DISCUSSIONS

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DISCUSSIONS

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Table of Contents

Letter from the Editor

Dear Reader,

Thank you very much for opening up this journal and taking time out of your schedule to read Discussions. If you are not familiar, Discussions is an Undergraduate Peer-Reviewed Research Journal from Case Western Reserve University. Our main objective is to captivate and inform audiences, such as yourself, of all the incredible research that Undergraduates from all over the country are involved in. We hope that you learn something new and are able to broaden your interests. It is my belief that current research is pushing the bounds of our knowledge and allowing our society to progress forward.

The articles found in this journal span the entire academic field from the hard sciences to the humanities. It is with great pleasure that I able to present them to you now. All of them are quite interesting and innovating. It all started with our 15 wonderful submissions. While we would have liked to take all of them, we had to narrow down the articles to only the very best, which is what you see now. With a 33% acceptance rate, our journal is becoming more competitive with each publication.

If you would like to be a part of the Discussions Journal, we have many positions available. Reviewers are the ones that have the tough job of selecting which articles are fit for publication. Copy editors are the ones who edit and refine the accepted articles to be ready for publication. Those in public relations manage distribution and advertising for the journal as well as membership development. Layout and design personnel are responsible for making the journal look professional and neat. If you would like to learn more about Discussions, feel free to email me at nwk14@case.edu.

As a reminder, if you are interested in publishing in Discussions, our next submission deadline is February 11th. Submission guidelines and more information are located in this journal as well as on our website: http://case.edu/provost/source/discussions/.

I would like to recognize Bharathi Muthusamy, the exiting Editor-in-Chief, for she was the driving force behind the publication of this journal and many others. In addition, I would like to thank everyone who helped in the publication of this wonderful journal, including Media Board for being so supportive throughout the entire production. Lastly, I would like to personally send a big thank you to Sheila Pedigo, our advisor, without whom this journal would not exist. Please enjoy yourself and let your mind be opened to new and exciting worlds that await you! Thank you for your time and attention.

Nathan Kong
Editor-in-Chief, Discussions Research Journal

# Ape fracture patterns show higher incidence in more arboreal species.

ABSTRACT

In the following study, the Hamann-Todd Osteological Collection at the Cleveland Museum of Natural History was examined to compare long bone fracture incidence among wildshot chimpanzees (*Pan troglodytes*), gibbons (*Hylobates lar*), and lowland gorillas (*Gorilla gorilla*). The initial hypothesis was that the more arboreal species, the chimpanzees and gibbons, would have greater incidence of longbone fractures as a consequence of spending more time in an arboreal environment and the associated increased risk of falling.

First, the percentages of individuals that had long bone fractures, including fractures of the radius, ulna, humerus, tibia, fibula, and femur, out of the total population for each species were compared. Additionally, among those individuals with long bone fractures the percentages that had long bone fractures of specifically the upper limb were compared among species. The results showed a general trend toward higher incidence in long bone fractures among the more arboreal species. However, comparison of proportions of upper limb fractures shows that chimpanzees have the highest ratio of upper to lower limb fracture, followed by gibbons, and then followed by both humans and gorillas. These findings do not appear to correlate to time spent in the trees but may be caused by other factors such as bone strength, behavioral adaptations, and possible selection bias. Apes suffer a very high fracture incidence as a result of their arboreal lifestyles, but since there is such an enormous risk associated with this form of locomotion, there must be great evolutionary advantage to outweigh the cost. Analysis of these fracture patterns gives insight into behavior, adaptation, and evolution of apes.

INTRODUCTION

For the great apes in the wild, long bone fractures can be devastating, and their occurrence is an important factor in evolution. Since one likely cause of long bone fractures is falls, the hypothesis was that more arboreal primates would show greater fracture incidence. Since the upper limb is longer than the lower limb in apes, the upper limb was expected to sustain a greater proportion of the fractures. Differences in the proportions of upper limb bone fractures could elucidate how the apes vary in the causes for long bone fractures. In this study, the proportion of individuals with long bone fractures and the proportion of upper limb fractures were compared in *Pan troglodytes* and *Hylobates* in samples from the Hamann-Todd Osteological Collection at the Cleveland Museum of Natural History. These data were compared to previous literature on different collections of gibbons, chimpanzees, gorillas, and humans. The differences between these apes' behavior and physiology, based on their divergent evolutionary histories, should elucidate the underlying causes for differences in fracture incidence and distribution.
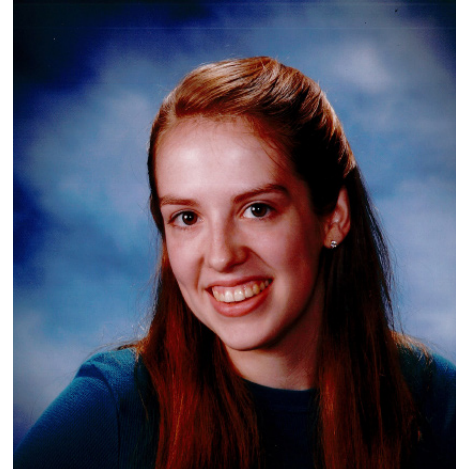
Sarah Hoffman

Sarah is a senior from Medway, Massachusetts majoring in Biology and Physical Anthropology at Case Western. In her free time she enjoys tap dancing with the Spartan Tappers and volunteering at the Cleveland Clinic. She is hoping to attend medical school next fall.

-Acknowledgements-

MATERIALS AND METHODS

Data were collected from the Hamann-Todd Collection at the Cleveland Museum of History using gibbons and chimpanzees. The specimens' long bones were analyzed for fractures, with 37 gibbons and 62 chimpanzees sampled. Data were also obtained from a study by Robert Jurmain (1997) involving investigation of skeletons of chimpanzees and gorillas for traumatic injuries. Lovell (1990) also studied chimpanzee and gorilla fractures, using a sample from the National Museum of Natural History in Washington D.C. Bulstrode (1990) sampled wild gibbons for fractures. Human samples were obtained from Donaldson and colleagues (1990) and Meling and colleagues (2009).

