



**MCNAIR RESEARCH JOURNAL
UNIVERSITY OF OREGON**

2018

University of Oregon McNair Scholars Program Research Journal

The Ronald E. McNair Post-Baccalaureate Achievement Program prepares low-income, first-generation college students and students from underrepresented groups to pursue graduate study that culminates in PhD degrees. At the encouragement of the McNair Foundation, Congress named the Program to honor the legacy of Ronald McNair, an African American NASA astronaut and physicist who died aboard the space shuttle Challenger in 1986. Each year the UO supports approximately twenty-six qualifying undergraduate McNair Scholars who show potential and commitment to complete doctoral-level work.

Susan Lesyk, Director, Teaching and Learning Center
Gail Unruh, Director, McNair Scholars Program
Karen Kelsky, Advisor, McNair Scholars Program



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Acknowledgements

The University of Oregon
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acknowledges with sincere
appreciation the guidance and
encouragement given by faculty
and mentors who have
helped make possible
the academic achievements
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**University of Oregon
McNair Scholars Program
Research Journal**

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**Abstracts by McNair Scholars
at the University of Oregon**

Reducing Protein Expression in the pMT Vector

Amanda C. Baker
Biology, Philosophy

Faculty Mentor: Kenneth E. Prehoda
Chemistry, Institute of Molecular Biology

Graduate Student Mentor: Michael L. Drummond
Institute of Molecular Biology

Stem cell protein polarity during mitosis is an evolutionary conserved mechanism that is crucial for the morphogenesis of differentiated cell types as well as for stem cell self renewal. When protein polarity is disrupted, cancerous traits such as increased cell numbers may occur. To understand how polarity proteins localize to the cell membrane, we have expressed these proteins into Schneider 2 cells (S2 cells) by transfection using the metallothionein promoter (pMT) vector. This vector carries the genes of polarity proteins into S2 cells and helps to express those proteins within the cells. However, the pMT vector outputs far more protein than necessary. Cells with the pMT-EboxMut vector displayed a reduced output of protein expression in comparison to the normal pMT vector. The pMT-EboxMut allows us to turn down the amount of protein expression as a volume knob controls sound. Ultimately, through developing more efficient and rapid technique of studying polarity protein localization we will be able to further our understanding of the molecular nature of cancer.

Investigation of Nucleic Acid Binding to Palladium Surfaces

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Nanotechnology is a relatively new field that exploits the unique optical, electronic, and catalytic properties that many materials exhibit when their size is confined to the nanoscale. Palladium nanoparticles have shown great potential for catalytic applications. Previous work has demonstrated strong interactions between oligonucleotide sequences and palladium nanoparticles, but the specifics of these interactions have yet to be determined. This study investigates the binding interactions between nucleotides and palladium surfaces. Nucleotides are characterized before and after absorption to the palladium surfaces to determine differences in orientations and binding behaviors. Competitive binding assays assess the affinity of polynucleotide sequences of various chain lengths and compositions towards palladium surfaces. We predict that the knowledge gained will allow us to exert greater control over the synthesis of palladium nanoparticles using nucleic acid sequences.

Did I Hear You Right? A Question of Selective Attention and Language

Chalice Closen

Psychology

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Psychology

The current research seeks to examine the relationship between language and brain processing speed. Previous research, such as Cakir-Isbell & Neville (in prep), revealed a difference in processing speed between linguistic and non-linguistic auditory probes. However, questions about that research remain. Perhaps the results were due to a pop-out effect, and the results were affected by the linguistic probes standing out more than the non-linguistic probes, or perhaps the results were due to an inherent ability of the brain to detect language. To test the hypothesis that the brain responds more quickly to the language quality of the probes, a dichotic listening paradigm is used with three types of probes: two probes from the narrators' own voices and one of white noise. An EEG will monitor participants' brain electrical responses and reaction speed to each of the three probes. These results will extend previous research and contribute to the continuing study of language and brain processing speed.

A Microanalysis of the Language Socialization of One International Graduate Teaching Fellow: Ending a Dialogic Lecture in the Classroom

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International graduate teaching fellows (IGTFs) play an important role in undergraduate education, leading many labs, discussion sections, and even teaching some lower-level classes. However, little research has focused on the effects of instruction that IGTFs receive in pre-service training sessions and addressed, on a micro level, how this instruction contributes to the development of IGTFs' pedagogical skills. The current study uses a language socialization framework (Ochs, 1993; Schieffelin & Ochs, 1986, 1996; Watson-Gegeo, 2004) to show how one IGTF, Xu, is socialized through the use of language while being socialized in the use of language to become a "dialogic," or "interactive," teacher. In particular, this study uses conversation analysis (Schegloff et al., 1974, 1977) to focus on the ways in which both explicit instruction and implicit modeling by the course instructor contributed to Xu's development and his use of closing sequences in interactive lectures. In particular, we show how explicit teacher instruction and intervention influenced Xu's use of announcements before bringing the class to a close.

Visuospatial Contextual Processing in the Right Superior Parietal Lobule

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Psychology

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Psychology

An observer's perception of the visual attributes of an object is colored by the context in which the object is seen. In general, the information provided by the context of a scene is beneficial to the observer's judgment, but that is not always true in the case of visual illusions. The neural structures involved in processing the visuospatial contextual information are not fully identified. Previous research has demonstrated that a region in the superior parietal lobule (SPL) in the right hemisphere plays a role in at least some circumstances. Here, we test the generality of this finding by using transcranial magnetic stimulation to temporarily disrupt the neural processes of this structure and assess the effect on subjects' susceptibility to the Ponzo illusion. Our results indicate that the right SPL does not process the contextual information that drives the Ponzo illusion and suggest that this structure is not a general-purpose processor of all visuospatial contextual information.

**An Evaluation of International
Non-Governmental Organizations (NGOs):
A Comparison with the World Bank and the IMF**

Bara Mbengue

French

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International Studies

Criticisms of neoliberal ideals of development have risen to a high level in the discourse of developers. As a consequence of this trend, international Non-Governmental Organizations (NGOs) have increased in importance. Many scholars describe them as both the challengers and the alternatives to the present system. However, more needs to be understood about how they function by examining their operations, funding, projects, and personnel. Also, understanding the relationship between the organizations and the members of a community highlights one determinant of NGO successes in a postmodernist era. The approach of NGOs is contrasted with that of development agencies such as the World Bank. An analysis of the contrasting approaches may help to explain not only the challenges that NGOs face but also how they can help provide effective alternatives for sustainable development. Exploring the work of four NGOs in an era of postmodernism casts light on whether they may be better alternatives to the neoliberal organizations of the present system.

Predicting Parenting Stress in Families with Preschoolers with Disabilities

Christabelle Moore

Psychology

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A growing body of research demonstrates that parents of children with autism spectrum disorders (ASDs) report more stress, depression, and caregiving burden than parents of typically developing children (Baker et al., 2003; Weiss, 2002) or parents of children with other developmental disabilities (Abbeduto et al., 2004). This study investigated the relationship between child characteristics and parenting stress among families of preschool children ($N = 98$) with developmental disabilities, including those with ASDs. More specifically, we examined the relations between various self-report parenting stress measures, the relations between child characteristics and parenting stress, and to what extent individual child characteristics predict parenting stress. In general, parents of children with ASD did not report significantly more stress than parents of children with developmental delays. Controlling for demographics, child characteristics successfully predicted parent stress and depressive symptomatology. These findings provide educators, clinicians and researchers with more specific knowledge about the role of child behavior in the context of parenting a preschooler with autism or other neurodevelopmental disabilities.

Synthesis of Tungsten Oxide Nanowires via Thermal Vapor Transport

Benjamin Nail

Chemistry

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Chemistry

We report the synthesis of crystalline 1D tungsten oxide nanowires with diameters of 10-60 nm and lengths of hundreds of nanometers in a low-pressure quartz tube furnace using a WO_3 powder source and Ar/O_2 gas flow. We analyzed the morphology and composition of the resulting nanostructures using scanning electron microscope (SEM) and X-ray diffraction (XRD) studies and then related our findings to the growth conditions present during synthesis. Our research shows that the O_2 partial pressure of the system and the presence of H_2O vapor play critical roles in the formation of 1D crystalline structures. We also demonstrate the controllable oxidation of WO_2 nanowires to monoclinic WO_3 nanowires while still retaining the preferred 1D morphology. Further, our XRD studies have revealed the details of the physical change in crystal phase that occurs during this controlled oxidation process.

Graduate Student Use of and Client Reaction to Humor Implemented During Aphasia Therapy

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Communication Disorders and Sciences

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Communication Disorders and Sciences

Effective therapy can assuage psychosocial and communicative frustrations associated with aphasia. Although Simmons-Mackie and Schultz (2003) have suggested that humor used during therapy with people with aphasia (PWA) enhances the interactional dimension of therapy, no studies have investigated how graduate student clinicians use humor during aphasia therapy. This study explored how student clinicians used humor during aphasia therapy and how PWA responded to that humor. Participants included University of Oregon (UO) graduate student clinicians and individuals who had aphasia therapy sessions with student clinicians at the UO clinic. Student clinicians completed surveys assessing their perceptions of humor they used during aphasia therapy sessions. Participants with aphasia were interviewed regarding their perceptions of humor used during therapy sessions with student clinicians. Results cast light on how student clinicians develop this skill, how student clinicians use humor, and how clients perceive graduate student use of humor during therapy.

Molecular Cloning

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Post-doctoral Mentor: Chong Liu
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Mosaic analysis with double markers (MADM) is a critical method that allows gene knockout in clones that can be used to determine cell lineage. By using this method, the aberrations in individual cell lineages prior to the final transformation can be analyzed. In that way, a cancer (tumor progression in vivo) could, in principle, be analyzed. To understand more about a specific gene, it needs to be amplified or isolated. In this case, molecular cloning is a fundamental part of the process and needs to be completed before a specific gene can be studied in depth. Molecular cloning is the critical method to amplify a specific gene of interest. New DNA molecules are constructed by inserting different fragments of DNA molecules at four different restriction sites along the same backbone between EcoRV and XhoI and between Sall and BamHI.

Documenting the Undocumented through Theater Arts

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Spanish

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Theatre Arts

Contemporary Latina/o theater art in the United States illuminates issues of race, gender, and ephemeral identity among undocumented immigrants. Playwright Gloria Anzaldúa theorizes that the borderland consists of two worlds existing simultaneously. One world is the physical border between the United States and Mexico. The other world is internal and concerns how undocumented people live dual lives, balancing unethical compromise and opportunity. José Cruz González's play *Marisol's Christmas* focuses on undocumented immigrants who struggle with borderlands. The characters are shipwrecked optimists, suspended between the place of origin, to which they cannot return, and the mirage of opportunity seemingly offered by their new home, but just outside of their reach. Investigating the Spanglish in *Marisol's Christmas* using Anzaldúa's borderlands theory reveals the complex identities of the undocumented immigrants as portrayed in this example of Latina/o theater art by characters who also represent, to varying degrees, the masses.

Online Supplemental Learning

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Center for Advanced Technology in Education

In this age of information, students and virtually anyone with access to a computer and the Internet have terabytes of valuable educational material at their fingertips. Yet, the current literature and formal educational practices have focused only on authoritative academic sources to determine the benefits of online learning. This study examines the potential of several widely used but non-academic websites as educational tools to help prepare high school and college students for coursework in various subjects. Building on Rand J. Spiro's Cognitive Flexibility Theory of teaching ill-structured concepts in a hypermedia environment, video and text-based resources from websites such as YouTube and Wikipedia are used to establish knowledge schema necessary for learners to assimilate new knowledge. In cooperation with the Center for the Advanced Technology in Education at the University of Oregon, this study describes and evaluates strategies for the use of these online resources to establish context and assist in students' acquisition and comprehension of knowledge.

**AIN'T I A POET?
Women Claiming Credibility
in the Poetry Slam**

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Sociology

Faculty Mentor: Elizabeth Reis
Women's and Gender Studies

The National Poetry Slam is an annual competition that draws teams of poets from around the country; it is poetry and performance as an extreme sport. Critics claim that the Slam is the “death of art,” but defenders believe that it is “the story of where American poetry went wrong and what it is doing right for itself.” Slam has gained academic attention with previous studies addressing the “performance of race” or the use of humor as slam strategies. However, those studies have tended to ignore gender as a dynamic influence within the Slam. This study utilizes interviews at the 2011 National competition to explore the current experiences of women slam poets. Its focus is on performance styles, body language, and narratives women use as they compete. Preliminary field work suggests that despite being a male dominated stage, the slam provides a platform for empowerment for women identified poets.

Selected Papers

Reducing Protein Expression in the pMT Vector

Amanda C. Baker
Biology, Philosophy

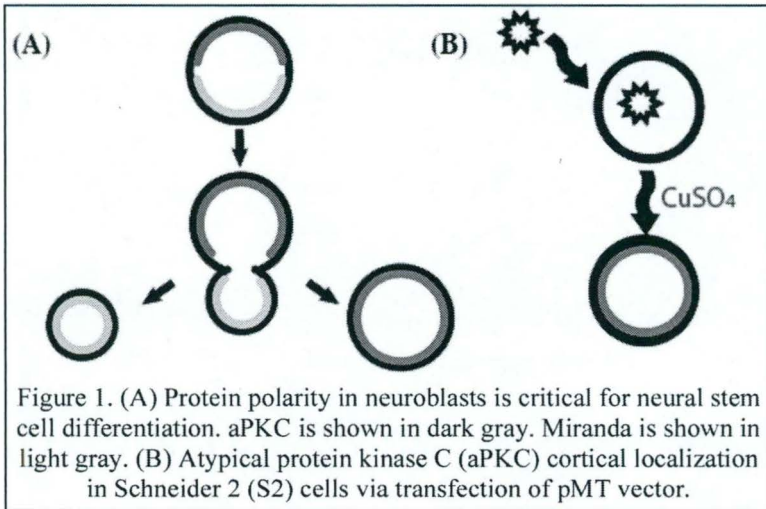
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Introduction

Stem cell protein polarity is a fundamental and dynamic process that guides cellular differentiation and proliferation during development. Protein polarity can be observed in cell types ranging from zygotes to highly specialized epithelial cells. For decades an entire field of cancer research has been dedicated to understanding the mechanisms behind protein polarity, mechanisms that are dictated by an array of protein-protein interactions. One popular and highly genetically characterized model organism that is used to study protein polarity is *drosophila melanogaster*, or the fruit fly.

In the fruit fly, neuroblasts (neuronal stem cells) set up protein polarity to divide asymmetrically. While neuroblasts supply the central nervous system with neural cells of specific fate and function, neuroblasts also self renew after division in order to repeat this process. Renewal occurs because of the separation of polarity proteins to the apical and basal domains of the cytoplasm (Figure 1A). The polarity proteins that are localized to the



apical domain of the cell cortex act as self-renewal factors that will yield a neuroblast after division. On the other hand, separate polarity proteins on the basal cortex of the cytoplasm will yield a precursor cell of a neuron after division.

Many polarity proteins have not been well characterized, including the kinase atypical protein kinase C (aPKC), which is important to polarity because it aids in the physical restriction of basal polarity proteins. At the metaphase plate during mitosis, aPKC restricts the basal fate determinate, Miranda, to the basal cortex through phosphorylation, a process by which a protein kinase attaches a phosphate group to another protein in order to change the behavior of it. Phosphorylated by aPKC, Miranda dissociates from the apical membrane and is restricted basally. Although this provides clear evidence about the maintenance of basal polarity, this information fails to explain how aPKC is able to be anchored to the apical domain of the dividing cell. It is clear that aPKC is fundamental for maintaining protein polarity. Yet important questions remain about how aPKC does

this, what parts of it are crucial for localizing to the cell cortex, and how we tune the correct dose of aPKC in S2 cells.

