Children with Specific Language Impairment exhibit significant language disorder in the absence of autism, hearing impairment, general developmental delay, or any significant neuropathology. In this presentation, I will review current proposals concerning SLI and several studies that examine processing at several levels of language along with evidence that suggests a broader deficit underlying SLI than has been previously suggested.

Let me start with some acknowledgements, which is always a good place to start. First is the funding from NIDCD without which this work would not be possible. In particular I want to call your attention to “Real Time Examination of Childhood Language Impairment,” which is my current grant with my now late colleague Dave Swinney, who is very much responsible for my interest in sentence-level processing in language impairment; David’s work is now being carried on by Tracy Love at San Diego State University. I also show a partial list of the most notable and most involved collaborators, particularly, Valerie Schafe who is a colleague at The City University Graduate Center, as well as a variety of graduate students and post-docs who have collaborated with me on this work. I will also acknowledge people along the way as I talk about work that is uniquely theirs.

To put this topic in a broad context, our discussion today will focus exclusively on children with language impairment, but there is a variety of clinical groups who until recently have been studied separately with the goal of describing the specific language impairments of a given clinical syndrome. But what we have come to realize is that although there are some unique characteristics to each of these groups, there are also some commonalities that are important. The commonalities tell us about the aspects of language that are most relevant to language impairment, but they also tell us about some of the basis that is shared across some or all of these groups. So I am not going to say too much more about this but I wanted to be clear about the wider perspective on the specific discussion of this clinical entity.

What defines specific language impairment? These children have an IQ that is in the normal range, typically defined as 85 or above. There are exceptions to what I am about to say, but we can say that they are in the lower range of normal, and this can confound the results; you do not know if differences between groups are due to difference in IQ or to language status. For instance, performance IQ assessed by the
Raven’s Progressive Matrices, a widely used test of non-verbal intelligence, arguably uses some internal language to promote decisions about complex items. So even those performance tasks might put children with language impairments at a disadvantage. The children have normal hearing sensitivity; they have no reported emotional or behavioral disorders. They do not have any significant neurological conditions, no perinatal bleeds, no seizures, no sub clinical seizures. They do have a significant deficit in language production. People usually define this as at least 1.25 standard deviations below the mean on some omnibus language test. They often but not always have an obvious deficit in language comprehension. One of the obvious problems with that assertion is that language comprehension instruments are quite limited. Language comprehension is usually tested by means of pictures, a vocabulary task in which four pictures are presented and the subject is asked to point to the picture that corresponds to a word, or to a picture that refers to the plural or the past tense of completed events. Those are fine measures, but they are limited. Though they have clinical value, they do not reveal all the comprehension deficits these children might have.

What are some of the developmental characteristics of these children? They exhibit late emergence of first words, slow vocabulary development, late emergence of syntax. By the time that they are 18 months old many of these children can be identified as late talkers. By 24 months a child is defined as a late talker if there are fewer than 10 words in the production vocabulary, and the child has not yet started to combine words. Late talkers are an interesting group; not all of them end up with some language impairment. Some of them have a burst of development and catch up, but I have questions about that, and that is a whole other talk.

One of the intriguing aspects of SLI that has attracted a great deal of investigative attention is the morphosyntactic errors, particularly concerning tense. Cross linguistically, different patterns tend to emerge. English is an odd language to study morphosyntax because there just is not much, it is quite sparse. There is one specific researcher, Laurence Leonard who has been quite active in studying a whole bunch of other languages.

They do seem to express errors in complex sentences, in both producing and comprehending complex sentence. And there is some evidence that they have deficits in comprehending discourse, which for school age children is problematic, particularly by the time they hit third grade, when the discourse level of the classroom changes markedly. They show other deficits as well and the relation of these deficits to their language deficits requires a close examination, which we will turn to later. But just to give you this quick list, they have deficits in speech perception, revealed in work by Paula Tallal in the 1970’s that seemed to suggest that these children have a temporal deficits in their speech perception. This deficit has been written about in many different ways: things that are presented rapidly, or aspects of speech that are very brief, or that are surrounded by elements that are longer, so they are relatively brief compared to what comes before and after. There is also some notion that Tallal proposed that their deficits have to do with things that change rapidly. None of this is uncontroversial but whatever the exact nature of these deficits is, it is clear that these children have to do have perceptual deficits.

