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“Two Children Found Four Caterpillars”

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AAAL/ March 27, 2012
Boston MA

Is that…

Distributively and/or Collectively?

Does it make a difference for children's math? How?

Collective and Distributive (Vendler, 1967)

A	B		
			

Which is it?!

Is one better than the other?

All the flowers are in a vase.

Three flowers are in a vase.

Every/ each flower is in a vase.

Starting point--

- The semantic, syntactic, and pragmatic properties of quantifiers are not well-fixed for children.
- How do they sort them all out?
- What happens while they're figuring them out?

Acknowledgments

- Much of this work was done in conjunction with the DELV Project National Institutes of Health (NIDCD) Contract #N01 DC8-2104 to Harry Seymour, Principal Investigator at the University of Massachusetts Amherst, with Thomas Roeper and Jill de Villiers at UMass and Smith College as co-investigators for the *Diagnostic Evaluation of Language Variation-DELV tests (2003, 2005)*

- Some of the materials and conceptualization during a stint at the University of Wales, Bangor –

Canolfan ESRC Centre
dros Ymchwil i Ddwyieithrwydd
for Research on Bilingualism

- Margaret Grace (B.A., 2010) helped with the child participants

Plan of today's talk

1. Brief background on implicit semantic properties of words telling about quantities ("how many," numbers, "some"), especially wrt **collectivity** and **distributivity**
2. The role of specific markers of distributivity (and collectivity): "each" and "together"
3. Developmental trends
4. Impact on some simple math problems

(This is in L1.We're moving toward cross-linguistic analyses, and have a few comparisons, but we're not there yet.)

Early experience with the collective & distributive

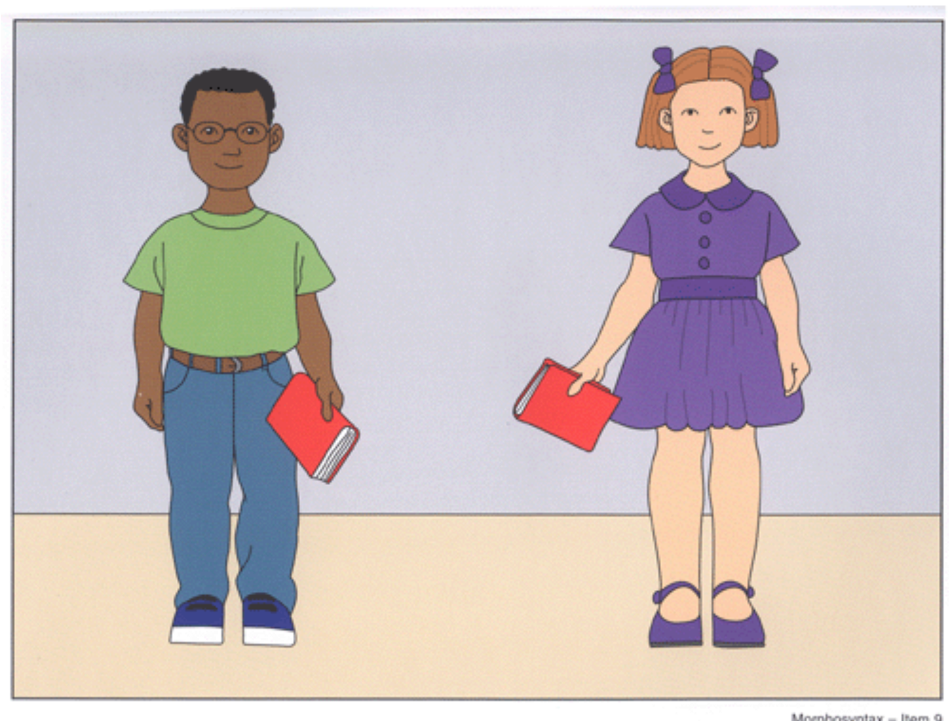
- Child learns lexical items very early "all gone" (collective)
- They learn 1 to 1 counting (very distributive)
- ?How learn implicit (or possibly context-driven) properties?

“Baselines” or Biases

Before testing the math,
explore responses to
Neutral,
Distributive Bias, &
Ambiguous
examples

Neutral

How many books do the children have?



