Final Progress Report for Research Projects Funded by Health Research Grants

Instructions: Please complete all of the items as instructed. Do not delete instructions. Do not leave any items blank; responses must be provided for all items. If your response to an item is "None", please specify "None" as your response. "Not applicable" is not an acceptable response for any of the items. There is no limit to the length of your response to any question. Responses should be single-spaced, no smaller than 12-point type. The report **must be completed using MS Word**. Submitted reports must be Word documents; they should not be converted to pdf format. Questions? Contact Health Research Program staff at 717-783-2548.

1. **Grantee Institution:** Albert Einstein Healthcare Network

2. **Reporting Period (start and end date of grant award period):** 01/01/2012 – 06/30/2013

3. **Grant Contact Person (First Name, M.I., Last Name, Degrees):** Mary Klein, PhD

4. **Grant Contact Person's Telephone Number:** 215-456-7216

5. **Grant SAP Number:** 4100057650

6. **Project Number and Title of Research Project:** 1 - Task-switching: A Window to Cognitive Control Deficits in Aphasia

7. **Start and End Date of Research Project:** 01/01/2012 – 06/30/2013

8. **Name of Principal Investigator for the Research Project:** Myrna Schwartz, PhD

9. **Research Project Expenses**.

   9(A) Please provide the total amount of health research grant funds spent on this project for the entire duration of the grant, including indirect costs and any interest earned that was spent:

   $ 52,017.39

   9(B) Provide the last names (include first initial if multiple individuals with the same last name are listed) of **all** persons who worked on this research project and were supported with health research funds. Include position titles (Principal Investigator, Graduate Assistant, Post-doctoral Fellow, etc.), percent of effort on project and total health research funds expended for the position. For multiple year projects, if percent of effort varied from year to year, report in the % of Effort column the effort by year 1, 2, 3, etc. of the project (x% Yr 1; z% Yr 2-3).

Last Name, First Name	Position Title	% of Effort on Project	Cost
Nozari	Post-doc	25	8,461.20
Gagliardi	Research Assistant	85	17,077.35

9(C) Provide the names of **all** persons who worked on this research project, but who *were not* supported with health research funds. Include position titles (Research Assistant, Administrative Assistant, etc.) and percent of effort on project. For multiple year projects, if percent of effort varied from year to year, report in the % of Effort column the effort by year 1, 2, 3, etc. of the project (x% Yr 1; z% Yr 2-3).

Last Name, First Name	Position Title	% of Effort on Project
None		

9(D) Provide a list of **all** scientific equipment purchased as part of this research grant, a short description of the value (benefit) derived by the institution from this equipment, and the cost of the equipment.

Type of Scientific Equipment	Value Derived	Cost
None		

10. Co-funding of Research Project during Health Research Grant Award Period. Did this research project receive funding from any other source during the project period when it was supported by the health research grant?

Yes_____ No____X_____

If yes, please indicate the source and amount of other funds:

11. Leveraging of Additional Funds

11(A) As a result of the health research funds provided for this research project, were you able to apply for and/or obtain funding from other sources to continue or expand the research?

Yes_____ No_____X_____

If yes, please list the applications submitted (column A), the funding agency (National Institutes of Health—NIH, or other source in column B), the month and year when the application was submitted (column C), and the amount of funds requested (column D). If you have received a notice that the grant will be funded, please indicate the amount of funds to be awarded (column E). If the grant was not funded, insert "not funded" in column E.

Do not include funding from your own institution or from CURE (tobacco settlement funds). Do not include grants submitted prior to the start date of the grant as shown in Question 2. If you list grants submitted within 1-6 months of the start date of this grant, add a statement below the table indicating how the data/results from this project were used to secure that grant.

A. Title of research project on grant application	B. Funding agency (check those that apply)	C. Month and Year Submitted	D. Amount of funds requested:	E. Amount of funds to be awarded:
None	☐NIH ☐ Other federal (specify:_____) ☐ Nonfederal source (specify:_)		$	$

11(B) Are you planning to apply for additional funding in the future to continue or expand the research?

Yes_____ No_____X_____

If yes, please describe your plans:

12. Future of Research Project. What are the future plans for this research project?

The results have informed our efforts to identify executive function deficits that might contribute to individual differences in aphasia presentation. The Schwartz lab is moving on to develop an executive function battery suitable for testing these individuals with language impairment. Nozari has completed her post doctoral training in the Schwartz lab and expects to continue to research the relationship of task-switching deficits to frontal lobe damage.

13. New Investigator Training and Development. Did students participate in project supported internships or graduate or post-graduate training for at least one semester or one summer?

Yes_____ No___x_____

If yes, how many students? Please specify in the tables below:

	Undergraduate	Masters	Pre-doc	Post-doc
Male				
Female				
Unknown				
Total				

	Undergraduate	Masters	Pre-doc	Post-doc
Hispanic				
Non-Hispanic				
Unknown				
Total				

	Undergraduate	Masters	Pre-doc	Post-doc
White				
Black				
Asian				
Other				
Unknown				
Total				

14. Recruitment of Out-of–State Researchers. Did you bring researchers into Pennsylvania to carry out this research project?

Yes_____ No____x_____

If yes, please list the name and degree of each researcher and his/her previous affiliation:

15. Impact on Research Capacity and Quality. Did the health research project enhance the quality and/or capacity of research at your institution?

Yes_____ No____x_____

If yes, describe how improvements in infrastructure, the addition of new investigators, and other resources have led to more and better research.

16. Collaboration, business and community involvement.

16(A) Did the health research funds lead to collaboration with research partners outside of your institution (e.g., entire university, entire hospital system)?

Yes_____ No_____x_____

If yes, please describe the collaborations:

16(B) Did the research project result in commercial development of any research products?

Yes_____ No___x_____

If yes, please describe commercial development activities that resulted from the research

project:

16(C) Did the research lead to new involvement with the community?

