Not All Verbal Fluency Tasks Are Created Equal: Lexical Access from 3 to 5

ABSTRACT

Verbal fluency tasks are often used by both psycholinguists and clinicians to measure lexical access ability. These tasks have primarily been used with school-age children and adults, and the task demands and methods have varied greatly among researchers. In the current study, three-to-five year old children were given two verbal fluency tasks. On the Single Category Naming (SCN) task, children rapidly named animals. On the Multi-Category Naming (MCN) task, children named one item from each of ten categories. We also gave these children tests of vocabulary, syntax, and articulation. First, we demonstrate that scores on each task increase with age, especially between the ages of three and four. Second, we compare scores on the two tasks, finding that scores are only moderately correlated, which suggests that different verbal fluency tasks measure different abilities. Finally, we compare scores on each of the verbal fluency tasks with scores on the linguistic tasks, demonstrating that different linguistic abilities are involved in each task at different ages, which explains the lack of perfect correlation between scores on the two verbal fluency tasks. We suggest implications for choosing an appropriate verbal fluency task based on age and cognitive ability, ending with special considerations for children with developmental disabilities.

INTRODUCTION

In order to understand or produce a sentence, a person must not only know the pronunciation, meaning and syntactic behavior of the words that compose the sentence, but also must be able to retrieve these words efficiently and accurately (see. Swinney, 1979). The ability to access words from one's lexicon is therefore a key component of human language processing and production, of great import to psycholinguists and clinicians alike. The vocabularies and lexical access abilities of adults and school-age children have been well-studied (e.g. Levelt, 2001, Marslen-Wilson, 2001, Forster, 1976), although there are many conflicting models of lexical access—some parallel, some serial; some reflecting semantic organizations, others favoring phonological organization, etc. (see Caramazza, 1997, for a discussion). Additionally the vocabularies of young children have been well-studied (Funnel, Hughes & Woodcock, 2006, Messer & Dockrell, 2006, Weizman & Snow, 2001, Dickinson, McCabe, Anastasopoulos, Peisner-

Feinberg, & Poe 2003). However, the lexical access abilities of young children remain relatively understudied. In this paper we examine lexical access in typically-developing preschool-aged children.

In adults and school-aged children, researchers have explored lexical access by analyzing slips of the tongue (e.g. the seminal work by Victoria Fromkin, 1980; Moller, Jansma, Rodriguez-Fornells & Munte, 2007) and the tip of the tongue phenomenon (e.g. the seminal work of Brown & McNeil, 1966; Schwartz & Metcalfe, 2011), and there are various models of how phonologically-related (or occasionally, semantically-related) words inhibit successful lexical access (see Brown, 1991, for a review of some of these models) . Although these analyses have provided valuable insights, one nagging concern with tip of the tongue and slip of the tongue studies is the extent to which it is valid to draw conclusions about normal lexical access from instances of lexical access failure. The few studies on the tip of the tongue phenomenon in children (e.g. Hanley & Vandenberg, 2010) and slips of the tongue in children (see Jaeger, 2005, and references therein) have generally concluded that adult and child lexical access is essentially the same. However, using slip of the tongue studies with children is particularly problematic in that it is difficult to know whether children have made an error because they have failed to retrieve an intended word or for other reasons: because the word they use means something different to them than it means in Standard English or because they cannot articulate the word they have retrieved.

Another technique that is widely used to study lexical access is priming (see Hoey, 2005, and references therein), in which participants are primed with a written word and then asked to respond to a target written item. For example, by deciding whether the target is a word or non-word in a lexical decision task (first introduced by Rubenstein, Garfield, and Millikan, 1970; see meta-analysis by Lucas, 2000) or by saying the target as soon as it appears, in a speeded naming task (e.g. Van den Bussche, Van den Noortgate & Reynvoet 2009). Through these methods, researchers can learn whether a particular word facilitates or inhibits the lexical access of another word. Although priming studies have greatly added to our knowledge of the mechanisms that adults and older children use to retrieve words, as well as provided evidence for the positive relationship between lexical access and reading ability in school-age children (see Logan, Schatschneider, and Wagner, 2009, and references therein), the task demands of lexical priming studies, in particular the ability to read, limit their use with young children and impaired populations.

Several researchers have tried to accommodate this limitation by using a modified Stroop task in which children simultaneously see a picture and hear a word that exactly matches the picture (e.g. they see a tree and hear *tree)*, is somewhat related to the picture (e.g. they see a tree and hear *flower)*, or is not related to the picture at all (e.g. they see a tree and hear *clown*). Children are asked to name the item in the picture, and the researchers evaluate, for example, whether seeing and hearing the same item facilitates accessing the word, or whether seeing and hearing similar but non-identical items inhibits accessing the word (e.g. Brooks & MacWhinney, 2000). Although this technique provides insight into children's lexical access, it is limited in that a single picture usually matches several lexical items. For example, a picture of a blue vase containing roses can correctly be identified as *blue, vase, flowers, roses,* etc. Therefore, it is difficult to control for unwanted interfering information (See Vitkovitch, Cooper-Pye, & Leadbetter, 2006, for discussion).

Another priming method that does not require literacy is a Confrontation Naming task (see Riva, Nichelli & Devoti, 2000), in which a participant sees one picture at a time and is asked to name the item in the picture. However, this task has the same problems as a modified Stroop task. Additionally, Confrontation Naming is generally only used with impaired populations (e.g. Kaplan, Goodglass, & Weintraub, 1983), as most normally-developing children can so easily access words corresponding to pictures that confrontation naming is effectively a test of productive vocabulary rather than lexical access ability.

A final method for studying lexical access is verbal fluency. Tests of verbal fluency take various forms, but in general, a person is given one or more categories as a prompt and is asked to name items belonging to that category (e.g. they are asked to name animals). Verbal fluency tasks have the advantage of having relatively few task demands, making them appropriate for both normally-developing and impaired adults and children.

In normally-developing adults and school-age children, verbal fluency tasks have generally been used to gain insight into category structure. For example, W. K. Estes argued that success on a verbal fluency task requires the participant to "organize output in terms of clusters of meaningfully related words" (1974). These tasks have generally been used with elementary-school-aged children (Crowe & Prescott, 2006, Synder & Munakata, 2010, Koren, Kofman & Berger, 2005, Lucariello, Kyratzia & Nelson 1992), and researchers have used connectionist modeling to search for shifts from thematic to taxonomic organization throughout childhood. Although this method has rarely been used with younger children, one exception is the work by Lucariello et al.[1] who tested 4 year olds in addition to older children and adults and argued that use of taxonomic clustering increases with age.

Given that lexical access is a key aspect of language comprehension and production, it is not surprising that impairments in lexical access generally, and verbal fluency in particular, have been noted in a number of neuropsychological disorders (Tombaugh, Kozak, & Rees, 1999) and that tests of verbal fluency are included in several neuropsychological assessments (e.g. *A Neuropsychological Assessment II* (*NEPSY II*, Korkman, Kirk & Kemp, 2007, the Multilingual Aphasia Examination, Benton & Hamsher, 1977). Indeed, verbal fluency tasks have demonstrated that lexical retrieval appears to be a particular area of linguistic weakness for older children and adults with language impairments such as Specific Language Impairment (Weckerley, Wulfeck, & Riley, 2001), dyslexia (Cohen, Morgan, Vaughn, Riccio & Hall, 1999, Levin, 1990), and stuttering (Boysen & Cullinan (1971); children with various developmental disorders including Asperger's Syndrome (Spek, Schatorje, Scholte, & van Berckelaer-Onnes, 2009) and Down syndrome (Nash & Snowling, 2008); and children with emotional and behavioral disorders including depression and anxiety (Baker & Cantwell, 1990) and attention deficit hyperactive disorder (Felton, Wood, Brown, Campbell, & Harter, M. R., 1987). Collectively, these findings further support the argument that intact lexical access ability is important for success at a variety of cognitive tasks and/or that a variety of cognitive impairments can impede successful lexical access.

