Integrating Critical Literacy and Critical Numeracy in K- 8 Classrooms

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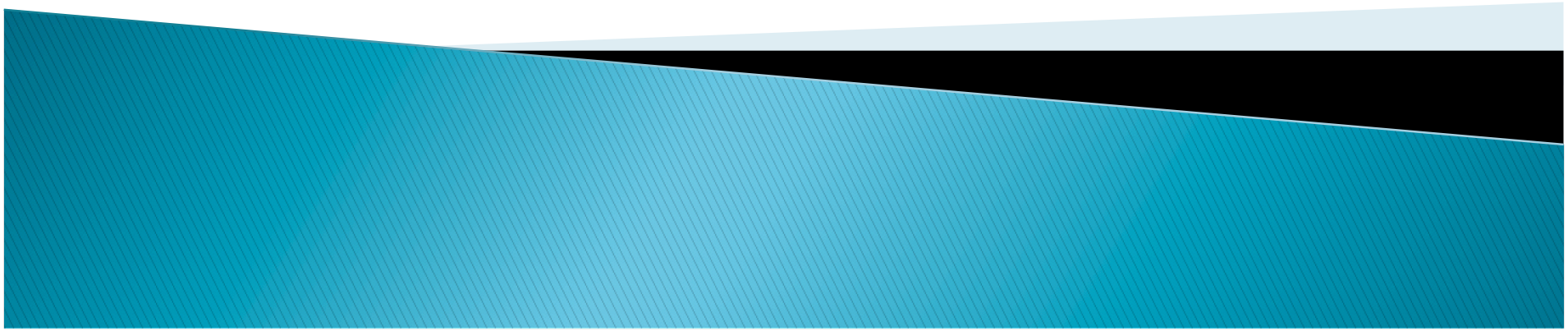
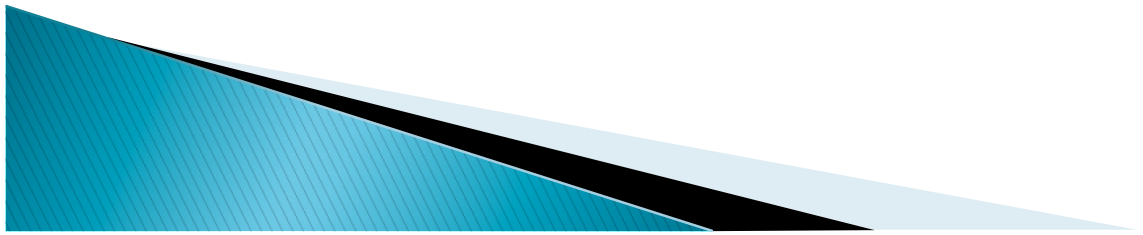
Joint Statistical Meetings

August 1, 2011



A Call for Statistical Literacy in Elementary Mathematics

- NCTM's *Principles and Standards for School Mathematics* (2000)
  - Sections on K–2 and 3–5 Data and Probability
  - Little emphasis on critical disposition
- ASA's *Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report (*2007)
  - Main audience is grades 8–12 teachers
  - Emphasis on a "healthy dose of skepticism"



Incorporating Critique in Data-related Instruction

- Begins with young children (preschool – grade 3)
- Expands throughout elementary school
- Involves all content areas: social studies, science, mathematics, health, reading

What are Features of a Critical Disposition?

- A skeptical stance involves an understanding that data texts are human constructs, and that:
  - Data is the result of choices people made;
  - There are limits to any data display;
  - Even “authoritative” sources can be questioned, interrogated and challenged.

Literacy Principles for Instruction

- Reading and writing are related.
- New knowledge builds on the familiar.
- Reflection builds understanding.