Yes_____ No___x_____

If yes, please describe involvement with community groups that resulted from the research project:

17. Progress in Achieving Research Goals, Objectives and Aims.

List the project goals, objectives and specific aims (as contained in the grant agreement). Summarize the progress made in achieving these goals, objectives and aims for the period that the project was funded (i.e., from project start date through end date). Indicate whether or not each goal/objective/aim was achieved; if something was not achieved, note the reasons why. Describe the methods used. If changes were made to the research goals/objectives/aims, methods, design or timeline since the original grant application was submitted, please describe the changes. Provide detailed results of the project. Include evidence of the data that was generated and analyzed, and provide tables, graphs, and figures of the data. List published abstracts, poster presentations and scientific meeting presentations at the end of the summary of progress; peer-reviewed publications should be listed under item 20.

This response should be a DETAILED report of the methods and findings. It is not sufficient to state that the work was completed. Insufficient information may result in an unfavorable performance review, which may jeopardize future funding. If research findings are pending publication you must still include enough detail for the expert peer reviewers to evaluate the progress during the course of the project.

Health research grants funded under the Tobacco Settlement Act will be evaluated via a performance review by an expert panel of researchers and clinicians who will assess project work using this Final Progress Report, all project Annual Reports and the project's strategic plan. After the final performance review of each project is complete, approximately 12-16 months after the end of the grant, this Final Progress Report, as well as the Final Performance Review Report containing the comments of the expert review panel, and the grantee's written response to the Final Performance Review Report, will be posted on the CURE Web site.

There is no limit to the length of your response. Responses must be single-spaced below, no smaller than 12-point type. If you cut and paste text from a publication, be sure symbols print properly, e.g., the Greek symbol for alpha (α) and beta (ß) should not print as boxes (□) and include the appropriate citation(s). DO NOT DELETE THESE INSTRUCTIONS.

Objective #1: assessing a non-linguistic cognitive control ability (task-switching) in individuals with aphasia.
Objective #2: breaking down task-switching to more simple cognitive processes and investigating each in turn in individuals with aphasia.

The specific aims were:

1. Assessing transient vs. sustained switching costs in individuals with aphasia, and comparing each type of cost to normal age-matched controls (Experiment 1). . By "cost", we mean that it takes longer to make a two-choice manual response ("reaction time", measured in milliseconds (ms)) in one experimental manipulation versus another. The critical manipulation here is whether in a given block of trials, the participant is performing a single task (size task: indicate by button press whether a pictured object is small or large; category task: indicate if it's natural or man-made), or if s/he is switching between the size and category tasks. *Transient costs* are measured within switch-task blocks, by comparing reaction times on trials where the task repeats (size, size) versus trials where it switches (category, size). (Difference between underlined items indexes the transient cost.) *Sustained costs* are measured by comparing repeat trials (size, size) in single-task blocks (where all trials repeat) versus switch blocks.

2. Determining the contribution of working memory load to sustained and transient costs in individuals with aphasia, and comparing it to normal age-matched controls (Experiment 2).

3. Determining the contribution of response conflict to sustained and transient costs in individuals with aphasia, and comparing it to normal age-matched controls (Experiment 3).

4. Investigating individual differences in the effects listed in 1-3, with regard to the size and site of the lesion.

Our proposal outlined an investigation of executive-function deficits in aphasia utilizing a sensitive experimental procedure called "task-switching". An initial pilot phase (2 patients, 2 controls) led to some changes in the experimental design, and, more importantly helped generate a specific hypothesis that thereafter framed the project. The hypothesis is that executive deficits are causally related to the clinically significant condition known as "non-fluency". The project has proceeded in several steps, each of which is detailed below. First, we refined and operationalized the construct of fluency. Next, we conducted a group-level lesion-symptom mapping analysis that confirmed a significant correlation between non-fluency and lesions in brain areas that are deemed crucial for executive control. The third step, was an experimental investigation of task-switching performance in three participants with aphasia – two non-fluent and one fluent – along with 22 neurologically-intact controls. Since matching elderly controls to patients' exact age and education is difficult and much information is lost during averaging these factors, we have sampled a relatively large number of elderly individuals to provide a closer approximation to the population norm. This sample had an average age of 62.77 years, and education of 15.22 years. The analyses, the details of which we report below, support the prediction that the non-fluent patients, but not the fluent patient, would be impaired in task-switching. Moreover, we have shown that the two non-fluent patients, who have different lesion profiles, show different types of impairment in task-switching.

We started our investigation by looking at clinical measures of fluency. The widely used Western Aphasia Battery (WAB) bases the measurement of fluency (speech rate) on the aphasic person's conversational speech and complex-picture description. Fluency is rated on a 10-point scale, based on criteria that deliberately conflate disruptions in the speech flow arising at the levels of single words and multi-word utterances. For present purposes, this is a critical distinction: We hypothesize that non-fluency results from an executive deficit that specifically impacts the ability to produce multi-word phrases efficiently and correctly, i.e., a grammatical deficit. Testing this hypothesis requires a measure of fluency that is not contaminated with the person's ability – or lack thereof – to produce single words. To create such a measure, archived WAB fluency scores for 139 individuals with aphasia in the Moss database (www.mappd.org) were regressed on their picture-naming scores. The beta derived from this regression model was used to calculate an expected fluency score for each patient, based on his/her picture naming ability. Specifically, we created a new measure expressing the discrepancy between the expected fluency score and the actual fluency score (Expected – Actual), where a positive value indicates that the actual fluency is lower than what is expected based on the patient's single word production abilities. We hypothesize that this refined measure of verbal non-fluency — which can no longer be attributed to word finding deficits — is due to executive deficits.

To test this hypothesis at the group level, we used the archived lesion files of 107 patients in the Moss registry. These lesions were traced by trained research staff at Moss, and reviewed by an experienced neurologist, all blinded to the behavioral data. The lesions were then warped onto the standard MNI (Montreal Neurological Institute) template, which makes it possible to overlay different individuals' lesions for the sake of group analysis. Using these lesion files, we performed a voxel-based lesion symptom mapping (VLSM) analysis, a statistical technique in which one measures the correlation between lesion presence and behavioral scores voxel-by-voxel across the whole brain (or left hemisphere, in this case) and identifies regions in which the correlation exceeds a threshold that is appropriately corrected for the multiple comparisons. If our hypothesis about the relationship between fluency and executive ability is correct, we expect the correlation with non-fluency to be carried by voxels in brain regions that are known to be crucial for executive functions. The results confirmed this prediction. With the statistical threshold set to a level that insures no more than 1% false positives among voxels identified as significant (i.e., False Discovery Rate correction, $q = .01$) we found significant effects in frontal areas, specifically left middle frontal and inferior frontal gyri, as well as the underlying white matter (Figure 1). Both middle and inferior frontal gyri have been previously implicated in studies of task-switching, which, as we noted, is sensitive to a variety of executive functions.