Given the broad range of cognitive processes and disorders thought to be associated with lexical access, it is possible that the type of verbal fluency test selected could provide different insights into the nature of lexical access and the lexicon or could affect a diagnosis.

Two common forms of verbal fluency tasks are what we will call single-category naming tasks (SCN) and multi-category naming tasks (MCN). In an SCN verbal fluency task (Thurstone, 1938), a person is given a single category (e.g. animal, or the letter "s") and asked to name as many items as he or she can from that category in a set period of time. In an MCN verbal fluency task (e.g. Loftus & Freedman, 1972) a

[1] This work differs from ours in several important ways. While the work by Lucariello et al. compares 4 year olds to 7 year olds and adults, our work traces development between the ages of 3 and 5. Additionally, the number of participants in our study was much greater.

person is given a series of categories (e.g. animal, food, color) and asked to name one item that belongs to each category. As soon as the person gives a response to the first category (animal), he or she is given another category (e.g. food).

Although both SCN and MCN verbal fluency tasks are used to measure lexical access ability, differences between the two tasks could entail that they measure slightly different abilities. In order to investigate the differences between these tests, we used both of these measures to evaluate the lexical access abilities of a single group of preschool children. Additionally, in order to evaluate the relationship between performance on each of the tasks and performance on other linguistic tasks, we tested children on receptive vocabulary, receptive syntax, and articulation, and investigated the relationships between scores on the lexical access tests and scores on the other linguistic tests. Finally, we evaluated each individual age group to determine how lexical access ability, and what may facilitate it, develops over this age span. We discuss our findings for children at each age and suggest implications for choosing an appropriate verbal fluency task.

METHODS

Participants

Participants included 275 children drawn from the Perionatal Environment and Genetic Interaction (PEGI) study (Stromswold, 2006). We included all 3-5 year old monolingual English-speaking children who completed all tasks relevant to our analyses[2]. The mean age of children was 4.6 years (SE=.04 years, range 3.1-5.9 years).[3] Approximately half of the children were females (N=139) and half males (N=136).

Stimuli

Our parent-administered tests were designed to assess children's lexical access abilities and their skills in the areas of spoken and receptive language most frequently assessed in standardized language tests (vocabulary, syntax and articulation). In a previous study investigating the validity and reliability of our parent-administered tests, we found high correlations between scores on all of our tasks (lexical access,

[2] A small subset of the children participated in the experiment more than once, with a minimum of one year between testing dates. For this small subset, we used the child's most recent results.
[3] Age calculated from due date

vocabulary, syntax, and articulation) and scores on the Clinical Evaluation of Language Fundamentals-Preschool (CELF) core subtests (Wiig, Secord, and Semel, 2004, mean $r = .48$, all p's < .0001).

Single-Category Naming (SCN) task: Name Animals

In the SCN lexical access task, children were told: *A dog is an animal. Can you name other animals*? Children then had 30 seconds[4] to name as many animals as they could. Two research assistants who were blind to all details of the experiment counted the number of animals named by each child, and this number was used as one measure of lexical access ability. The inter-rater concordance rate for number of animals named was over 95%, and a third research assistant acted as a tie-breaker for any inter-rater discrepancies.

If a child named the same animal more than once, the animal was only counted once. As a general rule of thumb, named animals were counted as unique, non-repetitions if they would be given their own entry in a standard encyclopedia. Several more specific instructions follow from that rule of thumb. If a child named two pronunciation variants of a single animal (e.g. "lamb" and the diminutive form "lamby"), credit was only given for a single animal. However, if a child named two phonologically-distinct words that can be used to refer to a single animal, credit was given for each animal named. Therefore, "puma" and "panther" were counted as distinct animals, as were adult and baby names of the same animal (e.g. "deer" and "fawn"); male, female and sex-neutral names of animals (e.g. buck, doe, deer); and animals and their superordinate class (e.g. "iguana" and "reptile"). In the same spirit, if an adjective and animal name can be compounded to form a distinct lexical item (e.g. "bluebird" or "polar bear"), the animal was counted as a unique animal. However, if an adjective simply modified an animal name (e.g. "red bird" or "white bear"), these animals were counted as being identical to the animal being modified. For example, if a child named both "bear" and "white bear", "bear" was only counted once, but if the child said "hummingbird and bluebird", the child received credit for saying two animals. Additionally, words that referred to imaginary or mythological creatures were counted (e.g. "unicorn" and "dragon"), but words that clearly did not refer to animals were not counted (e.g. "tree"). Lastly, proper names that clearly referred to an animal were counted (e.g. "Barney" or "Fluffy").

[4] Although many researchers use a 60 second interval in verbal fluency tasks, pilot data revealed that children uniformly stopped naming animals after 30 seconds.

Multi-category naming task (MCN)

In this task, children had a total of 30 seconds to name a single lexical item for each of the following ten categories: a part of the face, a vegetable, a number, a drink, something round, a part of a car, a piece of clothing, something red, a toy, something big. The prompts were given one at a time, and the next prompt was not given until the child either gave a response or refused to answer. No feedback was given between responses. Two research assistants determined the number of prompts for which each child provided a correct lexical item, with a third research assistant acting as tiebreaker in the event of any discrepancies. The inter-rater reliability for the two primary raters was over 98%.

The category prompts fell into three types. Some asked children to name a member of a superordinate category (e.g. “name a vegetable”); some asked children to name objects bearing a physical characteristic (e.g. “name something round”); and some asked children to name a part of an object (e.g. “name a part of the face”). In order to receive credit, a response had to have fit into the right type of category. For example, “convertible” was not a correct response to “name a part of a car”. In this sense, we were not only testing vocabulary or word association but rather the ability to retrieve lexical items from lexical categories at the right level. Responses were accepted as long as they could reasonably fit a prompt, erring on the side of leniency. For example, vegetable-like fruits such as *tomato, cucumber,* and *pepper* were acceptable types of vegetables, and jewelry was an acceptable piece of clothing. Additionally, any level of specificity, including proper names, was accepted. For example, both *doll* and *Malibu Barbie* were acceptable names of toys. Repeat correct responses were allowed, given that, unlike in the SCN, repetitions indicated correctly answering two different questions. For example, a child would have received credit for each answer of *tomato* in response to “name a vegetable”, “name something red”, and “name something round”.

Receptive Vocabulary

The Receptive Vocabulary test was a forced-choice picture-pointing task in which children listened to words and were asked to point to pictures of the corresponding words. Children saw twelve pictures simultaneously, eight of which they were asked to point to, and four of which were distracter items. Our task differed from typical forced-choice picture pointing tasks in that all twelve items were present for all trials. Like the SCN task, our receptive vocabulary task included assessment of children's knowledge of multiple items from a single semantic category (e.g. "saxophone" and "trumpet"). And like the MCN task, our receptive vocabulary task included assessment of children's knowledge from multiple superordinate categories (e.g. MUSICAL INSTRUMENT and CLOTHING). The number of items correctly identified was taken as a measure of receptive vocabulary ability, with a maximum possible score of eight.