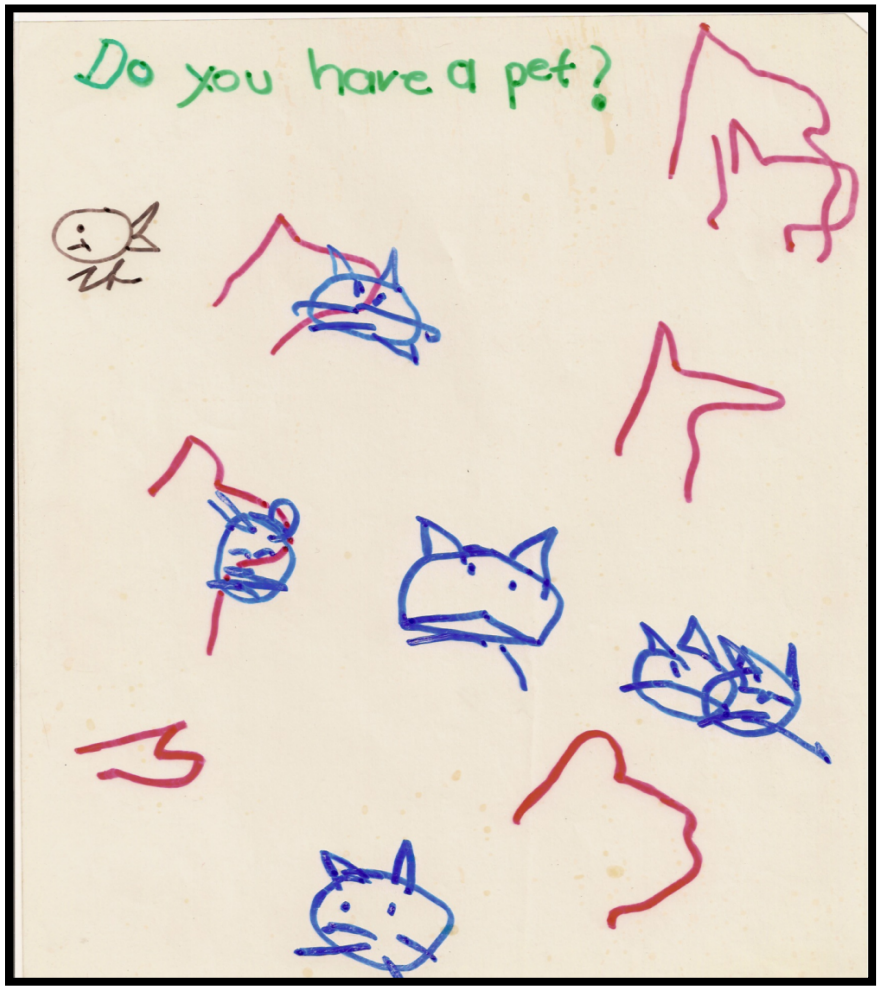
Implications for Statistical Literacy

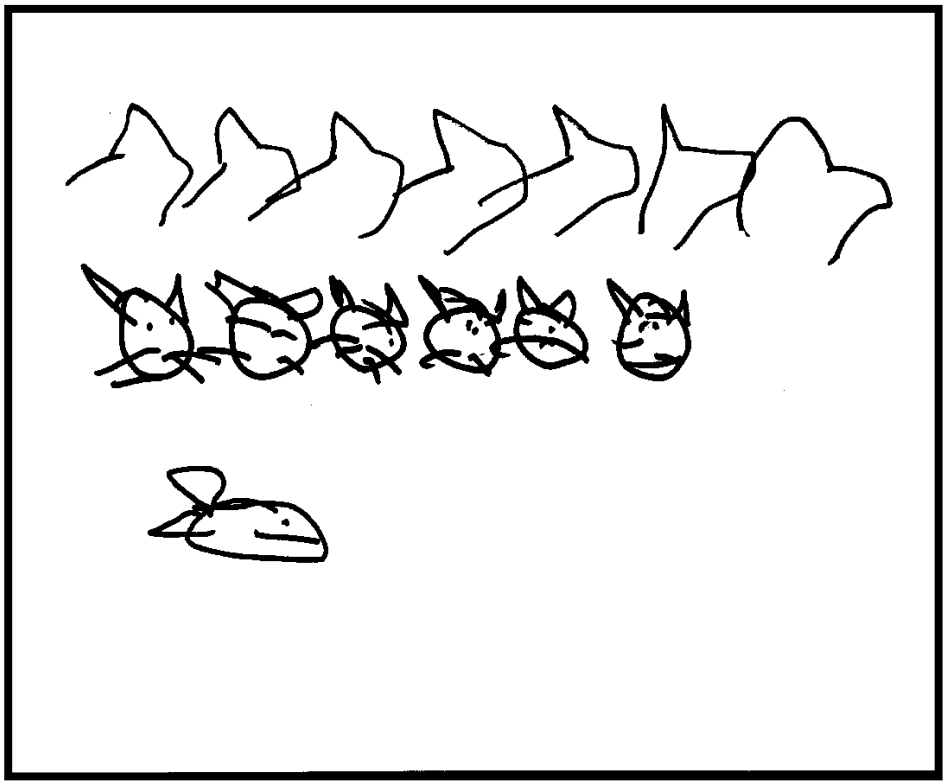
- Have children **construct** and **critique** data texts.
- Tie **data** to children's experiences and interests.
- Talk and write about experiences to expose **data** as **human constructs**.

