Knowledge Claim			Justification for reaching conclusion (or if lack thereof, explain why)		
pg; ln	Quote(s) of the knowledge claim	Asserted or considered	Is there justification? If not, why? (e.g., are there reasons to expect that the claim is assumed to be true by the audience addressed in the text, has the claim been previously supported in the text?)	pg; ln	Quote(s) of the justification
	Quoted knowledge claim (with elaboration or clarification inserted in CAPS as needed				Quoted justification (with elaboration or clarification inserted in CAPS as needed). If no justification is given, make a note of this, and include consideration of why this might be the case (e.g., are there reasons to expect that the claim is assumed to be true by the audience addressed in the text, has the claim been previously supported in the text?)

Knowledge Claim			Justification for reaching conclusion (or if lack thereof, explain why)	
pg; ln	Type of knowledge claim	Quote(s)	pg; ln	Quote(s)
2; 18-19	How to count	It seems uncontroversial to say that some children know how to count and others do not. But how can we tell them apart?	2; 19-35	If knowing how to count just means reciting the numeral list (i.e., “one, two, three...”) up to “five” or “ten,” perhaps pointing to one object with each numeral, then many two-year-olds count very well (Baroody and Price, 1983, Briars and Siegler, 1984, Fuson, 1988, Fuson et al., 1982, Gelman and Gallistel, 1978, Miller and Stigler, 1987 and Schaeffer et al., 1974). That kind of counting is good for marking time (e.g., close your eyes and count to ten...) or for playing with one’s parents, but reciting the alphabet or playing patty-cake would do just as well. The thing that makes counting different from the alphabet or patty-cake is that counting tells you the number of things in a set. Of course, counting only tells you this if you do it correctly, following the three ‘how-to-count’ principles identified by Gelman and Gallistel (1978). These are (1) The one-to-one principle, which says that “in enumerating a set, one and only one [numeral] must be assigned to each item in the set.” (p. 90); (2) The stable-order principle, which says that “[Numerals] used in counting must be used in the same order in any one count as in any other count.” (p. 94); and (3) The cardinal principle, which says that “the [numeral] applied to the final item in the set represents the number of items in the set.” (p. 80). As Gelman and Gallistel pointed out, so long as the child’s counting obeys these three principles, the numeral list (“one,” “two,” “three,”... etc.) represents the cardinalities 1, 2, 3,... etc.
3; 1-2	Counting Principles	In their 1978 book, Gelman and Gallistel argued that even 2-year-olds honor these principles when counting, because the principles are intuitively understood.		Citation (Gelman & Gallistel, 1978)
3; 4	Counting Principles	Other studies, however, have failed to provide support for the principles-first view.	3; 4-10	For example, three-year-old children often violate the one-to-one principle by skipping or double-counting items, or by using the same numeral twice in a count (Baroody and Price, 1983, Briars and Siegler, 1984, Frye et al., 1989, Fuson, 1988, Miller et al., 1995, Schaeffer et al., 1974 and Wagner and Walters, 1982). Children also violate the stable-order principle, by producing different numeral lists at different times (Baroody and Price, 1983, Frye et al., 1989, Fuson et al., 1983, Fuson et al., 1982, Miller et al., 1995 and Wagner and Walters, 1982).
3; 12-13	Counting Principles	These findings have led many observers to conclude that the how-to-count principles, rather than being understood from the outset, are in fact gradually learned. This is known as the principles-after (or skills-before-principles) view.	3; 4-10	For example, three-year-old children often violate the one-to-one principle by skipping or double-counting items, or by using the same numeral twice in a count (Baroody and Price, 1983, Briars and Siegler, 1984, Frye et al., 1989, Fuson, 1988, Miller et al., 1995, Schaeffer et al., 1974 and Wagner and Walters, 1982). Children also violate the stable-order principle, by producing different numeral lists at different times (Baroody and Price, 1983, Frye et al., 1989, Fuson et al., 1983, Fuson et al., 1982, Miller et al., 1995 and Wagner and Walters, 1982).