Syntax

The syntax test used a standard forced choice, picture-sentence matching with twelve trials. Children viewed two pictures at a time while listening to a semantically-reversible sentence, and then pointed to the picture that best depicted the propositional content of the sentence. The sentences and pictures were designed such that children could not select the correct picture unless they had mastered particular aspects of English morphosyntax that previous research has shown preschool-aged children sometimes have difficulty understanding, such as passive voice (e.g. Slobin, 1966) and binding of reflexives and pronouns to antecedents (e.g. Wexler & Chien, 1985). The sentences tested were semantically-reversible active and passive sentences (e.g. *the pig kissed the sheep* and the *pig was kissed by the sheep*, respectively) and sentences with reflexive and non-reflexive pronouns (e.g. the *bunny scratched himself* and *the bunny scratched him*, respectively). The number of pictures correctly pointed to was taken as a measure of receptive syntax ability, with a maximum possible score of twelve.

Articulation

The Articulation test was a standard word repetition task assessing the accuracy of children's articulation of onsets. Children repeated high-frequency, mono-morphemic, monosyllabic words, and their responses were considered correct if they correctly articulated the onset of a word. For example, for the word *split,* the child had to have correctly articulated the phonemes /s/, /p/ and /l/, and have said them in that order. Given that only onsets were considered for the purposes of scoring, if a child heard *rat* and repeated *rad,* credit was given. The onsets were selected to be appropriately difficult for each age group

(Sanders, 1972, Vihman, 1996), thereby avoiding ceiling or floor effects while minimizing the number of tested words. The number of onsets correctly articulated was taken as a measure of articulation ability, with a maximum possible score of twelve.

RESULTS

There are at least two ways in which lexical access could develop. The first way is quantitatively: older children could name more animals and items than younger children. The second way is qualitatively: older children's scores on the lexical access tasks could be more or less correlated with scores on the other linguistic tasks. We found evidence of both types of development.

Development of Lexical Access

Consistent with previous findings (e.g. Korkman, 2007) performance on both tasks improved with age. On the SCN task, three year olds named an average of 3.51 animals (SE=0.32); four year olds named an average of 6.05 animals (SE=0.20); and five year olds named an average of 7.61 animals (SE=.25). We found a high correlation between number of animals named and age ($r=.55$, $p<.01$). *See Figure 1A*. On the MCN, three year olds named an average of 4.30 items (SE=0.44); four year olds named an average of 6.62 items (SE=0.22); and five year olds named an average of 7.51 items (SE=0.23). We found a moderate correlation between number of items named and age ($r=.46$, $p<.01$). See *Figure 1B*. Being that the oldest child and youngest child differ by only 2 years, 3 months, these results indicate rather rapid development of lexical access, particularly between ages three and four.

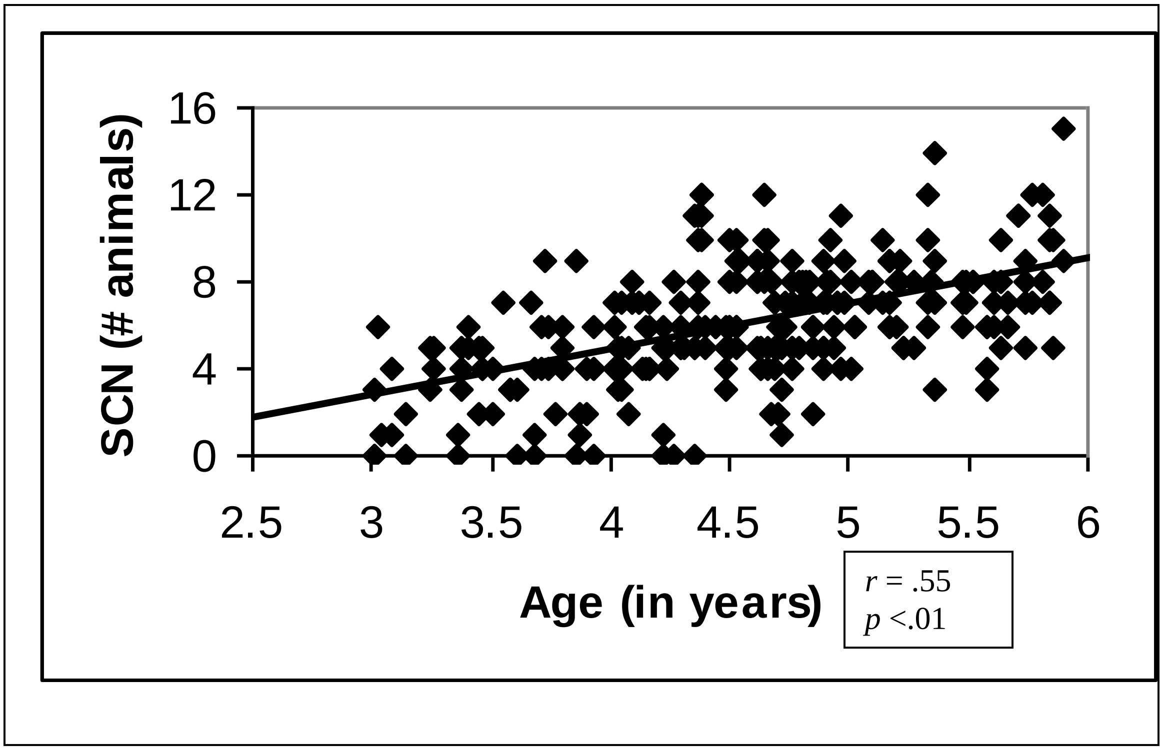

Figure 1A: Age in years and SCN score

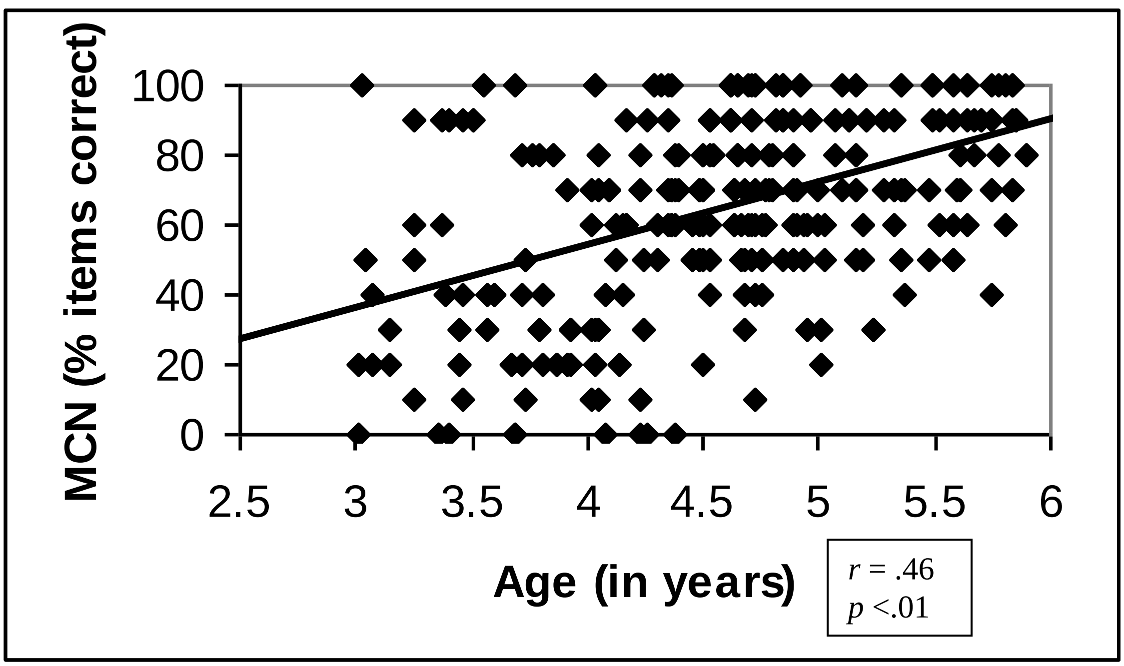

Figure 1B: Age in years and MCN score

Comparison of SCN & MCN

Next, we compared children's performance on the two lexical access tasks. There was a moderate correlation between scores on the two lexical access tasks for each individual age group: three year olds (r=.46, p<.01); four year olds (r=.48, p<.01); and five year olds (r=.34, p=.01, with none of the coefficients being significantly different than any of the others (all p's>.10). Because three, four, and five year olds took exactly the same SCN and MCN tests, data from all children were collapsed. We found a strong, although not perfect correlation between scores on the two lexical access tasks (r=.55, p<.01, see *Figure 2*).

