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Dear Friends,

It gives me great pleasure to present you with this year’s annual Winter Memory and Cognition Lab Newsletter. Over the past year, our students - graduates and undergraduates - and research staff have been very busy working on various research studies and I have asked them to provide brief updates for this issue of the newsletter.

This past year, we were able to congratulate two Ph.D. students on successfully defending their dissertations. Drs. Ken Hoyte and Arelys Feliciano are currently Post Doctoral Fellows at Michigan State University and Harvard University, respectively. Additionally, masters student Kara Fitzgerald completed her program in late summer and is in the process of applying to doctorate programs in Psychology. Finally, Senior undergraduate student Louisa Vesely received her Bachelor’s degree from Brandeis in Neuroscience and has joined the lab of Dr. Murray Grossman at the University of Pennsylvania as a Research Assistant. This is a bittersweet time for everyone in the lab, as we are saddened by losing members, but of course, thrilled for what they have accomplished while here. We wish them tremendous success as they move on in their careers.

Of course, we are also delighted to introduce new members to our lab. Over the summer, Miriam Kochman, Senior Honors Undergraduate, returned from studying abroad in France to join our lab. She is interested in teasing apart how different language components interact in comprehension of spoken language. Tora Olafsen joined our lab as a Research Assistant after receiving her bachelor’s degree in Psychology from St. Lawrence University in New York. Also, Tepring Piquado is a Neuroscience Ph.D. candidate who joined our lab after completing a nine week rotation with us. She is currently exploring how syntax and prosody affect overall understanding of language.

I sincerely hope that you enjoy reading about some of the work carried out in our laboratory, all of which would not be possible if not for your generous support throughout the years. On behalf of the Memory and Cognition Lab, we would like to wish you a merry holiday season and a Happy New Year.

Arthur Wingfield, Ph.D.
Nancy Lurie Marks Professor of Neuroscience
Director, Volen National Center for Complex Systems
The Many Faces of the Memory & Cognition Lab

Arthur Wingfield, Ph.D.
Lab Director

Raj A. Stewart,
Graduate Student

Patricia A. Tun, Ph.D.,
Associate Lab Director

Tigist Wubu,
Graduate Student

Tepring Piquado,
Graduate Student

Shin Ly,
Research Staff/ Lab Manager

Ethan Yetton,
Research Staff

David Starr,
Research Staff

Tora Olafsen,
Research Staff

Miriam Kochman,
Senior Honors Undergraduate

Lynn Lohnas,
Independent Study Undergraduate

Michelle Schlesinger,
Independent Study Undergraduate

Nicole Senecal,
Undergraduate Volunteer

Daniel Perl,
Undergraduate Volunteer

Hiram Brownell, Ph.D.,
Associate Researcher

L. Clarke Cox, Ph.D.,
Associate Researcher
Sign Language and Recall of Spoken Language

Raj Stewart, Graduate Student

A key part of the Memory & Cognition Lab’s research focus throughout the years has been examining language, and how different factors work separately or in concert to make language more or less difficult to understand. While the majority of our studies have focused on the most common form of human communication, spoken language, humans are able to articulate ideas and thoughts through non-verbal language as well. Of the forms of non-verbal language, one of the more widely used is sign language.

Sign language is employed by both hearing and non-hearing persons to provide a visual analog to standard spoken languages. In the case of American Sign Language (ASL), specific visual signs or combinations of signs correspond to words, phrases, or concepts in American English, complete with its own set of rules for grammar and syntax. Although ASL and spoken American English are not perfectly complementary, the heavy similarity affords us an opportunity to examine some of our lab’s focal research questions in a new sensory modality.

Previous work in the Memory & Cognition Lab has demonstrated that one way in which spoken language can become more difficult to understand is to change the presentation rate. Many of our longtime volunteers have been involved with studies where they were asked to repeat words or phrases that they heard at different speech rates; as speech is made faster, recall declines, and shows sensitivity to age and hearing. Building on these results, we will be using time-compressed video, which can present sign language at increased visual presentation rates, to study native (high-experience) and non-native (lower-experience) signer’s performance with fast ASL. We hope to show comparable changes in recall performance, giving an insight into potential parallel processing for auditory and visual language.