3; 15-17	Cardinality	Much more troubling for the principles-first view is evidence that young children do not understand the cardinal principle. That is, children do not seem to recognize that the last numeral used in counting tells the number of items in the set.	3; 18-24	One type of evidence comes from How-Many tasks. The version used by Schaeffer et al. (1974) is typical: “Each child was asked to count the chips in a line of x poker chips, where x varied between 1 and 7. After the child had counted the chips, the line was immediately covered with a piece of cardboard and the child was asked how many chips were hidden. Evidence that he knew... [the cardinal principle] was that he could respond by naming the last [numeral] he had just counted.” (p. 360)
3; 25	Cardinality	Some investigators have argued that the How-Many task overestimates children’s knowledge,	3; 25-27	Some investigators have argued that the How-Many task overestimates children’s knowledge, because some children actually do repeat the last numeral used in counting without (apparently) understanding that it refers to the cardinal value of the set (Frye et al., 1989 and Fuson, 1988).
3; 28-29	Cardinality	Conversely, it has been claimed that the How-Many task underestimates children’s knowledge (Gelman, 1993 and Greeno et al., 1984),	3; 28-34	Conversely, it has been claimed that the How-Many task underestimates children’s knowledge (Gelman, 1993 and Greeno et al., 1984), because many children respond incorrectly to the question “how many,” even after they have counted the array correctly. Rather than answering with the last numeral of their count, children who are asked “how many” usually try to count the set again. If they are prevented from recounting, they either make no response or give some numeral other than the last numeral of their count (Frye et al., 1989, Fuson, 1992, Markman, 1979, Rittle-Johnson and Siegler, 1998, Schaeffer et al., 1974, Wynn, 1990 and Wynn, 1992).
3; 35-36	Cardinality	Supporters of the principles-first position argue that such behavior generally demonstrates that children do understand the cardinal principle.	3-4; 36-2	They point out that it is pragmatically strange to ask “how many” immediately after counting (Gelman, 1993 and Greeno et al., 1984). To demonstrate this point, Gelman (1993) did a How-Many task with college students: “When we asked undergraduates a how-many question about 18 blocks, all of them counted but only one bothered to repeat the last count word said. Repeats of the question elicited puzzlement, some recounting, and so forth... “ (p. 80).
4; 3-4	Cardinality	In short, people disagree about whether the How-Many task underestimates, overestimates, or accurately measures children’s knowledge of the cardinal principle.	All previous justifications	All previous justifications
4; 5-6	Cardinality	if the How-Many task doesn’t test understanding of the cardinal principle, what does it test?	3; 25-27	See above
4; 6-7	Cardinality	(if) cardinal-principle knowledge cannot be tested by the How-Many task	3; 25-27	Some investigators have argued that the How-Many task overestimates children’s knowledge, because some children actually do repeat the last numeral used in counting without (apparently) understanding that it refers to the cardinal value of the set (Frye et al., 1989 and Fuson, 1988).

4; 9	Cardinality	The Give-N task 2 provides a different way of measuring cardinal-principle knowledge.	4-5; 5-32 (from 4; 9 to 5; 32)	The Give-N task 2 provides a different way of measuring cardinal-principle knowledge. In this task, the child is asked to create a set with a particular number of items. For example, the experimenter might ask the child to “Give two lemons” to a puppet. Studies using this task have found that children are often unable to create sets for numerals that are well within their counting range. For example, many children who can count to “five” are not able to create sets of five objects. Thus, if cardinal-principle knowledge is tested using the Give-N task (rather than the How-Many task) children appear to acquire the cardinal principle relatively late, and only after mastering the other two counting principles. Give-N studies have also yielded a new picture of how numerals are learned. It turns out that a child’s performance on the Give-N task goes through a series of predictable levels, first reported in a longitudinal study by Wynn (1992) and supported by many cross-sectional studies since (Condry and Spelke, 2008, Le Corre and Carey, 2007, Le Corre et al., 2006, Sarnecka and Gelman, 2004, Sarnecka et al., 2007, Schaeffer et al., 1974 and Wynn, 1990). These performance levels are found not only in child speakers of English, but also for Japanese (Sarnecka et al., 2007) Mandarin Chinese (Le Corre et al., 2003 and