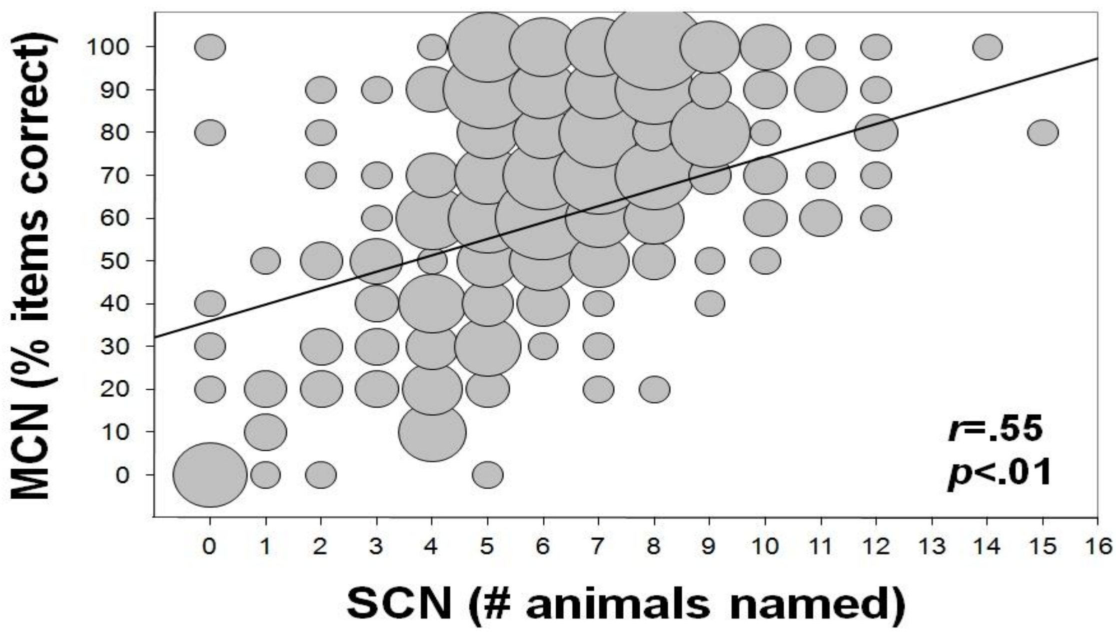

Figure 2: *Correlation between Scores on 2 Lexical Access Tests. Size of bubble reflects number of data points in that coordinate*

Linguistic Components of SCN & MCN

The fact that the correlation between scores on the two lexical access tasks is not perfect suggests that the tasks tap different skills, which might develop at different rates. In our final set of analyses, in order to explore the relationship between lexical access development and the development of other linguistic abilities, we conducted a series of simple and multiple regressions.

To the extent that children's ability to access items from their lexicons depend on their vocabulary, syntax, or articulation abilities, scores on these language tests will be correlated with lexical access scores.

Further, if any of these linguistic skills provides a contribution to lexical access that is unique from that provided by the other two skills, then multiple regression analyses will reveal that this linguistic skill is an independent predictor of lexical access ability. As outlined in the *Stimuli* section, we assessed children's receptive vocabulary, articulation, and syntax abilities. *Table 1* shows the means and standard errors on each task at each age as well as the maximum possible score on each task. Note that there were no ceiling or floor effects on any task.

Age		**SCN**	**MCN**	**Vocabulary**	**Articulation**	**Syntax**
3	**Mean**	3.51	4.30	4.77	8.89	8.26
	SE	0.32	0.44	0.26	0.38	0.25
4	**Mean**	6.05	6.62	6.03	10.00	9.92
	SE	0.21	0.22	0.14	0.2	0.16
5	**Mean**	7.61	7.51	6.42	10.74	9.92
	SE	0.25	0.23	0.17	0.26	0.16
Maximum Possible Score		N/A	10	8	12	12

Table 1: Children's Linguistic Tasks

Regressions

In order to investigate the linguistic skills composing lexical access ability, we performed correlations between the scores on each of the two lexical access tasks at each age. We also performed simple regression analyses with scores on each lexical access task at each age as dependent variables and scores on the other three linguistic tasks at each age as independent variables. We did not collapse the syntax or articulation analyses across all ages, because the items on these tasks varied by age group. Finally, we performed multiple regression analyses to determine which, if any, linguistic factors—vocabulary, syntax, and/or articulation—were significant independent predictors of scores on each of the lexical access tasks. Being that the SCN task and the MCN task were both designed to test lexical access, inclusion of either task in a multiple regression analysis as an independent predictor of the other task would have overshadowed the predictive power of the other linguistic factors. Therefore, <u>we did not include the</u>

SCN or MCN as independent variables in the multiple regression analyses. Furthermore, in order to be able to compare the results of the multiple regression analyses at different ages, we included vocabulary, syntax and articulation scores in all analyses.

AGE 3

SCN: Simple regression analyses revealed that SCN was moderately correlated with MCN (*r*=.46) and receptive vocabulary (*r*=.35), modestly correlated with syntax (*r*=.26), but not correlated with articulation (*r*=-.06). Even though SCN, receptive vocabulary, and syntax were all correlated, a multiple regression analysis revealed that only receptive vocabulary (ß =.31, *p*=.02) was a significant independent predictor of number of animals named on the SCN (*F* (3,49)=3.52, *p*=.02, Adjusted *r* squared=.13). *See Figure 3*.