On *DSLT* (Seymour, Roeper & de Villiers, 2000)

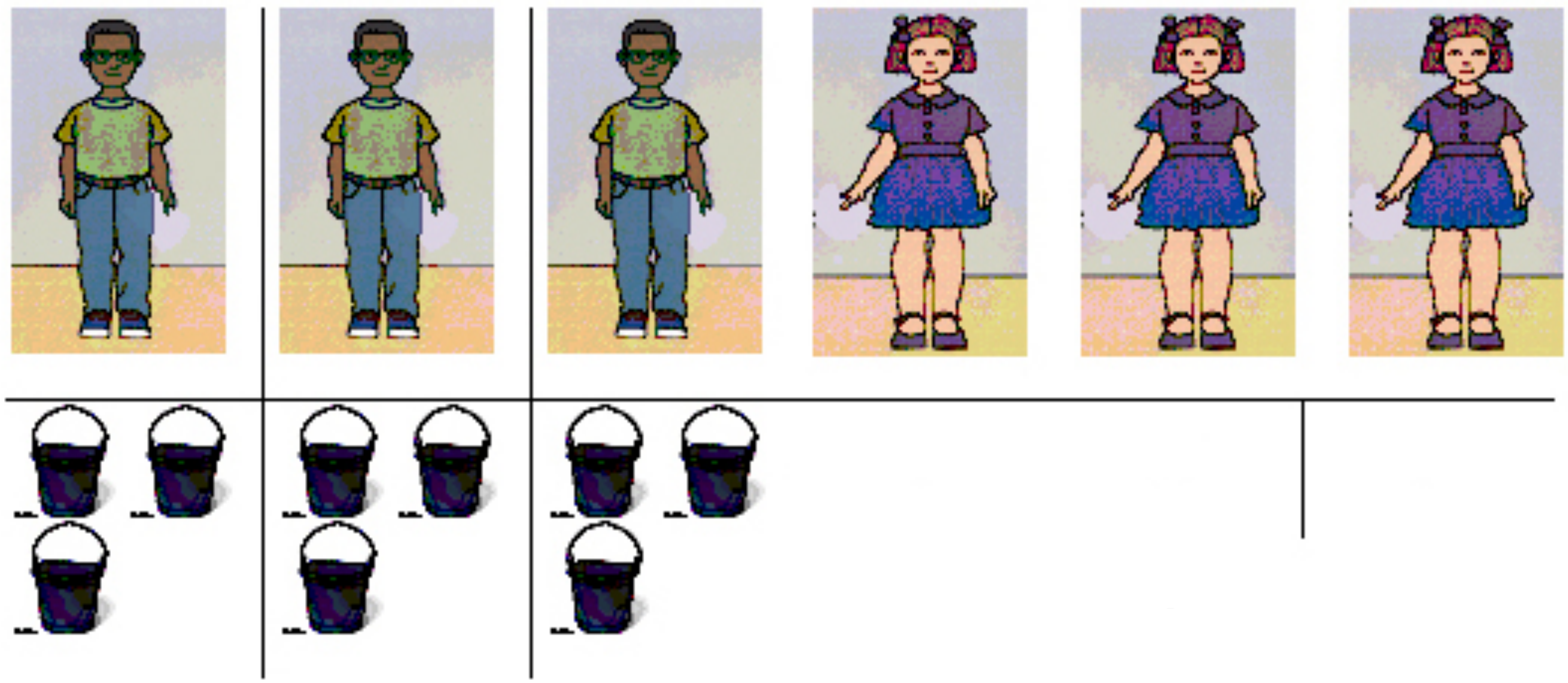
Body parts, distributive bias

How many hands do the children have?

Do the boys have two hands or four hands?

i.e. Is that *each* (distributed) or *all together* (collective)?

Intentionally ambiguous!



- Every boy has 3 buckets, and these girls have one bucket.

Is that one bucket for each girl? Or one in all?

Design

- 2 groups: L1 (English) adults and children

- Adult data from websurvey
- http://www.kwiksurveys.com/online-survey.php?surveyID=OIHKG_7f21b1b7

- Children (ages 3-10) tested with PPT adaptation of the survey, individually at their schools

