SUMMARY STATEMENT

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(Privileged Communication) *Release Date:* 10/31/2012

Application Number: 1 R21 HD076112-01

Principal Investigators (Listed Alphabetically):
ALLEN, JONT BRANDON PHD
JOHNSON, CYNTHIA (Contact)
Applicant Organization: UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN
Review Group: **LCOM**
Language and Communication Study Section
Meeting Date: 10/15/2012 RFA/PA: **PA11-261**
Council: **JAN 2013** ***PCC:*** **CDB -BM**
Requested Start: **04/01/2013**

Project Title: **Aural Confusions of Consonants and Vowels in Children with Reading Disabilities**
SRG Action: **++**
Next Steps: Visit http://grants.nih.gov/grants/next_steps.htm
Human Subjects: 30-Human subjects involved - Certified, no SRG concerns
Animal Subjects: 10-No live vertebrate animals involved for competing appl.

Project Year	Direct Costs Requested
1	125,000
2	150,000
TOTAL	275,000

++NOTE TO APPLICANT: Members of the Scientific Review Group (SRG) were asked to identify those applications with the highest scientific merit, generally the top half. Written comments, criterion scores, and preliminary impact scores were submitted by the assigned reviewers prior to the SRG meeting. At the meeting, the more meritorious applications were discussed and given final impact scores; by concurrence of the full SRG, the remaining applications, including this application, were not discussed or scored. The reviewers' comments (largely unedited by NIH staff) and criterion scores for this application are provided below. Because applications deemed by the SRG to have the highest scientific merit generally are considered for funding first, it is highly unlikely that an application with an ND recommendation will be funded. Each applicant should read the written critiques carefully and, if there are questions about the review or future options for the project, discuss them with the Program Contact listed above.

DESCRIPTION (provided by applicant)
For not discussed applications, descriptions may not be included.

CRITIQUE 1:

Significance: 7
Investigator(s): 3
Innovation: 8
Approach: 7
Environment: 3

Overall Impact: The Principal Investigators propose to test whether reading disabled 8-12 year old children experience difficulties with poor auditory perception of speech sounds, rather than phonological awareness per se. They propose to test whether auditory deficits for speech sounds and short term auditory memory problems are important components of reading disability. Although issues surrounding reading disabilities are significant in general, the impact of this research is diminished due to a lack of innovation in the theoretical ideas that are proposed, and the fact that this approach has been taken in quite a bit of previous research. There also appear to be issues with the approach itself, and the manner in which the studies line up with the main hypothesis.

1. **S**ignificance:

   Strengths

   - Understanding the mechanisms underlying poor performance in reading disabled children is an important area of study in general.
   - It is important to understand the reasons why phonological awareness is a strong predictor of reading performance.

   Weaknesses

   - The significance of the proposed research is undercut by the fact that the hypotheses have been described and tested in previous research in much the same way as is proposed here. Resp: See *weaknesses* in *innovation* section.
   - The main goal of the proposed research is stated as investigating abilities that are less central and less linguistic than phonological awareness. However, all of the tasks are quite linguistic in nature in that they focus on perception of spoken syllables, or matching spoken and written syllables, and they appear to be quite central to reading. Resp: The reviewer thinks our task is "central to reading." His view appears to be more positive than a weakness. The reviewer says "all of the tasks are quite linguistic in nature." We feel that our task is phonetic not linguistic. Almost all phological awareness tasks are done with meaningful speech. We are not doing this. We are trying to show the relevance of nonsense speech (phonetic speech ability) in predicting RD. In our experiments, we intended to bridge the continuum from phonetic to linguistic, by

design. In summary, we need to point out that our design is moving from sensory towared more central. This point was not clear in our existing proposal.

2. **I**nvestigator(s):

   Strengths:

   - Principal Investigator Johnson has a great deal of experience with language disorders research. She has published a number of articles on various aspects of children with language disorders.
   - Principal Investigator Allen is an expert in acoustics and speech perception, and is highly prolific.
   - The two Principal Investigators have collaborated and are capable of conducting the proposed research.

   Weaknesses

   - **N**o major weaknesses noted.

3. **I**nnovation:

   Strengths

   - The use of real speech from professionally-recorded talkers is an innovative aspect of this application. Resp: We need to say this in our proposal.