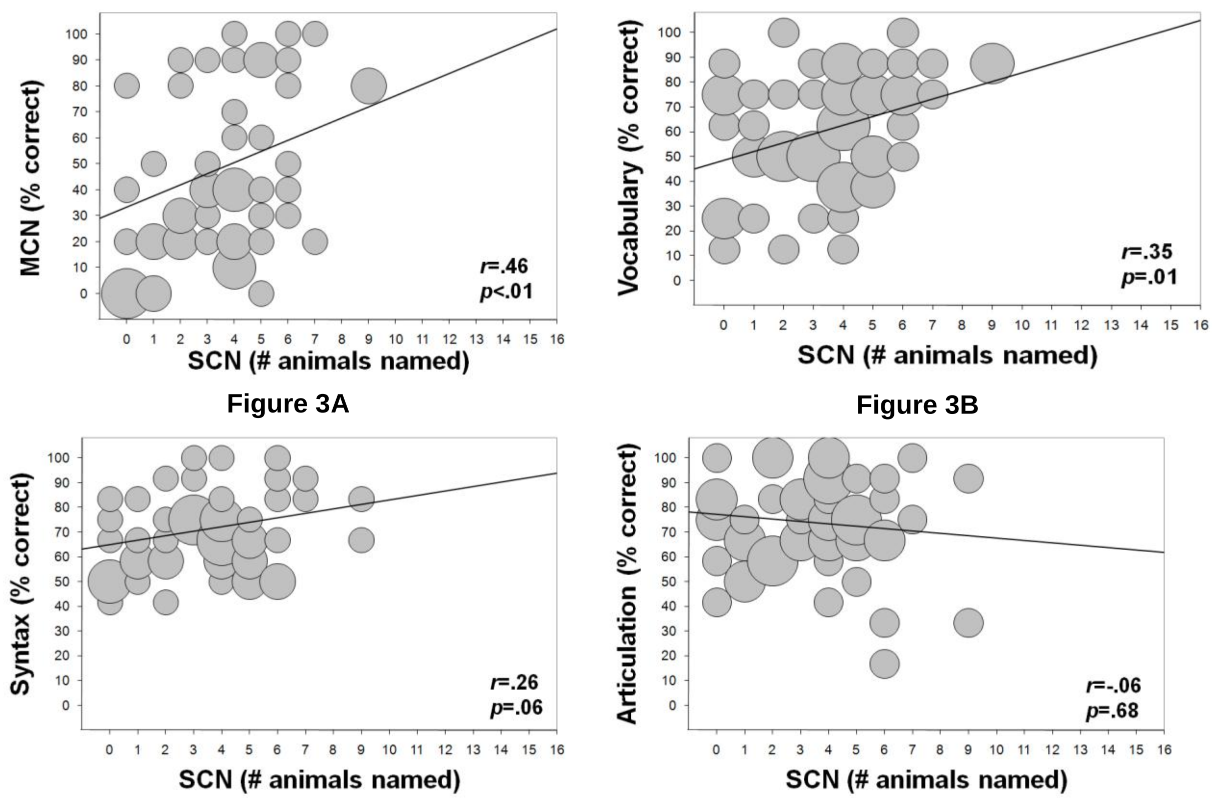

Figure 3: Correlation between SCN & Scores on MCN, Vocabulary, Syntax & Articulation, at Age 3
Size of bubble reflects number of data points in that coordinate

MCN: Simple regressions revealed that MCN was moderately correlated with SCN (*r*=.46) and receptive vocabulary (*r*=.46), and modestly correlated with syntax (*r*=.25) and articulation (*r*=.24). However, as was the case for the SCN, a multiple regression analysis revealed that only receptive vocabulary (ß =.42, $p<.01$) was a significant independent predictor of number of items named ($F(3,49)=6.15$, $p<.01$, Adjusted r squared=.23). *See Figure 4.*

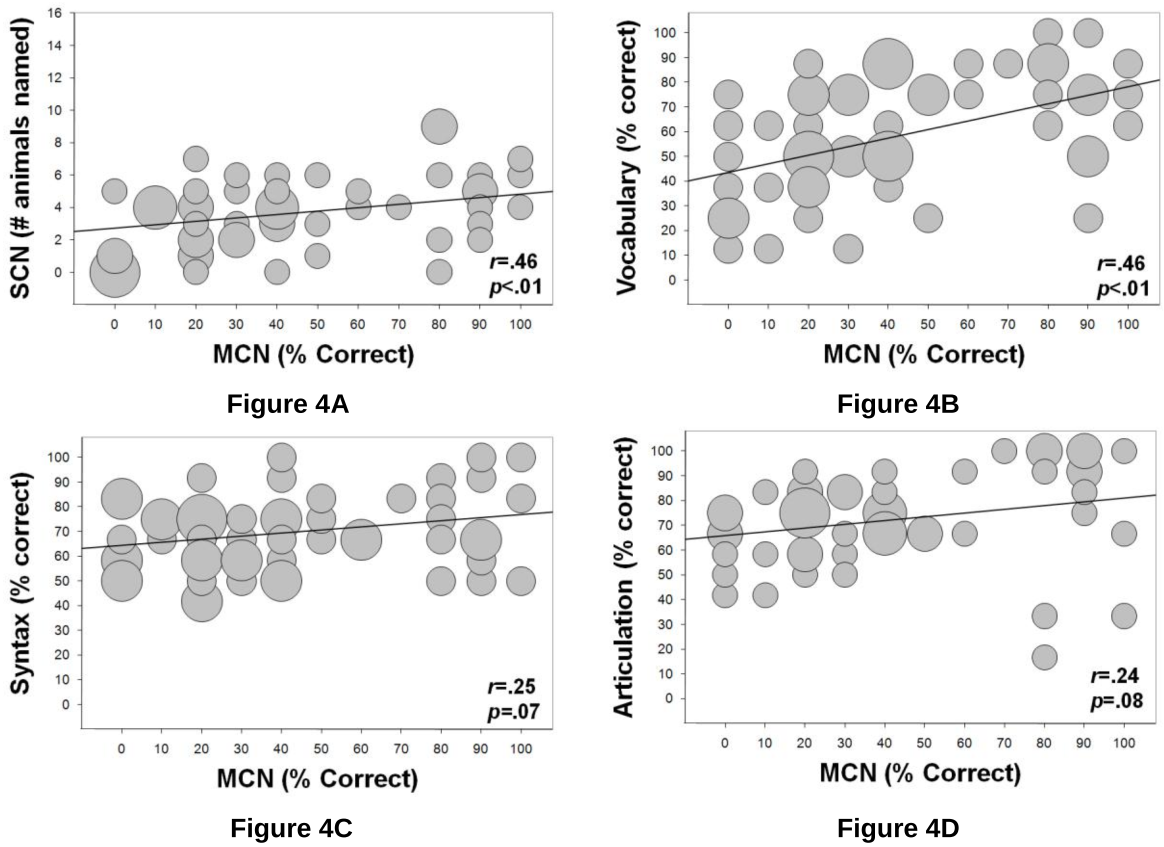

Figure 4: Correlation between MCN & Scores on SCN, Vocabulary, Syntax & Articulation, at Age 3
Size of bubble reflects number of data points in that coordinate

<u>AGE 4</u>

<u>SCN</u>: Also consistent with results from the three year olds, simple regression analyses revealed that SCN was moderately correlated with MCN (r=.48), receptive vocabulary (r=.35), and syntax (r=.41), and modestly correlated with articulation (r=.26). However, unlike results from the three year olds, in the multiple regression analysis, not only was receptive vocabulary a significant independent predictor (ß =.12, p=.02) but syntax was also a significant independent predictor (ß =.33, $p<.0001$) of number of animals named ($F(3,135)=13.28$, $p<.0001$, Adjusted r squared=.21). *See Figure 5.*