Li et al., 2003) and Russian speakers (Sarnecka et al., 2007). The developmental pattern is as follows. At the earliest level, the child makes no distinctions among the meanings of different numerals. On the Give-N task, she may always give one object to the puppet or she may always give a handful, but the number she gives is unrelated to the numeral requested. A child at this level can be called a ”pre-numeral-knower,” for she has not yet assigned an exact meaning to any of the numerals in her memorized numeral list. At the next level (which most English-speaking children reach by age 2-1/2 to 3 years) the child knows only that “one” means one. On the Give-N task, she gives one object when asked for “one,” and she gives two or more objects when asked for any other numeral. This is the “one”-knower level. Some months later, the child becomes a “two”-knower, for she learns that “two” means two. At that point, she gives one object when asked for “one,” and two objects when asked for “two,” but she does not distinguish among the numerals “three,” “four,” “five,” etc. For any of those numerals, she simply grabs some objects and hands them over. This level is followed by a “three”-knower level, and some studies also report a “four”-knower level. Collectively, children at these levels have been termed “subset-knowers” (Le Corre and Carey, 2007 and Le Corre et al., 2006) because although they have often memorized the numeral list up to “ten” or higher, they know the exact meanings for only a subset of those numerals. After the child has spent some time (often more than a year) as a subset-knower, her performance undergoes a dramatic change. Suddenly, she is able to generate the right cardinality for numerals “five” and above. But whereas she progressed through the subset-knower levels gradually (learning “one,” then “two,” then “three,”...) she seems to acquire the meanings of the higher numerals (“five” through however high she can count) all at once. We call children at this level cardinal-principle-knowers (sometimes abbreviated CP-knowers). Within-child consistency on a wide variety of tasks suggests that cardinal-principle-knowers differ qualitatively from subset-knowers. Most conspicuously, subset-knowers do not use counting to solve the Give-N task (even if they are explicitly told to count), whereas cardinal-principle-knowers do use counting – an observation that led Wynn, 1990 and Wynn, 1992 to call subset-knowers “grabbers,” and cardinal-principle-knowers “counters”. But the differences do not end there. For example, a “two”-knower is, by definition, unable to give three objects when asked for “three.” But a “two”-knower is also (a) unable to fix a set when told, for example, “Can you count and make sure you gave the puppet three toys?... But the puppet wanted three – Can you fix it so there are three?” (Le Corre et al., 2006); (b) unsure whether a puppet who has counted out seven items has produced a set of “seven” (Le Corre et al., 2006); (c) unable to point to the card with “three” apples, given a choice between a card with three and a card with four (Wynn, 1992); and (d) unable to produce the numeral “three” to label a picture of three items (Le Corre et al., 2006). Cardinal-principle-knowers succeed across the board on these tasks. Such qualitative differences in the counting behavior of subset-knowers and cardinal-principle-knowers suggest that what ultimately separates the groups is not just the size of the sets they can generate. Rather, it is that cardinal-principle-knowers understand how counting works, whereas subset-knowers do not.
4; 14-16	Cardinality	Thus, if cardinal-principle knowledge is tested using the Give-N task (rather than the How-Many task) children appear to acquire the cardinal principle relatively late, and only after mastering the other two counting principles.	4-5; 5-32 (from 4; 9 to 5; 32)	
4; 17	Meanings of Numerals	Give-N studies have also yielded a new picture of how numerals are learned.	4-5; 5-32 (from 4; 9 to 5; 32)	
4; 28-29	Meanings of Numerals	A child at this level can be called a ”pre-numeral-knower,” for she has not yet assigned an exact meaning to any of the numerals in her memorized numeral list.	4; 25-28	At the earliest level, the child makes no distinctions among the meanings of different numerals. On the Give-N task, she may always give one object to the puppet or she may always give a handful, but the number she gives is unrelated to the numeral requested.
4; 30-31	Meanings of Numerals	At the next level (which most English-speaking children reach by age 2-1/2 to 3 years) the child knows only that “one” means one.	4; 31-33	On the Give-N task, she gives one object when asked for “one,” and she gives two or more objects when asked for any other numeral. This is the “one”-knower level.