   Weaknesses

   - The application generally lacks in innovation and novelty. In terms of R21 criteria, the proposed research does not appear to break new ground or to be exploratory in nature. Resp: We not aware of anyone in the past who has studied phonetic detail in the deficits of developing speech perception in later-elementary school children with RD. We need to cite a few articles that clearly demonstrate that we are doing something novel (different than the lastest methods).
   - The ideas put forth in the application have been discussed in quite a bit of previous research. The tasks have also been used by a number of researchers. For example, Cornelissen, Hansen, Bradley, and Stein (1996, Cognition) CJ: I will Read this! measured confusions in dyslexics and controls on the basis of the same underlying logic. Others such as Brady have used these (e.g., repetition of syllables) and similar tasks with reading disabled children to address the same hypotheses. Resp: The only study mentioned by the reviewer is with adults with dyslexia. Our study examines children. The Cornelissens study is only with 9 consonants with only 1 vowel, whereas our study examines open set CVs and VCs with multiple speakers. The Brady study mentioned by the reviewer is with children, but it does not examine all English speech sounds (it is closed set), with only 1 speaker.

4. **A**pproach:

   Strengths

- The studies as a set are capable of providing interesting information regarding the perception of speech sounds.

Weaknesses

- It seems somewhat odd to state that consonant or vowel perception is being uniquely studied when CVs or VC are the stimuli. For example, when presented with "da da fa" and a subject selects the second "da" as the oddball, that could be due to poor perception of the consonant in "fa", or confusion caused by hearing 3 different CVs due to misperception of the vowel in one of the two "da"s. It is unclear how these possibilities would be disentangled. Resp: The control subjects very seldom made any errors, therefore, they were able to make these judgments based on the targeted sound change (i.e., the consonant) and not based on any untargeted sound change (i.e., the vowel). On any one trial, the reviewer could be right, that the child misperceived the vowel, however, none of the RD children performed this task anywhere close to chance (i.e., 33% correct) and all had some consonants on which they were highly accurate (with the same set of speakers). Therefore, even the RD children showed that they could often detect the targeted phonetic difference.

  Furthermore, if this were an issue, we would have seen it in the NSCM task, where the children simply imitated the syllables.

  The most convincing argument, however, is that with da da fa if the child chooses the second da (by Speaker 2), and misperceived the vowel as a schwa, he still failed to perceive the d-f difference. Therefore, he has made a consonant error, even if he has also made a vowel error.
- Other tasks (NSCM) mix perception and production, so that it may be difficult to disentangle the two in these studies. Resp: The point was to use two different tasks with very different characteristics. The SCO is purely perceptual, whereas the NSCM entails both perception and production. We are gradually increasing the components as the experiment proceeds.
- In addition, it is also unclear whether the auditory-visual integration task is solely about speech sound perception, given that the children have to read stimuli and match what they read to the sounds that they hear. Resp: We need to add a sentence at the beginning that explains the big picture: that we will gradually add in elements beyond speech perception (including visual print elements) as we progress through the experiments, in order to bridge the range of the complex tasks of reading.
- It is not entirely apparent whether CVCV patterns are actually sufficient to strain memory. At times, the Principal Investigators use the term "memory" which typically means longer term memory, and this is presumably not what they are talking about. Sometimes it sounds like working memory, although the short stimuli would not seem to be an issue for working memory. In general, this is somewhat unclear. Resp: Clarify in the Introduction (rebuttal section) that we did mean working memory and use this term consistently throughout the document (get references from Pam Souza at Northwestern and Lynn Bielski's dissertation. Also, Baddeley's work.) Suggest that we can create longer stimuli, to tax working memory. Point out (stress) that we have data that reveal that even CVs and VCs are taxing. We should not explicitly say CVCV, but rather describe that we will extend duration so that we find the point where participants become confused. We can say, such as CVCVs.

  Maybe we should remove working "memory" arguments.