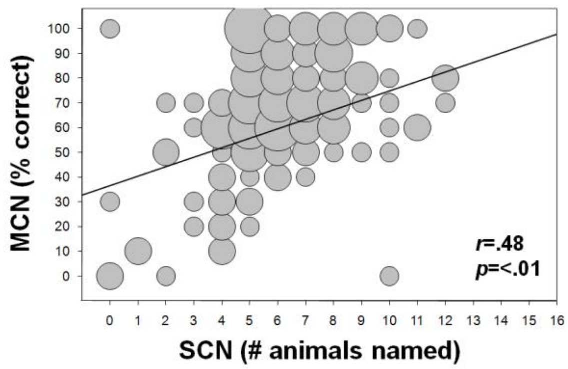

Figure 5A

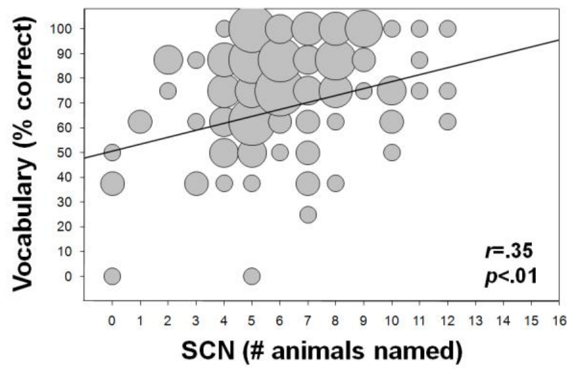

Figure 5B

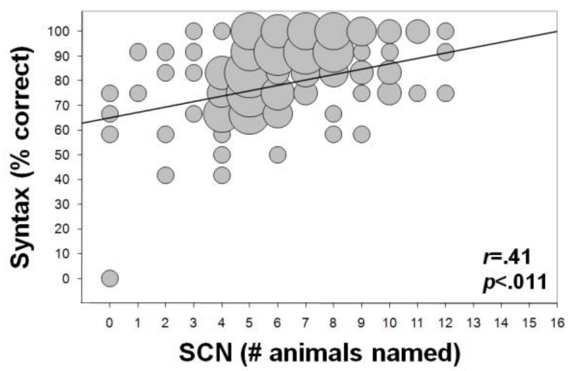

Figure 5C

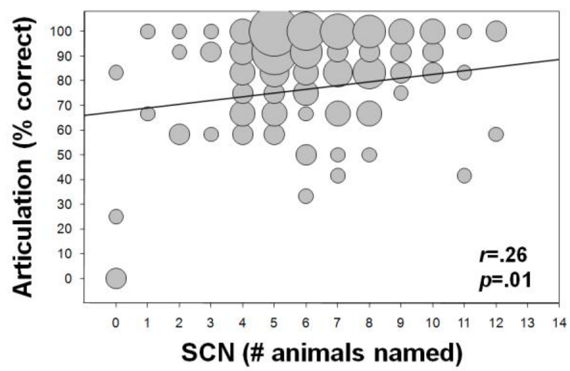

Figure 5D

Figure 5: Correlation between SCN & Scores on MCN, Vocabulary, Syntax & Articulation, at Age 4
Size of bubble reflects number of data points in that coordinate

<u>MCN</u>: Similar to results form the three year olds, simple regression analyses revealed that MCN was moderately correlated with all other scores: SCN (*r*=.48), receptive vocabulary (*r*=.35), syntax (*r*=.32), and articulation (*r*=.39). Similar to these simple regression results, but not to the multiple regression results from the three year olds, a multiple regression analysis revealed that receptive vocabulary (ß =.23, *p*<.01), syntax (ß =.19, *p*=.02), and articulation (ß =.27, *p*<.01) were all significant independent predictors of number of items named (*F*(3,134)=14.28, *p<.01*, Adjusted *r* squared=.23). *See Figure 6.*

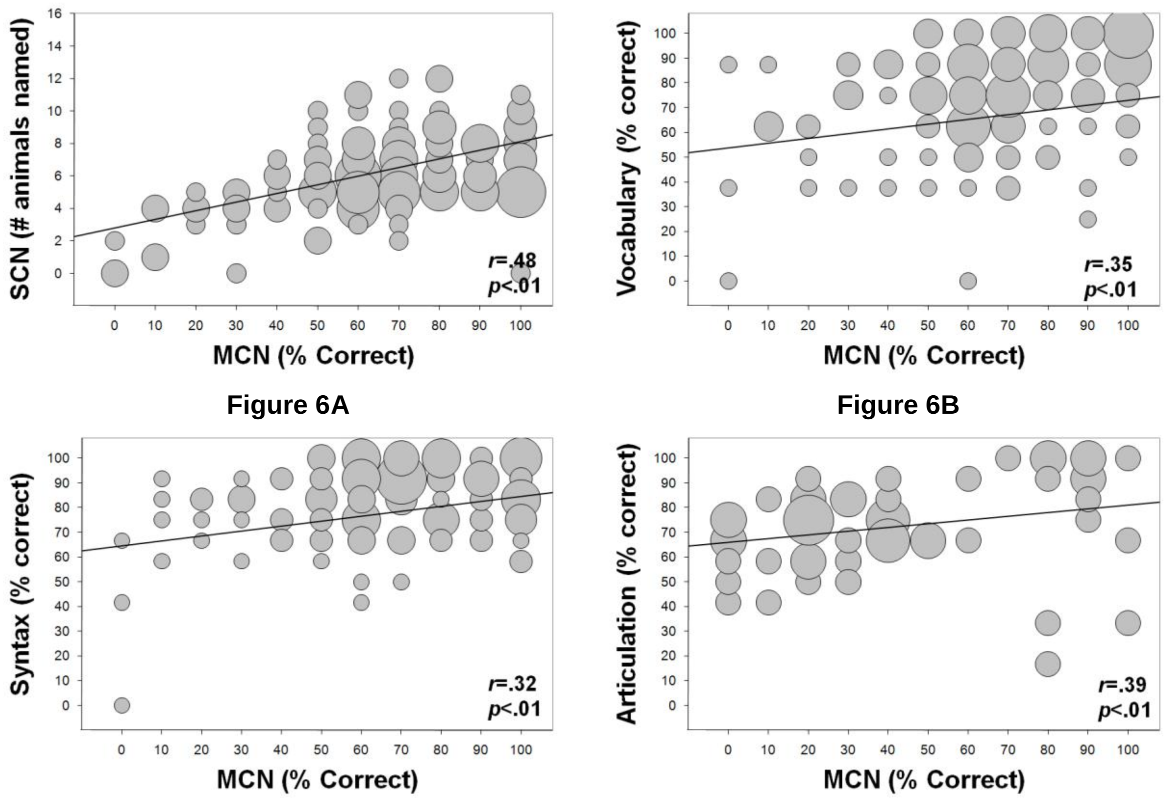

Figure 6: Correlation between MCN & Scores on SCN, Vocabulary, Syntax & Articulation, at Age 4
Size of bubble reflects number of data points in that coordinate

<u>AGE 5</u>

<u>SCN</u>: Unlike results from the younger age groups in which scores from most of the tasks were correlated, simple regressions revealed that SCN was moderately correlated with MCN (*r*=.34) and modestly correlated with receptive vocabulary (*r*=.12), but not correlated with syntax (*r*=.08) or articulation (*r*=.08). Following this trend, a multiple regression analysis revealed that there were no significant independent predictors of number of animals named (F(3,78)=.43, p=.73.). *See Figure 7.*