Having found support for our hypothesis at the group level with VLSM, we embarked on single-subject experiments to establish the relationship between non-fluency and executive functions, as measured by task-switching. While group level analyses have the benefit of detecting effects that prevail among a large group of subjects, single-subject analysis has the advantage of tighter and better experimental control. In our case, we selected three patients, two non-fluent, and one fluent (according to our refined non-fluency measure), who were carefully matched on demographic information, as well as on comprehension and single-word naming and repetition scores (Table 1). This matching is crucial, because when comprehension and word production abilities are matched, we can make the clear prediction that the two non-fluent patients should show poor executive abilities, while the fluent patient should not; that is, if our hypothesized

relationship between fluency and executive ability is correct.

Before testing the patients in the task-switching paradigm, we collected additional information to have a more complete picture of their production/fluency profile. All three patients completed a free narrative of Cinderella after reviewing a picture book to remind them of the story. The production rate for narrative words (i.e., non-repeated words that represent the propositional speech used to tell the story) was calculated for each patient, to ensure that the non-fluent patients produced fewer narrative words/min. These data are summarized in Table 1. The Quantitative Production Analysis (QPA), which quantifies aspects of grammatical production in terms of the lexical and structural complexity, was also applied to the Cinderella speech sample. The QPA was originally designed to characterize abnormalities found in agrammatic sentence production, but it can be useful for comparing and contrasting grammatical production abilities in different patients, especially the non-fluent ones. Table 2 presents the data. As expected from their matching word production scores, the non-fluent patients do not differ from the fluent patient in the production of open-class words, including nouns and verbs, or in the generation of simple sentences. However, they do score consistently lower than the fluent patient on indices of grammaticality, such as inflection, embedding and sentence well-formedness. We have also tested 22 neurologically-healthy adults as controls.

We used the task switching paradigm, described in detail in the grant, in which participants were asked to judge either the size or category (natural/man-made) of pictured objects. On single-task blocks, all trials involved the same type of judgment ("repeat" trials). In switch-task blocks, the required judgment switched across trials, as signaled by a cue. On half of these trials, the judgment was the same as the trial before ("repeat") and on half of the trials it switched to the other judgment ("switch"). After piloting 2 patients and 2 controls, we made a few changes to the original proposal, while keeping the task structure essentially the same: (1) We eliminated the manipulation of working memory, because the longer duration of the cue caused no change in performance. (2) Instead we increased the number of sessions from 3 to 4 to increase the reliability of the results (an IRB modification was submitted for this). Participants were tested in four sessions, two using button-press and two, using verbal responses. Figure 2 shows the response modality and the item-list for each session.

The data from the button-press sessions were combined (to counter practice or fatigue effects) and analyzed for response times (RTs) with two types of costs of interest. Sustained cost was calculated as the average RTs on repeat trials in the switch-task blocks minus the average RTs on repeat trials in the single-task blocks divided by the average RTs on repeat trials in the single-task blocks. A distribution of such costs was built based on the sustained costs for the control group, and each patient's individual sustained cost was then compared to this distribution using a standard correction method for small samples. None of the patients' sustained costs was significantly greater than those of our controls ($t = 1.61$, $p = .12$; $t = -.41$, $p = .69$ for the two non-fluent and $-.022$, $p = .84$ for the fluent patient). This is consistent with the previous findings that sustained attentional effects are mediated by the right hemisphere. Since none of our patients had lesion in the right hemisphere, we did not expect exaggerated sustained costs in them.

On the other hand, we did expect exaggerated *transient* costs in the non-fluent patients. Transient cost was calculated solely for the switch-block tasks and was defined as the average RTs on

switch trials minus the average RTs on repeat trials divided by the average RTs on repeat trials. A cost distribution was built as described for the sustained cost and comparison of individual patients' costs to the distribution followed the same format as above. In keeping with our predictions, the two non-fluent patients had significantly larger transient costs than the control ($t = 2.72$, $p = .013$; $t = 5.67$, $p < .001$), while the fluent patient was no different than controls ($t = .45$; $p = .66$).

Next, we examined if the profile of impairment was the same in the two non-fluent patients. According to their structural MRI scans (Figure 3), NF1 had a large lesion effacing left inferior frontal gyrus, and possibly severing it from the outflow from the anterior temporal lobe. NF2, on the other hand, had damage in his left middle frontal gyrus, with some involvement of inferior frontal gyrus. Note that both frontal areas were implicated in our VLSM analysis, as showing correlation with non-fluency. And, in agreement with that, both NF1 and NF2 did show exaggerated switching costs. However, the button-push sessions do not allow for determination of error types, thus the underlying deficit remains ambiguous. To better understand the underlying impairment, we looked at the error data from the two verbal sessions. Two types of errors can be distinguished: within-task errors (e.g. "small" for "large"), and between-task errors (e.g. "small" for "natural"). Figure 4 shows the error profiles across all sessions for the switch blocks, broken down the trial type.

Interestingly, the difference in the anatomy of the lesion generated two different response patterns: Although both NF1 and NF2 made considerably more errors than controls, NF1's errors were almost entirely (98%) within-task (e.g. 'small' for 'large', or 'natural' for 'man-made', but *not* 'small' for. 'natural'), while 58% of NF2's errors on the switch blocks were between-task (e.g. 'small' for 'natural'). The error data suggest problems in controlling conflict at two different levels: task and response. It is possible that a similar hierarchical structure underlies language production.

In summary, this project generated behavioral and neuroimaging data in support of the hypothesis that executive deficits are associated with non-fluency – a clinically significant component of aphasia. The single-subject experiments on task switching additionally produced an unexpected dissociation in the two non-fluent aphasic participants, raising the interesting possibility that multiple levels of conflict control are necessary to insure normal speech fluency. Future effort must be directed at understanding the nature of such a hierarchy of conflict.