Cognitively, the children seem to have deficits in processing speed. They almost always are slower than typically developing children of the same age in reaction time
measures with all sorts of tasks. They have deficits in working memory as indicated by
a suspect task — I will just roll my eyes at and not say too much more about this
measure — non-word repetition. I do not doubt that SLI children have deficits in
working memory. In fact, Claire Martin and I have done several studies investigating
this. The non-word memory data come mainly from Gathercole and Baddeley and are
basically examined in terms of Alan Baddeley’s model of working memory. The
difference between typically developing children and children with SLI is that in a task
requiring repetition of 3 nonsense syllables, the groups diverge slightly in performance.
At 4 syllables the SLI children simply collapse — that is the only performance
difference. Now, this measure could be contaminated by knowledge of multisyllabic
words, so it is not the best task.

One popular explanation is for this is that performance reflects a deficit in resource
capacity, but I am not a fan of this explanation. This just does not explain very much,
inasmuch as it invokes a rather general notion. In any case specific studies have not
explored this. There is some indication that children with SLI have problems with
attention, and that SLI can be comorbid with attention deficit disorders. There is also
some suggestion from studies Karen Martin and I have done with Susan Ellis Weismer
that children with SLI have difficulties with working memory tasks, which suggests
difficulties in suppression or responses and also difficulties in attention shifting.

Finally there are differences in neuroanatomy, particularly in an area called the
temporal plane, which is a triangle shaped area around Wernicke’s area usually larger
in the left hemisphere than the right hemisphere. Children with SLI do not exhibit a
hemispheric difference, or they show a right asymmetry when compared to age-
matched peers. Finally, I will show you at the end of the talk that there is some
difference in neurophysiology in processing language with these children.

How specific is this specific language impairment? As I have said, much of this
must be strongly qualified, but nonetheless the impairment is both specific and
specific to language in the sense that these children are not autistic, they are not
developmentally delayed, they are not hearing impaired, and they are not
neurologically impaired in a gross sense.

Dr. Joseph Jaffe: Do SLI children express the deficit with everybody or just with
their parents?
Professor Schwartz: With everybody.
Dr. Jaffe: If, as you say, it runs in families, then the families are going to have a
speech problem.
Professor Schwartz: That is an interesting point. It is not so much limited to
speech, but more broadly to language — syntax and semantics. There are a very small
number of studies that look at parent’s language when their children have SLI. And,
there seems to be some general recovery. You have to test more sensitively to tell but
you can tell. There general language day to day is generally normal. I am being
noncommittal here because some projects have followed children with SLI into
adolescence and early adulthood — though, not into parenthood — and have found
that in writing samples, these morphosyntactic errors in tense may persist. And there
is one study — I am not going to talk about it in length — of the KE family. People
have talked about them as if they have specific language impairment but they clearly
have a motor involvement that differentiates them. In that family there is clearly a generational history, as you asking about.

What are some of the outcomes for these children? Their social interactions are limited by the impaired language functions, though this has not been studied extensively. As I have said, there are morphosyntactic errors. People have talked about dyslexia as the outcome of SLI, not so much in reading but in the phonological impairment associated with dyslexia. Recently, Dorothy Bishop has suggested that the distribution of effect shows that SLI and dyslexia are two separate disorders, in which an individual might express both, either or neither. SLI children have other learning disabilities, such as in mathematics. Then, of course, as they go on in school if they have limitations in language production and comprehension they will have more limited abilities to acquire knowledge.