RESULTS

For the data sampled from the Hamann-Todd Collection, 7/37 (18.9%) of the gibbons had long bone fractures, and 6/62 (9.7%) of the chimpanzees had long bone fractures. Using the values obtained from this study and previously published data, averages were calculated. The averages were 26.0% for gibbons, 20.1% for chimpanzees, and 18.9% for gorillas (Figure 1). Jurmain also saw a difference in gender ratios, where males had a higher fracture incidence in chimpanzees, whereas females had higher fracture incidence in gorillas (1997). The data collected from the Hamann-Todd Collection shows lower levels of overall fracture incidence in both gibbons and chimpanzees than expected, since the literature values for both are higher. The incidence may have been lower due to a small sample size. However, within each study, the relative proportions show the expected trend. For the Hamann-Todd collection, gibbons show greater rate of fractures than chimpanzees. In Jurmain's study (1997) and Lovell's study (1990), chimpanzees show higher rate of fractures than gorillas. The study by Bulstrode (1990) shows that gibbons have a higher rate of fracture than chimpanzees and gorillas.
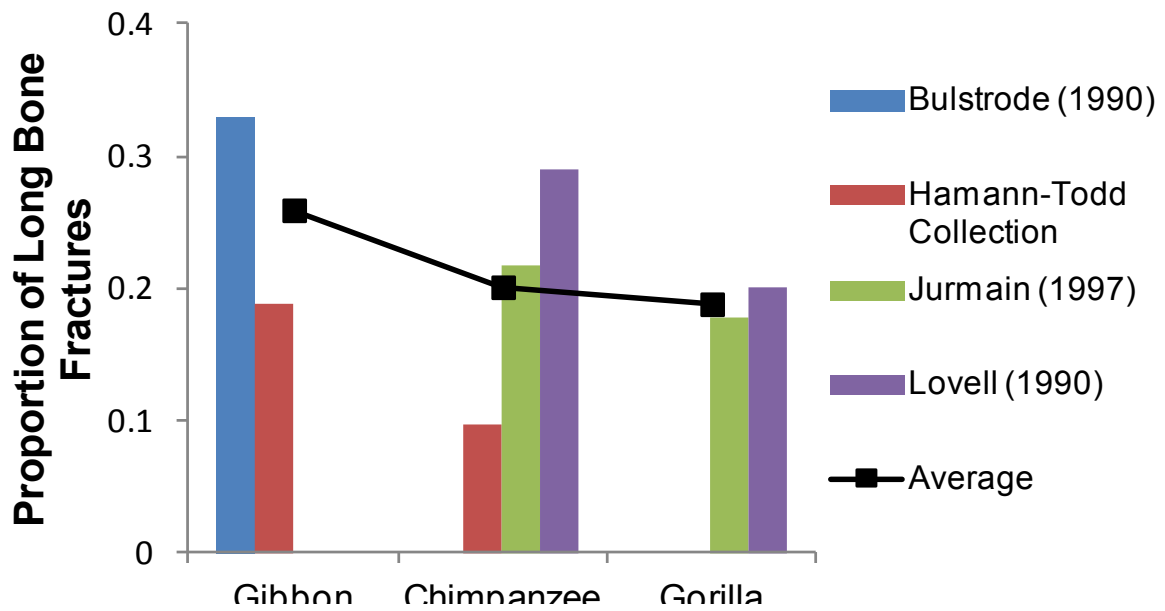

Figure 1. Incidence of long bone fractures in gibbons, chimpanzees, and gorillas. While the values, particularly for chimpanzees, vary among studies, the averages show that the more arboreal animals, shown decreasing from left to right, incur a higher proportion of fractures.
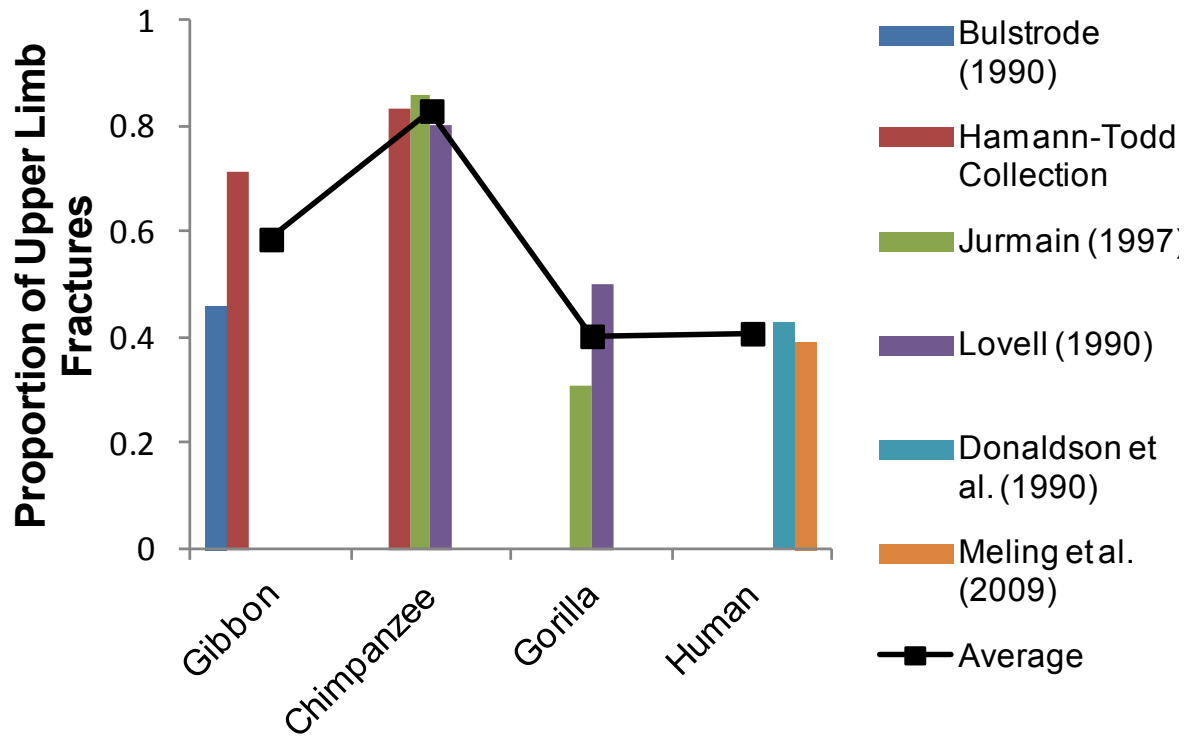
DISCUSSIONS

Figure 2. Proportion of long bone fractures that occur in the upper limb for samples of gibbons, chimpanzees, gorillas, and humans, shown decreasing in arboreality from left to right. Chimpanzees show the highest proportion of upper limb fractures, followed by gibbons. Gorillas and humans have a lower proportion of upper limb fractures.

The percentage of long bone fractures that occurred in the upper limb out of those individuals with fractures was calculated using their data and graphed (Figure 2). The Hamann-Todd Collection had 5/7 (71.4%) upper limb fractures in gibbons compared to 5/6 (83.3%) in chimpanzees. The averages, using values from published data and the Hamann-Todd Collection, gave a value of 58.7% for gibbons, 83.0% for chimpanzees, 40.4% in gorillas, and 40.9% in humans. The data show that for chimpanzees a substantially higher percentage of their fractured long bones occur in the upper limb, as compared with both gorillas and humans. Gibbons had a lower proportion of upper limb fractures than chimpanzees but generally higher than gorillas and humans.