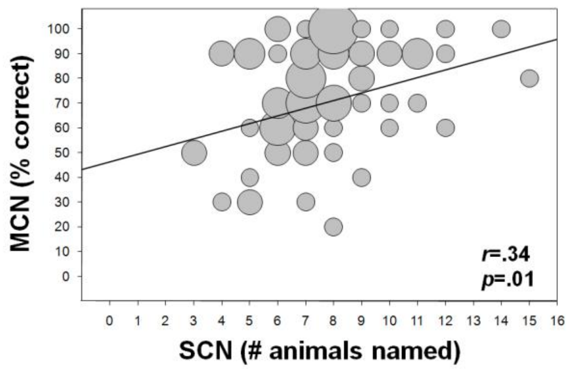

Figure 7A

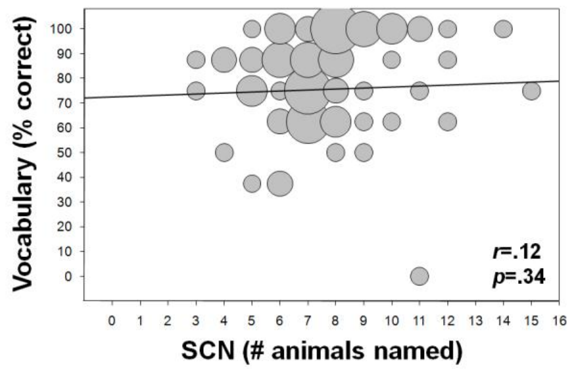

Figure 7B

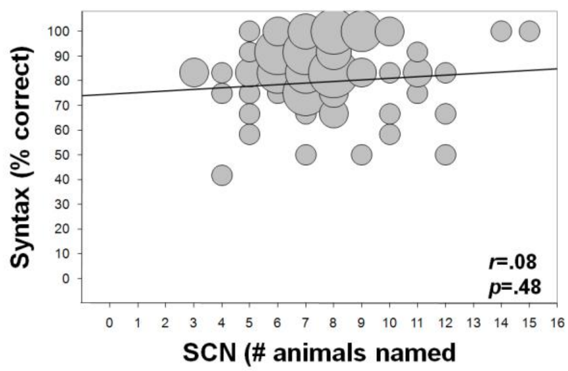

Figure 7C

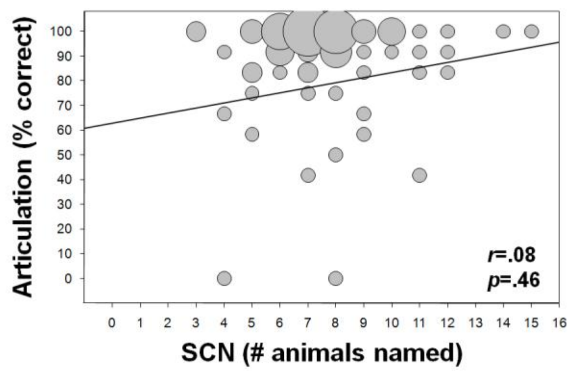

Figure 7D

Figure 7: Correlation between SCN & Scores on MCN, Vocabulary, Syntax & Articulation, at Age 5
Size of bubble reflects number of data points in that coordinate

<u>MCN</u>: Similar to results from the younger age groups, simple regressions revealed that <u>MCN:</u> MCN was moderately correlated with SCN (*r*=.34) and receptive vocabulary (*r*=.38), modestly correlated with syntax (*r*=.29), and moderately correlated with articulation (*r*=.31). However, contrary to results from the younger age groups, and following the trend of a decrease in independent predictors by age five, as demonstrated by the SCN results, only receptive vocabulary (ß =.30, *p*<.01) was a significant independent of number of items named (*F*(3,78)=7.19, *p<.01*, Adjusted *r* squared=.22). *See Figure 8.*

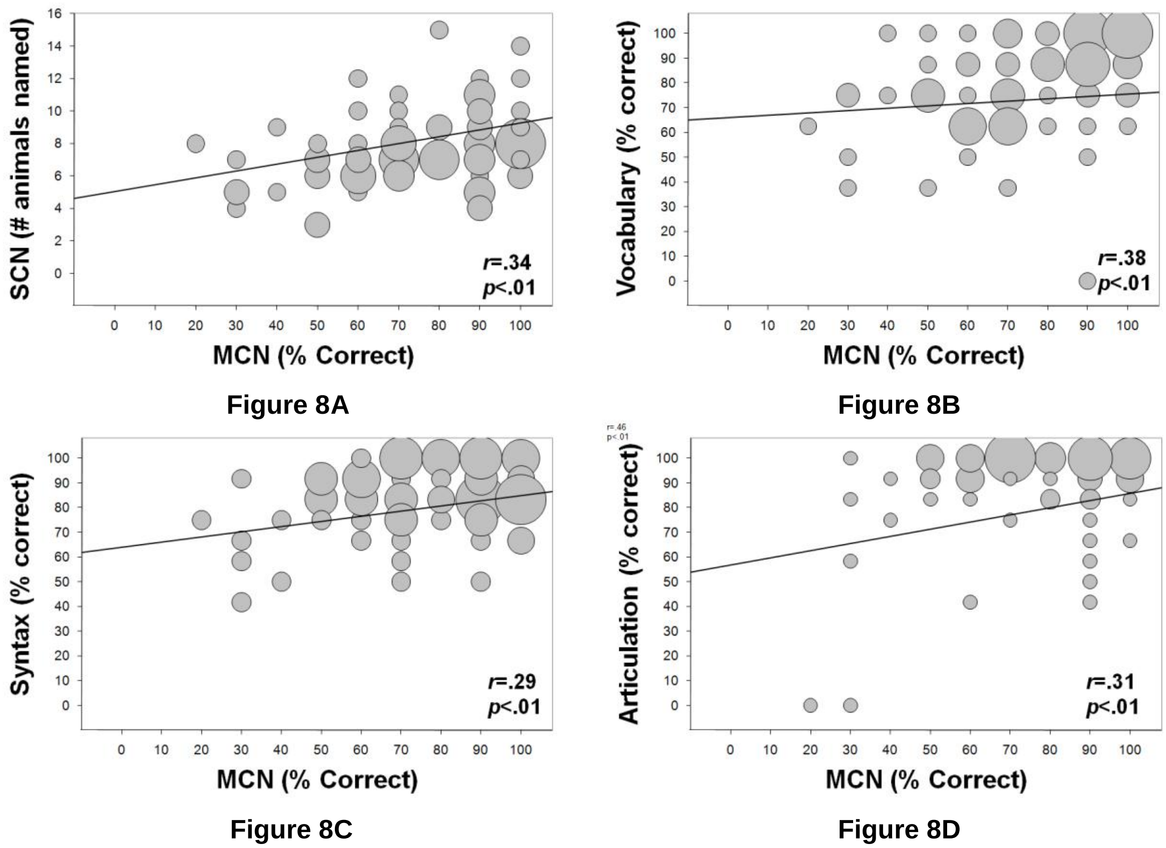

Figure 8: Correlation between MCN & Scores on SCN, Vocabulary, Syntax & Articulation, at Age 5
Size of bubble reflects number of data points in that coordinate

DISCUSSION

Developmental Trajectories

The current study is the first to investigate both types of verbal fluency tasks in preschool-age children. Results reveal a steep developmental trajectory[5] in verbal fluency between the ages of three and four. Although it is not clear why development is so rapid at this age, these results could reflect development in executive functioning, which increases dramatically at this age (e.g. Hughes, 1998); development of meta-linguistic awareness, which also increases at this age, although not as dramatically as at older ages (e.g. Edwards & Kirkpatrick, 1999); an increase in metamnemonic index, the degree to which a person is aware of his or her own memory and learning processes (Benjamin & Bjork, 1998); a

[5] Although it is somewhat problematic to make claims about development using cross-sectional data, it is in fact customary to do so both in language development studies (e.g. Brady et al., 1990, Borg, et al., 2007) and in studies of verbal fluency development across the adult lifespan (e.g. Van der Elst, et al., 2006).

conceptual restructuring from thematic to taxonomic categories (e.g Lucariello, et al, 1992, Mandler, 1983); or development of component linguistic skills.

Scores on the two lexical access tasks were not perfectly correlated with each other and differed in their correlations with scores on the other linguistic tasks**.** Although both lexical access tasks assess children's lexical access ability, the two tasks differ in a number of important ways, suggesting that they tap different linguistic abilities, which may have different developmental trajectories.