As a final note, given the nature of this study, we will be collaborating with the lab of Dr. Theresa Mitchell, a researcher at the University of Massachusetts Medical School’s Shiver Center in Waltham who has experience and expertise in both auditory-visual studies and deafness. We are excited about this joint work, and look forward to both involving our participants in this study, as well as presenting you with our findings.
Understanding Aphasia using prosody and self-paced listening

Tepring Piquado, Graduate Student

**What is Aphasia?**  Aphasia is a communication disorder that occurs after language has been developed. It is most commonly caused by a stroke, or a blockage of the blood supply to part of the brain. Cells affected by this blockage die and brain damage occurs, sometimes causing aphasia, which interferes with our ability to comprehend or produce language. Although the left hemisphere is associated with major language defects, we are most interested in patients who have right-hemisphere damage to understand how prosody effects communication.

**What is Prosody?**  There are many non-verbal aspects of language that enhance meaning. With this broad definition we could include hand-gestures, eye movements, and tone of voice. However, in our studies we concentrate on three specific elements of speech prosody, or intonation: frequency, amplitude and timing. You may have participated in Dr. Ken Hoyte’s research which isolated prosodic features in order to reveal which elements are most important to our understanding. In this study, you listened to sentences with and without prosodic elements. Then you were asked to identify the person doing the action. This taught us that we use timing only minimally compared to the other two features.

**What is Self-Paced Listening?**  You may have participated in Dr. Marianne Fallon’s study where you listened to sentences that were intermittently stopped to allow you to process the words and then continue at your own pace. We are developing a new study that relies on this technique, eliminates prosody and varies sentence difficulty. As a participant, you will listen to sentences with or without normal prosody, but this time the sentences will vary in syntactic difficulty and pause a few times during the sentence. This new study aims to determine how much prosody helps us understand speech.

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Anticipating the Speech of Others

Miriam Kochman

Have you ever been in the middle of a conversation with someone and felt as though you knew exactly what they were going to say next? This is a common experience, especially among people who know each other well. The ability to anticipate another person’s reply often helps us to follow conversations and to connect with those to whom we are speaking. Previous research on the subject has confirmed this useful skill, and in doing so, it has also revealed significant information about the way speech is organized in the brain.

However, there are still many unanswered questions. How far in advance can people anticipate speech? What is the essential aspect of language that makes speech anticipation possible? Should we even be searching for one specific facet of language, or perhaps a combination of several things? At the Memory and Cognition Lab, we are studying these questions in order to increase our understanding of human speech. Currently, we are researching planning capacity, and we hope to study the impact of prosody on speech anticipation. Prosody refers to the rhythmic patterns of speech, including pitch, loudness, and timing. Our goal is to gain insight into the brain’s abilities to organize, process, and comprehend speech.
“There will be time, there will be time…” - T.S. Eliot
Patricia A. Tun, Ph.D.

How often have we thought, “If only I had more time to do that…” For those of you who have participated in our “rapid speech” studies, this has almost certainly crossed your mind. One of the most robust findings in aging research is a very gradual slowing of cognitive processes across the lifespan, beginning in the 20’s for some tasks and continuing on through middle age and old age. For many simple tasks, such as responding as quickly as possible to a light or a sound, this slowing is a matter of a few milliseconds (thousandths of second) each year. Nevertheless, these changes do add up over the years. Because the research focus in our lab is on changes with age in processing spoken language, we have been especially interested in how rapid speech rates affect older adults’ ability to comprehend and remember speech.