From Principles to Classroom Practice

- Display the same data set in two different ways. What does each show/ not show?
- Brainstorm alternative
  - Questions
  - Definitions
  - Categories
- Investigate or imagine the possible effects of each version.

Grade 1: "Do You Have a Pet?"





Comparisons between the Two Representations

- The first graph showed the number of people polled, the kinds of pets each person owned, and those who owned multiple pets.
- The second graph does not show these relationships, but it does show more clearly the totals for each kind of pet.

Lessons from the Pet Graph

- There is no 1-1 correspondence between a set of data and its visual referent.
- Representations of data are human constructs.
- Composers of data texts make choices that affect what the audience sees/ doesn't see.
- Different representations of the same set of data can reveal some relationships and conceal others.

Grade 3: Science Experiment

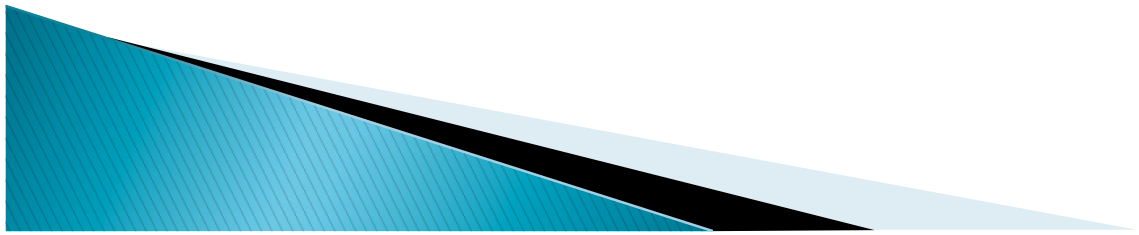
Which popcorn yields the highest rate of popped kernels?

Brand X or

Brand Y?

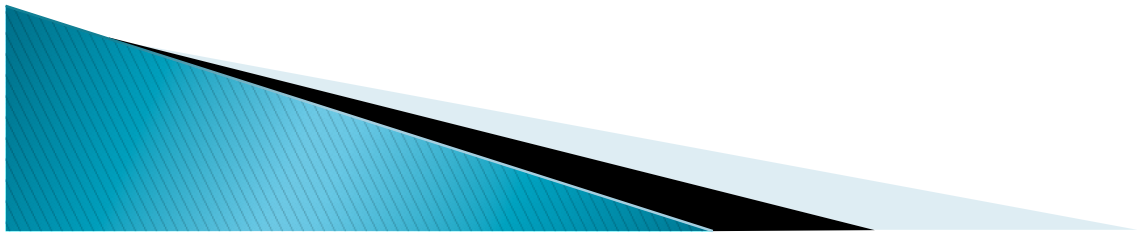
Critiquing data collection:

How do we ***define*** "popped?"