Accounts of SLI separate into two groups. One is a linguistic account; that there is a deficit these children have in their linguistic knowledge. One idea is that they do not form functional grammatical categories and this limits their ability to actually acquire productive syntax. Then there is this other idea that has been proposed by Mabel Rice and Ken Wexler called the extended optional infinitive. The idea is that children with SLI do not realize that you have to mark things like tense. Normally developing children go through a period like this as well but SLI children get stuck in this period for maturational reasons. They do not mark tense they think that stem forms are optional, which keeps them there. And there are other proposals as well. I meant to put Heather van der Lely’s proposal up there. She has suggested that children with SLI have a domain specific deficit in their ability to establish grammatical relations across a sentence. For instance, this deficit is expressed as an inability to establish a relation between an antecedent noun at the beginning of a sentence and a pronoun that comes later in the sentence. And she believes that this is very domain specific.

The other group of accounts relies on general cognitive functions that cut across domains. For example, there has been discussion of central processing deficits underlying SLI. Some have proposed that children with SLI exhibit cognitive slowing and that this affects them across a number of different kinds of tasks. There is Paula Tallal’s view that children with SLI have speech perception deficits and there is even a fix to this, a method developed by Scientific Learning company called Fast ForWord®, but its clinical effectiveness has not been consistent.

Then there is this idea of Michael Ullman taken from the aphasia literature, that children with SLI have a procedural deficit. The conceptualization is that children with SLI do better with irregular past tense (TEACH and TAUGHT) which they can simply commit to memory, than they do with a regular past tense which requires a rule or procedure (COUNT and COUNT+ED). Michael and one of his students by the name of Pierpont proposes a model of this view, and if there is not a lot of evidence yet it is an interesting idea. Finally there is the Gathercole and Baddeley perspective that the basis for SLI is a working memory deficit.

What are some of the limitations with these theories? There are all these processing theories, but the data which people base these theories come from what we called end-state data, either of language production during a language sampling session. Or, comprehension responses resulting from a picture verification test, for instance.
None of the hypothetical functions underlying the coherent response, right or wrong, is ever examined directly. If the response is right this is certainly a good sign, but nothing leading to the response is examined. When the response is wrong there is little to permit an analysis of the causal events in the chain that led to the wrong response. In comprehension tasks you can be clever about this by using the right foils but you still do not have any insight in the process.

Even if you do try to it is hard to imagine how to create tasks of matched complexity to equate language and non-language working memory tasks. And there is always this issue that you have to be much of a modularist to think this way but shapes patterns sounds, they all have this different status for us than language. So to find something that really would equate across language and non-language tasks, even in working memory, would be challenging.

**Professor Edward E. Smith:** Don't people look at the correlations between the magnitude of the working memory deficit versus the magnitude of the language deficit? Since you have high correlations then it starts to be convincing, but without high correlations I do not blame you for just ignoring it.

**Professor Schwartz:** You are absolutely right; they have looked at correlations and in some cases with the non-word repetition tasks, which I was so dismissive of a few minutes ago. A larger scale study looked closely at the poor scores on the non-word repetition in relation to the child's status as SLI, aiming to be predictive. But there really has not been a plausible explanation offered linking the two functions.

**Unidentified guest of the seminar:** Are the children all native speakers of English, or are they bilingual or are they trilingual.

**Professor Schwartz:** That is a very good question. All the studies of mine that I am describing today excluded children who have exposure to other languages, which, in New York becomes increasingly complex to manage.

**Unidentified guest:** I ask because bilingual children can have some of these symptoms of late first word

**Professor Schwartz:** You are absolutely right. There have been a small number of studies looking at language impairment in bilingual children because this is a serious issue. This is difficult even in a clinical setting, let alone a research setting, it is very difficult to distinguish children who are bilingual or who are perhaps slow in learning their second language versus those who truly have language impairment. And it is usually only by testing in both languages that you can make a diagnosis. There are a handful of studies looking at children who are bilingual, but it is a difficult population to identify, and in all other cases people go to great lengths to avoid that complication.