- The Principal Investigators focus on reading disability, rather than dyslexia or specific language impairment. Given an assumed mixture of children at The Reading Group, a clear plan for distinguishing among these populations should be included. Resp: Add a sentence that our only criterion for inclusion in the reading disabilities group is that the child has trouble reading, based on referral by the Reading Group (because the child was currently receiving reading intervention). We are using an assessment battery of reading and spoken language tests, so we can sort out differences in ability and functionality, assuming they can be measured by these tests. (did we mention these additional control tests in our proposal?). If we find subgroups on our experimental tasks, we will see if those error patterns can be explained by the childs reading profile. Mention that our children don't have obvious SLI.
- The training component consists of telling a subject what they did wrong following an error. This does not appear to be particularly sophisticated or novel. Resp: What is novel is our search and identification of the source of RD, being directly related to phone-confusions.

  The task is significantly higher in error for RDs than for RCs (normal reading group). At the end we are trying to determine if feedback improves the RD subjects. This is our "more sophisticated" logical next step. The latter could be a hypothesis that we float.

  Remove wording re "training" from our proposal.
- There appears to be an issue regarding whether the experiments have sufficient power to detect effects. The studies include a total of only 39 reading disabled and 30 control subjects, and with the current overall design, there will be only 13 reading disabled and 10 controls per experiment. Resp: It is not the number of subjects that determine the power, it is the number of data points. Based on our existing data, since we are reporting individual subjects, thus we will have sufficient power. In our pilot studies, we had sufficient power to find significant differences with 11 RDs and 6 RCs.
- The Principal Investigators should explain why they plan from the outset to test unequal numbers of reading disordered and control subjects. Resp: The normals (RC) tend to have lower variance, and act similar, while the RD break into unpredictable subgroups, thus form natural sizes, beyond our control. Furthermore it is simply a matter of cost. We will run equal group size if we can afford to do so.

5. **E**nvironment:

   Strengths

   - The environment at the Beckman Institute provides all of the necessary facilities to conduct the proposed research.

   Weaknesses

   - No letter of support from The Reading Group is included in the application. Resp: We will obtain a letter of support from the RG.

Protections for Human Subjects:
Acceptable Risks and/or Adequate Protections

- Risks to human subjects are minimal, and all consent and data protections are in place. Data and Safety Monitoring Plan (Applicable for Clinical Trials Only):

  Not Applicable (No Clinical Trials)

Inclusion of Women, Minorities and Children:
G1A - Both Genders, Acceptable
M1A - Minority and Non-minority, Acceptable
C2A - Only Children, Acceptable

- Subjects will be equally split between genders, which are appropriate.
- A substantial number of minority subjects are expected based on past experience, and this is acceptable.
- Subjects will consist of children 8-12 years old. Given that the application deals specifically with the development of phonological abilities in children, this is scientifically acceptable.

Vertebrate Animals:
Not Applicable (No Vertebrate Animals)

Biohazards:
Not Applicable (No Biohazards)

Budget and Period of Support:
Recommend as Requested

CRITIQUE 2:

Significance: 3
Investigator(s): 3
Innovation: 4
Approach: 6
Environment: 2

Overall Impact: This application focuses on measuring phonetic perception and plasticity in children 8-12 years old with and without RD. Given that the underlying processes of phonological awareness are still not well understood, understanding more about a potential role for phonetic perceptual deficits in RD is important. Ascertaining a more refined profile of phonetic perceptual errors, especially one that is individualized, is an interesting idea, and has the potential for more tailored intervention, should impaired phonetic perception prove to be a driving factor in phonological awareness development. Weaknesses include a lack of clarity in terms of which aspects of and how the application adds to the current literature, as well as recruitment, definition of dyslexia, and questions about the relationship between the experiments and the regular intervention the children receive at the clinic.

1. **S**ignificance:

   Strengths

   - Reading disability is debilitating and can result in life-long barriers to education and employment. Phonological awareness is known to be a cause of RD, and understanding the underlying processes that contribute to phonological awareness is therefore important. Phonetic perception/categorical discrimination in RD and dyslexia has long been an area of interest but findings are inconsistent, so understanding more about how deficits in this area contribute to phonological awareness could contribute important knowledge about our understanding of how to develop better interventions for RD.

   Weaknesses

   - No major weaknesses noted.

2. **I**nvestigator(s):

   Strengths

   - Together the investigative team of Allen and Johnson has the expertise and knowledge to carry out the proposed experiments.

   Weaknesses

   - Although Dr. Allen brings great expertise to the application, and Dr. Johnson has clinical and research expertise for the proposed set of experiments, either the expertise in reading disabilities of the current investigative team needs to be made more explicit in the application, or a consultant with expertise in this area should be considered. These comments are particularly related to the issue of classification/definition of RD (see below). CJ: Get Usha Goswami as a reading consultant. Emphasize CJ's experience with RD, including teaching and clinical expertise.