DISCUSSION

The numbers of fractures observed are artificially low because of the nature of museum specimen collection. These museum specimens were wild shot, meaning these numbers do not include those animals that fell from trees and died of their injuries, only those who survived

their injuries. This also presents an artifact since some species may be better adapted to survive fractures than others. Since smaller animals are generally less likely to die from falls, they may have an artificially elevated fracture incidence in the museum population. When larger animals fall, they often die, so their skeletons would not reach a museum osteological collection. Therefore, proportions could reflect this difference rather than the differences in how often these apes fall, producing a selection bias. This could contribute to the higher incidence in gibbon fractures than in gorillas, although these rates also reflect the fact that gorillas spend less time in the trees due to their large bodies. As Bulstrode describes, the strength of bone is related to the severity of the penalty if it is broken (1990). Gorillas have very robust bones, so if they are fractured, it may be more devastating to the individual than if a gibbon breaks the same bone. This means more gibbons may be surviving with fractures, causing the wild shot populations to have many gibbons with fractures and fewer gorillas with fractures, since possibly a greater proportion of gorilla fractures are fatal. However, this does not necessarily in-

dicate that gibbons fall more, though it would make sense because they are both more arboreal and their elongated upper limbs may be more susceptible to random breaks upon falling.

Gorillas likely have a lower proportion of upper limb fractures because they spend less time climbing trees than chimpanzees, so they have less risk of falling and causing trauma to the upper limb. This hypothesis was tested by analyzing gibbons, which are even more arboreal than chimpanzees, to see if they have even higher rates of fracture and particularly upper limb fracture. The gibbons did have higher rates of longbone fractures than chimpanzees in the Hamann-Todd Collection, although specimens from the Hamann-Todd Collection showed a much lower overall fracture incidence in chimpanzees compared to the literature values. The gibbons showed a smaller proportion of upper limb fractures compared to chimpanzees.

The fragility of the gibbon skeleton might explain why gibbons had a lower proportion of upper limb fractures than chimpanzees. It was expected, since gibbons have very long upper limb bones, that they would have a greater proportion of upper limb fractures than chimpanzees, but the data show the reverse is true. The cause may be that since gibbons have smaller and more fragile skeletons, they are more prone to fractures of the lower limb caused by hitting branches while climbing. For chimpanzees, they may only suffer long bone fractures from falls, which more frequently break their upper limb bones. Their bones and muscles of the lower limb may be too strong to suffer from fractures through hitting branches while climbing. Since several gibbon specimens were observed to have fractures in the femur but not in the tibia or fibula, it is suspected that they sustain lower limb injuries from swinging through the trees more frequently than chimps and the other large apes.

In humans, the upper limb is not nearly as robust but is much less used than the other apes due to bipedal locomotion. While bipedalism reduces the amount of upper limb fractures in humans, other behaviors contribute to high rates of fracture in modern humans, including sports and other activities that strain the human skeleton in ways it is not evolved to tolerate. Humans are evolved to use their upper limb to carry loads such as food collected to provision the family or to carry a dependent infant. Such use does not overly strain the upper limb, so in wild human populations, one would not expect much trauma to the human upper limb. The proportion of upper limb long bone fractures would most likely be much lower in a wild human population.

In modern humans, injuries to the upper limb occur in many sports, including baseball and tennis, behaviors to which humans are certainly not adapted. Fractures of the upper limb were shown to vary based on sports in a study by Sinha and colleagues (1999), which showed fractures involving weight lifting (football, weight lifting, wrestling) had fractures distal to the elbow whereas throwers (pitchers, soccer goalie, javelin) had fractures in the shoulder girdle. Swingers (golf, tennis) had stress fractures in the lower ribs. This study shows how injuries to the upper limb are common in sports that require humans to use it in ways that they are not adapted for. A chimpanzee would have no problem pitching all day, since its upper limb is adapted to that type of motion (overhead suspension). Chimpanzees and present-day humans must be considered differently in their limb fractures since chimpanzees are living in the environment in which they evolved, whereas humans have relatively recently rapidly changed the stresses on their bodies. It would be interesting to study the upper limb fracture incidence in a wild human population.

In humans, as bipedal animals, common injuries such as rotator cuff tears to the upper arm do not affect reproductive success as strongly as in quadrupedal animals. In a pair-bonding human, a fractured upper limb may mean the human could not hold as much food or as many babies, but he or she would still be able to locomote, gather food, and mate. In a chimp, upper limb fractures are much more serious, jeopardizing the ability of the animal to locomote at all, let alone find food or a mate. The relatively high rates of healed fractures in the apes (~20%) suggest that they must fall very often, since fatal falls are not accounted for, and that they are well-adapted to surviving despite fractures. Jane Goodall (1986) noted how often chimps fall from trees, observing 23 falls over 2990 hours in 1978 and 28 falls over 1975 hours in 1979. These values are lower than actual numbers, since not all falls could be observed. For adults, particularly males, most falls occurred during an instance of aggression with another chimpanzee, whereas infants fell most often while playing. Goodall recorded how chimps surviving injuries had limited abilities to locomote for weeks after the injury (1986). Nonhuman primates that sustain serious fractures must have some way to survive without use of their broken limbs, most likely through social relationships. Some evidence shows gibbons may pair bond (Geissman and Orgeldinger 2000), so a gibbon may provision food to its injured mate, allowing it to survive an injury that would otherwise kill it.

Gender differences may also shed light on the causes of upper limb fractures. Male chimpanzees had a higher incidence of fractures than females, whereas the re-

verse was true for gorillas in Jurmain's study (1997). Male chimpanzees likely had higher rates of fracture due to aggression between males for access to females. The most commonly fractured bone in the chimpanzee skeleton is the ulna. As Jurmain (1997) describes, such fractures are called "parry fractures" in humans and are caused by raising the arm to block a blow. This suggests that chimpanzees are engaging in aggressive behavior that may also influence the distribution of their fractures. However, such fractures can also be caused by falls so it remains unclear whether one of these explanations or a combination of the two best reflects reality. For the gorillas, the cause of gender discrepancies is that females spend more time in the trees, making them more susceptible to falls, and therefore fractures. For gorillas, their body size makes climbing particularly risky, though they spend less time in the trees than chimpanzees and gibbons, which is reflected in their lower fracture incidence.

Chimpanzees are adapted for living in the trees and there is very strong selection for chimpanzees that are good climbers, since falls are often fatal or debilitating enough to negatively impact reproductive success. Natural selection is always eliminating those who lack the agility or bone strength to avoid severe injuries. Those with stronger bones may be more likely to survive a fall or avoid a fracture, however, natural selection is confined by how strong chimpanzee bones can be before the weight of the bone and the resources required to make it are too great (Bulstrode, 1990). There will inevitably be a large amount of fractures caused by falls from trees as a consequence of non-human primates' adaptations to tree climbing. They are evolved in numerous ways, from the grasping hallux to the inflexible spine to the long upper limb bones, to be good climbers, a form of locomotion central to their way of life. Fractures from falling out of trees is a necessary consequence of life in the trees, but one which chimps can accept since the benefits of climbing trees so greatly outweigh the costs for them. Trees contain the food they eat and keep them safe from predators. Though it may be risky to climb trees, it may be more risky not to.