To investigate these questions, constructs of aPKC were made that lacked the particular pieces of aPKC predicted to be responsible for its cortical localization. Through the method of DNA transfection, the pMT vector carried the gene of interest into host S2 cells. After transfection, expression of the gene of interest is stimulated with the addition of copper ions in the form of copper sulfate^{1,2} (figure 1B). Initial imaging for the amount of protein expression revealed an overabundance of aPKC from the pMT vector. The overabundance is indicated by the fact that aPKC was present in the cytoplasm of the cell and is no longer restricted to the cell cortex. To eliminate this cytoplasmic concentration of aPKC, the promoter sequence of the pMT vector was altered to reduce aPKC expression. Developing a more efficient and rapid technique of studying polarity protein localization by creating the pMT-EboxMut and reducing the amount of aPKC, we will be able to more quickly advance our understanding of the molecular nature of cancer. Using S2 cells rather than fly embryo transfection to look at the behavior of polarity proteins can save months of time.

Results and Discussion

The first step focused on investigating the DNA element to which RNA Polymerase binds. RNA Polymerase binds to a DNA element known at the -10 -35 region, which is upstream from the transcription initiation site of the pMT vector.³ This element contains a special -35 sequence known as the E-Box (consensus sequence: CANNTG). The E-Box causes high levels of mRNA expression.⁴ Alterations of the E-Box from CANNTG to CTACCG decrease the enhanced green fluorescent protein (EGFP) mRNA expression in transgenic mice, as well as EGFP expression (Figure 2).⁵

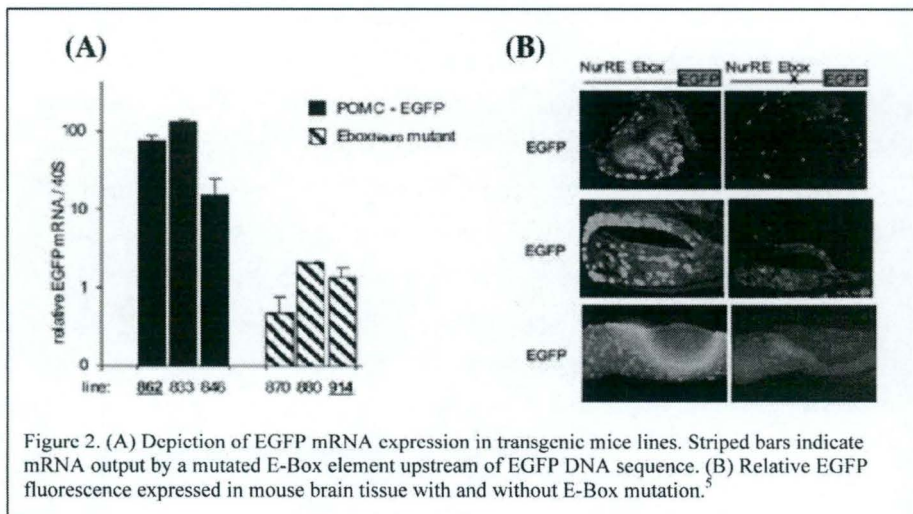


Figure 2. (A) Depiction of EGFP mRNA expression in transgenic mice lines. Striped bars indicate mRNA output by a mutated E-Box element upstream of EGFP DNA sequence. (B) Relative EGFP fluorescence expressed in mouse brain tissue with and without E-Box mutation.⁵

One of the key characteristics of the E-Box element is that it is a palendromic sequence. In other words, in the state of a single strand of DNA, these elements will fold onto themselves because they have complimentary nucleotide base pairs at either end of the DNA sequence. This palendromic structure is essential in the association of these elements to their corresponding transcription factors, including RNA polymerase.⁵ The E-Box mutations designed to reduce binding to transcription factors eliminated the presence of the palendromic structure and prevented folding and association with the transcription factors. Using a qualitative comparison of protein expression levels based on relative fluorescent intensity, the pMT-EboxMut vector clearly exhibits a decrease in the amount of aPKC expressed (Figure 3).

A reduced affinity between the promoter DNA and RNA polymerase occurred because mRNA was transcribed at a lower concentration. This resulted in reduced expression of aPKC. After collecting images, quantitative analysis measured the pixel intensity emitted by the fluorescent anti-

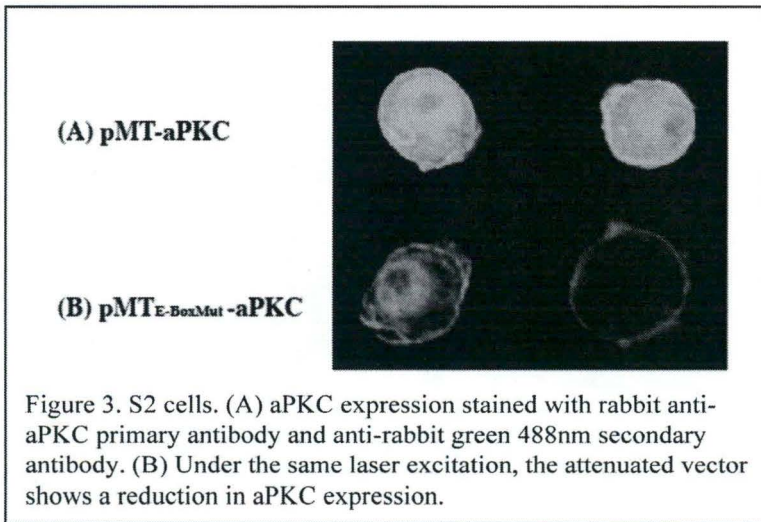


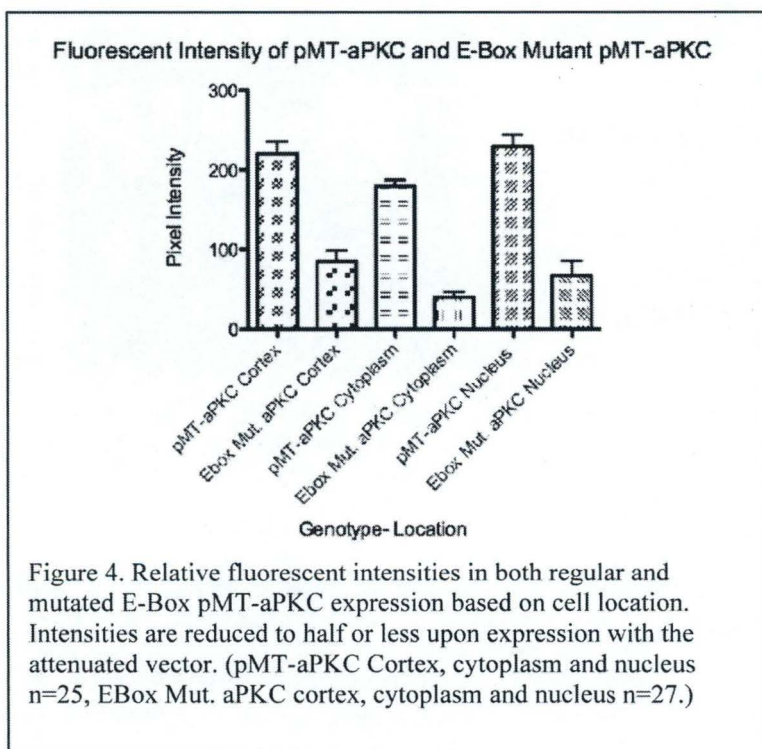
Figure 3. S2 cells. (A) aPKC expression stained with rabbit anti-aPKC primary antibody and anti-rabbit green 488nm secondary antibody. (B) Under the same laser excitation, the attenuated vector shows a reduction in aPKC expression.

bodies attached to aPKC in S2 cells. The collected data came from the same transfection session, and the analysis used the same settings on the confocal microscope. Those procedures helped to reduce variables that otherwise would interfere with the quantification. Results indicated that the attenuated pMT vector expressed a concentration of aPKC with abundance reduced by roughly 60 percent. (Figure 4). Regions measured for aPKC concentrations included the cell cortex, cytoplasm and nucleus. The areas showing the most significant reduction in aPKC concentrations were the cytoplasm and the nucleus (Figure 4). With these data, it is clear that the pMT-EboxMut controls the level of aPKC in S2 cells much as a volume knob regulates sound.

Materials and Methods

Construction of Mutant E-Box in pMT and S2 Expression

The E-box mutation was transformed from CANNTG to CTACCG using QUICKCHANGE mutagenesis. The vector and primer



samples underwent a polymerase chain reaction (PCR). The mutations were verified by DNA sequencing. The aPKC coding sequence was then inserted into the pMT and pMT E-box mutant vector at 5' BglII and 3' XhoI restriction sites. *Drosophila* Schneider (S2) cells were conserved in Schneider's medium with 10% fetal bovine serum (Sigma-Aldrich) at room temperature. Following procedures published by Wee et al. (2011),⁶ transfection was carried out by adding approximately 3×10^6 cells per well in a 6-well plate and transfected with 500 ng total DNA per well using the Effectene (QIAGEN) protocol. The cells were incubated for 24 hours. Gene expression was induced by adding 2.5 μ l of 0.5 mM CuSO₄ for 24 hours.

Immunohistochemistry, Staining and Imaging

To facilitate antibody staining, 200 μ l of S2 cells were placed on 12-mm-diameter glass cover slips in a 24-well plate and allowed to attach to the glass for 1 hour. The cells were fixed for 20 min with 4% paraformaldehyde in PBS followed by three rinses of wash buffer (0.1% saponin in PBS) and two rinses of block buffer (0.1% saponin and 1% BSA in PBS). The primary antibody used was rabbit anti-aPKC (1:1,000; Santa Cruz Biotechnology). Cover slips were incubated overnight with primary antibodies at 4°C and rinsed three times in block buffer followed by incubation with species-specific green (488 nm) secondary antibodies (Invitrogen) diluted in 1:500 block buffer at room temperature for 2 hours. Mounting was completed by rinsing the cells three times with washing buffer and then placing each cover slip in VectaShield Hard Set (No Dapi) solution. Images of the cells were obtained by using a BioRad confocal microscope at the objective of 60X using the program LaserSharp with the following settings: 12.8-Kr, 1.6-Iris, 8.5-Gain, and 1.5-Offset. All images were taken using the same laser intensity in the green laser channel of the confocal microscope. Images were analyzed using ImageJ and graphs were created with Prism.

Conclusion

Overall, protein expression of aPKC from the pMT-EboxMut vector was reduced. These data support the findings of Lavoie et al. 2008 in that a lower expression of protein follows the elimination of the E-Box palendromic quality, a procedure followed in this study. Until now, however, these results have never been seen in S2 cells. With the reduced expression of polarity protein in S2 cells, we are now able to study polarity protein localization. Reduction in protein expression from the pMT-EboxMut vector was exemplified by measuring the reduction in protein

fluorescent pixel intensities in S2 cells, which represents the amount of aPKC expression from each pMT vector. The pMT-EboxMut vector displayed a drop of 100 pixel units or more in the nucleus, cytoplasm and cell cortex, thus providing evidence that aPKC expression is less in the pMT-EboxMut vector compared to expression levels using the unaltered pMT vector. This research will aid in the development of a cultured protein polarity model cell that can be subjected to structure-function tests of aPKC and other proteins via genetic domain deletion. The pMT-EboxMut vector will aid in these studies because it acts as a protein expression volume knob that has been turned down. With the expression knob turned down, we are able to see exactly where aPKC is localizing in the S2 cell. In all, understanding the function of polarity proteins such as aPKC will bring us much closer to understanding protein polarity in general and its relation to the behavior of stem cell division and cancer. Here we have developed a more efficient and rapid technique of studying polarity protein localization with the pMT-EboxMut vector. Now we will be able to further our studies and understandings of the molecular nature of protein polarity and cancer at a faster pace.

Future Directions

With evidence of a reduction in protein expression by the pMT-EboxMut vector, we are able to express other polarity proteins in S2 cells to replicate the dynamics and localization observed in *drosophila melanogaster* neuroblasts. We may also use various aPKC constructs with deletions in various domains in order to understand how aPKC localizes to the cell membrane.

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Special thanks: Ken Prehoda, Mike Drummond, The Prehoda Lab, Gail Unruh, Karen Kelsky, Kalindi Devi-Dasi, the McNair Scholars Program and Peter O'Day of SPUR.

Did I Hear You Right? A Question of Selective Attention and Language

Chalice Closen
Psychology

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Graduate Student Mentor: Ryan Giuliano
Psychology

Introduction

In the past, many studies have examined the human capacity to attend to sounds and enhance information from relevant sources while suppressing information from other, irrelevant sources (e.g., Coch, Sanders, & Neville, 2005; Hillyard, 1981; Bentin, Kutas & Hillyard, 1995). Research is typically done through dichotic listening tasks in which participants are asked to attend to one stream of sounds while ignoring a separate stream of distracting sounds.

One approach to the dichotic listening paradigm is to use two different story tellers, one male and one female, who read separate sets of stories, one played on the left side of the participant and the other on the right (Coch, Sanders, & Neville, 2005; Stevens, Lauinger & Neville, 2009; Isbell, Karns, & Neville, in prep). Implanted within the stories are two types of distracter probe sounds: a computerized /ba/, used as the linguistic probe, and a computerized /buzz/ or static sound, used as the non-linguistic probe.

This paradigm is effective in the examination of event-related brain potentials (ERPs) obtained through an EEG recorded while a participant is listening to the stories and time-locked to the onset of the different probes. Findings from ERPs have revealed that the brain response to the probes is enhanced by attention, with the effect occurring as early as 100 ms after probe onset (Coch, Sanders, & Neville, 2005). Adults displayed an early positive response (P1) followed by a negative response around 100 ms (N1), while studies involving children have also noted that probes presented on the attended side elicit larger amplitude ERPs relative to probes presented on the unattended side (Stevens, Sanders, & Neville, 2006; Stevens, Lauinger, & Neville, 2009).

Recent research suggests that linguistic probes have a more pronounced distraction effect than non-linguistic probes (Isbell, Karns, & Neville, in prep). The ERP data for these conditions showed an earlier attention effect for the linguistic probes than for the non-linguistic probes. More specifically, linguistic probes elicit an attention effect at the P1, while non-linguistic probes elicit an attention effect roughly 100 ms later at the N1 (Isbell, Karns, & Neville, in prep). However, these results have given rise to new questions. It is possible, for example, that the results are due to the linguistic probes standing out more from the story-telling environment than the non-linguistic probes. It is also possible that the effects are present because of the probe's linguistic nature, and the human brain's inherent capacity to detect language.

The current project answers these questions by using multiple linguistic probes, one for each narrator. As in the Isbell, Karns, and Neville experiment (in prep), the linguistic probes were the syllable /ba/, but unlike those previous studies, the linguistic probes were not computer generated. Rather, two spoken linguistic probes were used: one in the same spectral envelope of the speakers reading the stories and one outside that

spectral envelope. Meanwhile, one non-linguistic probe was retained, a computerized /buzz/, identical to the non-linguistic probe used in previous studies (Stevens, Lauinger, & Neville, 2009).

The proposed set of probes allows for two possible testing outcomes. The first tests whether the earlier attention effect for the linguistic probe is due to spectral match, while the second tests whether it is the linguistic nature of the probe that drives the earlier attention effect. If the earlier attention effect reported by Isbell, Karns, & Neville (in prep) is due to the /ba/ syllable standing out more from the attended narrative, then the linguistic probe that does not match the narrator, the incongruent probe, will produce an earlier effect than the other probes. This would support the idea that the early attention effect is the result of a low-level pop-out effect. A pop-out effect is caused by the linguistic probe being louder or more pronounced than the story during which it is presented, causing the brain to respond not so much to language itself as to a distracting sound that stood out significantly from the rest of the story. However, if the congruent probe, the linguistic probe matching the attended narrator, elicits an earlier and larger magnitude effect, the result would provide strong evidence that the attention system of the human brain is specialized for language processing. Such an early language-related effect would be expected for the congruent linguistic probe and would be consistent with previous research suggesting that attending to language involves tuning in to the spectral envelope of the speaker being heard (Kerlin, Shahin, & Miller, 2010). Within this paradigm, however, the possibility exists that both of the linguistic probes show the same early effect. That result would support the idea that it is simply the linguistic nature of the probe that is significant. The final two scenarios would provide support for the idea that human brains have an inherent ability to attend to language.