Lessons from Defining “Popped”

- Language and numbers work together.
- Definitions of terms can expand or narrow what gets counted.
- Critics can interrogate scientific data.



Grade 5: Cereal Ads on Kids TV (Examples from 4-month unit)

- Critiquing a Consumer Reports ranking system
- Critiquing their own survey
- Displaying their survey results to persuade their audience

What Makes a Cereal"Very Good"?

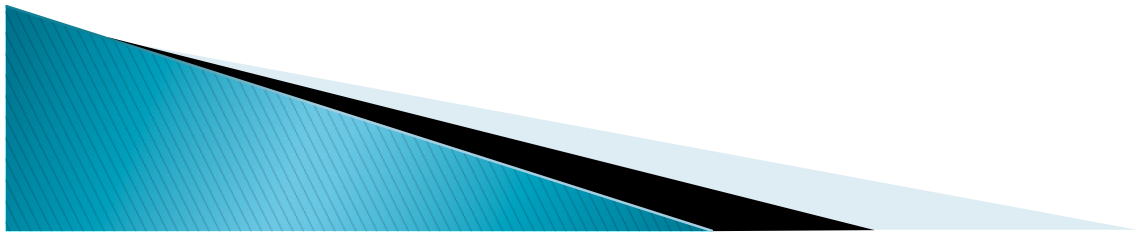
Cereal	Sugar	Sodium	Fiber	Rating
Cheerios	1 g	210 mg	2 g	Very good
Honey Nut Cheerios	9 g	190 mg	2 g	Very good
Frosted Flakes	11 g	140 mg	1 g	Good
Reduced Sugar F. Flakes	8 g	180 mg	< 1	Good

Source: Boyles, S. (2008, October 1). Kids cereals: Some are 50% sugar. Retrieved from: http://www.webmed.com

Questioning the Ranking Scale

- The children questioned the range of 0-9 grams of sugar in the “Very Good” category.

- They questioned the weight placed on each criterion (sugar, sodium, fiber). As a result, they suggested lowering or raising the rating of several cereals.



Lessons from *Consumers Report*

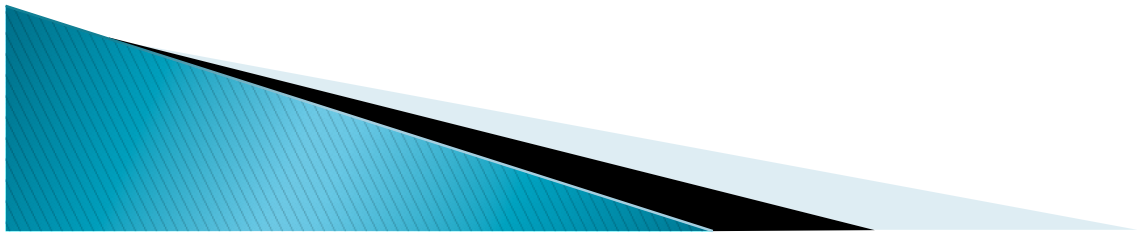
- Definitions and categories of data are human constructions.
- Ranking systems can involve many interrelated categories.
- Interpreting ranking systems involves questioning the choices of criteria that were made.
- Children can critique published texts and authoritative sources.