Professional presentations: (1) We presented the results to the Academy of Aphasia (Nozari, N., Schwartz, M., Coslett, B. (2012). Fluency of Speech Depends on Executive Abilities: Evidence for Two Levels of Conflict in Speech Production. *Procedia - Social and Behavioral Sciences.* 183-184). (2) We also presented a poster at the annual Workshop on Language Production (Nozari, N. & Schwartz, M. (July, 2012). Fluency of Speech Depends on Executive Abilities: Evidence for Two Levels of Conflict in Speech Production. Poster presentation,7th International Workshop on Language Production, New York, NY.)

TABLES

Patients	Demographic information			Word Production		Comprehension		Fluency		Exaggerated Cost/error		
	Age (yrs)	Ed (yrs)	MPO (yrs)	PNT (%)	PRT (%)	Sem-Word composite† (%)	Simple sentence (%)	Expected–actual WAB	W/ min‡	Sustained	Transient	Errors
NF1	49	13	96	78	97	77.7	97	1.58	30.1	No	Yes	Yes
NF2	49	12	37	83	95	76.7	100	1.88	35.4	No	Yes	Yes
F	55	14	13	79	100	81.4	100	-1.36	62.8	No	No	No

Table 1- Background Information and results for the two non-fluent (NF1, NF2) and the fluent (F) patient.
Ed = Education; MPO = Months post-onset; PNT = Philadelphia Naming Test; PRT = Philadelphia Repetition Test; Sem = Semantic; W/min = (Narrative) words per minute; yrs = years.
† Sem-Word composite comprehension score was created by averaging comprehension of semantics (using Camels and Cactus Test, and Pyramids and Palm Trees Test) and single words (using Auditory discrimination test (Non-delayed), Lexical decision task (word and nonword variants), Peabody picture-vocabulary test (Third Edition), and Philadelphia picture-name verification test).
‡ W/min was obtained by counting the number of narrative words during free narration of Cinderella.

Patient	Speech complexity									
	Open class words	Verbs	sentences	Mean NP length	Closed class words	Inflection index	Mean VP length	Mean sentence length	Proportion of well-formed sentences	Embeding index
NF1	74	34	24	1.13	77	.58	2.34	6.04	.63	.13
NF2	71	36	28	1.11	83	.82	2.52	5.07	.75	.07
F	64	28	18	1.22	90	.91	3.29	8.61	.89	.22

Table 2- QPA results. The columns in purple are indices of speech complexity.

FIGURES

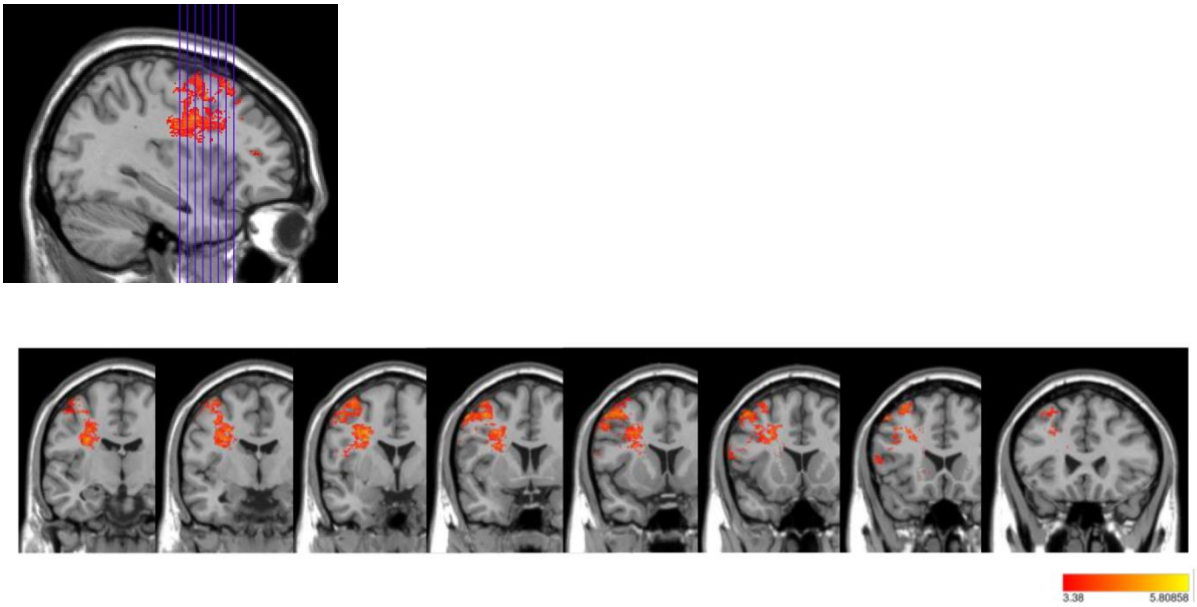

Figure 1- VLSM results at the FDR of 0.01.

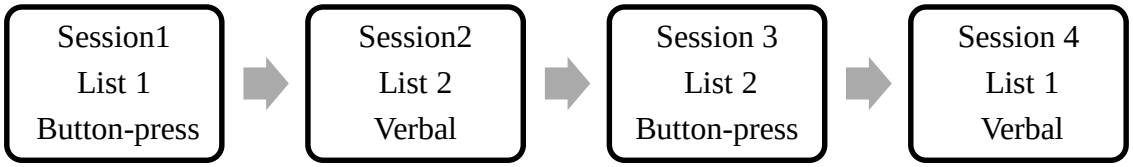

Figure 2- Sessions 1-4. Two lists of pictured items were used. Response modality could be either button-press or verbal.