L1 Adults	L1 children
33	54

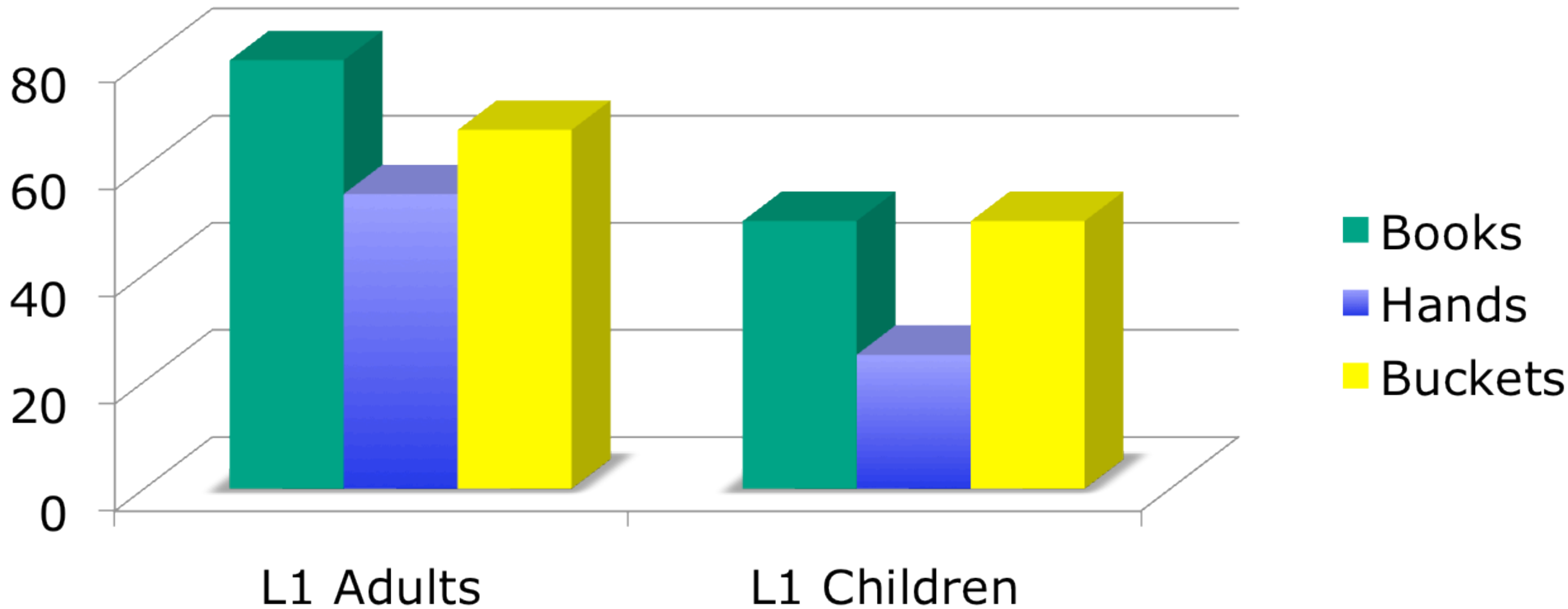
Collective or Distributive Responses by Group by Condition

% collective responses

	L1 adults (n = 33)	L1 children (n = 56)
Neutral (books)	80%*	50%
Distributive bias (hands)	55%	25%
Ambiguous (buckets)	67%**	50%

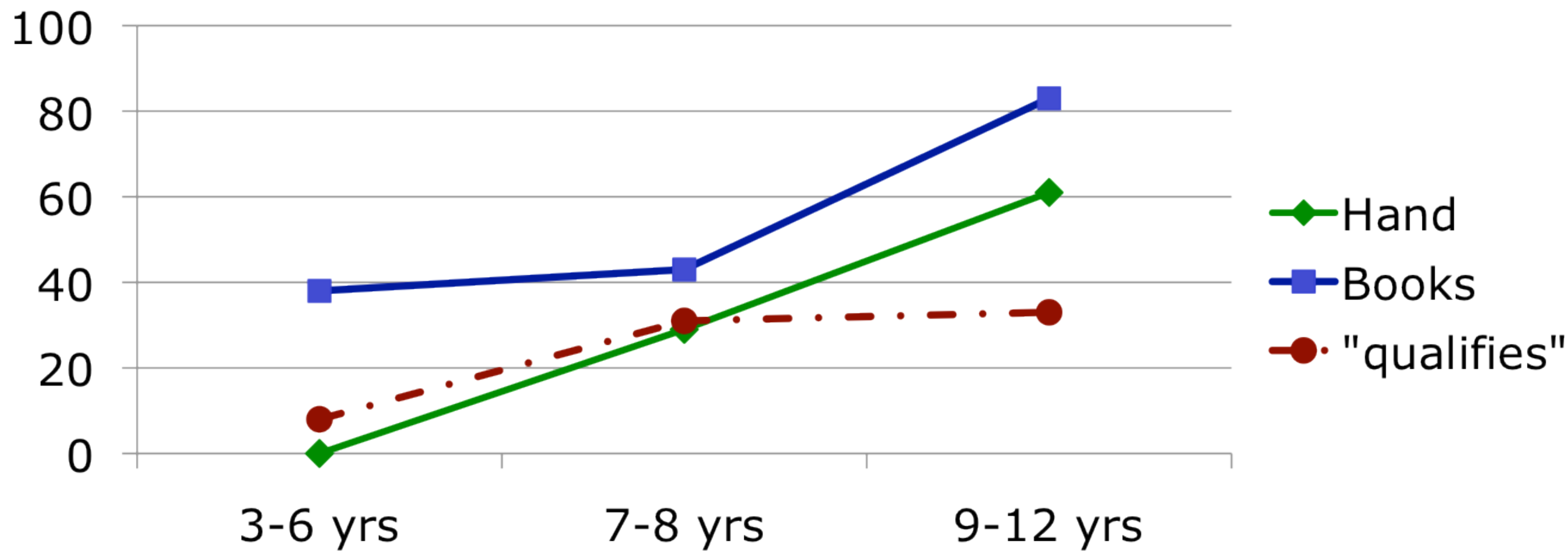
*25% give explanations in terms of needing “each” or “together” (6% of children also commented.); **some wanted to be parallel to first part of sentence.