Differences in the verbal fluency tasks themselves, and in the linguistic components they involve, can account for the two tasks' different developmental trajectories. For the three year olds, receptive vocabulary was the only independent predictor of scores on either verbal fluency task. One explanation we considered was that vocabulary size could play such an integral role in verbal fluency only when vocabulary is small and thus, a limiting factor. In other words, it could have been possible that for the three year olds, the lexical access tasks were essentially tests of receptive vocabulary. However, if vocabulary were a limiting factor on the SCN, this would entail that the three year olds only knew the names of approximately 3 or 4 animals, the mean number of animals named, or as few as 0 animals, the lowest score a three year old earned on the SCN. In stark contrast, according to the MacArther-Bates Communicative Development Inventories, by 30 months the majority of children can name almost 60 animals (Dale & Fenson, 1996). It is therefore more likely that for three year olds, the receptive vocabulary task measured not only vocabulary but also, to a degree, lexical access, which had the effect that scores on the receptive vocabulary task predicted scores on both the SCN and the MCN independently. Being that the independent predictor was the same across lexical access tasks, at age three, either test of verbal fluency will likely be equally useful in testing or diagnosis.

However, for older children, the independent predictors of scores on each verbal fluency task diverged. At age four, articulation was an independent predictor of MCN score but not of SCN score. By age five, none of the other core linguistic tasks were independent predictors of SCN score, but receptive vocabulary was still an independent predictor of MCN score. If the goal is to gain a pure measure of lexical access ability, not tinted by other linguistic skills, SCN seems to be a more suitable test.

Differences in Retrieval Demands

Several of the differences between the SCN and the MCN stem from the nature of the lexical categories themselves. First, success on the MCN requires accessing a single lexical item from multiple categories. In contrast, success on the SCN requires accessing multiple items from a single category: animals. Second, optimal performance on MCN necessitates quickly locating the prompted category, retrieving a word from that category, and then quickly switching to the next prompted category. Conversely, performance on SCN necessitates naming all categories from a single large category. Consider an analogy in which lexical access is equivalent to searching for a book in the library. Under this analogy, MCN primarily measures the speed at which a child can traverse a library and locate books in several different sections. The greatest time demands are in travel between sections. In contrast, SCN primarily measures the speed at which a child can pull several books off shelves located in the same section. Here, the greatest time demands are in navigating a single section.

Third, in MCN, some of the prompts asked children to name a member of a superordinate category (e.g. *name a vegetable*); some asked children to name objects that had a certain physical characteristic (e.g. *name something round*); and some had children naming a part of an object (e.g. *name a part of the face*). In SCN, the prompt always encouraged children to name members of a superordinate category (*name animals*). Returning to the library analogy, while success on SCN requires that a child can find several books in the same card catalogue; success on MCN requires that a child can find a single book in each of several catalogues (e.g. subject, author, title).

Lastly, the two lexical access tasks differ in that there are more members of the animal category than there are members of many of the MCN categories. Previous research on the effect of semantic neighborhood density on lexical access has yielded mixed results, even when comparing different measures within the same study. For example, one study found that near neighbors inhibit lexical access but distant neighbors facilitate lexical access (Mirman & Magnuson, 2008); another study found that semantic neighborhood density inhibits lexical access, but only in impaired populations (Bormann, 2011); a third study found that semantic neighbors inhibit lexical access unless the distracter items are masked in a modified Stroop task, in which case, semantic neighbors facilitate lexical access (Finkbeiner & Caramazza, 2006), and so on. Although the effect of semantic neighborhood density is clearly still under debate, it is likely that the size of a category is one of many factors that affects the ease with which the category can be traversed. Any effect of semantic neighborhood density, whether positive or negative, would distinguish the SCN from the MCN in terms of difficulty of retrieval. Additionally, given that the animal category is larger than the MCN categories, a child would be more likely to get "stuck" on an MCN prompt, either because the child could not think of a word or because the child struggled with articulating the words that he or she wanted to say. Conversely, in SCN, if a child could not think of or pronounce a word, a greater variety of alternative words were available.

Differences in Associated Linguistic Components

SCN and MCN also differ in terms of their comprehension demands. On all three levels—vocabulary, syntax, and articulation—the comprehension demands are higher for MCN. In terms of vocabulary, for success on MCN, children must understand the names of several categories. In contrast, for SCN, children only must understand the name of one category—and the word *animal* is acquired by most children before age 2 (Dale, et al., 1996). The instructions were syntactically more complex on the MCN, which included three different types of prompts: *Name a blank, Name something blank, Name a part of a blank*. For each question, the child needed to comprehend a new instruction, some of which included prepositional phrases. For SCN, the child only needed to comprehend the syntax of the instruction once, and the syntax was rather straightforward. Similarly, the receptive phonological demands were greater for MCN, in which the child needed to process each prompt. In these ways, SCN is inherently a purer test of lexical access.

Additionally, SCN and MCN differed in terms of their expected likelihood for fostering phonological priming effects. If children phonologically cluster, we might expect articulation scores to correlate more highly with scores on SCN in that strong phonological awareness could lead both to success on the articulation task and self-priming on the SCN. For example, a participant with strong phonological skills might say */kangaroo/* and then */cougar/*. Previous work has suggested that adults phonologically self-prime during verbal fluency tasks (e.g. Slowiaczek & Hamburger, 1992). Phonological self-priming would be less likely on MCN, where participant responses are interspersed with questions and where the semantic categories are both narrower and inconsistent from response to response. The fact that articulation scores were not a significant independent predictor of number of animals named indicates a lack of phonological clustering in children.

On the other hand, one reason for greater correlation between articulation scores and MCN scores than SCN scores could be that children who struggle with articulation had less choice on MCN. Being that children most likely have more vocabulary in the animal category than in any of the MCN categories, and being that there are several monosyllabic names of animals but not as many monosyllabic words in the MCN categories, the MCN likely poses more challenges with articulation.

Implications for Children with Developmental Disabilities

Consideration of the differing task demands involved in each type of verbal fluency task is important for choosing the task that best accommodates the nature of a child's impairment. For example, Weckerley et al. (2001) argue that Specific Language Impairment—generally characterized as a language-specific disorder—may in part be attributable to general processing difficulties. For children with SLI, decreasing additional task demands could be necessary for forming an accurate picture of verbal fluency ability. In particular, Specific Language Impairment is generally subdivided into two types, receptive and expressive (Rapin, 1996). A child with receptive SLI could be expected to perform more poorly on the MCN task, which has greater comprehension demands. In contrast, a child with expressive SLI could be expected to perform more poorly on the SCN task, which has greater production demands. Depending on the reason for testing, a clinician might choose the task that is expected to be more or less challenging for a particular child.

As another example, researchers disagree about whether ADHD inhibits verbal fluency (compare Felton, et al. 1987 and Cohen, et al. 1999). It is possible that the effect of ADHD on verbal fluency depends on its comorbidity with dyslexia (Cohen, et al. 1999) or on the child's ADHD subtype (e.g. inattentive or hyperactive). Taking these factors into consideration, some children with ADHD could have more success on the MCN task, in which they will receive continuous prompts and will be less likely to get distracted as they might on the SCN after naming only one or two animals. On the other hand, some children with ADHD could find the SCN easier, given that this task only requires processing a single prompt; continuously processing the prompts on the MCN could prove cumbersome.

A child who stutters would most likely have more success on the SCN, because the MCN has greater articulation demands. A child with Asperger's Syndrome could do very well on a verbal fluency task naming items from a category of high interest but do very poorly naming items from a social category. For example, one study in which adults with high functioning autism were given several verbal fluency tests found that they performed most poorly on a verbal fluency task naming professions (Spek et al., 2009). Finally, a child with an anxiety disorder might be more successful on SCN, which is generally less cognitively demanding and therefore could be less anxiety-provoking. Ultimately, consideration of the differences between the two tasks outlined in this paper combined with a careful evaluation of an individual child's abilities could be used to select the most appropriate verbal fluency task.

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