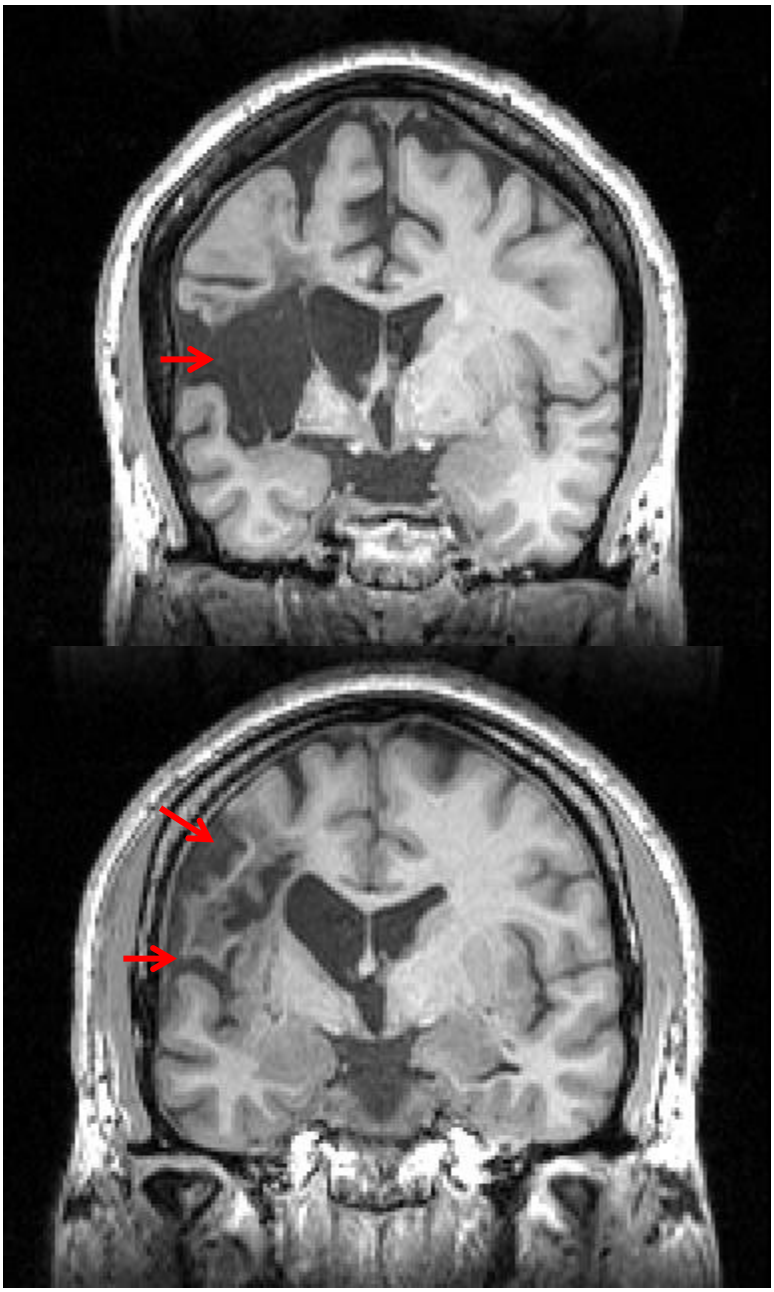

Figure 3- Structural MRI of the two non-fluent patients. NF1 (above) has a large lesion in left inferior frontal gyrus. Nf2 (below) has lesions in both left middle frontal and inferior frontal gyri.