4; 34-38	Meanings of Numerals	Some months later, the child becomes a “two”-knower, for she learns that “two” means two. ... This level is followed by a “three”-knower level, and some studies also report a “four”-knower level.	4-5; 36-2	For any of those numerals, she simply grabs some objects and hands them over. This level is followed by a “three”-knower level, and some studies also report a “four”-knower level. Collectively, children at these levels have been termed “subset-knowers” (Le Corre and Carey, 2007 and Le Corre et al., 2006) because although they have often memorized the numeral list up to “ten” or higher, they know the exact meanings for only a subset of those numerals.
5; 6-8	Cardinality	she seems to acquire the meanings of the higher numerals (“five” through however high she can count) all at once. We call children at this level cardinal-principle-knowers (sometimes abbreviated CP-knowers).	5; 3-5	After the child has spent some time (often more than a year) as a subset-knower, her performance undergoes a dramatic change. Suddenly, she is able to generate the right cardinality for numerals “five” and above.
5; 32	How Counting Works	cardinal-principle-knowers understand how counting works, whereas subset-knowers do not.	5; 9-29	Within-child consistency on a wide variety of tasks suggests that cardinal-principle-knowers differ qualitatively from subset-knowers. Most conspicuously, subset-knowers do not use counting to solve the Give-N task (even if they are explicitly told to count), whereas cardinal-principle-knowers do use counting – an observation that led Wynn, 1990 and Wynn, 1992 to call subset-knowers “grabbers,” and cardinal-principle-knowers “counters”. But the differences do not end there. For example, a “two”-knower is, by definition, unable to give three objects when asked for “three.” But a “two”-knower is also (a) unable to fix a set when told, for example, “Can you count and make sure you gave the puppet three toys?... But the puppet wanted three – Can you fix it so there are three?” (Le Corre et al., 2006); (b) unsure whether a puppet who has counted out seven items has produced a set of “seven” (Le Corre et al., 2006); (c) unable to point to the card with “three” apples, given a choice between a card with three and a card with four (Wynn, 1992); and (d) unable to produce the numeral “three” to label a picture of three items (Le Corre et al., 2006). Cardinal-principle-knowers succeed across the board on these tasks.

5-6; 33-2	Cardinality	Because these two groups are separated by their knowledge of the cardinal principle, they offer us a way of finding out whether the How-Many task underestimates, overestimates, or accurately taps cardinal-principle knowledge. More importantly, they give us a way to explore the nature of cardinal principle knowledge itself.	5; 9-29 see also 6; 4-26	Within-child consistency on a wide variety of tasks suggests that cardinal-principle-knowers differ qualitatively from subset-knowers. Most conspicuously, subset-knowers do not use counting to solve the Give-N task (even if they are explicitly told to count), whereas cardinal-principle-knowers do use counting – an observation that led Wynn, 1990 and Wynn, 1992 to call subset-knowers “grabbers,” and cardinal-principle-knowers “counters”. But the differences do not end there. For example, a “two”-knower is, by definition, unable to give three objects when asked for “three.” But a “two”-knower is also (a) unable to fix a set when told, for example, “Can you count and make sure you gave the puppet three toys?... But the puppet wanted three – Can you fix it so there are three?” (Le Corre et al., 2006); (b) unsure whether a puppet who has counted out seven items has produced a set of “seven” (Le Corre et al., 2006); (c) unable to point to the card with “three” apples, given a choice between a card with three and a card with four (Wynn, 1992); and (d) unable to produce the numeral “three” to label a picture of three items (Le Corre et al., 2006). Cardinal-principle-knowers succeed across the board on these tasks. <NEW QUOTE: 6; 4-26> 1.2. Unpacking the cardinal principle The cardinal principle is often informally described as stating that the last numeral used in counting tells how many things are in the whole set. If we interpret this literally, then the cardinal principle is a procedural rule about counting and answering the question ‘how many.’ If so, then cardinal-principle-knowers should answer the ‘how many’ question correctly (i.e., they should repeat the last word of a count) whereas subset-knowers should not. In other words, the How-Many task should accurately tap cardinal-principle knowledge. The first question of the present study then, is: Is the cardinal principle a procedural rule about counting and saying ‘how many’? Alternatively, the cardinal principle can be viewed as something more profound – a principle stating that a numeral’s cardinal meaning is determined by its ordinal position in the list. This means, for example, that the fifth numeral in any count list – spoken or written, in any language – must mean five. And the third numeral must mean three, and the ninety-eighth numeral must mean 98, and so on. If so, then knowing the cardinal principle means having some implicit knowledge of the successor function – some understanding that the cardinality for each numeral is generated by adding one to the cardinality for the previous numeral. The second question of the present study then, is: Is the cardinal principle a conceptual rule that is related to knowledge of the successor function? If children know how the numeral list instantiates the successor function, they should understand two things: (1) The direction of numerical change: In the numeral list, the word that denotes cardinality N + 1 will come after the word denoting cardinality N. (2) The unit of numerical change: The word for cardinality N + 1 must be the very next word in the numeral list, after the word for cardinality N.