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The Contribution of HPG axis-hormones and hormone replacement timing on cognition and associated signaling

Jesal Shah

Jesal Shah was born in Gujarat, India in 1990. Raised in America, she had the opportunity to receive great education as well as to partake in many hobbies including gymnastics, swimming, band, and soccer. As a young adult, Jesal spent much of her time volunteering in hospitals and animal shelters, as she was an animal-lover as well as a fan of science. Aspiring to become a doctor, she majored in Biology at Case Western Reserve University and minored in Chemistry and Environmental Studies. Jesal is currently a CWRU Alumni and resides in Little Rock, AR where she will be attaining her Master's Degree at the University of Arkansas for Medical Sciences. She plans to go to Medical School to become a physician.

ABSTRACT

Many women experiencing menopause show cognitive function deficits and have an increased risk of developing Alzheimer's Disease (AD). While estrogen (E2) has been shown to improve cognition and improve molecular signaling associated with learning and memory, these effects are lost if estrogen replacement is not started within a critical time period, close to menopause onset. During menopause the ovaries no longer produce estrogen. Thus, the negative feedback of estrogen onto gonadotropin production is lost, and gonadotropins such as Luteinizing Hormone (LH) increase substantially. The downregulation of LH (in the absence of E2) leads to cognitive improvements identical to those observed when E2 is administered right at the onset of menopause. This study attempts to find data on the changes in signaling proteins that are important for learning and memory. In order to test the hypothesis that cognitive changes after menopause are primarily driven by increases in LH not decreases in estrogen levels, mice were treated with LH regulators in the short-term, soon after menopausal onset, and in the long-term. They were then tested for levels of protein expression in the hippocampal area of the brain. This experiment attempts to determine whether the signaling molecules being studied are controlled by the menopausal state and other treatments. It determines whether estrogen's actions on these signaling cascades are independent of its ability to downregulate luteinizing hormone and whether the loss of effectiveness of E2 on cognition when treatment onset begins long after menopause is related to changes in these signaling cascades. The data reveals LA is better at downregulating LH than E2, especially in the long-term, and that the tested signaling molecules are affected by aging. The results are relevant in not only determining the effects of hormones and aging on the learning and memory process but also finding preventative measures for neural degenerative disorders such as Alzheimer's disease.

INTRODUCTION

Alzheimer's disease (AD) is an age-related, degenerative disorder that attacks nerve cells in the brain resulting in memory loss, decrease in thinking and language skills, and behavioral changes. Sex steroid hormones are regulators of neuron survival in multiple Central Nervous System regions and across a variety of circumstances ranging from normal development to neural injury [1]. The progressive decrease in sex steroids with age is an important factor for age-related Alzheimer's disease [1]. Hormones are not only a significant part of the endocrine system but

are also important in neural processes such as cognition. In women, the hormone estrogen plays a huge role in modulating the signaling cascades involved in cognition and regulating the signaling molecules involved in the processes of learning and memory. Abundant experimental, epidemiological and clinical evidence suggest that neural action estrogens can reduce the risk for AD [1]. This is evident in the increased risks of cognitive disorders that develop after menopause. In women, the age-related decrease in sex steroids is characterized by menopause via estrogen (E2). Women experiencing menopause have a tendency to show cognitive function deficits and are at risk of developing neurodegenerative diseases. In the hypothalamic-pituitary-gonadal (HPG) axis, the neurons within the hypothalamus release Gonadotropin-releasing Hormones (GnRH) to the anterior pituitary, which synthesizes and secretes the gonadotropin Luteinizing Hormone (LH). Normally in women, the ovaries produce estrogen which is part of the negative feedback loop to the hypothalamus in the brain. This results in an overall decrease in LH production. During menopause, the negative feedback of estrogen onto gonadotropin production is lost because estrogen is no longer being produced. As such, gonadotropins, for example luteinizing hormone (LH), increase substantially. The post-menopausal changes in E2 and LH levels have been associated with increased risk and development of AD and cognitive impairment [2, 3].

Conversely, the normalization of these hormones to physiological levels leads to cognitive improvement [4]. Hormone replacement therapy can artificially boost hormone levels, possibly prolonging life and reducing the incidence of dementia. Therefore if E2 replacement is administered at the onset of menopause, the treatment is effective; however, as the time interval between menopause onset and treatment increases, estrogen loses its ability to downregulate LH [3]. In the absence of E2, the drug Leuprolide Acetate (LA) can specifically downregulate elevations in the gonadotropin, LH, and can be used to differentiate estrogen from LH effects on neuronal function [5]. The gonadotropin releasing hormone antagonist can also improve cognitive function, and increase levels and phosphorylation of signaling molecules associated with the modulation of cognition [3]. This suggests that high LH, not low estrogen, is the primary driver of cognitive changes during menopause.

Elevations of serum LH occur during and after menopause. LH fluctuations have also been linked to cognitive deficits, AD predisposition, and decreased cognition-associated intracellular signaling [5]. Hormones such as estrogen are known to modulate cognition through a variety of intracellular cascades that are important in the formation and stabilization of long-term memories [6, 7]. Estrogen directly influences brain function through estrogen receptors located on neurons in multiple areas of the brain [14, 15]. The hormone also appears to have direct membrane-mediated effects on neurons. Its effects are both neuroprotective and neurotrophic [15]. Estrogen has been shown to protect isolated neurons in vitro from damage by amyloid protein, which is implicated in the pathogenesis of Alzheimer's disease [15]. At neuronal synapses, estrogen increases the concentration of neurotransmitters such as serotonin, dopamine, and norepinephrine [16]. It affects their release, reuptake, and enzymatic inactivation. It also increases the number of receptors for these neurotransmitters [15]. Synaptophysin and synapsin are both important molecules in the regulation of synaptic release and are both associated with improvements in memory function [10, 11]. Synaptophysin (SYP) is a calcium-binding glycoprotein found in the membranes of neurotransmitter-containing presynaptic vesicles, and it is believed to modulate the ef-
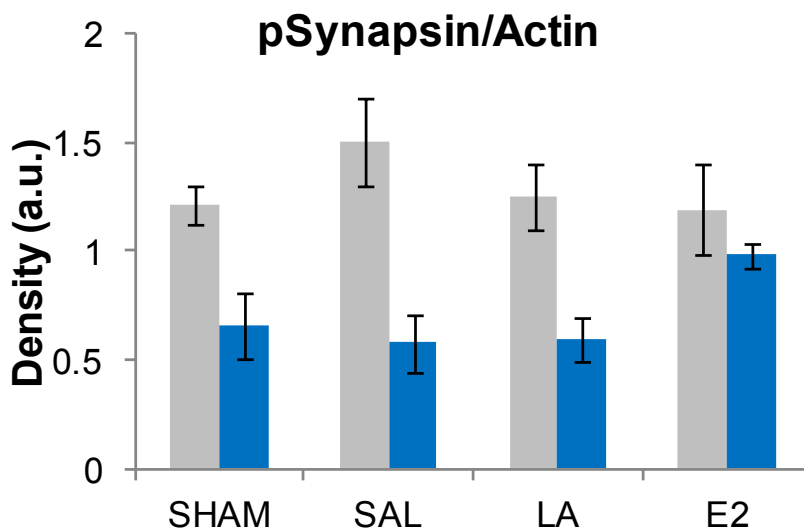