Literature Review

Evidence suggests that linguistic distracters elicit an earlier attention effect on the evoked response from the brain, compared to non-linguistic distracters (Isbell, Karns, & Neville, in prep). Linguistic probes, presented on the attended side, elicit larger amplitude ERPs than the same probes presented on the unattended side. With adults this is observed as an increase in positive voltage 50 ms after the onset of the probe. In the case of non-linguistic probes, however, the increase in ERP amplitude for the attended versus the unattended probe is seen at later stages of processing, from 100-200 ms after the onset of the probe. The objective of the current research is to examine the possible factors that lead to this earlier ERP response for the linguistic probes.

These findings will have important implications for our understanding of the factors impacting the development of selective attention. For example, Stevens, Lauinger, and Neville (2009) found that the brain response to probes in this paradigm appears to be reflective of a child's socioeconomic status (SES). In their study, children from low SES backgrounds showed less difference in their ERPs between attended and unattended channels of the stories, while those with a higher SES background showed a greater difference between attended and unattended ERPs. In this instance, the lack of attention effect observed in low SES children was due to a lack of distracter suppression as evidenced by larger amplitude ERPs to unattended probes. In a related vein, this paradigm is also important for examining the role of attention in language impairments (Stevens, Sanders, & Neville, 2006). Children with selective language impairments (SLI) also fail to show an attention effect, but in contrast to low SES children, children with SLI have a deficit in enhancing attended information, seen as a lack of amplitude increase for attended probes.

The current paradigm has proven to be a robust measure of selective attention for both adults and children (Coch, Sanders, & Neville, 2005). Although the morphology of the ERPs differs between children and adults, attention effects are observed in both groups, suggesting that attention networks are formed early in life, yet continue to develop. For both children and adults, ERPs provide a more sensitive measure of attention than behavioral measurements; the ERPs can identify differences in signal enhancement and suppress distracters.

Methodology

To answer questions remaining from previous research, this research continued to use those earlier paradigms, while adding modifications. Previously the probes used for both the linguistic and non-linguistic probes utilized computerized sounds. In an effort to minimize the spectral mismatch, the linguistic and non-linguistic probes were created from the narrators' own voices, both male and female. Each probe was a 100 ms clip of the /ba/ sounds from both narrators' voices taken directly from the narrations and converted to both left and right channel auditory clips. For the /buzz/ sounds, the 100 ms clips were rearranged randomly to create the effect of static or white noise. The non-linguistic sounds were also converted to the left and right channels, to be superimposed on both the attended and unattended narratives.

Participants were recruited through fliers placed around a university campus. All participants received monetary compensation for their time in the lab. At the time of testing, all participants received, signed, and returned consent forms before they participated in the tests. To measure the extent to which the human brain responds to all types of probes, each participant was fitted with a 32-electrode cap and had additional electrodes placed below the right eye, to the sides of both eyes and on both mastoids

behind the ears. These additional electrodes helped to compensate for EEG signal artifact due to eye movement, blinks, and muscle noise.

After fitting the cap and connecting all of the electrodes, researchers led the participants into a sound-attenuated booth. Each participant was seated between two speakers, on the left and right, and two to three feet from a computer monitor that displayed pictures from the attended story. Over an intercom, participants received oral instructions to remain as still as possible and to pay close attention to the story on the attended side. After those preliminary instructions the paradigm began. Each story was approximately 2.5-3.5 minutes in length, and at the end of each story participants were asked three comprehension questions from the attended story to ensure that they had attended to the appropriate story. A total of eight stories were played for each participant, varying the attended side in the pattern of LRRLRLLR. After the EEG was collected, subsequent processing stages helped to extract data around the times of the probe onset, from 100 ms before to 500 ms after the probes.

Results

Results of the data collected for participants ($n=22$) suggest that it is not simply the linguistic nature of the probes that elicits a response from the brain, but that the spectral envelope plays a role. Results show an early P1 effect elicited from probes that match the male attended narrator in the unattended ear, 50 to 100 ms after onset of the stimulus. This is contrasted with the later P2 response from the non-linguistic probes which displayed a response 50-150 ms later than the male linguistic probes. The female narrator did not produce the same responses as those from the male narrator. In keeping with previous research, it was found that hemispheric asymmetries exist, showing a right ear/left hemisphere advantage for the male narrator.

Discussion

The ability to selectively attend to relevant information is critically important for educational achievement and overall life success. The inability to suppress irrelevant information can hinder learning in an academic environment. Many questions related to the subject of language and dichotic listening remain to be answered. In this study, the use of the dichotic listening paradigm with slight alterations allowed us to take into consideration not only the mechanics of the brain itself, but also the role that language plays in those mechanics.

In the past, this listening paradigm has utilized a computer generated /ba/ sound superimposed over the story that participants hear. The use of a computer generated sound left open the possibility that previous research was confounded by a pop-out effect, in which the brain was responding simply to a distracting sound that stood out significantly from the rest of the story. The current research has eliminated those confounding elements from the study.

The results from the current study suggest that there is, in fact, a response to linguistic probes presented during the stories that is earlier and greater in magnitude than the response to non-linguistic probes. Linguistic probes created from the voice of the male narrator showed an early P1 effect displayed at 50-100 ms after the onset of the stimuli, compared to non-linguistic responses from 150-200 ms. These results also replicated past research showing a right ear/left hemisphere advantage. This right ear advantage proved to elicit even earlier and larger magnitude responses than the same probe presented in the left ear. However, these results were not seen with all linguistic probes, suggesting there is a need for further research.

Participants showed no response to female probes at any time after the onset of stimuli. These results seemed to contradict past research as well as

results from the male narrator in this current study. After a reexamination of the probes used throughout this study, a possible explanation is that the formant signature—the peaks of the spectral sound—of the female probe may be dissimilar from the male linguistic probe as well as the non-linguistic probe, in that the response to the female linguistic probe has a later onset. This later onset could be detracting from the effect of the probe and therefore diminishing the effect it has on the listener.

In the future it will be imperative that the probes be normalized not only on volume and type of sound but also on sound quality and the timed onset of the sound. Although in this study the male linguistic probe presented an earlier and greater magnitude response from the brain, it is difficult to say definitively that the language quality of the sound produced these effects. These results would have been more convincing had the second narrator produced the same effects. It remains reasonable to conclude that the brain responds to language much differently than other sounds in our environment. It is now the task of future research to determine what exactly causes these differences.

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Predicting Parenting Stress in Families with Preschoolers with Disabilities

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Introduction

This study investigated the relationship between child characteristics and parenting stress among families of preschool children with developmental disabilities, including those with autism spectrum disorders. Autism spectrum disorders (ASD) are characterized by impairments in social interaction and communication, and restricted, repetitive and stereotyped patterns of behavior, interests and activities (American Psychiatric Association, *DSM-IV-TR*, 2000). Chronic and pervasive, ASDs involve atypical social, communication, and behavioral characteristics that pose significant challenges for parents and families (Schieve, Blumberg, Rice, Visser, & Boyle, 2007). Moreover, substantial evidence demonstrates the need to investigate the relations between various child characteristics and parenting stress, given that parents of children with ASDs report more stress, depression, and caregiving burden than parents of typically developing children (Baker, McIntyre, Blacher, Crnic, Edelbrock, & Low, 2003; Weiss, 2002) or parents of children with other developmental disabilities (Abbeduto, Seltzer, Shattuck, Krauss, Orsmond, & Murphy, 2004).

Baker-Ericzen and colleagues (2005) found that parents of toddlers

with ASDs had significantly higher levels of child-related stress (i.e., child characteristics and behaviors that are stressful to parents) as reported on the Parenting Stress Index (Abidin, 1995). Phetrasuwan and Miles (2009) also studied parenting stress among parents of children with ASDs and found that the highest sources of overall parenting stress were: managing the child's demanding behaviors and upset feelings, imposing discipline, and dealing with the child's behavior in public places. The most salient ASD-specific symptoms reported to be stressful to parents included difficulties relating to people, expressions of fear or nervousness, the child's emotional responses, and verbal communication issues (Phetrasuwan & Miles, 2009). Although studies suggest that parenting a child with an ASD can be stressful, scholars have not yet adequately addressed the relationship of various parenting stress measures. Nor have scholars addressed the functional relationship between specific child characteristics and subsequent impacts on parenting stress during the preschool years for parents of children with developmental disabilities including ASDs.

Autism spectrum disorders are the fastest growing neurodevelopmental disorders in childhood (Centers for Disease Control and Prevention, 2007). Current prevalence estimates suggest that 1 in 110 children will be diagnosed with an ASD (Centers for Disease Control and Prevention, 2011). Increasing evidence demonstrates the urgency of early diagnosis and intervention practices to afford children and families the most favorable outcomes. Given that parenting stress may decrease the effectiveness of early intervention for children with ASDs (Osborne, McHugh, Saunders, & Reed, 2008), understanding what factors may influence or predict parenting stress is an important research priority. Surprisingly, few studies have specified which child characteristics are most related to parent stress in children with developmental disabilities. Therefore, my research will extend previous work and fill this gap in the literature.

This study (a) investigated whether the various types of parenting stress and mental health measures (i.e. Parenting Daily Hassles, Family Impact Questionnaire, and Parenting Stress Index) are related; (b) evaluated whether child characteristics (i.e. demographics, adaptive behavior, problem behavior and social skills) and parenting stress in families with preschool aged children with developmental disabilities are related; and, (c) determined, after controlling for child demographic variables, to what extent individual child characteristics predict parenting stress. Previous findings suggested the existence of positive correlations among the various types of parenting stress and mental health measures (a). Also, previous research suggested that parents would have higher self-reported stress, negative family impact, and depressive symptomatology as a function of parenting a child with lower adaptive functioning, higher maladaptive and problem behavior, and lower social skills (b). Finally, we expected that maladaptive functioning, problem behavior and low social skills, traits more common in children with ASD than typically developing children, would be the most predictive of parenting stress, negative family impact and depressive symptomatology (c). In contrast to previous research, however, findings from this study suggest that, in general, problem behavior is the most predictive child characteristic of parent stress, negative family impact, and depressive symptomatology, regardless of ASD diagnosis.

Method

Participants

The data were taken from a sample of families (N = 98) with preschool-aged children with developmental disabilities who were included in a larger study involving a 12-week parent training intervention (Principal Investigator, McIntyre). Specifically, the group consisted of 80 boys and

18 girls; 58 of the 98 had developmental delays, and 40 had been diagnosed with an autism spectrum disorder ($M_{age} = 46.81$ months, age range: 2-5 years old). See Table 1 for demographic comparisons between developmental delay (DD) and autism spectrum disorder (ASD) groups. The data were collected over a 2-year period (2004–2006) by Laura Lee McIntyre while she was a faculty member in the Department of Psychology at Syracuse University. Some of the participants were included in a randomized controlled trial to investigate how The Incredible Years Parent Training Program (with modifications for children with developmental disabilities) compared to care-as-usual (control) in terms of increased positive parent-child interactions and decreased child problem behaviors (McIntyre, 2008). Analysis of this extant database affords an excellent opportunity to further investigate the impact of children's behavior and characteristics on parenting stress. Moreover, the existence of a parent training program offers indirect support to this study because parents of children with developmental disabilities, particularly parents of children with ASDs, often experience negative parent-child interactions as a result of child behavior problems, which in turn lead to elevated parent stress. For these reasons many parent-training interventions have been developed to support families of children with ASD and other developmental disabilities.

The families who participated in the study were all residents of New York State. As is the case for many other studies, small sample size continues to be a challenge for researchers in this field. Although data were collected from participating families pre- and post-treatment, the current study uses pre-assessment measures only to maximize the sample size, given that the response to intervention is not a focus of the current study. Originally, all assessments were collected in the participants' homes. To analyze the original data set, the current study used measures that focused on child characteristics and parenting stress and well being.

Measurements for Child Characteristics

Demographics. Demographic data were collected on children participating in the study. Of relevance to the current investigation were: age, sex, race, and diagnosis (autism or other developmental disability).

Adaptive behavior. The Vineland Adaptive Behavior Scales (VABS; Sparrow et al., 1984) is a structured interview given to individuals with or without disabilities to assess adaptive behavior. Primary caregivers served as respondents on four subscales: (a) Communication, (b) Daily Living Skills, (c) Socialization, and (d) Motor Skills. These subscales were combined to make up the Adaptive Behavior Composite standard score ($M = 100$; $SD = 15$).

Maladaptive behavior. The Child Behavior Checklist for Ages 1½-5 (CBCL; Achenbach, 2000) is a 99-item parent-reported checklist that indicates child problems in both internalizing and externalizing domains. Caregivers respond to questions on a scale of not true (0), somewhat or sometimes true (1), or very true or often true (2) now or within the past 2 months. The CBCL yields a Total Problem score, broad-band Externalizing and Internalizing scores, and narrowband scores (Emotional Reactivity, Anxious/Depressed, Somatic Complaints, Withdrawn, Sleep Problems, Attention Problems, Aggression Problems, and Other Problems).

Social skills. The Social Skills Rating Scale (Gresham & Elliot, 1990) assesses children's social skills and problem behavior. The Social Skills Scale, which is of relevance to the current study, is a 38-item scale in which caregivers report the perceived frequency and importance of their children's social behaviors in the domains of cooperation, assertion, responsibility, and self-control. The combined scores of the four domains comprise a Total Social Skills score.

Measures of Parenting Stress and Well-Being

Parenting stress. The Parenting Stress Index, 3rd edition (PSI-3; Abidin, 1995) asks caregivers to use a five-point scale ranging from strongly agree to strongly disagree to assess a variety of child and caregiver characteristics. The index used six child domain scales (Distractibility/Hyperactivity, Adaptability, Reinforces Parent, Demandingness, Mood, and Acceptability) and seven parent domain scales (Competence, Isolation, Attachment, Health, Role Restriction, Depression, and Spouse). An additional Life Stress Index of 19-items covered a range of stressors.

Parenting daily stress experiences. The Parenting Daily Hassle (PDH; Crnic & Greenberg, 1990) questionnaire measures a parent's everyday stress occurrences. The PDH is a 20-item index of parent's daily stress experiences pertaining to typical child rearing activities. The caregiver rated the frequency and intensity of each hassle.

Family impact. The Family Impact Questionnaire-FIQ (Donenber & Baker, 1993) is a 50-item questionnaire that asks about a "child's impact on the family compared with the impact other children his/her age have on their families." Of interest to this study are two scales, the Negative Impact on Feelings about Parenting (9 items) and Social Relationships (11 items); the two scales were combined to form a Negative Impact Composite (see McIntyre, 2008).

Parent depression/well-being. The Center for Epidemiologic Studies-Depression Scale (CES-D; Radloff, 1977) is a 20-item self-report to measure parent's depressive symptoms of moods and feelings.

Results

After dividing the sample families into two groups—those with a child with an ASD and those with a child with a developmental delay (DD) but not an ASD—the demographics for the two groups were com-

pared (see Table 1). The groups did not differ on most items, either related to the child (age, sex, race, received early intervention) or related to the family/mother (biological mother, age, education–bachelors degree, living with partner, government aid, siblings with learning or behavioral problems, parent learning disability, parent mental health problem). However, chi-square significance tests revealed that the DD group had significantly fewer children living with their biological mothers, $\chi^2(1, N = 98) = 8.55$, $p < .01$, and significantly more children with siblings who had learning or behavioral problems, $\chi^2(1, N = 98) = 4.94$, $p < .05$.