Percentage of Collective Responses by Group



- Hands, as expected, more distributive than other objects for both groups
- Books & buckets: 5:2 said I need "each" to distribute vs. needing "together" for collective
- (Note: L2 adults required more explicit markers ("each"/ "together")
- Children 50:50 haven't established preference (except hands).

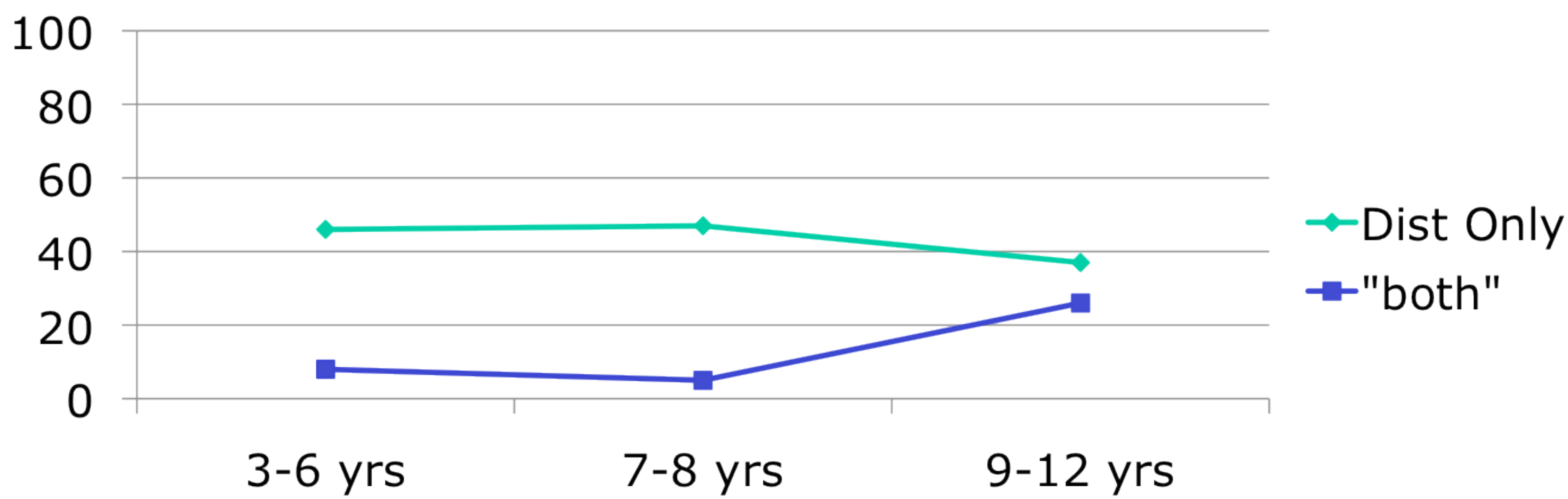
Percent Collective Responses by Age



- Age trend, older children more like adults
- "Qualifiers" – by 7 years realize that they can't assume distributive or collective, and are more likely to say (not assume) "each" than "together"

Ambiguous Buckets

- Cf Adults 67% collective



Explaining is still hard

- “One for everybody” (reason for distributive)
- “*these* equals *all”* –one for all (but means each)

- “plural girls equals plural buckets”

- *Clearer:* “ one to share”; “all have their own”
- Collective reasons: “Doesn’t say *each.”*

(i.e. if you mean to distribute, you have to say each).