If you have been feeling as though people on television and radio seem to be talking faster and faster, you are correct. Part of that observation may rest on age-related changes in mental speed, but it is also true that many shows and advertisements in the media are using rapid speech to cram in more information in their valuable allotted time. Some radio talk shows use electronic speech compression of the talk segments in order to create more time for advertisements. In addition, there has been a growing perception, particularly among young adults, that individuals who speak rapidly are more intelligent; thus, shows like “West Wing” often involve rapid-fire spoken interchanges that may be difficult for older adults to follow.

In order to investigate how rapid speech rates affect listeners of different ages, we use a computerized sound editing system that time compresses spoken passages by removing imperceptibly small bits of the speech signal. For example, if a passage takes 60 seconds at a normal conversational speech rate of about 180 words per minute, this system can compress it to 75% of that time (45 seconds) or even 50% of that time (30 seconds), and younger adults can still follow the speech reasonably well. By contrast, our studies have shown that older adults have much more difficulty remembering material presented at these rapid rates. Even when the sound level is of the same loudness that makes remembering relatively easy for speech at a normal rate, the feeling of many listeners is that they “can’t hear” the fast speech. This suggests the locus of the problem is in central speed of processing information, rather than hearing acuity. A recent study verified this by “restoring” time back to a passage that had been compressed by adding in small pauses at the end of clauses and sentences to allow the listener a bit of extra time to finish processing and integrating what was heard. When we provided this extra catch-up time, even though the speech itself was still speeded up we found that both younger adults and older adults were able to remember just as much as if the passage was presented normally. So, if you are having trouble following a speaker, the solution may not be to turn up the volume, but to slow down the rate. Perhaps someday technology will make that easier to accomplish.
Basic Primer on Audiograms
Raj Stewart, Graduate Student

A key part of the research conducted at the Memory & Cognition lab is focused on the quality of how we hear different sounds; to address this, short hearing screenings are incorporated into many of our studies. Frequently, our volunteers have questions about the screening results, particularly basic audiogram interpretation. In response to your interest, presented below is a brief summary of some of the more common hearing profiles that we see in the lab, along with visual examples. Note that for all graphs, hearing test frequencies are presented in ascending order left to right, from a low pitch to a high pitch. Hearing levels are in ascending order from top to bottom, moving from good hearing to poor hearing.

At the left is an example of a clinically normal hearing profile. A pure tone is tested at each frequency from 250 Hz to 8000 Hz. The threshold is the lowest sound intensity at which a person can hear the tone. For both older and younger adults, normal hearing is defined as having thresholds at 20dB or lower at all tested frequencies. This profile exceeds that limit at every frequency, with levels at 5dB or 10dB across the range.

Next is a sample of an audiogram that might be obtained from a listener who has a slight degree of high frequency hearing loss, as noted by the higher thresholds at 4000, 6000, and 8000Hz. Although there is some loss at these frequencies, please keep in mind that, because many sounds used in spoken language occur between 500Hz and 4000Hz, daily activities may not be significantly affected. This type of hearing profile is common among older adults, due to natural age-related changes in hair cells and other auditory organs.

Our final sample displays what is referred to as a “noise-notch”, indicated by the pronounced dip in threshold levels at 4000Hz, followed by a recovery at higher frequencies. Noise notches are often observed as a consequence of a listener's exposure to loud noise; commonly, this noise exposure occurs in workplace environments that involve loud machinery, firearms or blasting caps, or excessively amplified music. Over time, hearing loss across multiple frequencies may develop.

While the screenings conducted in our lab are fairly accurate and contribute to ongoing research, we encourage you to consult with your primary care provider or a clinical hearing specialist should you have detailed individual questions.
Hearing Research with Unique Populations

David Starr, Research Staff

While a majority of our studies focus on hearing and memory in aging, some of our research investigates other populations of people. One such study, conducted with Clarke Cox, Ph.D., chief audiologist at the Boston Medical Center, looks at people who have permanent mild to moderate hearing loss in only one ear. In our studies we typically try to form groups that differ on only one factor, such as hearing, so that we can determine its effect on other factors. It is often difficult to perfectly match the groups for other qualities that might influence our tests, such as cognitive ability or age. Unilateral hearing loss participants give us the opportunity to study the effect of hearing loss without having to control for these other factors.