Interrelations of parenting stress measures

Pearson correlation analysis was used to address the first research question of whether there are correlations among various parenting stress measures (Parenting Daily Hassles, Family Impact Questionnaire, and the Parenting Stress Index). Fifteen of the twenty-one inter-correlations of parenting stress measures were significantly positively related with Pearson r coefficients ranging from low (.20) to very high (.81) in that as parents reported higher levels of stress on subscales of the PSI, they also tended to report higher negative family impact (FIQ-Negative) and more depressive symptomatology (CES-D). (See Table 2.) The following six intercorrelations did not have significant relationships: PSI–Life Stress X PSI–Child Domain, PDH X PSI–Child Domain, PDH X PSI–Parent Domain, PDH–Life Stress, FIQ–Negative X PSI–Life Stress, and CED–D X PSI–Life Stress.

Interrelations of child characteristics and parenting stress measures

As with the first question, Pearson correlation analysis was used to explore the second research question of whether there are correlations between the child characteristics (i.e. demographics, adaptive behavior, problem behavior and social skills) and parenting stress in families with

preschool aged children with developmental disabilities. The results revealed some surprising relationships. For example, children's greater adaptive behavior on the Vineland Adaptive Behavior Scales (i.e., communication, daily living skills, socialization and motor skills) was significantly negatively related to higher scores on the PSI-Child Domain, $r(97) = -.22, p < .05$, and significantly positively related to higher scores on the PSI-Parent Domain, $r(97) = .21, p < .01$, and PSI-Life Stress, $r(97) = .28, p < .01$. Also, maladaptive child characteristics and problem behavior captured by the Child Behavior Checklist (CBCL), and lower social skills measured in the Social Skills Rating System (SSRS) were significantly related to higher ratings of parent stress and depressive symptomatology on the PSI-Child Domain, PSI-Parent Domain, PSI-Total, FIQ-Negative, and the CES-D measures, respectively (Table 3). Notably, a significant correlation existed between gender and PDH, with parents of boys tending to identify higher levels of parenting daily hassles. These findings warrant further investigation to evaluate specific child behaviors on the Vineland and subdomains of the CBCL and SSRS to determine if there were differences between families with a child with an ASD and those with a child with another DD.

ASD and DD group comparisons

On the CBCL, children in the ASD group had more withdrawn behavior, $t(96) = 3.22, p < .001$, and less anxious/depressed behavior, $t(96) = 3.28, p = .001$, than children in the DD group. On the SSRS, children in the ASD group tended to show less cooperation, $t(95) = 2.68, p < .05$, less assertion, $t(95) = 4.91, p < .001$, and less responsibility, $t(95) = 4.87, p < .001$. A comparison of the scoring for both groups on the parenting stress and mental health measures revealed that they were similar on all sub-domains except PSI Acceptability (Child). An examination of that exception

showed that parents of children in the ASD group reported higher parent stress due to the child's behavior being less acceptable than the parents had hoped for or expected, $t(94) = -2.30, p < .05$.

Predictors of parenting stress

Finally, seven hierarchical linear regressions allowed an exploration of the third research question. After controlling for child demographic variables, the extent to which individual child characteristics predict parenting stress. The goal of using that set of seven regressions was to determine which child characteristics accounted for reported parent stress (PSI Total, PSI Child, PSI Parent, PSI Life Stress, FIQ Negative, PDH, and CES-D). Child demographics (Step 1) were entered first (age, gender, ASD diagnosis), followed in step 2 by child characteristics (Vineland, CBCL, SSRS). In all analyses, two blocks were entered in consecutive order to control for demographics and understand the variance accounted for by child characteristics. Results are presented in Tables 6-12. Notably, child characteristics accounted for 38% of the variance on the PSI–Total, 59% of the variance on the PSI–Child domain, 20% of the variance on the PSI–Parent domain, 9% of the variance on the PSI–Life Stress scale, 41% of the variance on the FIQ–Negative scale, and 19% of the variance on the CES–D. Although child characteristics did not account significantly for the variance on the PDH, child demographics did play a role, accounting for 9% of the variance.

Discussion

Researchers have suggested that parents of children with ASDs report more stressful events than parents of children with other developmental disabilities (Smith et al., 2010) and also that among caregivers of individuals with neurodevelopmental disorders, higher levels of stress seem to be elicited by the behaviors unique to children with ASD (Lyons et al., 2010).

This study evaluated the correlations among child characteristics and parenting stress in families of preschoolers with a developmental delay (DD) or a diagnosed autism spectrum disorder (ASD) and determined the extent to which child characteristics predicted parenting stress on various mental health outcome measures.

Correlations among various parenting stress measures

It was expected that all measures would have significant positive correlations. However, the data did not support that hypothesis. Although the majority of measures had significant positive intercorrelations, six did not. Notably, the PDH did not correlate with either the PSI–Child Domain, PSI–Parent Domain, or the PSI–Life Stress scale. Also, the PSI–Life Stress scale did not correlate with either the PSI–Child Domain, FIQ–Negative, or the CED–D. These findings suggest two separate but related conclusions. First, as the PDH captures common daily hassles (e.g., sibling arguments, children resisting bedtime, children underfoot, children interrupting), it makes sense that parents of children with or without developmental delays would experience these daily occurrences, and these experiences do not explain unique heightened parent stress. Rather, atypical child behavior may be more important than common daily hassles in determining stress. Second, the PSI–Life Stress scale can capture potentially stressful sources beyond the parent’s control, especially stressors that seem unrelated to a child’s behavior, negative impact on the family by their child’s behavior, or depressive symptomatology. These findings may be a function of socio-economic status, housing, job loss/change, or some other environmental influence that is not captured in the measures. Further, because there is a depression subscale built into the PSI–Parent Domain, which was in fact significantly related to the PSI–Life Stress scale, the lack of a relationship between the PSI–Parent Domain and the CES-D is surprising. These

findings are somewhat incongruent with the hypothesis and previous literature that parenting stress is related to depressive symptoms on the CES-D (Phetrasuwan and Miles, 2009).

Correlations among child characteristics and parenting stress

Based on the current body of literature, caregivers were expected to report higher levels of stress, negative family impact, and depressive symptomatology as a function of parenting a child with lower adaptive functioning, higher maladaptive and problem behavior and lower social skills. Moreover, parents of children with an ASD were expected to report higher levels of stress, negative family impact and depressive symptomatology than parents of children with DD. A Pearson correlation analysis was conducted followed by comparison analysis between groups (DD vs. ASD). In the preliminary correlation analyses, children's maladaptive problem behavior and lower social skills were related to higher self-reported parent stress, negative family impact, and depressive symptomatology. These findings are consistent with recent literature that has argued that children's behavior problems tend to be the most stressful, namely the lack of prosocial behavior (Lecavalier, Leone & Wiltz, 2006). However, in this study, higher adaptive functioning measured by the Vineland (i.e., communication, daily living skills, socialization, and motor skills) was significantly related to higher reported parenting stress on the PSI-Child Domain. This unexpected finding may speak to the nature of having a high-functioning child with a disability. Parents' expectations of their child's behavior may be lower if the child has a moderate to severe delay, whereas a parent with a child with a mild to moderate delay (i.e., high functioning) may have unrealistic expectations for the child's behavior and experience more stress. In other words, a parent's appraisal of a child's behavior may also contribute to reported parent stress. Clearly,

more research is needed to determine if this is the case.

Next, the responses for both the DD and ASD groups were compared on the measures of child characteristics and parenting stress. Results from the CBCL showed that children with ASD tended to have less anxious/depressed behavior and more withdrawn behavior than children with DD. This finding makes sense because, given the symptomatology of ASDs, children with ASDs tend to be or seem to be more withdrawn and show less emotion compared to similar-age peers. Additionally, children in the ASD group tended to display less cooperation, assertion, and responsibility on the SSRS. Importantly, as social skills are a vital part of preschoolers' daily interactions with family, friends, and community members, deficits in social skills are predictive of parent stress. Neece and Baker (2008) found that children's social skills accounted for elevated maternal parent stress beyond factors of intellectual level and behavior problems. Clearly social skills deficits in children with ASDs interfere with parent's expectations, which may then influence parent-child interactions and overall parent affect.

Results from the parenting stress and mental health measures showed that the groups were similar on all sub-domains except PSI Acceptability-Child. This domain captures stress arising from the child's behavior being less acceptable than the parents had hoped or expected. We anticipated that the groups would differ, and that parents of children with ASD would report higher parent stress, higher negative family impact and more depressive symptomatology. Previous research has been inconsistent on this point. In one instance, data suggests that even the most knowledgeable parents and caregivers of children with autism, regardless of demographics, reported high levels of stress and aggravation (Schieve et al, 2007). However, Phetrasuwan and Miles (2009) found no change in parenting stress as a function of the child's autistic symptoms. These results

highlight the need to continue investigating parent stress among groups of parents who have children with different developmental disabilities. Currently, there is no general agreement that parenting a child with ASD or developmental delay of any nature will predict or guarantee a more stressful parenting/caregiving experience than parenting a child without a delay.

Notably, gender differences were not significant between the DD and ASD groups but gender was significantly related to parenting daily hassles, in that parents of boys tended to report more daily hassles. This could be related to the high number of boys in the study ($n = 80$, $N = 98$). Because it is more common for boys to have a DD or an ASD than girls, it is expected that in studies of this nature the majority of participants will be male. Likewise, the majority of primary caregivers and survey respondents tend to be mothers, as we found in this study. However, it is not clear whether differences exist in levels of stress related to parenting a boy or girl with a DD or ASD, whether the caregiving/parenting experience for fathers is different, or whether there is something unique about the mother-son dyad that promotes more stress.

Predicting parenting stress from child characteristics

The current body of literature suggests that parenting a child with higher maladaptive functioning, problem behavior and lower social skills would be the factors most predictive of parenting stress, negative family impact and depressive symptomatology, regardless of child demographics. This was the case for all outcome measures except the PDH, in which gender was the only significant predictor. This result suggests that something about parenting a boy is uniquely difficult. Importantly, all other models revealed that child characteristics significantly accounted for the variance. Specifically, adaptive behavior accounted significantly for

the variance on the PSI–Total, PSI–Parent domain, and PSI–Life Stress. Social skills accounted significantly for the variance on the PSI–Child domain. Problem behavior accounted significantly for the variance on the PSI–Total, PSI–Child, PSI–Parent, FIQ–Negative scale, and CES–D. Consistent with our findings, Baker-Ericzen and colleagues (2005) found that maternal stress on the PSI–Child domain was significantly predicted by a child’s level of social skills, while parents of toddlers with ASD had significantly higher stress in both PSI–Child and PSI–Parent domains compared to parents with typically developing children.

It is understood that the more severe the ASD, the greater the impairment in social interaction and atypical behavior. Lyons, Leon, Phelps, & Dunleavy (2010) found that severity of ASD was the primary and most stable predictor of caregiver stress, such that, the higher the ASD severity, the higher the caregiver stress. Parents of children with ASD seem to be at-risk for stress and depressive symptomatology compared with parents of typically developing children and parents of children with other developmental disabilities, yet the findings from this study suggest this differentiation is not as clear. In fact, a subset of families, regardless of ASD diagnosis, may be more negatively affected by their pre-existing expectations for their children’s behavior rather than the child’s level of functioning alone. This possibility was exemplified by our finding that the PSI–Acceptability subdomain revealed a significant difference between the ASD and DD groups, the only significant finding among all subdomains of parent stress and mental health outcomes. Because diagnosis of ASD did not significantly account for the variance in any hierarchical linear regression model, parent stress cannot be reliably predicted simply by having an ASD diagnosis. Moreover, regardless of an ASD diagnosis, having a high-functioning child with a developmental disability seemed to cause more parent stress than having a low-functioning child.

Limitations

There are several limitations to these findings, and the results should be interpreted with care. Self-selection is an issue; parents who self-select to be in a study may be seeking to find a solution, can afford the opportunity, and live in a geographical region to have access to participate in a study. Therefore, the participants are less likely to be representative of the national or global ASD or DD population and their families. Although the issue of self-selection exists here, the heterogeneous sample of participants in this study are representative of the region from which the data were drawn. Another limitation is that the measures, intended to capture the construct of self-reported parent stress, were primarily completed by mothers. It would be interesting to see what differences in levels of parent stress might be reported by fathers. Mothers are often the primary caretakers and tend to be the most representative in parent reporting procedures in this field of research. The parent-child relationship is of particular importance to healthy outcomes for families and further research is required to understand if these results are exclusive to the mother's appraisal, or are representative of the stress felt by both parents. A third limitation is that the severity of ASD was unknown, and we cannot determine which specific child characteristics of one ASD classification contribute to reported parent/caregiver stress. Although the severity of the delay was important for inclusion in the study, that stipulation did not specifically extend to the severity of ASD. In other words, children needed to be delayed as determined by the Vineland Adaptive Behavior Scales, but the severity of ASD was outside the scope of this study. Furthermore the severity of the delay may not be as important as a parent's appraisal of their child's behavior on subsequent parenting stress and negative family impact.

Summary and Implications

This study extends previous research that a child's maladaptive and problem behavior strongly relates to parent stress and depressive symptomatology. In general, parents of children with ASD and parents of children with a developmental delay reported similarly on measures of stress and depressive symptomatology. Our findings support the notion that regardless of the existence of an ASD diagnosis, parenting a preschooler with maladaptive and problem behavior is difficult enough to elicit stress and negative affect. Unfortunately that stress may interfere with effective parenting, and in turn, lead to decreased positive parent-child interactions. Moreover, the preschool years are a critical developmental period to implement interventions. Because previous evidence suggested that child characteristics, negative family impact, and parenting stress were stable in the preschool years (Baker et al., 2003), it will be important for future research to investigate whether the severity of a developmental delay exclusively affects stress. The current study casts doubt on the notion that a child's lower functioning is predictive of elevated parent stress and highlights the need for further research. Also, previous research as well as this study related parenting stress to depressive symptoms. That relationship is likely bi-directional, in that stress and depressive symptoms are not mutually exclusive and may both serve to lower perceptions of well-being. This is an important consideration for future research pertaining to development and implementation of family and parent intervention.

Finally, although outside the scope of this study, the genetic heritability of ASD may play a role, such that measuring a parent's broad autism phenotype (BAP) (i.e., behavior characteristic of ASD) may help clarify past findings of stress among families with children with ASD. Recent research is beginning to shed light on the relationship between parent stress, BAP, and child characteristics. Ingersoll and Hambrick (2011)

measured parent depression, parenting stress, child symptom severity, parent broader autism phenotype (BAP), coping strategies, social support, and demographic characteristics. After controlling for demographic variables, regression analyses showed that parents with higher ratings of broad autism phenotype used more maladaptive coping strategies, had greater symptomatology for depression, and less social support. Because our findings suggest that parent appraisal may play a large role in determining parent stress, future research is still needed to understand the role of parent broad autism phenotype to parent-child interactions.

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Table 1
*Demographics of Families of Children with Developmental
Delay and Autism Spectrum Disorders (N = 98)*

Demographic	DD (n = 58)	ASD (n = 40)	t or χ^2
<u>Child</u>			
Age in Months <i>M (SD)</i>	47.17 (10.29)	46.29 (10.74)	$t = 0.41$
Sex % (n) Male	75.9 (44)	90.0 (36)	$\chi^2 = 3.16$
Race – Caucasian % (n)	77.9 (45)	85 (34)	$\chi^2 = .83$
Received Early Intervention (0-3yrs) % (n)	74.1 (43)	87.5 (35)	$\chi^2 = 2.60$
<u>Mother/Family</u>			
Maternal Status - Biological mother % (n)	75.9 (44)	97.5 (39)	$\chi^2 = 8.55^{**}$
Maternal Age in Years <i>M (SD)</i>	34.79 (8.80)	34.70 (5.63)	$t = .06$
Maternal Education - Bachelors Degree % (n)	32.8 (19)	47.5 (19)	$\chi^2 = 2.17$
Working (part- or full-time) % (n)	42.9 (24)	42.5 (17)	$\chi^2 = .001$
Living with Partner % (n)	77.6 (45)	87.5 (35)	$\chi^2 = 1.55$
Government Aid % (n)	46.6 (27)	33.3 (13)	$\chi^2 = 3.48$
Siblings with Learning or Behavioral Problems % (n)	62.5 (25)	36.4 (12)	$\chi^2 = 4.94^*$
Parent Learning Disability % (n)	27.6 (16)	13.2 (5)	$\chi^2 = 2.80$
Parent Mental Health Problem % (n)	45 (18)	13.2 (5)	$\chi^2 = 4.03^*$

Note. * $p < .05$, ** $p < .01$.