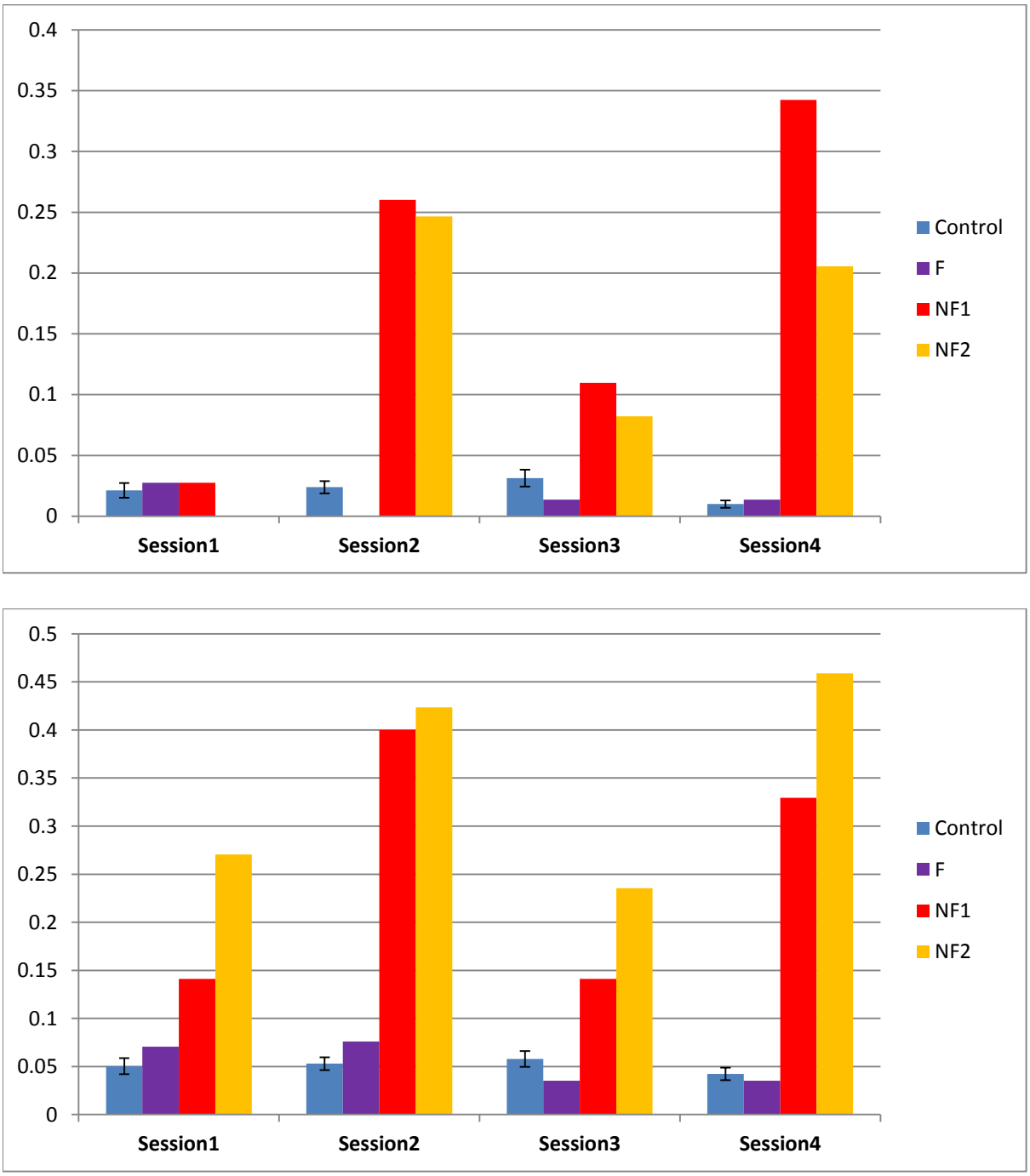

Figure 4- Error proportions in session1 1-4 for the switch blocks, broken down by repeat trials (upper panel) and switch trials (lower panel). The blue bars show averaged error rates over 22 control participants (error bars reflect 2 standard errors). The other bars error proportions for the Fluent (purple), NF1 (red) and NF2 (yellow) patients.

18. Extent of Clinical Activities Initiated and Completed. Items 18(A) and 18(B) should be completed for all research projects. If the project was restricted to secondary analysis of clinical data or data analysis of clinical research, then responses to 18(A) and 18(B) should be "No."

18(A) Did you initiate a study that involved the testing of treatment, prevention or diagnostic procedures on human subjects?

__x___Yes
_____No

18(B) Did you complete a study that involved the testing of treatment, prevention or diagnostic procedures on human subjects?

__x___Yes
_____No

If "Yes" to either 18(A) or 18(B), items 18(C) – (F) must also be completed. (Do NOT complete 18(C-F) if 18(A) and 18(B) are both "No.")

18(C) How many hospital and health care professionals were involved in the research project?

___0__Number of hospital and health care professionals involved in the research project

18(D) How many subjects were included in the study compared to targeted goals?

___29___Number of subjects originally targeted to be included in the study
___30___Number of subjects enrolled in the study

Note: Studies that fall dramatically short on recruitment are encouraged to provide the details of their recruitment efforts in Item 17, Progress in Achieving Research Goals, Objectives and Aims. For example, the number of eligible subjects approached, the number that refused to participate and the reasons for refusal. Without this information it is difficult to discern whether eligibility criteria were too restrictive or the study simply did not appeal to subjects.

18(E) How many subjects were enrolled in the study by gender, ethnicity and race?

Gender:
__15__Males
__15__Females
_____Unknown

Ethnicity:
_____Latinos or Hispanics
_30___Not Latinos or Hispanics

_____Unknown

Race:
_____American Indian or Alaska Native
_____Asian
__8___Blacks or African American
_____Native Hawaiian or Other Pacific Islander
_22___White
_____Other, specify:_____
_____Unknown

18(F) Where was the research study conducted? (List the county where the research study was conducted. If the treatment, prevention and diagnostic tests were offered in more than one county, list all of the counties where the research study was conducted.)

Montgomery County

19. Human Embryonic Stem Cell Research. Item 19(A) should be completed for all research projects. If the research project involved human embryonic stem cells, items 19(B) and 19(C) must also be completed.

19(A) Did this project involve, in any capacity, human embryonic stem cells?
_____Yes
___x__ No

19(B) Were these stem cell lines NIH-approved lines that were derived outside of Pennsylvania?
_____Yes
_____ No

19(C) Please describe how this project involved human embryonic stem cells:

20. Articles Submitted to Peer-Reviewed Publications.

20(A) Identify all publications that resulted from the research performed during the funding period and that have been submitted to peer-reviewed publications. Do not list journal abstracts or presentations at professional meetings; abstract and meeting presentations should be listed at the end of item 17. **Include only those publications that acknowledge the Pennsylvania Department of Health as a funding source** (as required in the grant agreement). List the title of the journal article, the authors, the name of the peer-reviewed publication, the month and year when it was submitted, and the status of publication (submitted for publication, accepted for publication or published.). Submit an electronic copy of each publication or paper submitted for publication, listed in the table, in a PDF

version 5.0.5 (or greater) format, 1,200 dpi. Filenames for each publication should include the number of the research project, the last name of the PI, and an abbreviated title of the publication. For example, if you submit two publications for Smith (PI for Project 01), one publication for Zhang (PI for Project 03), and one publication for Bates (PI for Project 04), the filenames would be:

Project 01 – Smith – Three cases of isolated
Project 01 – Smith – Investigation of NEB1 deletions
Project 03 – Zhang – Molecular profiling of aromatase
Project 04 – Bates – Neonatal intensive care

If the publication is not available electronically, provide 5 paper copies of the publication.

Note: The grant agreement requires that recipients acknowledge the Pennsylvania Department of Health funding in all publications. Please ensure that all publications listed acknowledge the Department of Health funding. If a publication does not acknowledge the funding from the Commonwealth, do not list the publication.

Title of Journal Article:	Authors:	Name of Peer-reviewed Publication:	Month and Year Submitted:	Publication Status (check appropriate box below):
1. None				☐Submitted ☐Accepted ☐Published

20(B) Based on this project, are you planning to submit articles to peer-reviewed publications in the future?

Yes___x_____ No_____

If yes, please describe your plans:

We are in the process of writing the manuscript for publication in a speciality cognitive neuroscience journal. We expect to have it submitted before the end of 2013.

21. Changes in Outcome, Impact and Effectiveness Attributable to the Research Project.
Describe the outcome, impact, and effectiveness of the research project by summarizing its impact on the incidence of disease, death from disease, stage of disease at time of diagnosis, or other relevant measures of outcome, impact or effectiveness of the research project. If there were no changes, insert "None"; do not use "Not applicable." Responses must be single-spaced below, and no smaller than 12-point type. DO NOT DELETE THESE INSTRUCTIONS. There is no limit to the length of your response.

None.

22. Major Discoveries, New Drugs, and New Approaches for Prevention Diagnosis and Treatment. Describe major discoveries, new drugs, and new approaches for prevention, diagnosis and treatment that are attributable to the completed research project. If there were no major discoveries, drugs or approaches, insert "None"; do not use "Not applicable." Responses must be single-spaced below, and no smaller than 12-point type. DO NOT DELETE THESE INSTRUCTIONS. There is no limit to the length of your response.