One Question from a Survey Given to 2nd, 4th, and 6th grade Classes

- What makes you most interested to buy a cereal? CIRCLE 1 or 2

Toy Game Taste

Clothes/School supplies Nutrition Cash card

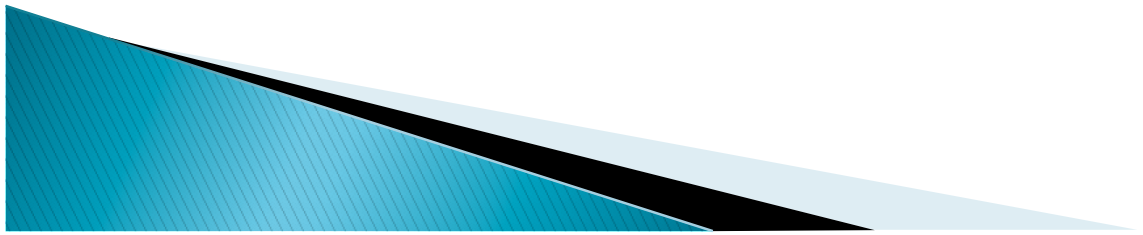


Questioning the Design and Results of the Incentive Question

- The children "imagined the effects" of spatial arrangement and sequence of choices of incentives. They alternated incentives that they *thought* targeted younger children vs. older children, as well as taste and nutrition.
- Allowing 2 choices might make responders feel less "pressured."
- The children realized that the tabulations might not fully represent the wishes of responders, e.g. because of limited choices of incentives. They also could not differentiate between responders' first and second choices.

Lessons from the Cereal Incentive Question

- Language, visual arrangement, and sequence of questions influence the data that are gathered.
- There are differences between results and conclusions.
- No text is neutral. All texts reflect the interests, experiences, and cultural perspectives of the authors.



A Second Question from the School Survey

- Who in your family picks out the cereals?