Figure 1. Protein expression of phosphorylated synapsin. Short-term treatment shown in grey and long in blue. There is no effect of ovariectomy or any of the treatments when started short term after ovariectomy. E2 replacement started a long interval after ovariectomy significantly upregulates the levels of pSynapsin compared to all other groups.
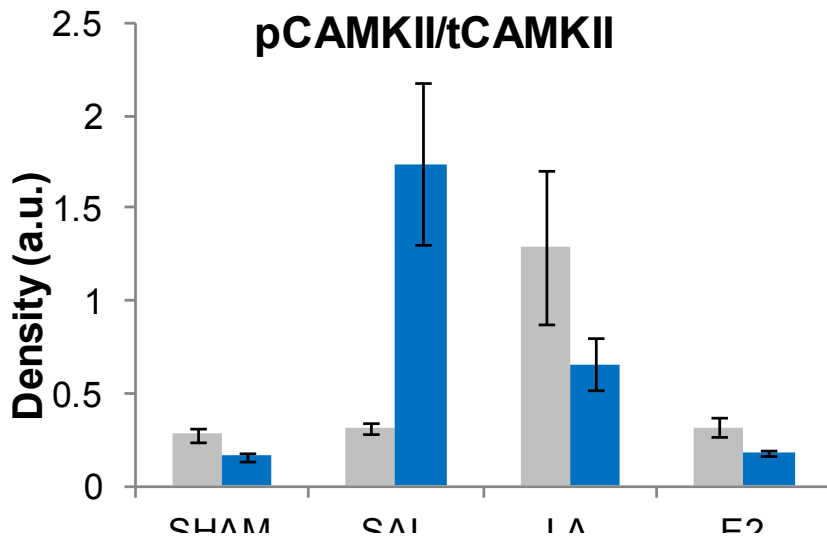
Figure 2. Protein expression of phosphorylated CAMKII. Short-term treatment shown in grey and long in blue. There is no effect of ovariectomy on pCAMKII expression; however, LA treatment leads to a significant upregulation compared to all treatments. pCAMKII is significantly upregulated by OVX when measured 6 months after the procedure compared to all groups. LA treatment when started long-term is significantly downregulated compared to short-term and long-term OVX but still significantly elevated compared to SHAM and E2 groups.

ficiency of synaptic vesicle cycles. Normally, synaptophysin decreases with age in the hippocampus and various cortical regions. Synapsin is an abundant brain protein essential for regulating neurotransmitter release. Phosphorylation of synapsin by PKA or CaM Kinase I inhibits its binding to phospholipids and dissociates synapsin from synaptic vesicles [17]. Synapsin I is an exclusively pre-synaptic protein, so its deletion can block the enhancements of learning, presynaptic plasticity, and Long Term Potentiation (LTP) [11].

Memory is created by the persistent modification of strength of synapses. One such modification is LTP which occurs in the hippocampus. LTP has associative properties that match the process of learning. Once it is triggered by the rise in postsynaptic calcium, modification can be maintained for up to an hour [8]. In order to facilitate both LTP and the formation of new memories, glutamate receptor 1 (GluR1), an important subunit of the AMPA receptor, must be phosphorylated at amino acid Ser845, which leads to the mobilization of the AMPA receptor from the post-synaptic density to the synapse [6, 9, 18]. Signaling events, such as the autophosphorylation of calcium-calmodulin kinase II (CAMKII), lead to the phosphorylation of GluR1 [9]. The maintenance of AMPA receptors is due to the ability of CaMKII to maintain its activity for long periods of time after its initial activation by calcium. CaMKII is a critical protein in LTP because it has special properties which make it exhibit persistent changes.

Women experience both elevations in LH and declines in estrogen during and after menopause. Similarly, after ovariectomy (OVX), rodents also have elevations in LH and declines in estrogen providing a good model to study hypothalamic-pituitary-gonadal-axis hormone-cognition interactions [12] as well as the learning and memory signaling cascades. It is unknown if the changes

in signaling cascades are related to 1) whether the signaling molecules studied are modulated by menopausal state and our treatments, 2) whether E2 actions on these signaling cascades are independent of its ability to down-regulate LH, and 3) whether loss of effectiveness of E2 on cognition when treatment onset begins long after menopause. Therefore, it is the goal of this project is to study the changes in the signaling proteins important for learning and memory to determine such relationships.

MATERIALS AND METHODS
Animals

Female, 8 month-old C57/BL6 mice were ovariectomized (OVX) and treated with saline (SAL), Leuprolide Acetate (LA) (7.5 mg/kg SC) (for the downregulation of LH) and E2 (5ug SC) for 3 months. The SAL treatment is also known as OVX and will be used interchangeably. This treatment emulated the symptoms of menopause. For the short-term treatments, the drugs administered immediately after surgery from months 1 to 3. For the long-term treatments, drugs were administered 4 months after surgery to determine effects of treatment timing. The SHAM mice served as a control since they did not experience menopausal conditions.

Tissue processing and Western Blots

For western blot analysis, hippocampus tissue was homogenized, and protein levels were determined for approximately 16 samples. The hippocampus was chosen for testing because it is the center of the brain associated with memory and cognition. 20ug aliquots of tissue were loaded and separated by electrophoresis on 8% acrylamide gels. Primary antibodies of both phospho- and total CaM Kinase II (Promega), synaptophysin (Invitrogen), and phospho-Synapsin (Calbiochem) were used in dilutions of

DISCUSSIONS

1:5000, 1:1000, and1:200 respectively. Gels were then transferred to PVDF membranes, probed with rabbit antibody, and visualized using a chemiluminescence-based detection (Denville). The blots were compared to the loading-control protein actin, which is expressed at a constant level regardless of the treatment applied to the original organism.

Quantification

Western blots of both the tested proteins as well as the actin were quantified by densiometric measurements using ImageJ (NIH) data analyzed by ANOVA and post-hoc comparisons.

RESULTS

Overall, our data reveals trends in protein expression as the term of the treatment increases. Phospho-synapsin expression decreases with age regardless of the treatment. Phospho-CAMKII expression as opposed to total CAMKII expression varies with regards to treatment, while synaptophysin expression increases with age in each treatment group.

Phospho-synapsin is not affected by ovariectomyor by treatments in the short term after ovariectomy, but it is reduced in the long term with each treatment. Interestingly, the reduction in phospho-synapsin expression from E2 replacement had a smaller difference compared to the SHAM mice and the other treatments (Figure 1).

The trend of decreased phospho-CAMKII expression with increasing age is not as defined as with the other proteins because with the SAL treatment there is an overexpression of the protein long after the onset of menopause- in particular 6 months after; however the autophosphorylation of CAMKII is not affected within 3 months from the OVX. LA increased levels of pCAMKII significantly at

both time-points yet, levels in LA treated animals were significantly lower to those of OVX animals in the long-term group (Figure 2).