None.

23. Inventions, Patents and Commercial Development Opportunities.

23(A) Were any inventions, which may be patentable or otherwise protectable under Title 35 of the United States Code, conceived or first actually reduced to practice in the performance of work under this health research grant? Yes_____ No___X_____

If "Yes" to 23(A), complete items a – g below for each invention. (Do NOT complete items a - g if 23(A) is "No.")

a. Title of Invention:

b. Name of Inventor(s):

c. Technical Description of Invention (describe nature, purpose, operation and physical, chemical, biological or electrical characteristics of the invention):

d. Was a patent filed for the invention conceived or first actually reduced to practice in the performance of work under this health research grant?
Yes_____ No____

If yes, indicate date patent was filed:

e. Was a patent issued for the invention conceived or first actually reduced to practice in the performance of work under this health research grant?
Yes_____ No____
If yes, indicate number of patent, title and date issued:
Patent number:
Title of patent:
Date issued:

f. Were any licenses granted for the patent obtained as a result of work performed under this health research grant? Yes_____ No X

If yes, how many licenses were granted?_____

g. Were any commercial development activities taken to develop the invention into a commercial product or service for manufacture or sale? Yes___ No____

If yes, describe the commercial development activities:

23(B) Based on the results of this project, are you planning to file for any licenses or patents, or undertake any commercial development opportunities in the future?

Yes_____ No____x_____

If yes, please describe your plans:

24. Key Investigator Qualifications. Briefly describe the education, research interests and experience and professional commitments of the Principal Investigator and all other key investigators. In place of narrative you may insert the NIH biosketch form here; however, please limit each biosketch to 1-2 pages. *For Nonformula grants only – include information for only those key investigators whose biosketches were not included in the original grant application.*

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors in the order listed on Form Page 2.

Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME Myrna F. Schwartz, Ph.D.	POSITION TITLE Associate Director, Moss Rehabilitation Research Institute
eRA COMMONS USER NAME	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
New York University, New York, NY	BA	1968	Psychology
University of Pennsylvania, Philadelphia, PA	Ph.D.	1974	Psychology
Johns Hopkins School of Medicine, Balt., MD	Post-doc	1975-1977	Behavioral Neurology

Personal statement.

My 30+ year research career has been devoted to advancing the understanding and treatment of acquired aphasia by relating its varied symptom presentation to the computational, and neural architecture of the language system. My record of publications, service, and grant awards in these areas constitute strong qualifications for my role on this application.

A. Positions and Honors.

Previous & Present Academic and Hospital Appointments

1974-1976 Instructor, Swarthmore College.
1977-1979 Asst Professor in Neurology, The Johns Hopkins University School of Medcine
1977-1979 Research Associate in Neurology, The Baltimore City Hospitals.
1979-1986 Assistant Professor of Psychology, University of Pennsylvania.
1986-2001 Associate Professor, PM&R, Temple University, School of Medicine
1992- Associate Dir & Sr Res Scientist, Moss Rehabilitation Research Institute (also, Dir, Neuropsychology Research Lab; Dir of Res, MossRehab Aphasia Center)
2001- Research Prof of Phy Medicine & Rehabilitation, Thomas Jefferson University

Current Adjunct Appointments

1993- Adjunct Professor of Psychology, Temple University
1997- Adjunct Professor in Communications Sciences, Temple University
1999- Adjunct Professor in Speech-Language-Hearing Science Program, La Salle University, School of Nursing
2001- Adjunct Prof of Phys Med & Rehabilitation,Temple Univ Honors and Awards
1997 J. Stanley and Helene M. Cohen Prize for Research (AEHN)
1997 Keynote address British Neuropsychological Society and British Psychological Society Special Group in Clinical Psychology. London.
1998 Invited address to the Academy of Aphasia
2003 Keynote address, British Aphasiology Society, University of Newcastle, U.K
2011 Keynote address, Southeastern Psychological Association (SEPA)

Professional Organization Memberships and Positions

Academy of Aphasia - Membership Committee (1990-2), Program Committee (1982-5), Board of Governors (1994-7); American Psychological Association (through 2009); International Neuropsychology Society; Psychonomic Society; Cognitive Neuroscience Society.

Grant Reviewing Responsibilities

Standing member NIH Sensory Disorders and Language Study Section, (1990-93)
Member NIDCD Programs Advisory Committee, (1996-98).
Member NIH Reviewer Reserve, (1993 – present)
Standing member NIDCD Communication Disorders Review Committee (CDRC) (2007-2011)
Ad hoc reviews for: NIDCD; Med Res Council of Canada; Med Res Council of Great Britain

Journal Editorial/Reviewing Responsibilities

Editorial Boards: Current – Cognitive Neuropsychology. Past - Cortex, Language and Cognitive Processes, Neuropsychological Rehabilitation**. Ad hoc reviewer** - Brain and Language, Neuropsychologia, Neurocase, Psychological Bulletin and Review, Journal of Memory and Language, International Journal of Neuropsychology, Aphasiology, Journal of Cognitive Neuorscience