SLI children divide up into subgroups; there is a fair amount of variability in the severity in the language impairment, in the areas affected by the language impairment. People have divided the subtypes into children who only seem to have expressive disorders and children who have both receptive and expressive deficits. Heather van der Lely argues for grammatical SLI. She excludes, children who might be borderline autistic or Asperger's, she also excludes children with phonological deficits as most SLI studies do. The hallmark for these children is exclusively grammatical deficits, assessed in a series of probes. It is a really interesting and intriguing idea. In a larger studying of
SLI children Dorothy Bishop and colleagues found that fewer than 5% of them had GSLI. And even in van der Lely’s project they have an age range from 7 to 20, which introduces huge norming problems when the measure is reaction time. There really is no successful method to compose a group with such disparate ages. But I think it is an interesting and potentially useful way to assess individual cases, although I do not believe that this subtype represents SLI more generally.

Dorothy Bishop has suggested that there is actually a continuum from SLI to autism with a group of children that have what she calls a pragmatic disorder, defined by a questionnaire that Dorothy and her colleagues have developed that asks about the child’s verbal and social interactions. The importance of this hypothesis is that many SLI children are actually cases of undiagnosed, high functioning autism and should not be classified or treated as SLI at all.

My interest in this started when I was a doctoral student, but in the last 10 to 15 years I have developed a number of investigative tools to look at various aspects of SLI. Here is a quick sampling of some of the studies that I have done. I am not going to talk about fMRI today, but I have one project ongoing in Spain and another just getting started now, and sometimes in a few years form now when that is done, I hope I can come back and talk about that.

We are looking for the underlying causes of SLI, and in the relations among clinical populations exhibiting autism, hearing impairment and Williams Syndrome. Overall, we want to be able to paint a more coherent picture of childhood language disorders. The goal is a shift of emphasis toward viewing language impairment as a symptom of an underlying deficit. Our field has spent much of our time trying to describe the language deficits themselves, but really what we are after is the fundamental functions that produce the deficit when they are compromised. But describing these clinical types in reference to structural linguistic deficits is not sufficient. I think there are cognitive processes that underlie it that are really at the heart of it. I am going to present a few behavioral studies and a couple of electrophysiological studies to give you an idea of what we have found over the next six years.

Frances Schaffer who is now at Hunter College was interested in looking at the Ganong effect, which is basically a lexical effect on speech perception. If you ask people to make categorical judgments about an acoustic series varying from /da/ to /ha/, they will produce a labeling function with a boundary intermediate between the voiced and voiceless consonants. If the same acoustic variants are embedded in the word DASH and the non-word TASH, the boundary items are reported as DASH, because it is a real word and phoneme judgments are influenced by lexical representations. Fran was interested in vowel duration and final consonant voicing and we did somewhat more complete design than Francis Ganong had done. I expected that children with SLI would have weak lexical representations and would not have strong lexical bias, but in fact they had stronger lexical bias than the typically developing children. And by way of explanation, we also did some other testing showing that these children do have perceptual deficits. Evidently, they somehow make these guesses based on words that are familiar to them.

I would also like to say a bit about the phonological organization of the lexicon. Larry Leonard and I did a series of studies with very young children with SLI, at the
one word stage, which is comparable to a typically developing child 18 months old. We taught them novel words that were either phonologically consistent or inconsistent with their existing vocabulary. We had words with sounds that they had never attempted. And then we had words that were made up of sounds that were in their adult targets when they produced things but not in their speech. For example, when they would pronounce /t/ instead of /č/ for CHICKEN. We then made up non-words based on these categories of sounds and exposed the children to objects and the made up names for these objects for a period over a month. The children with SLI showed a selectivity, they were better, faster, for words with the consistent sounds, and slower to learn words with the inconsistent sounds; this was true for both groups. Remarkably, the children with SLI exhibited an interesting anomaly when they produced these attempted words; they made completely different errors than what they had made in the developing sample. In contrast, the typically developing children produce a nonword with an /č/ with the same error that they had had at the beginning of the experiment. With the SLI children it was as if they did not recognize that they had a way of producing this sound; there was nothing systematic to it. They somehow were not in touch with the phonological characteristics of their existing vocabulary.