3. **I**nnovation:

   Strengths

   - Ascertaining a more refined profile of phonetic perceptual errors, especially one that is individualized, is an interesting idea, and has the potential for more tailored intervention, should impaired phonetic perception prove to be a driving factor in phonological awareness development.

   Weaknesses

   - It is not entirely clear which aspects of the application are new. For example, short-term auditory memory difficulties for speech sounds has long been known to be an area of difficulty for those with RD, and the literature on phonetic perception in RD is substantial (and results are mixed). Aside from the more refined individual profile of phonetic perceptual errors, how would this expand the literature more? How is the measurement more refined? The current proposed set of studies is not fully articulated within the context of existing literature. Resp: We need to emphasize Allen's studies on acoustic features, and clearly state why this is relevant. This is new! CJ: Our main goal is to try to determine which acoustic features are deficient in the RD ears. "Its like mapping the genome." We are trying to specifically target the intervention, on the specific errors. Our hypothesis is that children with RD cannot decode phonemes when reading because they cannot distinguish *certain* phones aurally ("phonetically" vs. "phonemically.")

     Point this out explicitly by stating, "This is innovative because..." We need to question why short-term memory is worse for RDs: It is possible, maybe even likely, that memory is poor because of low phonemic awareness, not the other way around. Good memory requires well defined labels on the units being processed (phones in this case) (i.e., re the CVCV... experiment).

4. **A**pproach:

   Strengths

   - Developing a more refined way to measure phonetic perceptual errors, especially related to developing individual phonetic perceptual profiles as related to RD is potentially an important contribution, and may clarify how the weaknesses in this area contribute to RD.
   - Documenting past and concurrent intervention, which RD studies generally do not do, is important.

   Weaknesses

   - It is not entirely clear how this builds upon, expands, and refines current approaches and findings of previous categorical perception studies in RD/dyslexia. For example, what are the methodological weaknesses of the past studies in terms of how they measured phonetic perception, and how do the proposed experiments directly address these weaknesses and build upon previous literature? CJ: In the many years of previous research on children's phonological awareness, most studies have used real words. This means that in an oddball task, the target sound varies but the remainder of the words is not held constant, as it is in our nonsense syllables. In our

task, the child's attention must be clearly focused on the sound in the target position. This reduces sources of confusion. In the proposal, we need a sentence that points out the differences in methodology betweeen our study and the existing literature.

- Group criteria are unclear. There is no definition of RD and control beyond parent questionnaires and history. Are the investigators going to use the tests they administer to confirm classifications? If so, what are the criteria? What will they do about co-morbid SLI? Some studies have suggested that difficulties with phonetic perception in RD are only present when there is co-morbid SLI. CJ: We did an extensive 3-day assessment of hearing, reading, language, and cognition to confirm that children had RD. Include this in the proposal. We would expect an automatic co-morbidity of SLI and reading, if children have phonetic perception problems. Therefore, we expect to include such children. We will be able to document whenever this occurs, and we will regress it against our phonetic findings. Because we are reporting individual findings, this shold not pose a problem if our subgroups with RD are not equal in size (we no control over subgroup size) One of our reviewers, Fletcher, did publish an article on subgroups of dyslexia Cite Flax....Tallal et al. for rate of co-morbidity of RD and SLI.
- It is not clear how feasible recruitment Resp: i.e., of new subjects is. Recruiting 17 participants over three years for the pilot data is low compared to what they propose to do over 2 years. Although the investigators will pay for tutoring for the participants, which should yield a higher rate of response, more information or evidence is needed in terms of how they will get to their proposed sample size of 39 in the RD group. CJ: This took us three years because we were working on a shoestring budget. With funding, we will not have any trouble recruiting many more subjects from the Champaign-Urbana area.
- The intervention component is not clear. Is regular intervention at the clinic occurring the same time as data collection for their experiments, or are the experiments in H4 in lieu of their regular intervention? If participants will be doing their regular intervention on top of the proposed studies, what type of intervention is it? Will it be controlled for in terms of scope and fidelity, and timing of the auditory plasticity experiments (H4)? Overall, the timing and details of participant recruitment, classification, intervention and participation in experiments need to be clarified. CJ: While there is intervention going on, it is at the Reading Group, and not part of our experiment, and not under our control. This is how we will get our subjects. It would be unethical to control their ongoing intervention at the reading group. We will document the Reading Group's intervention and its success or failure.