The battery of tests that we are currently using was first developed as a means of testing for Auditory Processing Disorder (APD). People with APD hear normally, but have difficulty processing information. The method of testing for this disorder involves presenting participants with a series of tests to examine their entire hearing profile - including their comprehension of fast speech and their ability to listen to a conversation while there is a certain degree of background noise. Since the symptoms of APD can also manifest themselves in people with hearing loss, using this battery gives us insight into various challenges in processing that result from hearing loss. Hopefully, this will allow us to develop a clearer understanding of the changes that occur as hearing declines.

Improving Listening Efficiency

Michelle Schlesinger

What happens when listeners hear complex sentences and are asked to recall the ideas in the sentences? Last year, many of you participated in Dr. Marianne Fallon’s study where you heard sentences that varied in sentence complexity. While hearing these sentences, you paced yourself using a technique called an auditory moving window. At the end you were asked to recall the sentence and answer several comprehension questions. We found that regardless of age, listeners paused longer when the sentences were more complex. This finding gave rise to belief that aging does not impact sentence processing.

Later we examined task demands: either listeners recalled information or listeners answered simple comprehension questions. When listeners recalled ideas from the passages before comprehension, older adults paused differentially longer than young adults under the same condition. This finding prompted us to further examine why the recall condition differently affected older adults. Perhaps having listeners first recall the sentences created anxiety in some older adults because they were unsure of how they were going to perform. We would like to learn more about this new finding and use it to help older adults profit when recalling information from passages.

We hope many of you will participate in our new study that investigates listening efficiency with memory strategies. However, there will be a new twist to the study: We will ask that you alter your pacing in order to evaluate recall. Do you think that coaching participants so that they pause for longer time durations or pause for shorter time durations will help listeners recall more ideas from the passages? Come to the Memory and Cognition Lab and find out!
Interpreting Experimental Results
Lynn Lohnas

You might be familiar with the expression: “Let the numbers speak for themselves.” In the scientific world, however, it is rarely so easy. Scientists must use a variety of techniques to interpret the numbers they obtain in their experiments.

Some methods are meant to make sure their findings are not just a matter of chance. Intuitively, this can be thought of as the number of people in the experiment. You might guess that a study with two hundred people would be much more informative than a study with two people! In more mathematical terms, there is a formula used to calculate statistical significance. This ensures that if other scientists perform the experiment again, they should see approximately the same results each time.

Other methods used to interpret the results can, for instance, turn qualitative statements into quantitative statements. For example, one can say that “Younger people have better hearing than older people.” Yet the numbers from an experiment can explain the exact difference between their hearing levels. These techniques can also indicate which conditions better demonstrate the hearing differences. Understanding these details is important to unlocking the secrets behind hearing loss.

Here at the Memory and Cognition Lab, we are implementing more statistical analyses to the data from many of our experiments. This is important for the same two reasons mentioned above. While we have always tested for statistical significance, our new analyses allow us to interpret the results in more ways than before. In conclusion, by applying many different formulas to one set of experimental data, we can learn much more from each experiment.

Farewells

Jonathan E. Peelle, Ph.D., is now a Post Doctoral Fellow at the University of Pennsylvania. He is still collaborating with our lab on multiple research projects.

Ken J. Hoyte, Ph.D., completed his Ph.D. in August and is now a Post Doctoral Fellow at Michigan State University, where he is living with his wife, Kaliris Salas-Hoyte. The two married this spring in Puerto Rico. Kaliris is a neuroscience Ph.D. candidate at Michigan State University.

Marianne Fallon, Ph.D., is now Assistant Professor in the Department of Psychology at Central Connecticut State University.

Arelys Feliciano-Sanchez, Ph.D., completed her doctorate this summer and is now a Post Doctoral Fellow at Harvard University.