6; 8-9	Cardinality	the How-Many task should accurately tap cardinal-principle knowledge.	6; 4-9	The cardinal principle is often informally described as stating that the last numeral used in counting tells how many things are in the whole set. If we interpret this literally, then the cardinal principle is a procedural rule about counting and answering the question ‘how many.’ If so, then cardinal-principle-knowers should answer the ‘how many’ question correctly (i.e., they should repeat the last word of a count) whereas subset-knowers should not. In other words, the How-Many task should accurately tap cardinal-principle knowledge.
7; 11-12	Last Word Rule	the child’s understanding that the last word in a count sequence is the correct answer to a subsequent ‘how many’ question.	6; 30-35 BUT, SEE ALSO 14; 1-2	
7; 13-15	Direction of Change	tested whether children knew that (a) adding an element to a set requires going forward in the numeral list to represent the cardinality of the resulting set, whereas subtracting requires going backward [The direction task]	9-10; 34-15	The purpose of [The direction task] was to find out whether the child understood that moving forward in the numeral list represents adding items to a set, whereas moving backward represents subtracting items. Materials included two clear plastic plates (approx. 23 cm in diameter) and four small plastic tubs, each containing 12 small objects, six of one color and six of another color (light blue and magenta hair bands, green and orange jacks, red and purple bears, yellow and dark blue dragonflies). Each set of items was used only once; order of item presentation was randomized by allowing the child to choose the items for the next trial. The experimenter began each trial by placing either five or six items of the same color on each plate, saying for example, “OK, I’m putting FIVE bears on here [while placing five red bears on one plate]... and FIVE bears on here [while placing five purple bears on the other plate]... so this plate has five, and this plate has five.” Then the experimenter moved one item from one plate to the other, saying, “And now I’ll move one.” (In this example, one of the plates would now contain four red bears, and the other would contain five purple bears and one red bear.) Next the experimenter would say “OK, now there’s a plate with FOUR, and a plate with SIX. And I’m going to ask you a question about the plate with SIX. Are you ready? Which plate has SIX?” If the child attempted to count the items, the experimenter immediately covered up both plates and said “Oops! This isn’t a counting game – this is a guessing game. So you can just guess.” Each child received four trials, in randomized order: Two trials started with five items per plate, one trial asked about “four,” the other about six”; the other two trials started with six items per plate, one trial asked about “five,” the other about “seven.” Each trial was scored correct or incorrect.
7; 15-17	Unit of Change	[tested whether children knew that] if one item is added, the resulting cardinality is named by next numeral in the list, whereas if two items are added, the resulting cardinality is named by the numeral after that [the unit task]	10; 17-38	2.2.5. Unit task The purpose of this task was to find out whether the child understood that the unit of numerical increase represented by moving from one numeral to the next on the list is exactly one item. Specifically, this task tests whether children know that moving forward one word in the list means adding one item to the set, whereas moving forward more than one word in the list means adding more than one item to the set. Materials for this task included a wooden box (17.5 × 12.5 × 5 cm) and six small plastic tubs. Each tub contained seven identical toys (frogs, bananas, worms, sea horses, fish, or rabbits). Each set of items was used only once; order of item presentation was randomized by allowing the child to choose the items for the next trial. The experimenter began each trial by placing a number of items in the box, saying for example, “OK, I’m putting FOUR frogs in here.” Then the experimenter closed the box and asked the memory-check question “How many frogs?” If the child did not answer the memory-check question correctly (e.g., “four”), the experimenter said, “Oops, let’s try again” and repeated the beginning of the trial. After the child answered the memory-check question correctly, the experimenter said “Right! Now watch. .. “and added either one or two more items. Then the experimenter asked the test question, of the form, now is it N + 1, or N + 2? (e.g., “Now is it FIVE, or SIX?”) Each child received two warm-up trials (1 + 1 item and 1 + 2 items) followed by four test trials (4 + 1, 4 + 2, 5 + 1, and 5 + 2) in counterbalanced order. For the trials beginning with one item, the test question was “Now is it TWO, or THREE?” For the trials beginning with four items, the question was “Now is it FIVE, or SIX?” For the trials beginning with five items, the question was “Now is it SIX, or SEVEN?” No feedback was given after any of the trials, although children could see the contents of the box when the experimenter opened it to return the items to their tub. Each trial was scored correct or incorrect.