5. **E**nvironment:

   Strengths

   - The environment appears conducive to the proposed set of studies.

   Weaknesses

   - No major weaknesses noted.

Protections for Human Subjects:
Acceptable Risks and/or Adequate Protections

- The research is at an acceptable level of risk, and there are adequate protections in place to mitigate any risks.

  Data and Safety Monitoring Plan (Applicable for Clinical Trials Only):

  Not Applicable (No Clinical Trials)

Inclusion of Women, Minorities and Children:
G1A - Both Genders, Acceptable
M1A - Minority and Non-minority, Acceptable
C2A - Only Children, Acceptable

- The inclusion of women, minorities, and children is acceptable; focus on children is needed for the focus of the application, which is on reading development. Although the investigators state that the study is open to all participants regardless of minority status, the enrollment table makes no attempt to include those who are Asian, Native American, or Pacific Islander; some statement addressing this should be made. Resp: We have very little control over the subject population. RD children draw more heavily from lower socicoeconomic (SES) groups, which is out of our control. This seems to be the nature of the population of RD subjects, as is well document. Note that UIUC has one of the largest Asian populations in a small town, in the US. Add a sentence.

Vertebrate Animals:
Not Applicable (No Vertebrate Animals)

Biohazards:
Not Applicable (No Biohazards)

Budget and Period of Support:
Recommend as Requested

CRITIQUE 3:

Significance: 5
Investigator(s): 4
Innovation: 6
Approach: 3
Environment: 1

Overall Impact: There is already overwhelming evidence that speech perception and phonological awareness are related to reading difficulties. Resp: We acknowledged this. We are trying to find the underlying reasongs for this correlation. Additionally, with only a very few exceptions, given early and intensive effective interventions, children with RD can learn to decode although there are likely to be residual problems in fluency and comprehension. Resp: It seems that the Reviewer #3 is denying our preliminary data. Am I reading this comment correctly? Decoding is a high effort task and reducing the comprehention. Based on our data, we believe that they are not decoding effortlessly. Therefore, it is not clear what the proposed studies will really add to our understanding of reading disabilities. Resp: Reviewer #3 has not understood our results. Non-word repetition tasks have been used extensively in the reading literature and some recognition of this work would inform the investigation. Resp: Maybe we are unaware of this literature? CJ: I will cite the recent literature. Additionally, although the Principal Investigators have some relevant conference presentations, there are few relevant journal articles listed in the biosketch. Resp: This seems like an unreasonable request for an R21 proposal. I'm not sure how to get through to this person. What we are experts in is speech perception.

Protections for Human Subjects:
Acceptable Risks and/or Adequate Protections
Data and Safety Monitoring Plan (Applicable for Clinical Trials Only):

Inclusion of Women, Minorities and Children:
G1A - Both Genders, Acceptable
M1A - Minority and Non-minority, Acceptable
C2A - Only Children, Acceptable

Vertebrate Animals:
Not Applicable (No Vertebrate Animals)

Biohazards:
Not Applicable (No Biohazards)

Budget and Period of Support:
Recommend as Requested

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http://grants.nih.gov/grants/guide/notice-files/NOT-OD-10-080.html

The impact/priority score is calculated after discussion of an application by averaging the overall scores (1-9) given by all voting reviewers on the committee and multiplying by 10. The criterion scores are submitted prior to the meeting by the individual reviewers assigned to an application, and are not discussed specifically at the review meeting or calculated into the overall impact score. For details on the review process, see

http://grants.nih.gov/grants/peer_review_process.htm#scoring

MEETING ROSTER
Language and Communication Study Section Biobehavioral and Behavioral Processes Integrated Review Group CENTER FOR SCIENTIFIC REVIEW
LCOM October 15, 2012

CHAIRPERSON

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* Temporary Member. For grant applications, temporary members may participate in the entire meeting or may review only selected applications as needed.

Consultants are required to absent themselves from the room during the review of any application if their presence would constitute or appear to constitute a conflict of interest.