We also did a large-scale lexical decision study with children 7-9 years of age with SLI; the control conditions tested age-matched typically developing children. A subject simply had to make a word or non-word report, and we chose words based on the same kind of dictionary that Paul Luce, Mike Vitevitch and Dave Pisoni have used. We manipulated neighborhood density of the test words. A word comes from a dense lexical neighborhoods when its phoneme form is similar to many other real words, perhaps differing by a single segment. Of course, words can come in dense or sparse neighborhoods. Typically, there is an interaction between density and frequency such that it is easiest to access a high frequency word in a sparse neighborhood and hardest to access a low frequency word in a dense neighborhood. And we were just looking to see if we would get neighborhood effects in children with and without SLI. Typically developing children make more accurate and fast lexical decisions. SLI children do very poorly with non-words; they are at a chance level. They just are unsure at some level whether these are real words or not. SLI children also have markedly reduced density effects, which is also consistent with the early word learning study.

We also wanted to look at lexical access from a different way. Liat Seiger, who just finished her dissertation and is now at Lehman College, used a model initially developed for understanding Levelt's cross-modal picture-word interference paradigm. In this paradigm, a subject must name pictures presented in series while listening to words; the trick is that the specific words that are presented are related to the pictures, both semantically and temporally. This is really a word asynchrony. So you hear the word 500 ms after the onset of the picture. These are fairly typical probe points for this cross modal word interference task. This one we added because SLI and Typically Developing children might be slower than adults initially tested in this paradigm and it ended up being irrelevant. Interestingly there was a very late semantic inhibition in SLI at 300 ms. By the way, inhibition and facilitation is defined by how quickly you name the picture, if it is slowed by the appearance of the interfering auditory appearance, then it is inhibition. By the way, these are all controls with no
auditory condition, so you have a neutral condition. And the SLI children seem to have this late semantic inhibition that should have been suppressed at this point.

**Professor Smith:** How do SLI Kids do on the basic Stroop task?

**Professor Schwartz:** Ask me in about three months, we will have some data.

**Professor Remez:** It seems as if SLI children have a deficit in producing sufficient inhibition after lexical identification occurs. Alec Marantz has evidence of neural inhibition following contact in lexical identification, and this would be a miracle if it turned out that RT inhibition was actually a marker of neural inhibition.

**Professor Schwartz:** What I intended by that is that across these studies we see little bits of evidence that point to those kinds of problems in these kids, and it is something that we need to look at more directly.

In another assessment, we used a modification of a technique that Dave Swinney developed, cross-modal lexical priming. The way it was originally done with adults is that a spoken sentence is presented, and at a critical point in the sentence a printed item pops up on a screen, and the subject must decide whether it is a word or not. Dave and Tracy Love adapted this method to children by using a picture-word identity prime. Tracy did this study initially with typically developing children, and we are in the process of doing this with SLI as well. The function that we are measuring is the tracking of nouns when the syntax leaves a gap in a relative clause. For instance, in the sentence, “the zebra that the hippo kissed ran off,” who was kissed? Of course, it was the zebra, and the psycholinguistic story is that there is a gap after kissed that is filled by reactivating the noun ZEBRA. Using the probe technique developed by Dave Swinney, it is possible to show that the gap coincides with increased activation that affects the lexical decision to a probe presented shortly after the gap. And, if the probe is delayed a bit more, then the priming advantage disappears, as if the gap was filled and the function moved on. Of course, the noun and its role in the sentence is stored somewhere, but it is not active before or after the gap.