Markedness? Bias?

- More people requiring “each” to distribute

- Smaller number who required “in all” not to.

- Sounds like collective is the default (?),
- but kids need to learn it.

- *Might be language-specific*
- *L2 close to L1 English, but were much more likely to require explicit direction to distribute (e.g. 8/8 Asian)*

Back to practical interest : 2 children found 4 caterpillars?

How many did each child find?

How many altogether?

Two children found 4 caterpillars.

Two children (together) found four caterpillars (together)

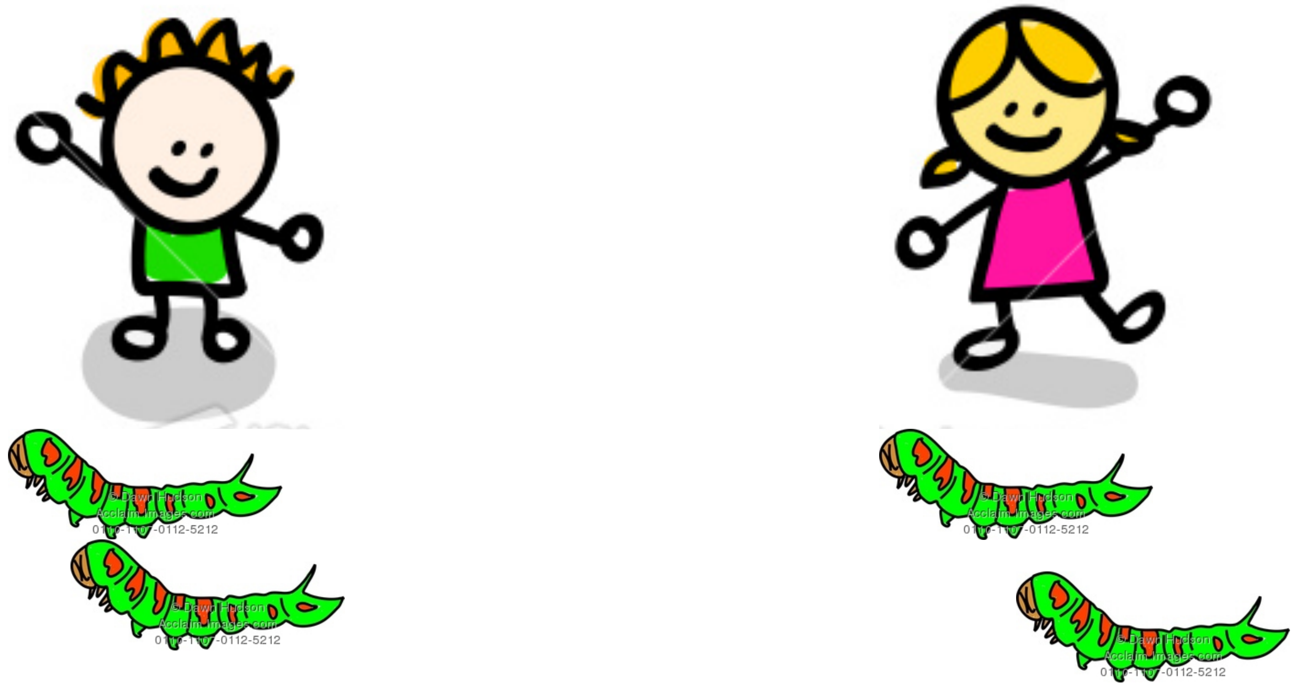
Collective/collective - CC

Two children found 4 caterpillars.

Two children (each) found four caterpillars (each)

Distributive/distributive - DD

Two children found 4 caterpillars.



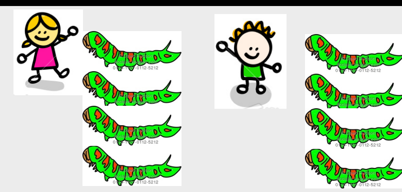
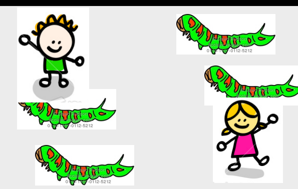
Two children (each) found four caterpillars (together/ in all)

Distributive/Collective - DC

Math translation: how many did each child find?