Table 2

Correlations among various Parenting Stress Measures (N = 98)

Variable	1	2	3	4	5	6	7
1. PSI-Child Domain	—						
2. PSI-Parent Domain	.49***	—					
3. PSI-Total Stress	.81***	.91***	—				
4. PSI-Life Stress	-.03	.32***	.20*	—			
5. PDH	.17	.19	.21*	-.15	—		
6. FIQ-Negative	.70***	.61***	.75***	.10	.23*	—	
7. CES-D	.47***	.71***	.70***	.18	.31*	.60***	—

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. PSI = Parenting Stress Index 3rd Edition, Child Domain, Parent Domain, Total Stress, and Life Stress; PDH = Parenting Daily Hassles; FIQ = Family Impact Questionnaire Negative Impact Composite; CES-D = Center for Epidemiologic Studies-Depression Scale.

Table 3

Correlations Among Child Characteristics and Parenting Stress and Mental Health Outcomes (N = 98)

Variable	PSI Child	PSI Parent	PSI Total	PSI Life Stress	PDH	FIQ Negative	CES-D
1. ASD Diagnosis	.06	-.04	>.00	-.18	.08	.07	.02
2. Age	.04	.03	.04	-.09	.17	-.04	.12
3. Gender	.08	-.03	.02	.01	-.25*	-.08	-.05
4. Vineland ABC	-.22*	.21**	.04	.28**	-.03	-.02	>.00
5. CBCL Total	.75***	.33***	.58***	.14	.05	.58***	.40***
6. SSRS Total	.50***	.31**	.45***	.13	.07	.41***	.32***

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. ASD Diagnosis = 0 = DD; 1 = ASD; Gender (1 = Male; 2 = Female); Vineland ABC = Vineland Adaptive Behavior Scales Adaptive Behavior Composite Standard Score; PSI = Parenting Stress Index 3rd Edition, Child Domain, Parent Domain, Total Stress, and Life Stress; PDH = Parenting Daily Hassles; FIQ = Family Impact Questionnaire Negative Impact Composite; CES-D = Center for Epidemiologic Studies-Depression Scale.

Table 4

Comparison of Children with Developmental Delay and Autism Spectrum Disorders (N = 98)

Variable	DD (n = 58)		ASD (n = 40)		t
	M	SD	M	SD	
Vineland ABC	63.98	9.78	60.73	8.49	1.75
CBCL Total Problems	67.90	31.6	63.30	21.4	.86
CBCL Externalizing	24.90	11.5	22.88	9.58	.94
CBCL Internalizing Broadband	17.95	11.2	17.33	6.42	.35
CBCL Emotional Reactivity	5.79	4.00	4.83	2.75	1.42
CBCL Anxious/Depressed	4.50	3.76	2.42	1.89	3.22***
CBCL Somatic Complaints	2.95	2.47	3.30	2.15	-.75
CBCL Withdrawn	4.71	3.23	6.78	2.82	-3.28***
CBCL Sleep Problems	5.48	3.82	4.72	4.41	.88
CBCL Attention Problems	5.66	2.81	5.70	2.20	-.09
CBCL Aggressive Problems	19.24	9.75	17.18	8.50	1.11
CBCL Other Problems	19.57	9.80	18.38	6.23	.68
SSRS Total Social Skills	107.0	15.0	104.7	11.9	.80
SSRS Cooperation	7.05	3.33	5.33	2.94	2.68*
SSRS Assertion	10.26	3.94	6.64	2.89	4.91***
SSRS Responsibility	4.60	3.95	1.36	1.58	4.87***
SSRS Self-Control	7.36	3.45	6.82	3.11	.81

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. Vineland ABC = Vineland Adaptive Behavior Composite (standard score). CBCL = Child Behavior Checklist (Total Problems and Broadband T scores, Narrowband raw scores); SSRS = Social Skills

Table 5

*Comparison of Parenting Stress and Mental Health Outcomes between
Parents of Children with Developmental Delay and Autism Spectrum Disorders (N = 98)*

Variable	DD (n = 58)		ASD (n = 40)		t
	M	SD	M	SD	
PSI Total Stress	268.86	49.14	269.28	44.64	-.04
PSI Child Domain	133.98	25.26	136.68	18.72	-.60
PSI Parent Domain	134.88	31.86	132.31	31.39	.39
PSI Life Stress	11.63	8.69	8.59	7.65	1.81
PSI Distract/Hyperactive (Child)	32.10	6.17	32.95	5.62	-.70
PSI Adaptability (Child)	33.33	7.84	33.05	5.68	.20
PSI Reinforces Parent (Child)	11.57	3.99	12.28	4.01	-.86
PSI Demandingness (Child)	26.31	6.83	26.26	6.12	.04
PSI Mood (Child)	12.78	3.86	12.28	3.33	.83
PSI Acceptability (Child)	18.24	4.40	20.24	3.77	-2.37*
PSI Competence (Parent)	31.21	7.96	30.82	8.02	.23
PSI Isolation (Parent)	15.02	5.54	14.77	4.56	.24
PSI Attachment (Parent)	12.43	3.26	11.79	3.64	.88
PSI Health (Parent)	14.81	4.71	14.46	3.84	.40
PSI Role Restriction (Parent)	20.48	5.76	21.69	5.89	-1.00
PSI Depression (Parent)	22.17	7.60	21.03	6.74	.78
PSI Spouse (Parent)	19.48	6.30	18.49	5.88	.79
FIQ Negative Impact Composite	29.53	11.81	31.15	11.83	-.66
Parenting Daily Hassles Total	109.67	35.78	114.68	27.60	-.78
CES-D	15.77	11.84	16.20	9.01	-.19

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. PSI = Parent Stress Index-III; FIQ = Family Impact Questionnaire; CES-D = Center for Epidemiological Studies Depression Scale.

Table 6

Hierarchical Linear Regression Analysis Predicting Parenting Stress Index–Total Score from Child Demographics and Child Characteristics

Predictor	PSI–Total	
	ΔR^2	β
Step 1 – Child demographics	.00	
Age		.04
Gender		.02
ASD diagnosis		.01
Step 2 – Child characteristics	.38***	
Adaptive behavior (Vineland)		.59***
Social skills (SSRS)		-.18
Problem behavior (CBCL)		.25*

Note. * $p < .05$. *** $p < .001$. Vineland = Vineland Adaptive Behavior Scales Adaptive Behavior Composite Standard Score; SSRS = Social Skills Rating System Social Skills Total Standard Score; CBCL = Child Behavior Checklist 1 ½ - 5 Total Problems T Score.

Table 7

Hierarchical Linear Regression Analysis Predicting Parenting Stress Index–Child Domain Score from Child Demographics and Child Characteristics

Predictor	PSI–Child	
	ΔR^2	β
Step 1 – Child demographics	.01	
Age		.04
Gender		.10
ASD diagnosis		.08
Step 2 – Child characteristics	.59***	
Adaptive behavior (Vineland)		-.02
Social skills (SSRS)		-.17*
Problem behavior (CBCL)		.73***

Note. * $p < .05$. *** $p < .001$. Vineland = Vineland Adaptive Behavior Scales Adaptive Behavior Composite Standard Score; SSRS = Social Skills Rating System Social Skills Total Standard Score; CBCL = Child Behavior Checklist 1 ½ - 5 Total Problems T Score.

Table 8

Hierarchical Linear Regression Analysis Predicting Parenting Stress Index–Parent Domain Score from Child Demographics and Child Characteristics

Predictor	PSI–Parent	
	ΔR^2	β
Step 1 – Child demographics	.00	
Age		.03
Gender		-.04
ASD diagnosis		-.05
Step 2 – Child characteristics	.20***	
Adaptive behavior (Vineland)		.39***
Social skills (SSRS)		-.15
Problem behavior (CBCL)		.36***

Note. * $p < .05$. *** $p < .001$. Vineland = Vineland Adaptive Behavior Scales Adaptive Behavior Composite Standard Score; SSRS = Social Skills Rating System Social Skills Total Standard Score; CBCL = Child Behavior Checklist 1 ½ - 5 Total Problems T Score.

Table 9

Hierarchical Linear Regression Analysis Predicting Parenting Stress Index–Life Stress Domain Score from Child Demographics and Child Characteristics

Predictor	PSI–Life Stress	
	ΔR^2	β
Step 1 – Child demographics	.04	
Age		-.09
Gender		-.03
ASD diagnosis		-.18
Step 2 – Child characteristics	.09*	
Adaptive behavior (Vineland)		.26*
Social skills (SSRS)		.09
Problem behavior (CBCL)		.19

Note. * $p < .05$. Vineland = Vineland Adaptive Behavior Scales Adaptive Behavior Composite Standard Score; SSRS = Social Skills Rating System Social Skills Total Standard Score; CBCL = Child Behavior Checklist 1 ½ - 5 Total Problems T Score.

Table 10

Hierarchical Linear Regression Analysis Predicting Family Impact Questionnaire–Negative Domain Score from Child Demographics and Child Characteristics

Predictor	FIQ–Negative	
	ΔR^2	β
Step 1 – Child demographics	.02	
Age		-.05
Gender		-.07
ASD diagnosis		-.07
Step 2 – Child characteristics	.41***	
Adaptive behavior (Vineland)		.12
Social skills (SSRS)		-.18
Problem behavior (CBCL)		.62***

Note. * $p < .05$. *** $p < .001$. Vineland = Vineland Adaptive Behavior Scales Adaptive Behavior Composite Standard Score; SSRS = Social Skills Rating System Social Skills = Total Standard Score; CBCL = Child Behavior Checklist 1 ½ - 5 Total Problems T Score.

Table 11

Hierarchical Linear Regression Analysis Predicting Parenting Daily Hassles Score from Child Demographics and Child Characteristics

Predictor	PDH	
	ΔR^2	β
Step 1 – Child demographics	.09*	
Age		.15
Gender		-.25*
ASD diagnosis		.05
Step 2 – Child characteristics	.01	
Adaptive behavior (Vineland)		.03
Social skills (SSRS)		-.11
Problem behavior (CBCL)		.04

Note. * $p < .05$. Vineland = Vineland Adaptive Behavior Scales Adaptive Behavior Composite Standard Score; SSRS = Social Skills Rating System Social Skills Total Standard Score; CBCL = Child Behavior Checklist 1 ½ - 5 Total Problems T Score.

Table 12

Hierarchical Linear Regression Analysis Predicting Center for Epidemiological Studies Depression Scale Score from Child Demographics and Child Characteristics

Predictor	CES-D	
	ΔR^2	β
Step 1 – Child demographics	.02	
Age		.12
Gender		-.05*
ASD diagnosis		.02
Step 2 – Child characteristics	.19***	
Adaptive behavior (Vineland)		.19
Social skills (SSRS)		-.16
Problem behavior (CBCL)		.41***

Note. * $p < .05$. *** $p < .001$. Vineland = Vineland Adaptive Behavior Scales Adaptive Behavior Composite Standard Score; SSRS = Social Skills Rating System Social Skills Total Standard Score; CBCL = Child Behavior Checklist 1 ½ - 5 Total Problems T Score.

Synthesis of Tungsten Oxide Nanowires via Thermal Vapor Transport

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Introduction

Tungsten trioxide (WO_3) is an n-type semiconductor that absorbs visible light and has applications in many technologies including gas sensors,¹ electrochromic displays,⁹ and devices for photoelectrochemical (PEC) energy conversion.³ Because of its capacity to absorb visible light, produce photocurrent,^{8,6} remain stable in aqueous electrolyte solution,¹⁰ and resist photocorrosion,^{4,2} WO_3 may also be used as a photocatalyst for solar water splitting.

Previous researchers have shown that the particle size of a photocatalyst plays a critical role in catalytic ability. Consequently, nanostructured WO_3 has attracted a great deal of research interest in recent years.⁶ Tungsten oxide nanowires (NWs) have previously been fabricated by a variety of methods including chemical vapor deposition (CVD), physical vapor deposition (PVD), sol-gel synthesis, and reactive sputtering.¹¹ The most commonly used method, PVD, involves a WO_3 source material that is

energetically evaporated (sublimed) by heat, ion-bombardment, electron beam, or some other high energy source and then condensed onto targeted substrates. The chemical composition, morphology, and orientation of the resulting PVD grown NWs are significantly affected by the growth conditions such as temperature, substrate material, and the presence of reactive gases.¹¹

In spite of the variety of methods reported for the fabrication of 1D crystalline tungsten oxide NWs, the lack of detailed knowledge regarding how specific growth parameters affect nanostructure morphology, com-

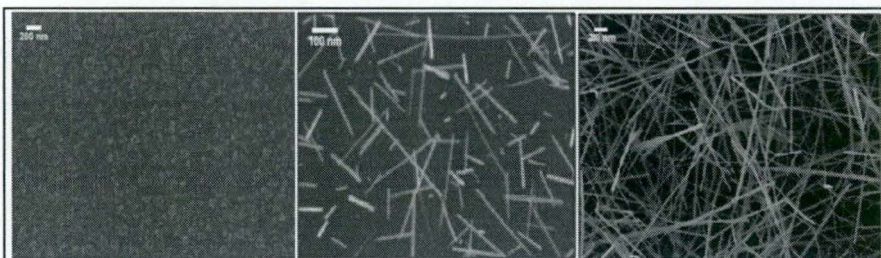


Figure 1. SEM images of WO₂ nanostructures deposited in (A) Ar-O₂, (B) Ar, and (C) Ar-H₂O.

position, and orientation remains an obstacle to the facile synthesis, controllable growth, and further study of these materials. This study examines the effects of O₂ partial pressure and presence of H₂O on the growth of crystalline tungsten oxide NWs.

Experimental Method

Researchers in this study performed all synthesis reactions using a horizontal tube furnace equipped with a quartz working tube (figure 2). All the reagents were analytical grade and used without further purification. Silicon substrates were first subjected to ultrasonic cleaning in commercial solution for 45 min. before being cleaned in a 1:3 mixture of H₂O₂ (30%) : H₂SO₄ (12M) for 15 min. Finally, the substrates were rinsed with

nanopure water and dried in a stream of N_2 gas. A layer of tungsten was deposited on the cleaned substrates by magnetron DC sputtering at 100 W for 100 seconds. Then the substrates were loaded into the low-temperature zone of

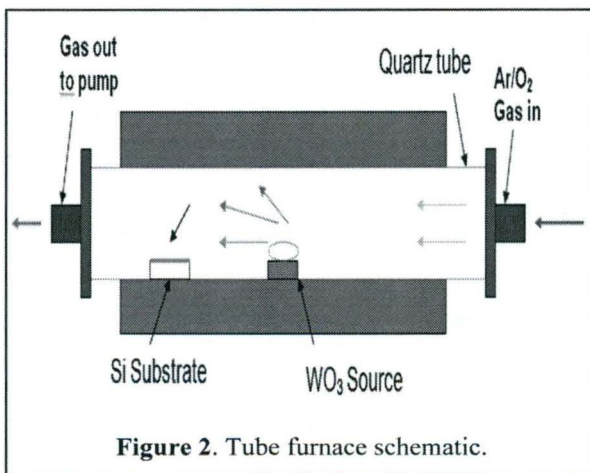


Figure 2. Tube furnace schematic.

the tube furnace for the deposition of tungsten oxide vapor.