In a pronoun and reflexive study from English, we exploited a method that we adapted from McKay and McDaniel, who originally used it with typically developing children. With the pronoun and reflexives, when a late pronoun reflexive occurs in a sentence and the antecedent is early in the sentence, the antecedent is reactivated automatically. Psycholinguists talk about this as a reflex, it happens very automatically and it is not a conscious thing. We wanted to see how SLI children would do with this. The SLI children are slower as we would expect, but they actually do establish the relation with both the pronoun and the reflexive. We are also conducting this study with a younger group of SLI children and they have great difficulty doing this, whereas the younger normally developing children do just fine. One of the things that I will say is that we often use offline probes where we ask the children questions related to the sentence and the children with SLI do terribly with this sentence. Even if they get the automatic processing right, it may be that translating that ability into a response to a question is somehow beyond them; and the functions that are involved in the translation from an automatic process to a conscious response we really do not know about.

**Professor Smith:** Did you give the results of the gap filling?
**Professor Schwartz:** No they do not show activation at the gap. But, of course, our testing opportunities are drastically limited, in contrast to adults. With adults, you can do the gap filling experiment with multiple probe points and you can test the individual parametric variants between subjects. With children and with clinical populations you do not want to run this between subjects. You have to run this within subjects and this limits the number of probe points that can be taken without fatiguing the subject, or using the same test item so often that the subject simply learns the test materials. One possibility in this gap study is that even though the SLI children do not activate at the gap, they activate later. Our answer to this, to the multiple probe point is to look at what would happen if you present these sentences at different speeds to children. This is actually an idea that Dave Sweeny had a number of years ago. I believe there are data from normal adults and from aphasics that show if you slow down the rate of presentation in sentence processing experiments, aphasics actually do better, and if you slow it down enough, normals begin to be disrupted. This fits with ideas that Dave and Tracy have had about the intricacy about the timing of sentence production, where slight deviations of sentence rate or processing rate or the availability of information can cause that process to go completely awry, and so the subject does not arrive at an actuate reading of the sentence.

**Professor Remez:** There is also a phonetic process that alters as a function of the rate of production. The phonetic assimilations and reductions could be specific to the pace of the utterance.

**Professor Schwartz:** To keep the trace memory of the phonetics?

**Professor Remez:** No, not exactly. I am proposing that when you speak more rapidly you have more assimilations, more reductions. You do not hit your vowel targets, the stop consonants are not held, there are actually different allophones that are produced at different rates.

**Professor Schwartz:** We are actually using an algorithm to change the rates, we are not actually having the talkers speak faster or slower.

**Professor Remez:** So you are using something like a speech compressor or a speech expander?

**Professor Schwartz:** Yes, I think an expander. So we start out at a base rate. For this first study of vowel perception, we were interested in children’s discrimination at 200 and 250 ms. We used nine step continua and we had a discrimination task, same vs. different, and we also used a behavioral odd ball task. A behavioral oddball task is used to elicit mismatch negativity, and we wanted behavioral data from that as well. In the ERP task, we used two conditions, a passive condition in which the child watched a silent video. In the attended condition, the child was asked to listen to the speech sound. This was a study done a while ago, and we have since gotten a little more careful about how we do passive and attended conditions.

Here is sort of a quick look at the results. Here is the adult N1 and P2 in the ERP, and this is before the subtraction has taken place. You always subtract the standard from the odd ball. Typically developing children produce a much larger response between standard and odd ball and the SLI children have virtually no difference, which is not very encouraging in some ways. These are the maps of current source density at the scalp. If you look carefully in the attended condition, the SLI children’s
pattern is different in both conditions but it is particularly disturbing that when the child is not actively attending to the sound, the typically developing children show this strong negativity which is completely absent in the SLI children. The interpretation of that is challenging to say the least, but it is completely different topography. So, to summarize, the deficits and differences in processing are greatest for the brief vowel stimuli. They do very poorly at categorization tasks.

Professor Remez: It is also consistent with the ERP data. It would be a big puzzle if they could categorize it.