B. <u>Selected Peer-reviewed Publications Relevant to the Proposal</u>

1. Dell, G.S., Schwartz, M.F., Martin, N., Saffran, E.M., & Gagnon, D.A. (1997). Lexical access in aphasic and nonaphasic speakers. *Psychological Review, 104,* 801-838.
2. Schwartz, M.F., Dell, G.S., Martin, N., Gahl, S., & Sobel, P. (2006). A case-series test of the interactive two step model of lexical access: Evidence from picture naming. *Journal of Memory and Language, 54*, 228-264.
3. Kimberg, D.Y., Coslett, H.B., & Schwartz, M.F. (2007). Power in voxel-based lesion-symptom mapping. *Journal of Cognitive Neuroscience, 19* (7), 1067-80.
4. Schnur, T.T., Schwartz, M.F., Kimberg, D.Y., Hirshorn, E., Coslett, H.B., & Thompson-Schill, S.L. (2009). Localizing interference during naming: Convergent neuroimaging and neuropsychological evidence for the function of Broca's area. *Proceedings of the National Academy of Sciences*, *106,* 322-327.
5. Schwartz, M.F., Kimberg, D. Y., Walker, G. M., Faseyitan, O., Brecher, A., Dell, G. S., & Coslett, H.B. (2009). Anterior temporal involvement in semantic word retrieval: VLSM evidence from aphasia. *Brain, 132* (12), 3411-3427.
6. Oppenheim, G.M., Dell, G.S., & Schwartz, M.F. (2010). The dark side of incremental learning: A model of cumulative semantic interference during lexical access in speech production. *Cognition*, 114, 227-252.
7. Schwartz, M.F., Kimberg, D.Y., Walker, G.M., Brecher, A., Faseyitan, O., Dell, G.S., Mirman, D. & Coslett, H.B. (2011). Neuroanatomical dissociation for taxonomic and thematic knowledge in the human brain. *Proceedings of the National Academy of Sciences, 108,* 8520-8524.
8. Middleton, E.L. & Schwartz, M.F. (2011). Density pervades: An analysis of phonological neighbourhood density effects in aphasic speakers with different types of naming impairment. *Cognitive Neuropsychology, 27,* 401-427.
9. Schwartz, M.F. & Dell, G.S. (2010). Case series investigations in cognitive neuropsychology. *Cognitive Neuropsychology*, 27, 477-494
10. Mirman, D., Strauss, T.J., Brecher, A., Walker, G.M., Sobel, P., Dell, G.S., & Schwartz, M.F. (2010). A large, searchable, web-based database of aphasic performance on picture naming and other tests of cognitive function. *Cognitive Neuropsychology, 27, 495-504.*
11. Nozari, N., Dell, G.S., Schwartz, M.F. (2011) Is comprehension necessary for error detection? A conflict-based account of monitoring in speech production. *Cognitive Psychology*, 63, 1-33.
12. Thothathiri, M., Kimberg, D.Y., Schwartz, M.F. (2011). The Neural Basis of Reversible Sentence Comprehension: Evidence from Voxel-based Lesion Symptom Mapping in Aphasia, *Journal of Cognitive Neuroscience*. 24 (1), 212–222.
13. Middleton, E.L. & Schwartz, M.F. (2012). Errorless learning in cognitive rehabilitation: A critical review. *Neuropsychological Rehabilitation*, 22, 138-168.
14. Walker G.M. & Schwartz, M.F. (2012). Short form Philadelphia Naming Test: Rationale and empirical evaluation. *American Journal of Speech-Language Pathology*, 21, S140-S153.
15. Schwartz, M. F., Faseyitan, O., Kim, J., & Coslett, H. B. (2012). The dorsal stream contribution to phonological retrieval in object naming. *Brain*, 135, 3799–3814.

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel and other significant contributors in the order listed on Form Page 2.

Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME Nazbanou Nozari, M.D., Ph.D.	POSITION TITLE Postdoctoral Fellow
eRA COMMONS USER NAME	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	YEAR(s)	FIELD OF STUDY
Tehran University of Medical Sciences	M.D.	2005	Medicine
University of Illinois at Urbana-Champaign	Ph.D.	2011	Cognitive Psychology
Moss Rehabilitation Research Institute	Post-doc	2011-2012	Neuropsychology
University of Pennsylvania	Post-doc	2011-2013	Cognitive Neuroscience

Personal statement.

My medical background and long history of patient research, together with my theoretical background in cognitive psychology and my strong record of combining basic science with clinical research, makes me a suitable candidate for conducting the type of research described in this grant.

A. Positions and Honors.

Current Academic Appointment

2011- present Postdoctoral fellow, University of Pennsylvania

Honors and Awards

American Psychological Association's New Investigator Award, 2013.
Robert J. Glushko Award for best dissertation in Cognitive Science. $10,000.
Academy of Aphasia's best student presentation award, Boston, MA, October 2009.
Travel grant for participation in the 2nd Congress on Brain and Behavior, Thessaloniki, Greece, November 2005. $500 (declined).

Professional Organization Memberships and Positions

Cognitive Science Society (member), Psychonomics Society (member).

Journal Editorial/Reviewing Responsibilities

Reviewer for Frontiers in Psychology, 2013-present.
Reviewer for the Journal of Experimental Psychology: Learning, Memory and Cognition, 2013-present.
Reviewer for the Memory and Cognition, 2012-present.
Reviewer for the PLoS One, 2012-present.
Reviewer for the Language and Cognitive Processes, 2012-present.
Reviewer for the Journal of Cognitive Neuropsychology, June, 2009- present.
Reviewer for the Journal of Memory and Language, June, 2008- present.

B. Selected Peer-reviewed Publications Relevant to the Proposal

- Nozari, N., & Dell, G.S. (2013). How damaged brains repeat words: A computational approach. *Brain & Language. 126(3),* 327-337.
- Dell, G. S., Schwartz, M. F., Nozari, N., Faseyitan, O., & Branch Coslett, H. (2013). Voxel-based lesion-parameter mapping: Identifying the neural correlates of a computational model of word production. *Cognition, 128(3),* 380-396.
- Nozari, N., & Dell, G. S. (2012). Feature migration in time: Reflection of selective attention on speech errors. *Journal of Experimental Psychology-Learning Memory and Cognition, 38*(4), 1084-1090.
- Budd, M. J., Hanley, & J.R., Nozari, N. (2011). Two routes or one in children's auditory repetition of single words? *Journal of Psycholinguistic research.* Nozari, N., Dell, G.S., Schwartz, M.F. (2011). Is comprehension the basis for error detection? A conflict-based theory of error detection in speech production. *Cognitive Psychology, 63(1),* 1-33.
- Nozari, N., Kittredge, A.K., Dell, G.S., Schwartz, M.F. (2010). Naming and repetition in aphasia: Steps, routes, and frequency effects. *Journal of memory and Language, 63*, 541-559.
- Nozari, N., Ferri, C.P., Farin, F., Noroozian, M., Salehi, M., Seyedian, M., & Prince, M. (2009). Validation of the 10/66 Dementia Research Group's 10/66 Dementia diagnosis in Iran. *International Psychogeriatrics, 21(3),* 604-605.
- Nozari, N., & Dell, G.S., (2009). More on lexical bias: how efficient can a “lexical editor” be? *Journal of Memory and Language, 60,* 291-307.