The trend in synaptophysin expression is age-related upregulation independent of the groups being treated. The protein expression is not altered by OVX or any of the treatments. When LA treatment is started 4 months post-OVX, the downregulation of LH significantly increased synaptophysin expression beyond age-associated levels. However, the E2 treatment started 4 months after post-OVX shows a smaller increase in protein expression when compared to the other treatments (Figure 3).

CONCLUSION AND DISCUSSION

Based on the results, the hypothesis that cognitive changes after menopause are primarily driven by increases in LH, not decreases in estrogen levels, is partially proven because the effects of LA and E2 are very similar in protein expression immediately post-OVX, but different long after OVX. This tells us that E2 is not as effective as LA when applied in the long-term, hence proving that cognitive changes post menopause are driven by increases in LH.

In addition, the data discloses that the tested signaling molecules are not considerably modified during menopause at least within the first 3 months. This suggests that cognitive impairment observed by OVX is unlikely to be driven through these cascades and are affected by some other cascades. Our results also show that synaptic transmission associated proteins show age-related effects in all our groups. For example, synaptophysin decreases with age in the hippocampus and various cortical regions [7]. Previously published data has shown that aging can lead to the incorrect regulation of many proteins involved in neuronal signaling that may be associated with age-re-

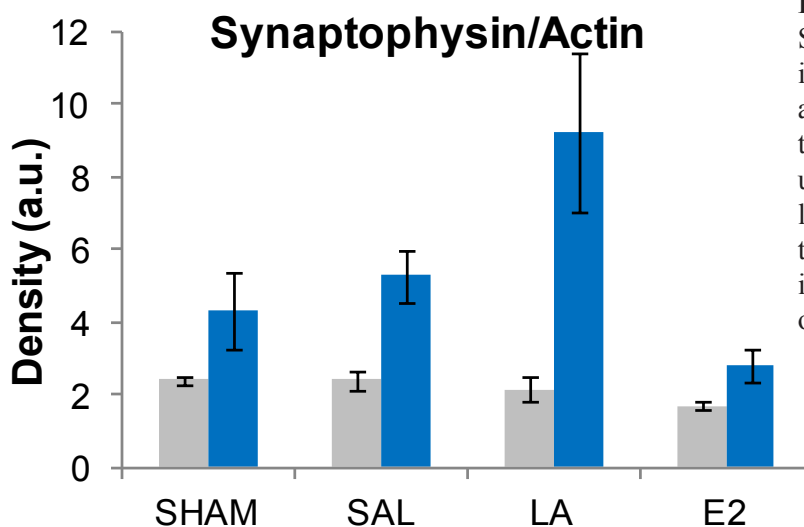**Figure 3.** Protein expression of synaptophysin. Short-term treatment shown in grey and long in blue. There is no effect of ovariectomy or any of the treatments when administered short-term after OVX. Synaptophysin expression is upregulated by age in all conditions (short vs. long). LA treatment when administered long-term after OVX leads to a significant increase in synaptophysin expression compared to all other groups.

lated diseases [13]. This makes sense because protein levels can be regulated by hormonal control, but with time, incorrect hormone levels can result in the dysfunction of proteins involved in synaptic transmission. Dysfunction in transmission can lead to a decrease in neurotransmitter release.

In another set of results, age-related downregulation of phospho-synapsin is prevented by E2 replacement when treatment is started long after OVX. The significance of these findings is unclear given that E2 replacement is not effective at improving cognition at this later interval. On the other hand, LA increases synaptophysin expression in our long-term group. It is unlikely that synaptophysin is a major modulator of cognition after menopause based on our data; instead, it might modulate the efficiency of synaptic vesicle cycles. However, the additional increases produced by LA could take part in cognitive protection. This could be due to LA being more effective than E2 in downregulating LH in the long term.

Lastly, while pCAMKII is not substantially changed by OVX at 3 months, it is significantly increased at 7 months post OVX. This could be in response to the decrease in levels of neurotransmitter release post-OVX in the long term due to synapsin. The increase in pCAMKII allows more AMPA receptors to reach the synapse to accept the few neurotransmitters released. On the other hand, LA treatment increases pCAMKII when treatment is started immediately after and long-term compared to SHAM, but the magnitude of increase is significantly lower than that of OVX (long-term). This is reasonable because LA downregulates LH creating effects similar to SHAM and E2.

It is challenging to isolate these signaling cascades to guarantee that other factors are not interfering with the processes. For example, calcium plays a huge role in cell signaling and transduction. CAMKII autophosphorylation is specific to intracellular calcium release, which is known to both improve cognition and lead to cytotoxicity. Differences in the magnitude of pCAMK in this study may therefore reflect positive and noxious increases in Ca++ release. The next steps would possibly be to test more samples, test other proteins in the signaling cascade to confirm the process and reasons why the levels go as the results show, or to somehow isolate these signaling cascades and see their effects purely from the treatments administered.

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Mindfulness and perfectionism

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ABSTRACT

Perfectionism is an individual's wish for the highest performance combined with critical evaluations of performance (Frost, Marten, Lahart, & Rosenblate, 1990). High levels of perfectionism are correlated with various disorders, including social anxiety disorder (Juster et al., 1996; Lundh & Ost, 1996), obsessive-compulsive disorder (Frost & Steketee, 1997), panic disorder with agoraphobia (Saboonchi, Lundh, & Ost, 1999), high levels of worry (Chang et al., 2007; Stober & Joormann, 2001) and low levels of mindfulness (Perolini, 2012).

Mindfulness involves purposefully attending to the present moment (Kabat-Zinn, 1994) and can be learned through meditation and present-moment joy training (Borkovec, 2002). While both meditation and present-moment joy techniques decrease levels of worry (Bishop, 2002; Borkovec, 2002), they have different approaches to increasing present-moment focus.

Because mindfulness involves taking a non-judgmental approach and perfectionism involves critical self-evaluation, individuals high in perfectionism may struggle to achieve mindfulness and to practice meditation. We hypothesize that higher perfectionism will predict smaller pre-post change in positive and negative affect and anxiety in individuals who learn mindful meditation. Furthermore, we hypothesize that perfectionism will not predict changes in pre-post scores in the above states for individuals who undergo present-moment joy training.

Undergraduate students completed questionnaires regarding anxiety, worry and attention, listened to a pre-recorded dialogue that explained either mindful meditation or present-moment joy training, and completed questionnaires again. In both conditions, significant pre- to post- change was found on the State Trait Anxiety Inventory for Adults (STAI-S) and Positive and Negative Affect Scale (PANAS) in Negative Affect, no significant pre- to post- changes were found on the PANAS in Positive Affect. Perfectionism and the paradigm were not found to significantly affect these pre-to-post changes.