8; 2	Meanings of Numerals	[the] numerals the child knows the exact meanings of	8; 1-35	Give-N task (Frye et al., 1989, Wynn, 1990 and Wynn, 1992). The purpose of this task was to determine which numerals the child knew the exact meanings of. How a child performed on this task determined her 'knower-level' (i.e., "one"-knower, "two"-knower, cardinal-principle-knower, etc.). Materials for this task included a green dinosaur puppet (approx. 24 cm tall and 24 cm in circumference), a blue plastic plate (11 cm in diameter), and 15 small plastic lemons (approx. 2 × 3 cm each). To begin the task, the experimenter placed the puppet, plate, and lemons on the table and said, "In this game, you will give things to the dinosaur, like this." (The experimenter mimes placing something on the plate, then slides the plate over to the puppet.) Requests were of the form "Can you give one lemon to the dinosaur?" After the child responded to each request, the experimenter asked the follow-up question, of the form "Is that one?" If the child said "no," the original request was restated (e.g., "Can you give the dinosaur one lemon?"), followed again by the follow-up question (e.g., "Is that one?"). This continued until the child said that she had given the dinosaur the requested number of objects. All children were first asked for one lemon, then three lemons. Further requests depended on the child's earlier responses. When a child responded correctly to a request for N, the next request was for N + 1. When she responded incorrectly to a request for N, the next request was for N − 1. The requests continued until the child had at least two successes at a given N (unless the child had no successes, in which case she was classified as a pre-numeral-knower) and at least two failures at N + 1 (unless the child had no failures, in which case she was classified as a cardinal-principle-knower). The highest numerals requested were "five" and "six." It was important to include the numeral "five" because earlier studies have reported that children who can generate sets of five in the Give-N task are cardinal-principle knowers (Wynn, 1990, Wynn, 1992, Le Corre and Carey, 2007 and Le Corre et al., 2006). But early testing showed that children often generated sets of five just by grabbing a handful, because five was the number that would fit comfortably in one of their hands. Also, we reasoned that "four"-knowers might generate sets of five just by adding lemons to the plate until the number was bigger than they could name. For these reasons, we requested "five" and "six" in alternation (i.e., all children who received two cardinal-principle requests got one request for "five" and another for "six"). A child was credited with knowing a given numeral if she had at least twice as many successes as failures for that numeral. Failures included either giving the wrong number of items for a particular numeral N, or giving N items when some other numeral was requested. Each child's knower-level corresponds to the highest number she reliably generated. (For example, children who succeeded at "one" and "two," but failed at "three" were called "two"-knowers.) Children who had at least twice as many successes as failures for trials of "five" and "six" were called
8; 38	Memorization of Numeral List	[the sequence task] This task measured the child's memorization of the numeral list up to "ten".	8-9; 38-4	This task measured the child's memorization of the numeral list up to "ten." To begin the task, the experimenter said, "Let's count. Can you count to ten?" If the child did not immediately start counting, the experimenter said, "Let's count together. One, two, three, four, five, six, seven, eight, nine, ten. OK, now you count." Each child's score reflects the highest numeral she reached without errors. For example, a child who counted "one, two, five" would have counted correctly to "two," and so would receive that score. Children were allowed to start over if they asked to, or if they did so spontaneously, but they were not told to start over by experimenters. For children who counted more than once, only their best count was used.