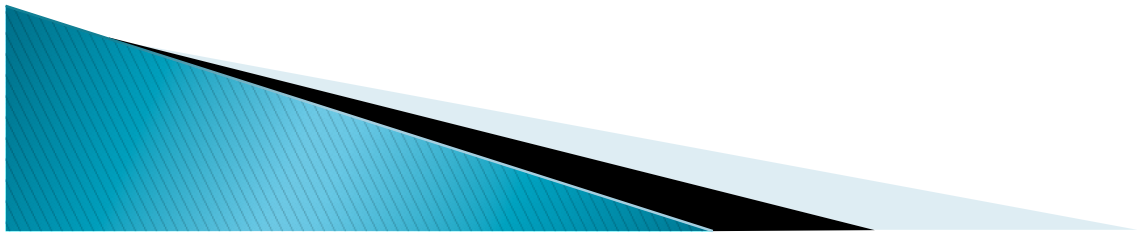
Me Adult Brother/sister

Me and an adult

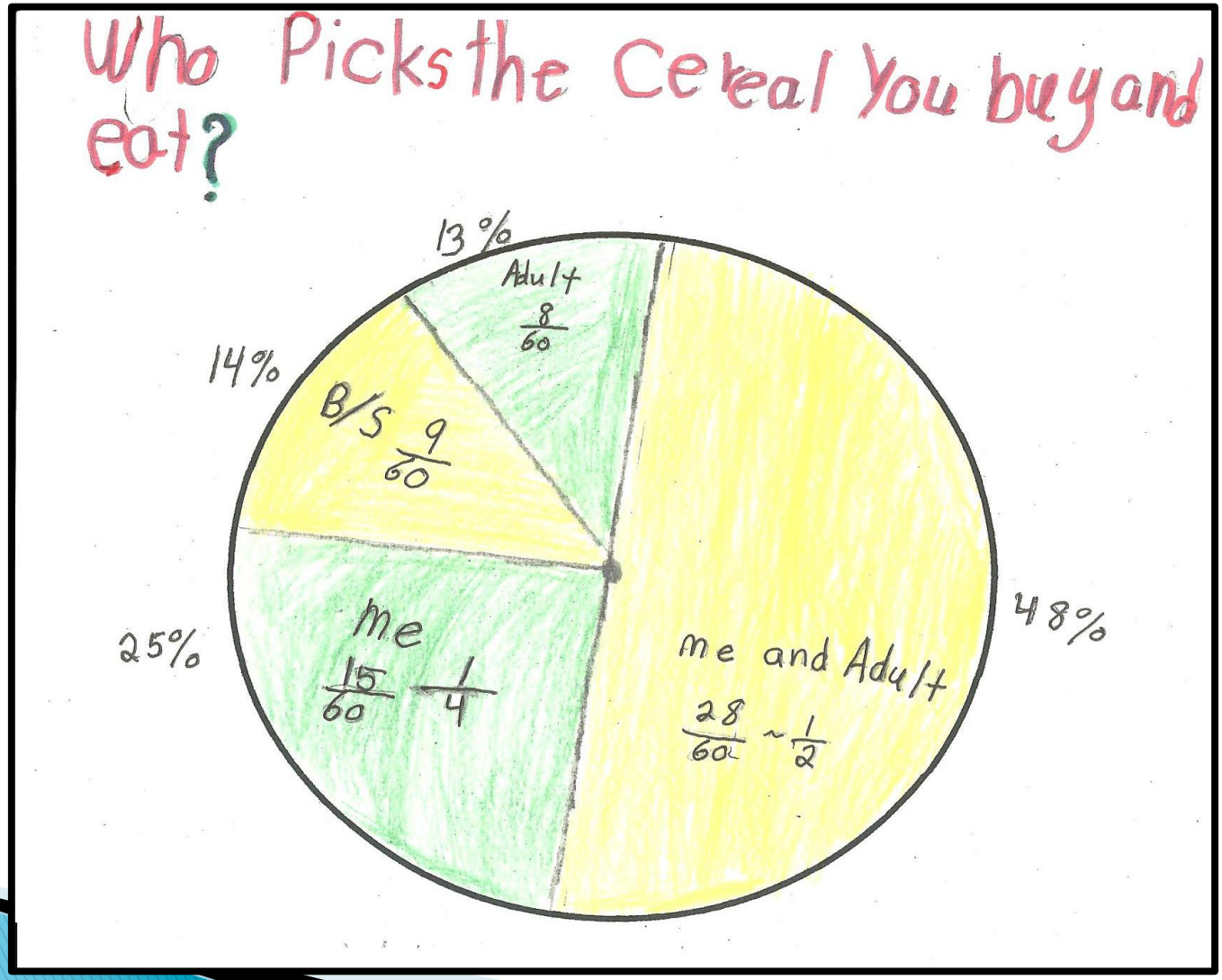
Results:

Me 15 Adult 8

Brother/Sister 9 Me and an adult 28



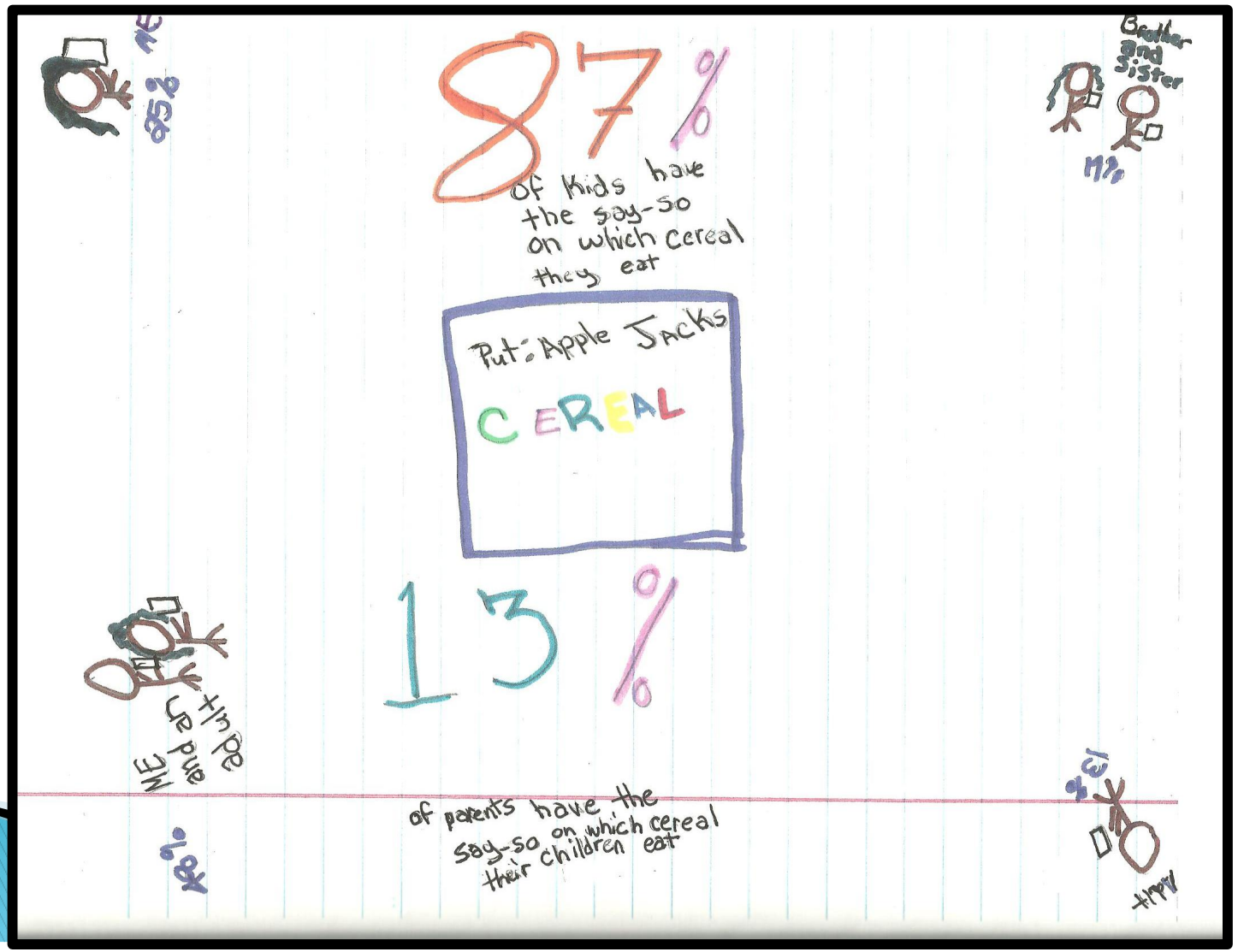
Pie Chart of Results for "Who Picks out Cereals"



Exploring Aggregated vs. Disaggregated Data

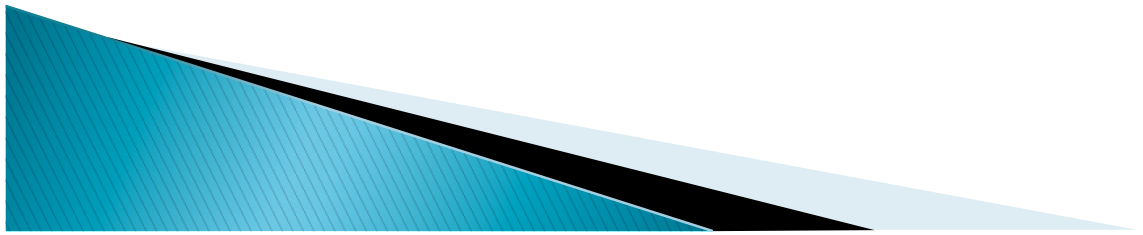
- David's question, "Which categories involve children in some way?" suggested that data could be aggregated. ("Me", "Me and an adult", "Brother/ sister")
- The aggregated total, 87% could bolster the students' argument that children play a major role in family cereal purchasing decisions.
- The children used the aggregated total in their presentation to the class.

Featuring the Aggregated Data for the Final PowerPoint Presentation



Lessons from the "Who Picks the Cereals" Representations

- How data are aggregated or disaggregated reveals some information and conceals other information.
- Words and visuals of numerical information can work together to create a powerful multimodal argument.



Closing Thoughts

- Critical numeracy/ statistical literacy must be an integral part of elementary instruction in all content areas.
- Elementary children are capable of assuming a critical stance toward data provided that the contexts are meaningful to them.
- Teachers can implement strategies for a critical stance toward data into everyday instruction.

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