Kara Fitzgerald, M.A., completed her masters in psychology over the summer and she is currently applying to Psychology Ph.D. programs.

Luisa Vesely, B.S., a senior undergraduate honors student, graduated last May and is currently working as a research assistant at the University of Pennsylvania.
In the News

Remember Your Mother Telling You to Eat Your Vegetables?
Tora Olafsen, Research Staff

New research reaffirms your mother’s advice: vegetables have been shown to slow cognitive aging, particularly preserving memory and keeping your brain young. A study conducted at the Rush Institute for Healthy Aging at Chicago’s Rush University Medical Center has found a positive correlation between more daily servings of vegetables and slower cognitive decline. The study tested more than 3,700 participants aged 65 and older over the course of six years. Those who ate at least 2.8 servings of vegetables a day slowed their rate of cognitive decline by about 40% - effectively having a brain that appeared five years younger than it physically was.

Researchers tested participants on short-term memory and delayed memory at the onset of the study, three years in, and at the conclusion of the study (six years in). The results showed that with a daily intake of vegetables (fruits did not have the same effect) older adults were able to stave off the effects of aging, particularly in regards to memory loss.

The study indicated that the most effective vegetables are leafy greens which are high in vitamin E. Leafy greens are also usually eaten with additional fats and oils (such as salad dressings, and mayonnaise) that help the body to absorb vitamin E. These healthy fats and oils can also lower cholesterol and keep arteries clear, which, in turn, can contribute to brain health.

In addition to activities like crossword puzzles, brain teasers and reading to keep the brain (and memory) from declining, eating healthy (just like your mother told you!) is a key ingredient to healthy aging.

The Positive Effect of Computer Games

*Ethan Yetton, Research Staff*

For years, video games were seen as being something for children - and something not particularly good for them, at that. Recently, though, adult acceptance of game playing has increased dramatically. In fact, many of our volunteers often talk about gaining familiarity with personal computers thanks to the games (for example, Solitaire or FreeCell) that come built in with many systems.

Well, you might want to keep playing!

It turns out that playing computer games may, in fact, help both memory and mental “sharpness” in older adults. For example, a new game (code-named “HiFi”) that is currently being investigated by Posit Science in San Francisco has been linked to higher scores (of about 5.5 points) on a standardized test of memory and attention. In the study (which involved 95 adults with an average age of 80), those who played the game for an hour a day over a period of eight weeks showed greater score increases than those who simply watched a daily lecture (their increase was about 2.2 points).

In another study, researchers from Institut Catala de Neurociencies Aplicades in Barcelona, Spain and the University of Pittsburgh School of Medicine looked at 46 patients with Alzheimer’s disease, all of whom were taking standard medications. Compared to those who stayed at home, people who partook in a daily three-hour program of arts and crafts and physical activity showed improved cognitive functioning, the effects of which lasted for about twelve weeks. People who were part of this program and additionally played a “cognitive task” game on the computer for twenty minutes three times a week still showed the beneficial effects after twenty four weeks.

A lot of research needs to be conducted on this idea. It’s great that there were performance boosts on clinical tasks, but how the effects of game playing show themselves in the real world have yet to be determined. Also, as with anything in life, moderation is key. Physical activity is very important for people in every age bracket, so make sure to keep exercising regularly, but don’t be ashamed to play your games!

**New Campus Map: Parking and Driving Directions**

Due to the construction of a new Science Complex, visitors to the Memory and Cognition Lab will now have a new parking designation on campus. As usual, you will receive a parking permit, appointment confirmation letter with written driving instructions, and a new map. If you have any concerns or questions about these changes, please feel free to contact us.
Season’s Greetings!

Thank you for your support!

Brandeis University
Memory and Cognition Lab
Volen Center - MS 013
P.O. Box 549110
Waltham, MA 02454-9110
Phone: 781-736-3273
web: www.bio.brandeis.edu/memlab