CC (together/together) Collective children/ collective caterpillars “Yes” (No operations)	(CD??)
DC (each /together) Distributive children/ collective caterpillars Divide. (=4/2)	DD (each/each) Distributive children/ distributive caterpillars Add (or multiply) (=4*2)

Results

Age	Coll/coll	Dist/Dist	Dist/Coll	Other
				
3-4 years N = 10	67%	8%	8%	17%
5-6 N = 12	31%	15%	15%	32%
7-8 N = 22	< 5%	14%	64%	10%
9-10 N = 10	< 5%	33%	55%	11%

Textbook answer

In summary:

How many did each child find? How many altogether?

- Older kids, a significant minority (1/3) added (Dist/dist)instead of dividing (Distrib/Collect). Get a different answer

- Younger kids especially gave collective/ collective (kids together found 4)

  - How can they ignore "each" in the question? (What if "each" means "all", as one child said? Or see Roeper et al. 2011, "each" not strongly distributive at the younger ages)

A	B	C
		

All the flowers are in a vase.

Every flower is in a vase

Each flower is in a vase.

Each versus *Every*—with flowers

Every	All OK	A best	B best (1-1)	C best	Reject B
L1 Adults	94%	21%	36%	18%	0
LI children	2%			60%	

Each	All OK	A best	B best	C best	Reject B (1-1)
L1 Adults	17%		90%		0
LI children	2%	24%	26%	32%	62%

For large percentage of children,
it was not about flowers—it was about VASES.

Each and every elicited same kinds of explanations

A	B	C
		

"[C], it's the only one with flowers in every vase." (9;4)

- "all vases are full" (8)
- * "not A or B, no flowers in those two vases" (6;2) (7;8)
- "No, they don't have flowers in all vases." (9)
- Key fact for children seemed to be exhaustivity, not individuation.

Pragmatics?? More real-world knowledge

- Decisions about whether to distribute or not based on the object involved:

Four people bought a dozen cookies for $12.

Did each person spend $12?

Four people bought a dozen roses for $3.

Did each person spend $3.

Same grammar, different decisions

	Split cookies?			Split flowers?	
	N	Y		N	Y
All	14	40		28	26
Non-native	3	12		6	9

Only one person didn't split the cookies but split the flowers. Twice as many people would not split the cookies but would split the flowers. Gave reasons based on normal cost of the objects.

What does it tell us?