The source material, WO_3 powder (Sigma Aldrich; particle size, 12 μm ; purity, 99.99%), was placed into a ceramic alumina boat and positioned upstream of the prepared substrates in the high temperature zone of the tube furnace. In some experiments water vapor was introduced by

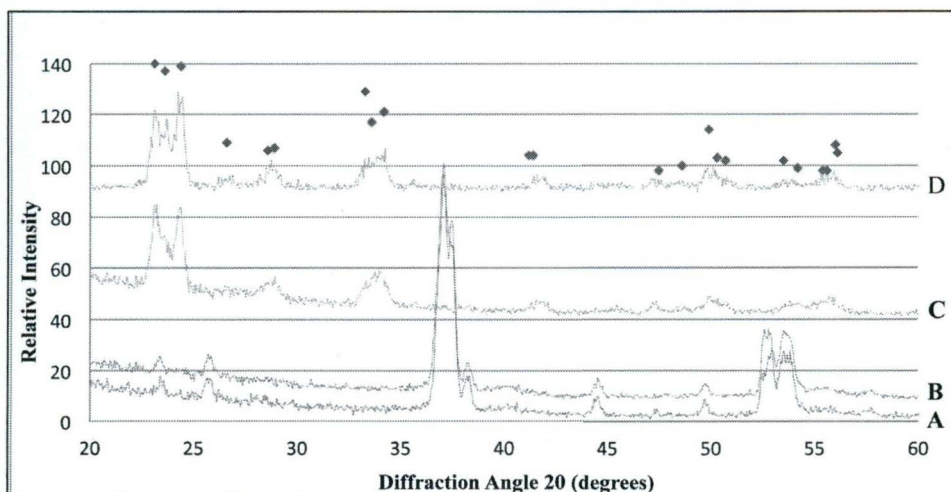


Figure 3. XRD patterns of oxidized nanowires (A-As prepared /B-400°/ C-500°/ D-600°) with markers showing known referenced peaks of monoclinic WO_3 .

placing an alumina boat filled with 3mL of nanopure H_2O upstream of the source boat in a cool region ($<100^\circ\text{C}$) of the tube furnace. After the quartz tube furnace was reduced to a pressure of approximately 1×10^{-4} Torr, Ar and O_2 gases were dispensed into the system at the desired rate and ratio using two mass flow controllers (MKS 10 SCCM) that were operated using Labview software, and the system pressure was monitored with a capacitance monometer.

The pressure was maintained at 1×10^{-4} Torr ($1-2 \times 10^{-1}$ Torr for H_2O runs) while the high-temperature region of the tube furnace was increased from room temperature to 700°C at a ramping rate of $25^\circ\text{C}/\text{min}$. After maintaining this temperature for 1 hour, the furnace was allowed to cool naturally to $<300^\circ\text{C}$ before removing the samples for characterization.

In the same low-pressure tube furnace, the samples were subjected to a post-synthesis oxidation treatment. First, all materials were removed from the system and the samples were placed in the 700°C region of the furnace. Second, the system pressure was reduced to 1×10^{-4} Torr to evacuate any atmospheric gases before dispensing high-purity O_2 gas into the furnace for 15 min. to backfill the furnace tube. Finally the furnace (figure 2) was heated to the desired temperature and maintained at these conditions for 75 min.

The morphology of the deposited nanostructures was observed using a scanning electron microscope (Zeiss Ultra 55) and the crystal structures were analyzed with X-ray diffraction analysis (Philips Panalytical XRD).

Results and Discussion

Figure 1 shows high magnification SEM images of the Si substrates after the vapor deposition procedure. All three samples were deposited at 685°C for 75 min. at a pressure of 200mTorr. The sample synthesized in the presence of O_2 gas (sample A) shows tungsten oxide deposition only

in the form of platelets with no NW growth. Because the amount of O_2 gas present during the synthesis of this sample was only 5% of the total gas mixture, the lowest output our equipment could achieve, we hypothesize that even a small

quantity of O_2 gas will react with vapor from the WO_3 powder to form an oxygen rich species (not WO_2) that lacks the ability to form 1D NWs. In contrast, the sample synthesized in inert gas (sample B) displayed some sparse growth of NWs, suggesting that a more oxygen deficient vapor species

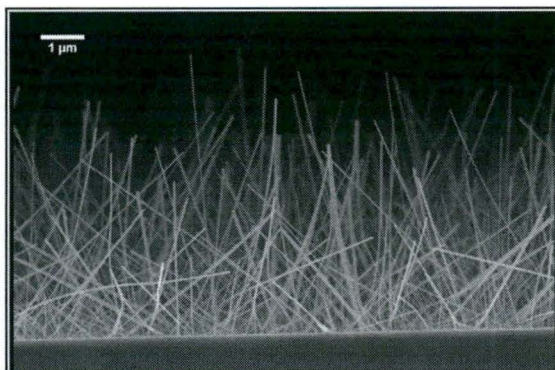


Figure 4. Cross sectional SEM image of sample C.

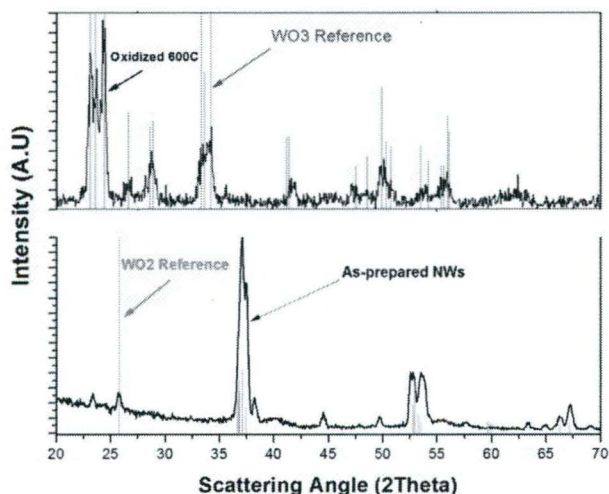


Figure 5. XRD spectra of NWs before (bottom) and after (top) 600° C Oxidation with vertical reference peaks.

WO_{3-x} lends itself to the formation of 1D NWs. Sample C was formed in the presence of H_2O vapor and the resulting SEM images show densely grown NWs with lengths of hundreds of nanometers (figure 4).

To explain the considerable

increase in the growth density and length of the NWs produced in sample C, we propose a mechanism by which the added H_2O vapor reacts with WO_3 to form the far more volatile hydrate species $\text{WO}_3 \cdot \text{H}_2\text{O}$. That hydrate, under conditions of high heat and

humidity, is known to have a much higher volatility than any other tungsten oxide species present in our system.¹⁰ Since a species with higher volatility will enter the vapor phase more readily than one with lower volatility, the hydrate may assist in the effective vapor transport processes, from source to substrate, by allowing more tungsten containing species into the vapor phase at any given time. Ensuring a steady and sufficient flow of tungsten oxide vapor to the growth sites by introducing H_2O into the system may explain the profound increase in both the length and abundance of the NWs in sample C.

The XRD patterns in figure 3 illustrate the controlled transformation of the as-synthesized WO_2 NWs (bottom) to monoclinic WO_3 NWs (top) during the low-pressure oxidation procedure. For the as-prepared XRD

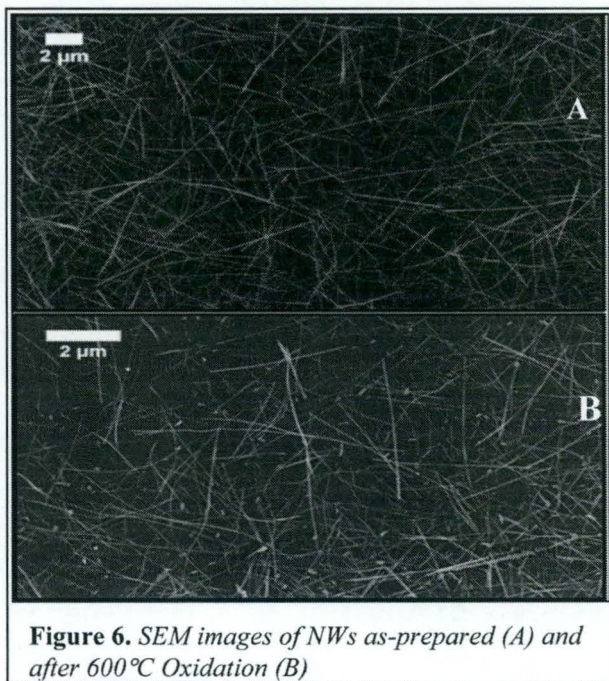


Figure 6. SEM images of NWs as-prepared (A) and after 600°C Oxidation (B)

patterns (bottom), we indexed the peaks at 25.8°, 36.4°, 53.4°, and 67.1° to the structure of WO₂. For the top pattern we indexed the primary peaks at 23.1°, 23.5°, 24.4°, 26°, 29.2°, 33.2°, 34.1°, and several others to the structure of monoclinic WO₃. Figure 5 shows the XRD patterns of the as-synthesized NWs and the fully oxidized NWs superimposed with referenced peak positions.

Contrary to some reports in the literature regarding the degradation of WO_x NWs during high temperature oxidation, the NWs oxidized in this study, oxidized between 400°-600°C, were completely intact (figure 6). We believe the low-pressure oxidation conditions used in our procedure may have played a crucial role in retaining the 1D morphology during oxidation.

Conclusion

In summary, our research group has synthesized WO₂ NWs on W sputtered Si substrates by physical vapor deposition in the presence of H₂O vapor and controllably oxidized the as-synthesized WO₂ NWs to monoclinic WO₃ by a high-oxygen low-pressure annealing treatment. The densely grown NWs were 10-60 nm in diameter and 1-3 μm in length. We found that the choice of gas mixture in the growth environment played a critical role in the density and morphology of the NWs. Additionally, we propose a vapor-solid (VS) growth mechanism for the NW growth in this study due to the fact that no liquid phase catalyst was present during the reaction.

The XRD study confirmed that the as-synthesized NWs were not of the desired stoichiometric composition (WO₃) but could be transformed from WO₂ to WO₃ through a post-synthesis annealing treatment under vacuum in a high O₂ environment. In contrast to some reports in the literature, we were able to observe the preferred 1D NW morphology even after our

annealing treatment. Further study on this topic would benefit from a more controlled method of introducing H₂O vapor so that the effect of relative humidity on NW synthesis can be better understood. Future plans for our research in this area include transmission electron microscope (TEM) studies of the NW crystal structure, electron beam induced current (EBIC) analysis, and electrochemical analysis of NW electrodes to evaluate their catalytic ability as a possible photoelectrocatalyst.

A particularly promising application of WO₃ NWs that should be considered is their function as a photoanode material in photoelectrochemical cells for solar energy conversion and storage purposes.

Acknowledgements

This research was supported by the University of Oregon McNair Scholars Program and the University of Oregon Department of Chemistry. The author would like to thank the Camcor Materials Characterization facilities at the University of Oregon as well as the following individuals for their assistance with this work; Paul Plassmeyer, Lena Trotochaud, Ngoc Nguyen, Kurt Langworthy, Andy Ritenour, and the great elusive nanowire.

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Humor In Aphasia Therapy: Graduate Student Use and Client Reactions

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Introduction

Aphasia is an acquired language disorder that affects to varying degrees an individual's comprehension and expression of language. Symptoms include difficulty with listening, speaking, writing and reading, as well as gesturing, drawing, and calculating (Cruice, Worrall, & Hickson, 2010). Aphasia may occur when the language centers of the brain sustain damage from a stroke, tumor, or other injury (Beach, 2007), with stroke being the most common cause of aphasia. The elderly population is most at risk for acquiring aphasia in part because as people age, they become more likely to experience a stroke (Engelter et al., 2006). Still, aphasia can affect an adult of any age (The National Aphasia Association, 2009).

People with aphasia (PWA) frequently struggle to articulate the words they are thinking (i.e., naming deficits), to repeat what others say, and to use proper grammar. Also, they may unintentionally create new words during conversation (jargon) or words that have no meaning in the context of the conversation. Aphasia interrupts the connection between thoughts and linguistic input/output (Damasio, 1992). Although persons may have the same thoughts or be capable of understanding spoken or written

information to the same degree as they had prior to acquiring aphasia, they will have more difficulty translating thoughts into coherent speech or decoding spoken and written language into concepts.

One analogy that illustrates this phenomenon likens the functioning of the language centers of the brain to a phone signal. For a person without aphasia, the signal is clear and easy to decipher. The individual is easily able to understand what others say over the phone and has no trouble transmitting a message. In contrast, for a person with aphasia, the signal seems distorted and the incoming message much more difficult to interpret. It is also more challenging for this individual to transmit a message because the signal alters the original message.

Because communication is the avenue through which people express ideas, feelings, and thoughts, communicative impairment may affect an individual's social, psychological, and emotional well-being. It is important that PWA receive effective therapy to help counteract the negative consequences of aphasia. One component of effective therapy is having an adequate interpersonal relationship between the client and clinician, a relationship that is affected by what occurs in therapy. Using more humor during therapy involving a client with aphasia has the potential to make therapy seem more "positive and enjoyable" than a session with less humor (Simmons-Mackie & Schultz, 2003, p. 763).

For many clinicians, graduate school provides the first opportunity to administer therapy to a client. The timing and manner in which graduate student clinicians develop professionally appropriate humor may have implications for their current and future clients. If students are not adequately employing humor, therapy might not be as effective as it could be. Additionally, a better understanding of how graduate students use humor during therapy could provide faculty with information about how much formal training is necessary in this domain for graduate

students. It is thus crucial to investigate how graduate student clinicians use humor and whether their use of humor benefits clients. An exploration into graduate student clinician humor use during aphasia therapy reveals that graduate student clinicians make sessions more positive by effectively using humor.

Of course the term “humor” is subjective. People have different ideas of what humor is, what humorous incidences look like, and what appropriate responses to humor might be. In this study I did not define humor for participants unless they specifically asked for a definition because I did not want to limit responses. I did, however, provide participants with examples of what specific types of humor could look like. In the one instance when a participant explicitly asked for a definition of humor, I approximated Simmons-Mackie and Schultz’s definition that humor is “something funny to someone involved in the interaction” (Simmons-Mackie & Schultz, 2003, p. 754).

Literature Review

Language allows expression of a variety of meanings during a social interaction. It enables people to share information, connect on an interpersonal level, and express themselves (Armstrong & Ferguson, 2010). Unfortunately, the language impairments that characterize aphasia change this social interaction and have a profound effect on a person’s psychosocial functioning.

Impact of Aphasia

Numerous studies report that the communication deficits caused by aphasia can impact a person’s participation in social activities and the breadth of a person’s social network. Bose, McHugh, Schollenberger, and Buchanan (2009) conducted a study in which they asked participants with aphasia and a control group of participants without aphasia to complete

Quality of Life questionnaires designed to measure different areas relating to aphasia. People with aphasia reported lower Quality of Life scores compared to typical controls. Also, after comparing the results of the questionnaire categories, the authors concluded that an individual's level of social participation is related to that individual's communication abilities. In particular, severity of a participant's aphasia was correlated with a greater perceived impact of socialization. Thus, these results indicate that communication problems associated with aphasia can adversely affect an individual's social participation.

Acquiring aphasia can also complicate how people interact in the community. Howe, Worrall, and Hickson (2008) investigated which factors beyond the general condition of aphasia impacted the level of community engagement for PWA. By interviewing 25 participants with aphasia to pinpoint what promotes and what discourages community involvement for PWA, the authors revealed that factors raising mindfulness about aphasia promoted involvement. This meant that PWA were more inclined to engage in activities in which people and institutions were cognizant of aphasia and its attendant language patterns. Unfortunately, the authors suggest that most people are unaware of the nature of aphasia. Participants reported that being afforded the opportunity to participate in events and interactions increased the likelihood of community involvement while a lack of opportunity discouraged it. People with aphasia were also more likely to be involved in the community when they would be interacting with others they knew in an unchanging physical setting. The authors noted that people without aphasia might also experience these deterrents and supports to community involvement, but deterrents are more problematic for people with aphasia because the person's language deficit makes issues more difficult to resolve (Howe, Worrall, & Hickson, 2008).