15; 3-4 AND 16; 2-5	Last Word Rule	a procedural How-Many rule) that has been learned by some children and not others. <NEW QUOTE: 16; 2-5> Many young children have formulated the generalization that the last word reached in a count is the appropriate answer to the question "how many." Furthermore, they apply this rule long before they demonstrate any understanding of the cardinality principle on tasks such as Give-N, that do not use the exact phrase how many.	14-16; 29-5	It is also apparent from Table 1 that most children either got both trials right (53 children) or got them both wrong (8 children). It was relatively rare for a child to get one trial correct and the other incorrect. Of course, the cardinal-principle-knowers usually got both trials correct, but even among the subset-knowers, only 5 children got 1 trial right and 1 trial wrong, whereas 26 children got both trials right or wrong. This error pattern makes sense if there is a rule (i.e., a procedural How-Many rule) that has been learned by some children and not others. It is not the pattern one would expect to see if all participants understand the relevant concepts but sometimes did not apply them because of procedural error. A constant, low level of error would make it much more likely for any given child to get one trial incorrect than to get both trials incorrect. To formally test these intuitions, we asked the following questions: (1) Does the rate of correct answers increase with knower-level or stay the same? (2) Is the rate of correct answering for each child essentially dichotomous (i.e., their probability of giving a correct answer is either very high or very low, so that they either get both right or none right)? We developed four models that expressed all four combinations of these two possibilities, and estimated the Bayes factors between these four models (to decide which model best fit the data) using the computational method known as 'reverse jump Markov chain Monte Carlo'. Results are given in Table 2. It is clear that the Dichotomous-Increasing model is by far the best one, with all of the Bayes factors exceeding the suggested scientific standards for 'very strong' evidence (see Kass & Raftery, 1995, p. 777). In other words, this analysis suggests that children either knew or didn't know a How-Many rule, and that their likelihood of knowing it increased with knower-level. Table 2. <SEE TEXT> Note. Bayes factors can be though of as betting ratios – e.g., the Continuous-Increasing model is 1966 times less likely to be generated by the current data than the most likely Dichotomous-Increasing model. The Log Bayes factors are included because they may be more familiar to some readers. Table options Thus, we see that many young children have formulated the generalization that the last word reached in a count is the appropriate answer to the question "how many." Furthermore, they apply this rule long before they demonstrate any understanding of the cardinality principle on tasks such as Give-N, that do not use the exact phrase how many.
18; 7-12	????	part of what separates cardinal-principle knowers from subset-knowers is an understanding of the mapping between (a) the direction of movement along the numeral list and (b) the direction of change in the numerosity of a set. Nevertheless, this can't be the whole story, because "four"-knowers succeed at the Direction task, but still do not use counting to solve the Give-N task (which is why they aren't cardinal-principle-knowers).	16; 24-27	Direction task. Only "four"--knowers and cardinal-principle-knowers performed above change on the Direction task, designed to test their understanding that going forward in the numeral list corresponds to adding items, and going backward corresponds to subtracting items
18; 12-13	????	There must be some other piece of knowledge -- something that only cardinal-principle-knowers know. [Because while it could be speculated that "part of what separates cardinal-principle knowers from subset-knowers is an understanding of the mapping between (a) the direction of movement along the numeral list and (b) the direction of change in the numerosity of a set. Nevertheless, this can't be the whole story, because "four"-knowers succeed at the Direction task, but still do not use counting to solve the Give-N task (which is why they aren't cardinal-principle-knowers)."]	18; 10-12	because "four"-knowers succeed at the Direction task, but still do not use counting to solve the Give-N task (which is why they aren't cardinal-principle-knowers) [FURTHERMORE, THIS APPEARS TO BE MAKING THE IMPLICATION THAT THE DIFFERENCE IN PERFORMANCE BETWEEN FOUR AND CP KNOWERS MUST BE CAUSED BY SOME DIFFERENCE IN KNOWLEDGE. GIVEN THAT BOTH GROUPS PERFORM SIMILARLY ON THE DIRECTION TASK, THE KNOWLEDGE TAPPED BY THAT TASK MUST NOT BE THE KNOWLEDGE THAT SEPARATES THEM...THERE MUST BE SOME OTHER PIECE OF KNOWLEDGE.]