BACKGROUND

Mindfulness is defined as purposefully attending to the present moment without making judgments (Kabat-Zinn, 1994). Moreover, mindfulness has been closely related to the concept of "acceptance" and "awareness" (Block-Lerner, Salters-Pedneault & Tull, 2005; Cardaciotto et al, 2008). Although closely related, acceptance and awareness have different nuances and connotations that help explain and capture the concept of mindfulness. Acceptance is often defined as allowing oneself to be open to reality, and to experience events to the fullest in the present moment. Conversely, awareness is behaviorally based and involves continuously being conscious of all aspects of experience (Cardaciotto et al, 2008).

Independently, awareness and acceptance have been associated with various disorders. Heightened awareness has been associated with positive experiences including higher ratings of pleasure during increased periods of attention and decreases in negative affect while focusing on positive aspects of the self. However, awareness has also been associated with more negative experiences including increased anger and hostility when focusing on the emotions affiliated with rejection and chronic negative affect that contributes to depression, anxiety, substance abuse and psychopathy (Cardaciotto et al, 2008).

As previously stated, acceptance involves being open to reality and experiencing events to the fullest in the present moment. Thus, individuals who struggle with acceptance may tend to avoid situations and experiences. Experiential avoidance has been associated with various psychological symptoms including increased panic symptoms, fear, depression, and anxiety (Cardaciotto et al, 2008). Furthermore, not accepting one's thoughts can lead to various phenomena such as heightened pain, more distress, increased anxiety and decreased quality of sleep. Such thought suppression has also been associated with depression, generalized anxiety disorder, specific phobia, posttraumatic stress disorder and obsessive-compulsive disorder (Cardaciotto et al, 2008).

Individually, acceptance and awareness can have detrimental psychological affects; however, combining these concepts to help achieve mindfulness has been shown to reduce anxiety, increase positive affect (Davidson et al, 2003), reduce stress and stress-related medical symptoms and enhance positive emotions and quality of life (Greenson 2008). Several interventions have been developed that involve taking a mindful approach, such as mindfulness-based stress reduction (MBSR), mindfulness-based cognitive therapy (MBCT), dialectical behavior therapy (DBT), acceptance and commitment therapy (ACT) (Block-Lerner, Salters-Pedneault & Tull, 2005; Cardaciotto et al, 2008) and Mindfulness-Based Eating Awareness Training (MB-EAT) (Greeson, 2008). One of the benefits of therapies that include a mindfulness component is that the mindful perspective can be applied to all of one's thoughts, not just psychological conditions that are targeted in other cognitive therapies (Block-Lerner, Salters-Pedneault & Tull, 2005). Moreover, these techniques have been shown to effectively treat psychological conditions including various anxiety disorders, recurrent major depression, chronic pain, borderline personality disorder and binge eating disorder (Greeson, 2008).

Both meditation and present-moment joy techniques have been shown to decrease levels of anxiety (Bishop, 2002; Borkovec, 2002); however, the two techniques have different approaches to increasing present-moment focus. Mindfulness meditation emphasizes the importance of accepting one's thoughts and emotions, whereas present-moment joy training emphasizes finding joy and intrinsic meaning in everyday tasks.

Mindful meditation is the practice of "non-doing"- it involves focusing on the present moment without imposing outside judgments. Moreover, meditation involves accepting reality and the present moment as perfect, not trying to do things perfectly or make things perfect (Kabat-Zinn, 1994). Mindfulness meditation has been associated with lower levels of anxiety, depression, anger and worry (Greeson, 2008).

Various studies have looked at the effects of mindfulness meditation on the mind and body. Researchers found that individuals who spent more time on formal meditation practices during an 8-week intervention period showed increased mindfulness (Carmody & Baer, 2008). In a separate 8-week period study, researchers found that mindfulness meditation training significantly reduced ruminative thinking in person with a history of depression (Ramel et al, 2004). Moreover, 8 weeks of mindfulness meditation training in the form of MBSR found that individuals increased their ability to focus their attention on the present moment as measured by an attention test (Jha, Krompinger Baime, 2007). Furthermore, individuals who completed 4 weeks of mindfulness meditation training, relative to somatic relaxation training and nonintervention control group, significantly reduced distress by decreasing rumination (Jain et al, 2004). Individuals who participated in five days of integrative mediation training, including mindfulness, improved scores on an attention test (Tang et al, 2007). Finally, in an 8-week study on clinically depressed and anxious participants, mindfulness meditation was shown to improve psychological wellbeing (Manzaneque et al, 2011).

In addition to mindfulness meditation, another approach to increasing present-moment focus involves finding joy and intrinsic meaning in everyday tasks (Borkovec, 2002). Although this technique is not as widespread as mindfulness meditation, it has also been shown to decrease levels of worry (Borkovec, 2002). Borkovec suggests that individuals high in worry create anxious feelings by worrying about potential threats, and thus are caught up in an illusory future and do not attend to the present moment. Furthermore, Borkovec claims that while it is possible for individuals to experience fear in the present moment, it is impossible for individuals to experience anxiety while paying attention to the present moment– there are no potential or worrisome threats that exist in the illusory future. By focusing on the positive aspects of present-moment tasks, individuals can avoid experiencing anxiety-provoking thoughts of the future, and enjoy even menial tasks in the present.

In addition to mindfulness, perfectionism is a key concept that will be addressed in this study. Perfectionism is defined as an individual's wish for the highest performance combined with critical evaluations of performance (Frost, Marten, Lahart, & Rosenblate, 1990). While this definition does capture the basis of perfectionism, perfectionism can be more complicated to describe, as it is a multidimensional construct (Besser, Flett & Hewitt, 2010). Various attempts to define this multidimensional nature have been made by different researchers in order to measure perfectionism. While different dimensions have been created, they all focus on several basic facets of perfectionism, namely personal aspects of perfectionism and aspects of perfectionism relating to others (Besser, Flett & Hewitt, 2010). The Frost Multidimensional Perfectionism Scale (FMPS) defined the multidimensional nature of perfectionism using five dimensions- concerns over making mistakes, setting personal standards for performance, the perceived expectations imposed on individuals by parents, the tendency to doubt the quality of one's performance, and organizational skills. These dimensions help capture the various aspects of perfectionism that leads to the tendency to have high expectations for oneself, while critically evaluating one's ability to achieve those expectations (Frost et al, 1993).

While setting high standards is associated with success and competency, the critical evaluations of one's behavior can be detrimental. As such, perfectionism can be a debilitating disorder and has been linked with various psychological and physical problems such as alcoholism, erectile dysfunction, irritable bowel syndrome, depression, anorexia, abdominal pain and writer's block (Frost, Marten, Lahart, & Rosenblate, 1990). Moreover, high levels of perfectionism are common in individuals with various psychological disorders, including social anxiety disorder (Juster et al., 1996; Lundh & Ost, 1996), panic disorder with agoraphobia (Saboonchi, Lundh, & Ost, 1999) and obsessive-compulsive disorder (Frost & Steketee, 1997).

Many cognitive theories regarding OCD have suggested that perfectionist tendencies contribute to the obsessions and compulsions typical of OCD individuals (Antony et al 1998). Obsessions are associated with maladaptive cognitions and intrusive thoughts that individuals are unable to forget about. By using thought control strategies intended to alleviate these maladaptive thoughts, individuals actually focus more on the thoughts, which furthers the development of obsessions (Fergus & Wu, 2010).