Semantic (and possibly pragmatic principles

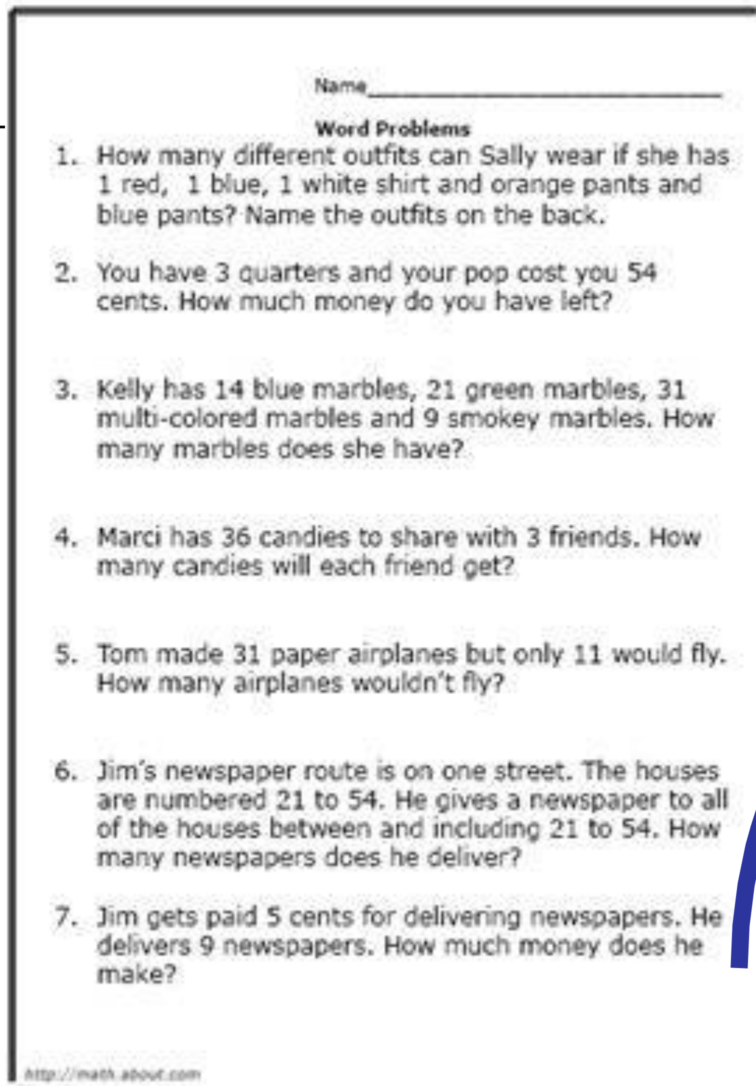
in addition to math facts,

must be learned (or taught) to help children arrive at the textbook response.

For L1 speakers. Even more perhaps for L2, or English-language learners.

Are these unusual questions?

Are children likely to encounter them in class, in tests, in real life?