Professor Schwartz: Right. And they seem to have some deficit in the automatic processing. Their ability to process when they are not directly attending to the speech is really quite limited. And there is this absent evidence of left hemisphere discrimination.

Unidentified guest of the seminar: With the typically developing children when you see this primary left activity, how would you explain it?

Professor Schwartz: The left hemisphere activity?

Unidentified guest: Yes what is the difference?

Professor Schwartz: That is always a good question. We assume that they are recruiting neurons to do this process, not in a conscious way but that is where the activity is localized. That is where you see the activity, because it is organized and localized. If it is diffuse as in other studies we have done with SLI, if subjects do not seem to have the left hemisphere localization, it suggests that there is something disorganized about the process. There is still processing going on because behaviorally they are still doing okay in the discrimination task but there is something that is not yet organized in these children, or might never be. One of the limitations of some of the studies is that it would be ideal to follow these children to see if things change as they mature. There has been one study, which actually did a mismatch with children and their mothers. In that study there was an absence of this mismatch negativity response, in both the children and their mothers. We have not done anything quite like that.

In this study, Valerie and I wanted to look at what one might say as the comparative stage of lexical access. Normally one assumes that there is some point of lexical access when you are actually comparing what you have heard, something you have stored from that, with existing representations. Herb Vaughan, who is a colleague at Einstein, suggested that we just use a matched sample task which seemed easy enough to me. We wanted to keep the words simple, so we used CVC words and non-words, we had a variety of conditions and we actually formed these minimal pairs by splicing and so we made sure that everything was as closely matched as possible. The CVCs either differed in the onset or in the coda, the first sound or the last sound. All the subject has to do was to report whether a second stimulus was the same as the first. What you actually see here is an ERP that indicates a temporally distinct response when there is an onset difference and a coda difference. So we are actually tracking a point at which there is a difference in response to the pair. This occurred reliably in adults and in typically developing children. Then we had SLI children who also exhibited the same thing but not with the same clarity.
**Professor Remez:** They are getting the onsets but not the codas?

**Professor Schwartz:** They do get the codas, actually. It might look like they do not, but this is because the traces get noisy somewhere along here. We have done some filtering with this and some further data analysis and what is interesting is the SLI children have this huge positivity that we think is reflective of a decision process. We see in every condition, and we do not see it with typically developing children.

**Professor Remez:** It is a positively going DC shift?

**Professor Schwartz:** Yes, and a huge one. We have been trying to find out for a while now, if this a decision process in children with SLI, what causes this degree of activity. Then there is this other part of these data. We have reaction time data from the decision process and we divided the data into non-words and words and the difference between the onset and the coda pairs, just to reduce it to a single number. What is noticeable about this is that for both the typically developing children and the adults there is a difference between nonsense and real pairs with real words taking less time to identify. With the SLI there is no significant difference, they are challenged both by the words and non-words, and they are slower overall. Making this decision between real world and non-real world is really quite difficult for them.

**Professor Lois Putnam:** How much slower are they overall than the typically developing children?

**Professor Schwartz:** I would say 15 or 20 percent.

**Professor Jaffe:** What is the age of these children?

**Professor Schwartz:** The age of the children in all of these studies is either 7-9 or 8-10. We use typically developing age matched children. Language matching has allsorts of issue and so we do not do that.

**Professor Jaffe:** And they distinguish between a word and a non-word?

**Professor Schwartz:** No, they distinguish between same and different items. This reflects, the fact that in a same different judgment it does not really matter if an item is a word or non-word for SLI children, but in typical adults lexical representations are used to make this distinction. These kids are having a much harder time accessing the lexicon or using it in the comparison process.

**Unidentified guest of the seminar:** Do you get frequency effects?

**Professor Schwartz:** Frequency of occurrence? These are all very high frequency words and I think it would be hard to differentiate them. It would be interesting to take a look at high and low frequency or a range of frequency in these to examine the effects. And with that I am going to stop. Thanks.