The social networks of PWA can be negatively affected by the

language difficulties related to aphasia. Davidson and colleagues (2008) explored how two groups of people older than 60 interacted with friends. One group consisted of people who had aphasia and the other group consisted of people who did not. Researchers observed participants' typical communication, and participants made reports regarding communication. Three participants with aphasia participated in a simulated recall task that focused on how they communicated with friends. Results showed that people with aphasia are less likely to keep in touch with friends than people without aphasia, a factor that may decrease the number of friends the person with aphasia has. This occurs both because it is difficult for PWA to establish new friends and to retain old friendships (in part because of their difficulties with communication). Vickers (2010) substantiated that finding and investigated how the social networks of PWA changed after acquiring aphasia. Participants with aphasia completed interviews and two questionnaires that included measures of communication skill, social participation, and perceived social support as well as other variables. Results showed that after acquiring aphasia, people reported associating with fewer friends and acquaintances and felt socially isolated.

In addition to feelings of social isolation, people with aphasia sometimes experience depression (Davidson et al., 2008). Because the onset of aphasia is typically abrupt, and the language issues affect most aspects of a person's life, people who acquire aphasia are susceptible to depression. Depression in individuals with aphasia may affect the individual's progress during therapy (Code & Herrmann, 2003), potentially rendering PWA unable to fully engage in the therapeutic process.

Therapeutic Practices and Humor

As aphasia affects the psychosocial dimension of a person's life, it is advantageous for the individual to seek and receive effective therapy

in which the individual may improve language functioning or learn compensatory strategies. Beginning with the post World War II era, aphasia therapy was based on the results of standardized tests (Williamson, Richman, & Redmond, 2011). Therapy during that era emphasized drills and language retraining. Later, Audrey Holland pioneered the notion that functional communication, that is, the practical application and uses of language in social interactions, was more important for PWA than “linguistic accuracy” (Armstrong & Ferguson, 2010, p. 480). This approach prompted others to study how people with aphasia communicate within social contexts instead of focusing on the person’s linguistic abilities in isolation (Armstrong & Ferguson, 2010). Currently, both functional communication and language impairment approaches are implemented during therapy with individuals with aphasia, depending on individual client profiles and preferences.

In addition to teaching clients with aphasia practical communication and language skills, it is also important for clinicians to utilize a variety of skills during a therapy session. One aspect of therapy that can potentially provide benefits to a client is the clinician’s appropriate use of humor during a therapy session. Potter and Goodman (1983) explored whether humor affected the performance of a client with aphasia during therapy. They provided two participants with aphasia with fourteen sessions of therapy. Researchers recorded the participant’s performance on selected therapy tasks that were implemented during each session. In the laugh condition, the clinician played an eighteen-second tape of prerecorded laughter (the humorous element of the study) at the beginning and end of each session. In the non-laughter condition the tape was not played during the session. The researchers found that both participants improved considerably in their therapy tasks across the time in which the laughter tape was played. Interestingly, during the time after the tape was removed,

both participants' performance on therapy tasks started to return to baseline. This finding illustrates that incorporating humor into therapy sessions can make therapy more productive for clients with aphasia.

Simmons-Mackie and Schultz (2003) also examined how humor was incorporated during therapy sessions with individuals with aphasia. They videotaped eight therapy sessions with various speech therapists (professional therapists and graduate student clinicians) and clients. In their analysis, researchers focused on what they considered to be humorous episodes that occurred during therapy sessions. The authors found that humor used during therapy promoted rapport between clinician and client, encouraged involvement in therapy activities by serving as a distraction for challenging tasks, and helped to maintain an individual's self-esteem after making a mistake or during criticisms. Humor potentially made a therapy session more effective because off-putting events were transformed into positive experiences. For instance, a clinician could make feedback more palatable by using humor to make the session more productive without embarrassing the client. Although it was not a major finding of the Simmons-Mackie and Schultz study, the authors did mention in passing that there were no patterns of humor use that differentiated the professional speech pathologists from the graduate student clinicians (2003). This is the only reference I could find in the literature regarding graduate student clinician use of humor during aphasia therapy, a fact that emphasizes the need for further investigation of this topic.

Purpose of the Study

The purpose of this pilot study was to investigate graduate student clinician use of humor and client perceptions of its use during aphasia therapy. Specifically, the two main research questions were:

1. Do graduate student clinicians use humor during therapy, as reported by their clients with aphasia?
2. Do graduate student clinicians report feeling comfortable and experienced using humor with clients, and endorse the importance of humor?

In this study I utilized both quantitative and qualitative measures to survey graduate student clinicians on their perception of humor in therapy and gain insight from PWA about their therapy experiences with graduate student clinicians.

Methods

Participants

To describe clinician and client perceptions of humor use during therapy, this study included two groups of participants with connections to the University of Oregon Speech-Language-Hearing Center: graduate student clinicians and participants with aphasia.

Graduate student clinician participants. Fourteen student clinicians returned surveys and consent forms. Four of the graduate student clinicians indicated they had not provided therapy for a client with aphasia. Only graduate student clinicians who worked with a client with aphasia at the University of Oregon Speech-Language-Hearing Center since beginning their graduate training were eligible to participate. Thus, this study included survey responses from ten participants.

Characteristics of graduate student clinicians. Survey responses indicated that six graduate student clinicians provided individual therapy for clients with aphasia, two provided group therapy, one provided both individual and group therapy, and one participant did not indicate what type of therapy he or she provided. Of the graduate student participants, eight self-identified as female, one as male, and one participant did not

indicate a gender. The ages for graduate student participants ranged from 24-37 years. The number of terms the graduate student clinicians worked with a client with aphasia ranged between one and three terms. Three graduate student participants indicated they received some sort of speech therapy in the past.

Recruitment. All graduate student clinicians who participated in this study were first-year graduate students in the Department of Communication Disorders and Sciences (CDS) at the University of Oregon. I recruited the graduate student clinicians during a practicum meeting that was mandatory for all CDS graduate students and explained the study's purpose and the procedures necessary for participation.

Participants with aphasia. All five PWA who participated in this study had received therapy for aphasia from CDS graduate students in the University of Oregon Speech-Language-Hearing Center.

Characteristics of participants with aphasia. An overview of participant characteristics can be found in Table 1. All participants with aphasia acquired aphasia from a stroke that occurred 3.5 or more years before the current study. Also, the participants were at least fifty years of age, had attended at least three sessions of therapy at the University of Oregon Speech-Language Hearing Center, considered English to be their first language, were Caucasian, and had mild to moderate aphasia. Two participants in this study were male and three were female. Participants with aphasia had therapy at the University of Oregon, but not necessarily during the past year.

Recruitment. My advisor, who specializes in working with people who have aphasia, recruited participants with aphasia through professional contacts. With permission from participants, my advisor provided me with the names and email addresses or phone numbers of people who were eligible and interested in being involved in this study. I called or emailed prospective participants and scheduled interviews.

Table 1
Characteristics of Participants with Aphasia

Participant (P)	Age	Gender	Race	Aphasia Severity	Aphasia Symptoms	Time Post-Onset (Years)
P1	82	Male	Caucasian	Mild-Moderate	Auditory comprehension; word finding	4
P2	75	Male	Caucasian	Mild-Moderate	Auditory comprehension; word finding; writing	8
P3	74	Female	Caucasian	Moderate	Word finding; Apraxia of speech; reading; writing	7
P4	58	Female	Caucasian	Mild-Moderate	Auditory comprehension; word finding; reading	3.75
P5	64	Female	Caucasian	Moderate	Auditory comprehension; word finding; reading; writing	3.5

Informed Consent. After the University of Oregon's Institutional Review Board (IRB) approved the project, recruitment activities began. Researchers involved in this project were Collaborative IRB Training Initiative (CITI) certified. During the study, however, an IRB administrative error was discovered and data collection ceased until the IRB approved changes to specific documents.

Measures

Graduate student clinician participants. The data from graduate student clinicians came from completed questionnaires. In addition to filling out demographic information (i.e., gender, age, number of terms the participant worked with a client with aphasia, number of clients with aphasia the participant has worked with, and whether the participant ever received any kind of speech therapy), the participants rated eleven questionnaire items on a scale from 1-5 (where 1 = strongly disagree and 5 = strongly agree).

Participants with aphasia. Semi-structured interviews were the basis for gathering information from participants with aphasia. An interview guide consisted of questions regarding the participant's demographic information (gender, age, ethnicity, and time since aphasia onset) and eight primary questions. The questions pertained to the participant's overall use of humor, the graduate student clinician's overall use of humor, the length of time the participant had been involved with aphasia therapy at the University of Oregon's speech clinic, comparisons between clinicians, attitudes toward humor use during therapy, and recommendations for graduate student clinicians.

Procedures

Graduate student clinician participants. Each graduate student clinician received a packet that consisted of two identical consent forms, a survey, and instructions including procedures for returning the survey and the date the survey was due back to the primary researcher. Packets were distributed to graduate student clinicians via private clinic mailboxes that belonged to each participant. Because the mailboxes were in a restricted area, my faculty advisor facilitated all document transactions with the graduate student clinicians. Participants returned the questionnaires within one week, as requested. The participants returned the completed surveys and a signed consent forms to my faculty advisor's mailbox. Participants were instructed to keep one consent form for their records.

Participants with aphasia. Interviews with each participant occurred in a reserved room in the Speech-Language-Hearing Center or in a reserved conference room in an adjacent building. Before beginning the interview, I read each line of the consent form with the participant and encouraged the participant to ask questions. After listening to responses to any questions, the participant signed the consent form. Each participant

received an identical consent form for his or her records. With a digital audio-recorder turned on, the interview began with questions that pertained to the participant's demographic information. The questions then followed the interview guide that related to the participant's perception of humor use during aphasia therapy. Throughout the interview, handwritten notes (observer comments) regarding what the participant said supplemented the audio recording.

The nature of the interview was intended to be conversational, allowing opportunities for follow-up questions about a participant's responses. Sometimes follow-up questions were intended to gain more information about a response or used to check for understanding. After the interview, I wrote down topics, patterns, and my perceptions regarding the interview. I then downloaded the audio files from the digital audio-recorder onto my computer. The files were deidentified, coded, and encrypted. I transcribed the interview from the audio file, adding observer comments to the transcript as well as brief descriptions of each participant's communicative ability.

Data Analysis

Graduate Student Clinician Participants

The analysis of the survey data included using descriptive statistics such as the mean, median, and range for each statement to help summarize graduate students' ratings of issues related to humor and therapy.

Participants with Aphasia

All interview data were transcribed by hand with salient and recurrent themes in each interview noted, compiled, and organized into categories based on similarities. Those similarities helped to identify several primary theme categories that described the broader issues that occurred in all (or nearly all) five interviews. The primary themes were: a) manner and role of

humor following stroke, b) presence and role of humor in therapy, c) client perceptions of graduate student clinicians, and d) development of humor use in graduate students. As primary themes encompassed a wide variety of topics, primary themes were divided and organized into subthemes. My advisor also organized the transcript data into themes. We compared our findings and discussed differences we found until we reached agreement. This helped to validate the integrity of themes by minimizing the effect of personal biases and opinions.

Results

The information gathered from graduate student questionnaires and client interviews was analyzed to explore whether clients with aphasia reported that graduate student clinicians used humor during therapy, whether graduate student clinicians reported feeling confident using humor with clients with aphasia, and whether student clinicians considered humor to be important in therapy.

Graduate Student Questionnaires

Based on topics within the questionnaire, items fit into one of the following four categories: a) clinician humor use and response, b) client humor use, c) clinician attitude toward humor, and d) clinician training. Means for the questionnaire responses are presented in Table 2. Individual student

clinician
questionnaire
items and
descriptive
statistics are
located in the
Appendix.

Table 2

Student Clinician Questionnaire Means by Category

Category	Mean (m)
Clinician Humor Use and Response	3.9
Client Humor Use	3.4
Clinician Attitude Toward Humor	4.7
Clinician Training	3.2

Clinician humor use and response. This category contained six questionnaire items (items 1-4, 8, and 9) related to the types and amounts of humor student clinicians reported using during an average therapy session with PWA and how student clinicians reported responding to client-initiated humor. Overall, graduate student clinicians reported using various types and amounts of humor during therapy with PWA and reported that they responded positively to humor initiation by clients ($m=3.9$).

Client humor use. This category contained three questionnaire items (items 5-7) related to student clinician perceptions of the types and amounts of humor their clients with aphasia used during therapy. Overall, student clinicians did not report their clients using specific types or amounts of humor ($m=3.4$).

Clinician attitude toward humor. This category contained one item (item 10) about the attitude of student clinicians regarding how important they considered humor in therapy to be. Overall, student clinicians reported that they consider humor an important aspect of therapy ($m=4.7$).

Clinician training. This category contained one item (item 11) about perceptions of how well formal training had prepared student clinicians to use humor during aphasia therapy. Overall, student clinicians neither agreed nor disagreed that their training prepared them to use humor in therapy ($m=3.2$).

Interviews with PWA

Every participant spoke of some use of humor, whether their own or that of graduate student clinicians in clinical or nonclinical settings. During interviews participants spoke about a variety of topics that related to humor, such as specific reasons for using humor, their individual preferences regarding humor, or about the nature of humor. Primary theme

categories that emerged across interviews included a) the manner and role of humor following stroke (change in humor after stroke and humor as a way to cope and connect), b) the presence and role of humor in therapy, c) client perceptions of graduate student clinicians (congeniality, satisfaction, responsiveness, and variety in graduate student clinician humor use), and d) the development of humor use in graduate students (preexisting humor and humor improvement).

Manner and role of humor following stroke. Participants noted how their sense of humor was (or was not) affected after having a stroke.

Change in humor after stroke. During interviews, all participants were asked whether their sense of humor changed after acquiring aphasia. There were a wide variety of responses to this question. One participant reported a reduction of humor use after acquiring aphasia. Two participants said their humor use did not change. One participant said the amount of humor she used increased slightly, and one participant said her sense of humor decreased after her stroke but has since improved. Additionally, in another part of the interview, Participant 2 noted:

It occurs to me, because there is times, times when your sense of humor isn't as effective, when you're trying to get some information that doesn't come out, that you'd like to get it out, so you're trapped and you so that, that happens. And I think more severe aphasias may have more difficulty with it. I'm pretty lucky. I am not as bad as shape, but I am not as severe damage as a lot of people are.

Participant 2's observation suggests that aphasia severity might affect how a person with aphasia is able to express a sense of humor.

Humor as a way to cope and connect. Three participants related humor to coping and connecting. Two participants identified humor—implicitly or explicitly—as a way to cope with difficult issues, such as

aging, death, and the frustrations and fears associated with having a stroke and acquiring aphasia. For instance, Participant 5 stated:

Then they'll [clinicians] know I really am have a stroke but it's still okay, you know. But it's okay, it's fun for me to be laugh. You know, and you, that's after all this time it's been very, you know, if you cry, that'd be not so good, well I, my job is when I'm done, with this, and I can talk and do what I'm doing.

Two participants associated humor being able to connect with other people. For example, Participant 1 described using humor to connect to other people in a building complex:

All, old all people in there. Some people are a hundred. One guy is ninety-seven. A woman is one-hundred and two, and to keep up with them, I have to see, making, everything funny for them, you know? What the hell's the point, why's it they, they're thinking while they're dying, you know, so I have to try, you know, and tell something funny.

Participant 2 noted that he used a sense of humor when he interacted with people at his work. He spoke of a man who was difficult to be around because his severe aphasia seemed to make him unreceptive to humor. This participant also suggested that using a sense of humor helped make interactions more "natural,"

I, I can communicate most of the time on just general comments. Like, I can handle that, and I can use constantly a sense of humor... that's the most natural part of it, whenever I'm with anybody, whether they whether they have aphasia or don't have aphasia.