21; 20-28	Count Cardinal Rule	[it has been suggested that, rather than just coming to understand cardinality all at one, children may learn] a count-cardinal rule, which says that the last word of a count sequence names the associated cardinality (this knowledge would be tapped by the How-Many task) and a cardinal-count rule, which says that the cardinal numeral for a set predicts the last word of a count sequence for that set (this knowledge would be tapped by the Give-N task.) Several studies have reported that the count-cardinal rule is learned earlier than the cardinal-count rule, which could provide an alternative explanation for the present findings. [21; 20-28]	21; 29-38	We are inclined to doubt this explanation, because of the results reported by Le Corre et al. (2006) in their Counting Puppet task, which cardinal-principle knowers pass and subset-knowers fail. In Le Corre's study, children were told that a character wanted, for example, six cookies. A puppet then counted out five cookies and the child was asked "is that six?" Like our How-Many task, the Counting Puppet task requires the child to listen to a standard (not tricky or unusual) count, and to make a judgment about the result of that count. The main difference is that our How-Many task uses the specific phrase "how many" in the test question, whereas the Counting Puppet task does not. There is no obvious reason why either task should be a better test of the count-cardinal rule than the other, and no obvious reason why subset-knowers should succeed at our task and fail at Le Corre's, if the count-cardinal rule were the issue. [21; 29-38]
22; 4	????	A how many rule is not the cardinal principle	14; 17-25 AND 6; 28-35	<NEW QUOTE: 6; 28-35> In order to answer the first question (i.e., Is the cardinal principle a procedural rule about counting and saying 'how many'?) We devised a How-Many task that avoids the pragmatic oddness of asking how many items are in a set the child just counted. In our task, the experimenter counted a set the child could not see, and then asked the child how many items there were. This task allowed us to assess when children learn a procedural 'how-many' rule (i.e., a rule saying that the answer to the question 'how many' is the last word of a count) and whether mastery of this rule corresponds to understanding of the cardinal principle (as measured by the Give-N task) Breaking down performance by knower level: Cardinal-principle-knowers almost always answered correctly (96% of trials) [I.E., ANSWERED CORRECTLY ON THE HOW MANY TASK, IN WHICH A RESEARCHER COUNTED A HIDDEN SET OF ITEMS, THEN ASKED THE CHILD HOW MANY. A CORRECT ANSWER WAS TO REPEAT THE LAST NUMBER WORD OF THE RESEARCHER'S COUNT]. This was significantly higher than the subset-knowers' overall success rate of 68%, $t(67) = 3.53$, $p = .001$; see Table 1. However, all subset-knowers did not perform alike. On the contrary, the data in Table 1 show that the most dramatic difference was between the pre/"one"-knowers and the "two"-knowers (25% correct and 64% correct, respectively). For "two"-knowers and above, the success rate is always over 60%. Thus, it appears that the answer to our first question (Is the cardinal principle a procedural rule about counting and saying 'how many'?) is no. Whatever knowledge allows children to succeed on the How-Many task, it is different from the cardinal principle.
28; 10-11	Interpretation of How Many	children's interpretation of the phrase "how many" changes as their understanding of counting grows.	28; 4-9	Although a 'how-many' rule is not the cardinal principle, it is interesting nevertheless. Three informative findings from the present study's How-Many task were that a) the great majority of children either got both trials correct or neither trial correct, indicating that they either knew the rule or didn't know it; (b) most children had learned the rule by the time they were "two"-knowers; (c) when children answered incorrectly, they either produced a different numeral or (less commonly) produced the numeral list itself (i.e., counted out loud).
22; 25-27	????	cardinal-principle-knowers have some implicit (albeit fragile) knowledge of how counting implements the successor function, whereas subset-knowers as a group do not.	17; 21-24	In the Direction task, unlike the How-Many task, it was not the case that children either got all the trials right or performed at chance. What is clear is that the task was a difficult one; although "four"-knowers and cardinal-principle knowers as a group succeeded on the task, quite a few individual children in each group performed at chance (which was 50% in this task, see Fig. 3).