**Applause.**

**Professor Remez:** I think we have time for a question or two.

**Unidentified guest of the seminar:** Do you see any prevalence in left-handedness or right-handedness when compared to normal populations?

**Professor Schwartz:** We have not seen it in our ERP studies; all the subjects have been right handed. There are some reports of ambidexterity or left-handedness, but we have not seen it.
Ms. Jamie Gamble: Considering learning disabilities, are there any other areas such as math that these children have difficulty in?

Professor Schwartz: As far as I know no one has done that epidemiology study. There was one study that focused on children 5-7 years of age and they did not look at associated deficits. There is a larger group study in the UK and some of the things they do report are difficulties with math particularly things that are more formulaic. There was one study that I know of by Barbara Fazio and the British group you and they have followed a large cohort and done a lot of testing.

Ms. Gamble: Have you drawn any conclusions about intervention, such as Fast ForWord. Are these working for SLI children?

Professor Schwartz: In terms of the research, we have not been doing that yet; we have felt that we are not quite there. There are some people that do intervention work. Ron Gillam, at Utah State in Logan, recently finished a double blind clinical trial for different intervention programs including Fast ForWord and it did not work. Some other things did. Also Mark Fey at the University of Kansas has done some intervention research but there is not much. I do think there are things about Fast ForWord that are interesting. In a non-systematic way it certainly calls the children’s attention to speech. And some children do well, but a lot of them hate the task and many of them do not show any general language gains. Also, I think that one thing that Fast ForWord does is to draw the children’s attention to speech and if in fact there are attention deficits that are affecting how children with SLI perceive speech, process speech, selectively attended to different aspects of language at a phonological and a syntactic level, maybe those kinds of interventions would be helpful.

Professor Remez: There are so many systems that are implicated, I do not know whether to think of this as a cascading deficit that begins at one place and propagates, or whether I should think of it as multiply caused, where it is possible for any one of these systems to go wrong and to produce SLI.

Professor Schwartz: Certainly an initial idea is of a perceptual deficit that would cascade somehow into a morphosyntactic and syntactic deficit. But it was never clear how exactly problems with /ba/ and /da/ would cascade into problems with gap filling.

Professor Remez: Or, into pragmatics.

Professor Schwartz: Right. Well a pragmatic deficit really is probably more about discourse processing as opposed to the social interaction. There was one study in the 1970s when pragmatics was very popular in child language that showed that if you match mean length of utterance produced by children with SLI and typically developing children they exhibited the same speech acts. There is this one odd pragmatic thing that SLI children have, and that is flexibility in use of language. Donahue did a couple of small studies with language learning disabled children in the early 1980s and found that they had those kind of deficits, and that counted as pragmatics.

But let me go back to this other point, or at least one of the ways that we can explore this—which is to explore more basic cognitive processes, various aspects of attention and executive function and working memory that go into things like perception, lexical access syntactic processing. I think we are not quite at that basic level yet. All of those Tallal tasks clearly have attentional and working memory
demands and the trick will be to begin to find some tasks and to pose the probes within language. These comparisons between language and non-language are really going to be too challenging but if you do this within language where you can control the language demands and vary the selective attention demands then you can begin to look at the extent to which these children might have deficits in attentional selectivity or in inhibition. It is not so easy but it is where we need to look because it is where the deficit probably lies. The daughter of my friend who just got married in the UK said, so language is the symptom? And for me that is most likely the explanation and where we need to look. Thanks very much.

Applause

Place: Kellogg Center, Room 1510
School of International and Public Affairs
420 West 118th Street
Time: 4:00 PM
Chair: Prof. Robert E. Remez, Barnard College, Columbia University

Partial list of attendees: Robert Remez, Robert Krauss, Lois Putnam, Joseph Jaffe, Jennifer S. Pardo, Edward E. Smith, Lauren Aguilar, Isabel Jay, Alexandra Suppes, Jamie Gamble, Daria Ferro

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