Name_________________________

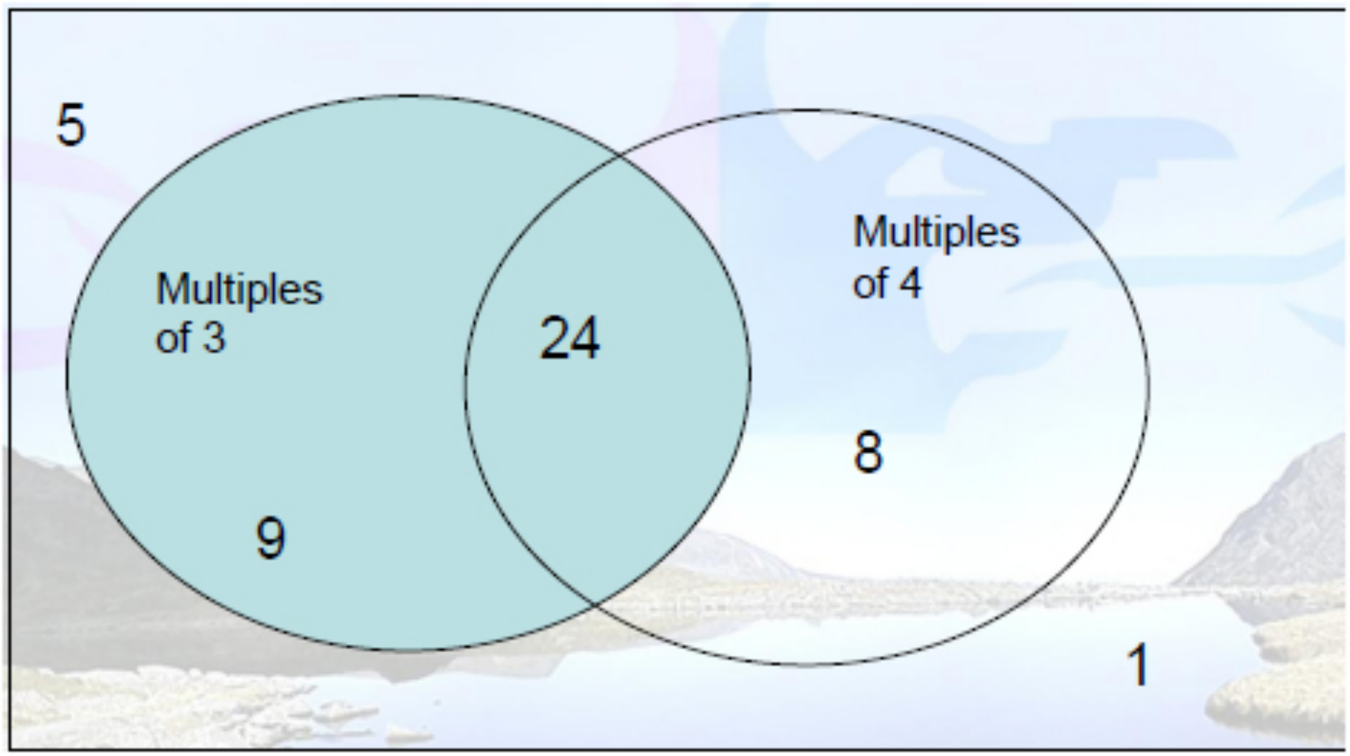
Word Problems

1. How many different outfits can Sally wear if she has 1 red, 1 blue, 1 white shirt and orange pants and blue pants? Name the outfits on the back.
2. You have 3 quarters and your pop cost you 54 cents. How much money do you have left?
3. Kelly has 14 blue marbles, 21 green marbles, 31 multi-colored marbles and 9 smokey marbles. How many marbles does she have?
4. Marci has 36 candies to share with 3 friends. How many candies will each friend get?
5. Tom made 31 paper airplanes but only 11 would fly. How many airplanes wouldn't fly?
6. Jim's newspaper route is on one street. The houses are numbered 21 to 54. He gives a newspaper to all of the houses between and including 21 to 54. How many newspapers does he deliver?
7. Jim gets paid 5 cents for delivering newspapers. He delivers 9 newspapers. How much money does he make?

http://math.about.com

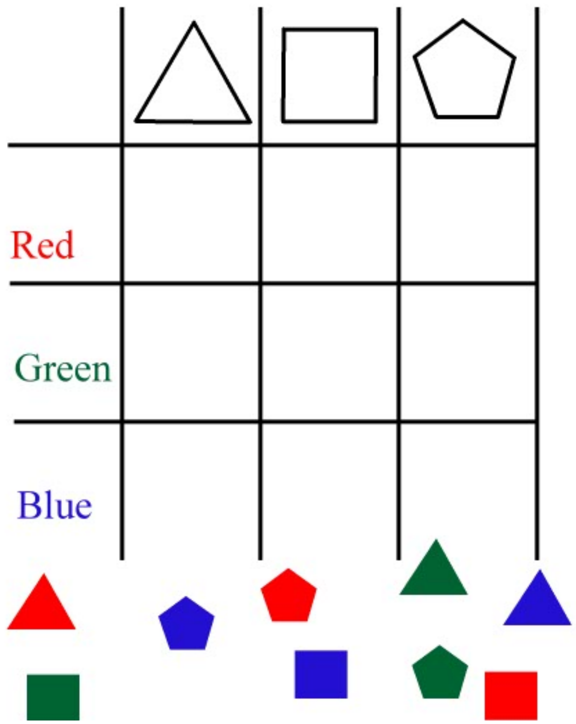
Jim gets paid 5 cents for delivering newspapers. He delivers 9 newspapers. How much money does he make?

"Give me a number that goes in each of the spaces in the diagram."



We asked, "how many numbers are being asked for?"

(How many spaces? Same or different? makes a difference in how hard it is to answer) http://www.k6-geometric-shapes.com/sorting-worksheets.html



Liu is separating the figures below according to their properties. So far, he has made two different groups. List at least 3 figures that could go into each group. Explain what all the figures in each group have in common.

Among the ambiguities in the item is the instruction that [some] figures "could go into each group." Is that one group per figure, or a single figure that could go into either group? Do all the figures have something in common regardless of group, or only by group?

Another wrinkle

Distributivity interaction with syntax

Distributivity of subject allowed (but not required) in simple sentence, but

is Blocked from entering embedded clause.

Example 1 – Different constraints under embedding

- *In our hospital, a nurse cares for every patient.*
- (say there are 100 patients)
- How many nurses are there? (you can give a number or a range)

Embedding example – con’t

- In our hospital, a nurse wants to care for every patient.
- (say there are 100 patients)
- How many nurses are there? (you can give a number or a range)
- Say why.

Native speaker pattern (adults)

People didn’t like the idea of one nurse for 100, but typically said

a) could be any number of nurses, but

b) had to be just one

25 of 33 (76%) restricted distributivity when embedded

Non-native speakers, > half, no clue

16 of 31 (51%) got the distinction

9 made no distinction between the sentences

3 said “it doesn’t say”

3 said “at least one” for the last sentence.

(What does “at least one” mean--when the answer is 1?) to me, could be more, but not less—but I’ve learned not to assume it means for others what I think it means

Summary

QUANTIFIERS – are a real challenge

Each vs all together

Every vs each

Where do they fit in sentences?

- How do they derive or change meaning according to the syntax of the sentence or pragmatics of the situation.

- How do we learn them?
- (or “unlearn” them)?

Lots more questions

- Lots more phenomena
- Lots more language groups.
- Do the survey (especially non-native English speakers).
  - http://kwiksurveys.com/online-survey.php?surveyID=OIHKG_7f21b1b7

<stop here>

Stop here?

Questions??

Please send example problems to
bpearson@research.umass.edu
(Roeper@linguist.umass.edu)

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