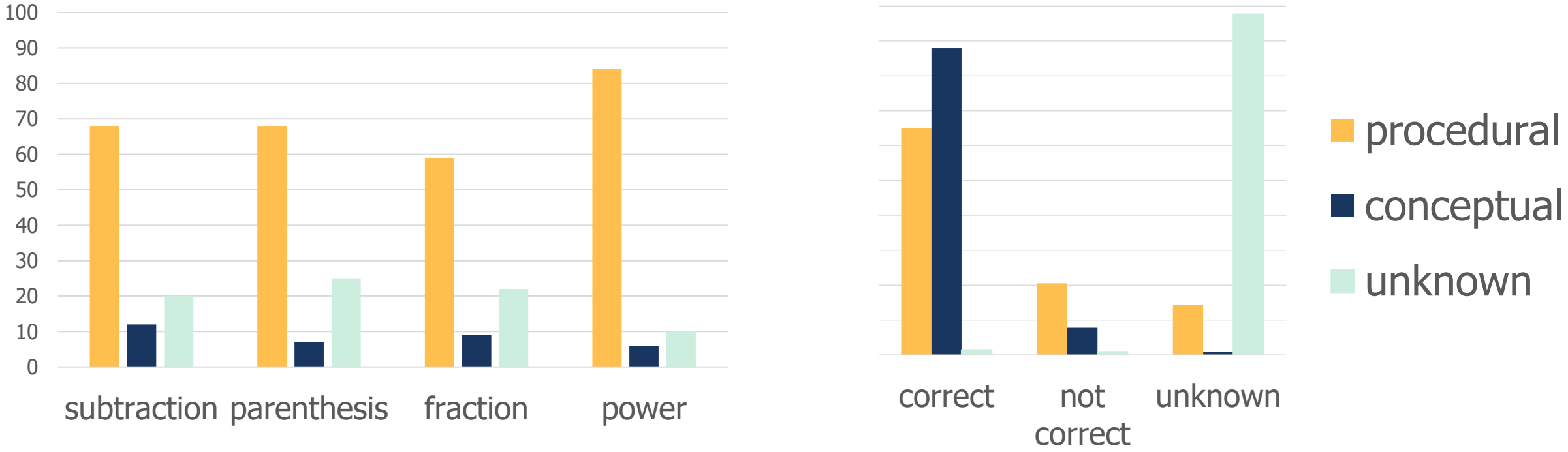


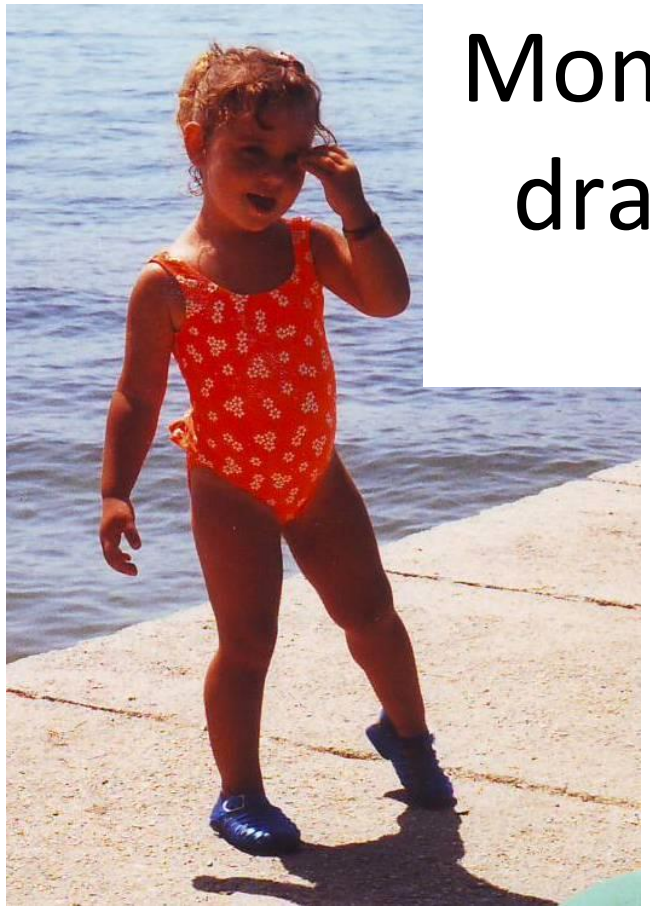




Quantitative







Mommy, please draw a puppy dog.

Mommy, why did you draw a piggy?

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