Presence and role of humor in therapy. In addition to speaking about humor in the context of nonclinical environments, participants also noted the presence of humor during therapy. One aspect of therapeutic humor they discussed was the value of humor in therapy. All five participants

agreed that humor helps during therapy or is otherwise important during therapy. When asked if humor helps during therapy, Participant 2 stated:

Oh, I'm sure, yeah. I- And it's a good question, because if you're investigating this process, finding a way to make its advance, advance continue to become part of the process, I think it's extremely important.

Two participants spoke of how humor can further therapy. One participant said that humor provides a break during difficult therapy tasks and that it serves as an alternative to crying. Another participant suggested that graduate student clinicians should use verbal humor to help clients improve. A different participant responded that using humor and talking during therapy helped him to get his clinician's attention. Two participants reported the importance of therapeutic tasks. One of those two believed that humor in therapy should not take precedence over these tasks (humor should be used rather than "comedy"), while the other spoke about how her professional clinicians expected her to complete challenging therapeutic tasks, which the participant seemed to appreciate.

Client perceptions of graduate student clinicians. Participants gave explicit overall impressions of graduate student clinicians and their humor use. Overall, participants spoke very favorably about graduate student clinicians. Clinicians were typically considered to be congenial (i.e. "pleasant" to work with), used humor satisfactorily, and were generally responsive to the participant's humor use.

Congeniality. Regarding the student clinicians' overall personality characteristics, two participants reported that graduate student clinicians, as a group, were typically "pretty friendly" and "just very nice people." Even when a participant commented that student clinicians somehow deviated from this affable baseline, the participant attributed the behavior to a positive source, professionalism, as seen in the following exchange:

Participant 5: Um, well they have to be, you know, they're the dog-I mean they're going to be doctors or not, you know, so they have to be a little like that. If I'm a little...that's fine, so...I think I think they were good people but nice too.

Researcher: ...So kind of nice but professional?

Participant 5: Yes, exactly.

Satisfaction. Four of the five participants, when asked if their clinicians did a good job of using humor, reported being pleased with the humor graduate student clinicians used during therapy. Some participants referred to the graduate student clinicians as a group while others referred to the most recent student clinician they had seen. One participant said that his clinician's humor use was "comfortable" without being "overwhelming." Another participant stated what she thought was the ideal amount of humor and said the amount of humor her graduate student clinician used was the amount she considered ideal.

Responsiveness. Some participants commented specifically on the pragmatics associated with humor use in therapy sessions with graduate student clinicians. Two participants described their student clinicians' humor use as being interactive. This essentially means that instances of using humor during therapy (or not using humor) by one person affected how the other person used humor. For instance, Participant 3 suggested that clinicians and clients adjust their humor use in response to the other person's humor use during therapy and that it is difficult for clients to use humor during therapy if the clinician does not:

I- All of the kids have been very good about that ev- however one of them um probably because I also did it. Not you know, is it, once in a while you have someone and you say um if the pe- if the other person doesn't do very much eventually you, you can't

do too much but if you know you're there and I'm in this is me [draws four circles, two of them next to each other, and draws arrow between them indicating one influences the other and vice versa].

Participant 2 made a similar observation:

I think sh- I think most of them including the last girl, I forgot her name now uh, and they're very pleasant and aren't in a position to start humor. They're drawing people who have aphasia and if they if I or somebody starts some sense of humor comment their feedback is usually in tune and relate with their sense of humor. So as a responsive more as sense of humor than initiating, I think that's the difference.

Also, P2 observed that clinicians typically do not “initiate” humorous interactions, but do reciprocate humor when a client uses it.

Variety in graduate student clinician humor use. Participants spoke about the amount and types of humor graduate student clinicians used during therapy. Overall, responses varied. Sometimes the response referred only to the most recent experience of working with a graduate student clinician, and sometimes the response referred to graduate students as a group. Regarding the amount of humor their graduate student clinicians used during therapy, participant reports ranged from no humor to “a lot” of humor. Three of the five participants were questioned directly about the types of humor—verbal and nonverbal—that their clinicians used. Regarding graduate student clinician use of verbal humor, one participant reported that graduate student clinicians differed in their use of humor; one said they did not “necessarily” use verbal humor, and another said they did. Regarding graduate student clinician use of nonverbal humor, two participants said student clinicians did not use nonverbal humor, and one said they did.

Development of humor use in graduate students. Participants made observations about humor acquisition that indicate student clinicians enter graduate school using humor. They also commented about how the student clinicians' humor use improved during students' career.

Preexisting humor. Two participants indicated that graduate student clinicians used humor in a natural way or suggested that the skill seemed to have been at least partially mastered prior to entering graduate school. Participant 2 said of graduate student clinicians (as well as professional clinicians and volunteers who work with people who have had a stroke) "they're in a business that they work with people and so they automatically become part of the process and have to have a sense of humor and relate to people." This suggests that perhaps the people who choose to work with stroke survivors have a natural propensity for "relating" to others as well as using humor. Participant 2 also explicitly said of student clinician humor use during therapy, "It was just natural." Another participant said that humor was "always there" (in therapy). These findings suggest that the student clinicians entered graduate school with the ability to use humor.

Humor improvement. Two participants indicated that student clinicians became better at using humor over time. Participant 5's comments suggest that the student clinician use of humor may improve over a term because they become more comfortable with the client during that time. In a later section of the interview, after being asked if her professional speech pathologists use more humor than graduate student clinicians, Participant 5 responded, "Well, I've known him for two and a half years, so yeah, now it's easier, yeah."

Participant 4, who had therapy with both masters and doctoral students, stated that "they're more humorous at the doctorate level, because uh, they're more serious at the Master's Degree because they're more, they're more, the- they're just, it's, it's just their personality." This suggests that

during the course of their careers, graduate student clinicians are more likely to employ a sense of humor after they accumulate more experience (as is the case with the doctoral students). Participant 4 added that “and um, but the the uh the master’s students I think are learning.” After being asked whether she thought teachers could help student clinicians learn to use humor more effectively in therapy she replied, “No they just learn it... They just learn it on their own.” Participant 4’s comments suggest that student clinicians might improve in their humor use through experience.

Discussion

The purpose of this study was to explore how graduate student clinicians use humor during therapy with clients who have aphasia. Research question 1 examined client perceptions of humor use during therapy, and results showed that most clients reported that student clinicians use humor during therapy. Clients did not report about specific types or amounts of humor, but suggested that graduate student clinicians were responsive to client humor use. Overall, clients reported being satisfied with student clinician humor use. Also, reports suggested that student clinicians seem to enter graduate school using humor and that they improve their use of humor over time. This result differs from what Simmons-Mackie and Schultz (2003) observed, in that they did not note patterns in humor use based on a clinician’s experience level. Research question 2 examined student clinician comfort, experience, and perception of humor. Results suggested that graduate student clinicians endorse the use of humor during aphasia therapy. Results from questionnaires were inconclusive regarding how student clinicians rated their comfort level and experience using humor in therapy sessions.

Results from the questionnaire and interview data suggested that both student clinicians and participants believe that using humor helps

or is important during therapy sessions. Both measures also indicated that graduate student clinician humor use varies both in terms of type and amount. This finding, coupled with the finding that student clinicians reported being aware of how they respond to their client's initiation of humor, supports the idea that student clinicians adapt their humor use to become more in sync with clients' humor use rather than using a set type or amount of humor. Because participants with aphasia reported a high satisfaction rate regarding student clinician humor use, this method of delivering humor appears effective. The harmonious use of humor between student clinicians and clients probably makes therapy more comfortable and thus a more positive experience. Also, using humor would likely help the student clinician and client feel more connected, a phenomenon Simmons-Mackie and Schultz (2003) called "building solidarity and affiliation" (p. 758). Furthermore, it seems if student clinicians respond positively to clients' attempts to initiate humor, all or part of the session would become more positive. If clients feel their attempts at initiating humor are validated, the result could be a more favorable view of the clinician, a factor that could explain why participants with aphasia reported that student clinicians were congenial. Code and Herrmann (2003) argue that "motivation increases and language and cognitive performance improve with positive mood and well-being" (p. 122). This suggests that the way graduate student clinicians use humor during therapy with PWA makes therapy more effective when the client's positive affect is enhanced.

The main limitations of this pilot study pertained to the limited sample of participants. Five interviews and ten questionnaires from individuals who were involved in therapy in the same university might not have provided a representative view of how all graduate student clinicians and PWA view graduate student clinician humor use during therapy. Future research samples could be significantly larger and might incorporate

views from multiple participants at numerous university clinics across the United States. Because the population used in this study was homogenous in terms of race and ethnicity, future studies might take this into account by including a heterogeneous sample of graduate student clinicians and PWA from multiple ethnic and racial backgrounds.

Two limitations related to the design of this study were that PWA only participated in one interview and that the graduate student clinicians did not participate in interviews. Future studies should include a more longitudinal design in which PWA would have multiple opportunities to share their experiences. If a client thought of any new insights between interviews, the client could then share those insights with the researcher. This design would also allow the researcher to confirm that his or her perceptions of the previous interview were correct and follow up on themes revealed in previous interviews. Overall, the depth of client's perceptions would be more extensively revealed. Further, although the questionnaires quantified the graduate student clinicians' perceptions of humor use during therapy, it also limited the graduate students' ability to share insights about humor use during therapy. Future research designs could incorporate interviews to gather more in-depth information from student clinicians. In addition, this expended information would be more easily compared to that from PWA. Those results might reveal specific similarities and differences between student clinician and client perceptions of humor use that were not captured by comparing the results of interviews to questionnaires. Also, both questionnaires and survey guides could include five or six examples of verbal and nonverbal humor, and a number range could be assigned to items measuring humor amount to make items less subjective (i.e. using humor "rarely" in a session would be 0-1 instances of humor each session). Researchers might also ask participants to describe how they define the concept of humor.

Findings from this study and future studies examining graduate student clinician humor use might be considered in the designs of new therapeutic practices. In an age when technology is advancing rapidly, there is the possibility that in the near future, student clinicians and clients may begin to rely more heavily on technology during therapy sessions for PWA. In some cases, technology might even alter the structure of therapy so that clients rely more heavily on technology and less on the student clinician. For example a client might be able to use a computer program on a home computer to go through speech drills rather than attending a therapy session. Although new technologies have the potential to improve therapy, findings from this study emphasize that student clinicians and clients should consider employing technology in a way that still creates opportunities for humorous interactions to occur during therapy so that a positive therapeutic experience may be maintained.

Acknowledgements

I would like to thank the McNair Scholars Program for funding this research. I would also like to thank my faculty advisor Dr. Karen McLaughlin and my advisors from the McNair Scholars Program Dr. Gail Unruh and Dr. Karen Kelsky for their assistance and editorial contributions.

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Appendix

Graduate Student Clinician Questionnaire Items

Number	Item
1	I use/initiate a lot of humor during an average therapy session with a client who has aphasia.
2	I use/initiate a lot of verbal humor (comments, jokes, etc...) during an average therapy session with a client who has aphasia.
3	I use/initiate a lot of nonverbal humor (facial expressions, gestures, etc...) during an average therapy session with a client who has aphasia.
4	I initiate humor more often than my client who has aphasia.
5	My client initiates a lot of humor during an average therapy session.
6	My client uses/initiates a lot of verbal humor (comments, jokes, etc...) during an average therapy session.
7	My client uses/initiates a lot of nonverbal humor (facial expressions, gestures, etc...) during an average therapy session.
8	I am very aware of how I respond to my client's attempts at initiating humor during therapy.
9	I respond positively to my client's attempts at initiating humor during therapy.
10	I think humor is an important part of therapy for clients with aphasia.
11	I feel my undergraduate and graduate professional training have provided me with adequate skills and knowledge regarding using humor during therapy.

Descriptive Statistics from Graduate Student Clinician Questionnaires

Statement #	Statement	Topic	Mean (m)	Median	Range
7	My client uses/initiates a lot of nonverbal humor (facial expressions, gestures, etc...) during an average therapy session.	Client Humor Use	3.5	4	1-5
8	I am very aware of how I respond to my client's attempts at initiating humor during therapy.	Clinician Humor Use and Response	4.3	4	3-5
9	I respond positively to my client's attempts at initiating humor during therapy.	Clinician Humor Use and Response	4.7	5	4-5
10	I think humor is an important part of therapy for clients with aphasia.	Clinician Attitude Toward Humor	4.7	5	4-5
11	I feel my undergraduate and graduate professional training have provided me with adequate skills and knowledge regarding using humor during therapy.	Clinician Training	3.2	3	2-5

Descriptive Statistics from Graduate Student Clinician Questionnaires

Statement #	Statement	Topic	Mean (m)	Median	Range
1	I use/initiate a lot of humor during an average therapy session with a client who has aphasia.	Clinician Humor Use and Response	3.95	4	2-5
2	I use/initiate a lot of verbal humor (comments, jokes, etc...) during an average therapy session with a client who has aphasia.	Clinician Humor Use and Response	3.8	4	2-5
3	I use/initiate a lot of nonverbal humor (facial expressions, gestures, etc...) during an average therapy session with a client who has aphasia.	Clinician Humor Use and Response	3.5	3.5	2-5
4	I initiate humor more often than my client who has aphasia.	Clinician Humor Use and Response	3.2	3	2-5
5	My client initiates a lot of humor during an average therapy session.	Client Humor Use	3.5	3.5	3-4
6	My client uses/initiates a lot of verbal humor (comments, jokes, etc...) during an average therapy session.	Client Humor Use	3.3	3.5	2-4

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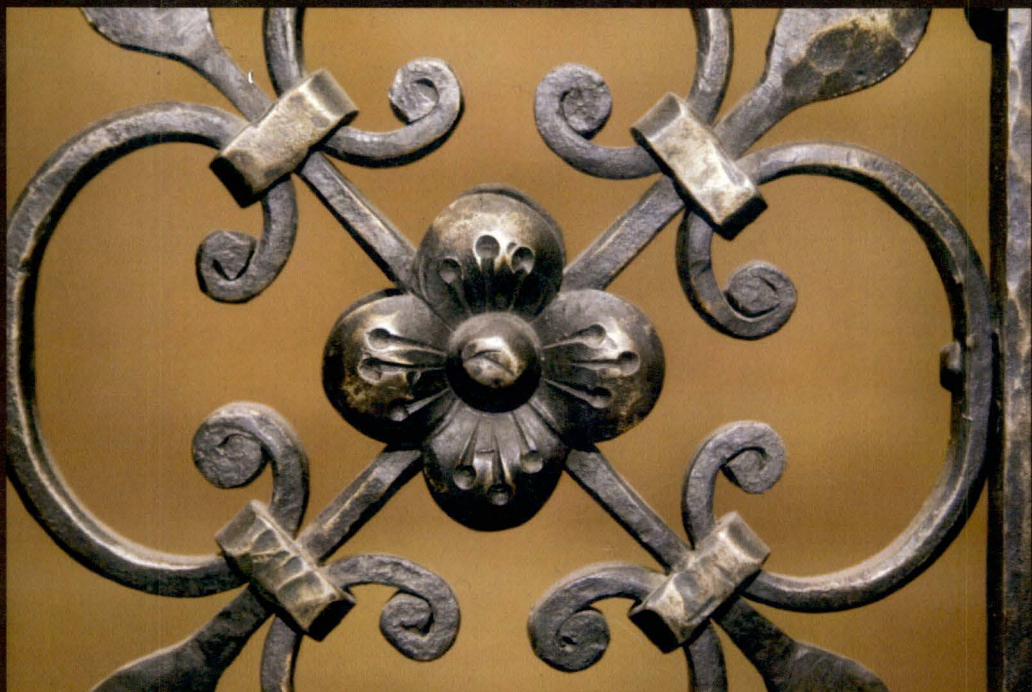
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The McNair Scholars Program is made possible through a grant from the U.S. Department of Education awarded to the University Teaching and Learning Center (TLC) and substantial institutional commitment (62% federally funded; 38% institutional support).



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