Several studies have confirmed the suggested correlation between perfectionism and OCD. In a study comparing perfectionism across clinical samples of individuals with OCD, panic disorder and non-anxious volunteers, patients with OCD had higher overall perfectionism scores than did non-anxious volunteers and had a higher "doubts about actions" score than did the individuals with panic disorder (Frost & Steketee, 1997). Moreover, another study found that five of the six subscales of the FMPS (all but Organizational) were significantly correlated with a measure of OCD severity, the Padua inventory (Rheaume et al, 1995). A separate study further found that the subscales "concern over mistakes" and "doubts about actions" were significantly correlated with compulsive indecisiveness, one of the dimensions of OCD (Frost & Shows, 1993). Furthermore, in a study comparing perfectionism across various anxiety disorders, OCD was found to have elevated total perfectionism scores on two separate multidimensional perfectionism scales (Antony et al, 1998).

In addition to being correlated with anxiety disorders, perfectionism is also correlated with high levels of worry, particularly in college student populations (Chang et al., 2007; Stober & Joormann, 2001). Worry is defined as an attempt to solve an issue with an uncertain outcome, but which has the possibility of multiple negative outcomes. While worry is often thought of as beneficial because it is a "problem-solving" process, it actually is a form of cognitive avoidance and hinders an individual's ability to process events emotionally (Fergus & Wu, 2010). Individuals high in worry become stuck in the problem-solving process and focus on the possibility of all of the negative outcomes, and are unable to focus and process what is happening during the present moment. A study examining the relationship between worry, procrastination and perfectionism found that worry is significantly correlated with both procrastination and perfectionism. More specifically, higher correla-

tions between worry and the perfectionism subscales CM and DA indicate that the perfectionist tendencies to be concerned about mistakes and doubt their actions may lead to high worry (Stober & Joormann, 2001). Additionally, a different study examining the relationship between perfectionism and domains of worry concluded that in addition to worry being highly associated with CM and DA, it is also associated with PC and PS. Thus, the effects of parental criticism and setting high personal standards for performance may further the relationship between perfectionism and worry (Chang et al, 2007).

Individuals high in perfectionism have also been associated with various coping methods, including ruminative brooding, a maladaptive form of coping (Blankstein & Lumley, 2008). Ruminative brooding, or rumination, is defined as a method of coping in which individuals focus their attention on negative mood including distress symptoms and negative emotions. In addition to being associated with perfectionism, many studies have shown that rumination is also associated with increased depressive symptoms as well as increased anxiety (Blankstein & Lumley, 2008). A study examining the extent to which dimensions of perfectionism are associated with rumination found a strong positive correlation between several dimensions of perfectionism and rumination. Though not explicitly found, this finding implies that perfectionist individuals characterized by ruminative thoughts may be more vulnerable to recalling and focusing on negative events (Flett et al, 2002).

Because all three conditions involve focusing on maladaptive cognitions or potential future outcomes, individuals high in worry, OCD and rumination may have a hard time focusing on the present moment. In particular, OCD compulsions and obsessions consume individuals thought processes and may prevent individuals from being able to focus on the present moment. Furthermore, individuals high in worry are focused on the potential negative outcomes that may result from the decision-making process. Thus, individuals high in worry may struggle to let go of their premonitions and achieve mindfulness in the present moment. Similarly, individuals who use rumination as a coping method may be unable to stop making negative judgments and fully accept the events going on in the present moment.

As previously discussed, individuals high in perfectionism are correlated with having symptoms of OCD, worry and rumination, and thus may struggle to focus on the present moment and achieve mindfulness. This correlation was, in fact, found in a recent study. While perfectionism has been strongly correlated with individuals high in anxiety and worry, it has been correlated with low levels of mindfulness (Perolini, 2012). As previously mentioned, an important dimension of mindfulness is acceptance. Ironically, acceptance also plays an important role in perfectionism. Perfectionism is an individual's wish for the highest performance combined with critical evaluations of performance; in other words, perfectionism is striving for highest performance, with an inability to accept not achieving those standards (Lundh, 2004).

There are several versions of acceptance that perfectionist individuals may struggle with–self-acceptance, other-acceptance and experiential acceptance. Self-acceptance involves unconditionally accepting oneself as is and has been correlated with personal adjustment and well-being. Other-acceptance is a person's ability to accept other people as they are; it has been strongly associated with parenting behavior. Finally, experiential acceptance is a person's ability to accept thoughts, feelings and emotions without trying to suppress or control them. Experiential acceptance is most highly correlated with mindfulness; mindfulness techniques focus on non-judgmentally focusing on the present moment, and accepting all emotions, thoughts, experiences, etc, that occur (Lundh, 2004).

Many studies have found that individuals high in perfectionism have a difficult time unconditionally accepting themselves, which may lead to an inability to accept other people (Flett et al, 2003). In addition to being correlated with perfectionism, low levels of self-acceptance have also been associated with depression, anxiety, and low levels of self-esteem, happiness and life satisfaction. Moreover, in a study examining the relationship between perfectionism and self-esteem with a focus on differences in self-acceptance, found that dimensions of perfectionism related to the self and others were all found to be correlated with lower levels of self- acceptance (Flett et al, 2003).

Individuals who struggle with acceptance may tend to avoid situations and experiences. In a study regarding the role of experiential avoidance in the relationship between maladaptive perfectionism and worry, researchers found that perfectionism and experiential avoidance are highly correlated. Furthermore, experiential avoidance was found to be a partial mediator of the relationship between perfectionism and worry (Santanello & Gardner, 2006). Because perfectionists are unable to accept failure, they may adapt by developing tendencies to avoid accepting their failures. Furthermore, perfectionists may begin avoiding certain tasks in the future if they know they are unattainable, so as to avoid failure. By avoiding these situations, perfectionists no longer have to worry about the potential failure, and thus do not worry as much (Santanello & Gardner, 2006).

Individuals high in perfectionism strive for unrealistically high standards in all aspects of their life, including in therapeutic processes, which may actually impede successful treatment (Lundh, 2004). Because perfectionists see many benefits with perfectionism, they may be resistant to recognizing that perfectionist tendencies may actually be detrimental to their well-being. In order to help perfectionists, therapists must focus on distinguishing perfectionistic strivings from perfectionistic demands - perfectionistic strivings can be healthy and help individuals be successful, but it is important that individuals are able to accept falling short of perfection. While some individuals will be able to finally understand the difference between perfectionistic strivings and perfectionistic demands, other individuals high in perfectionism may transfer their energy toward achieving perfect acceptance. This further complicates therapy and may be an ongoing dilemma for individuals with perfectionism (Lundh, 2004).

Because mindfulness involves accepting the present moment and one's emotions and feelings, and perfectionism is correlated with low levels of acceptance, individuals high in perfectionism may struggle to take a mindful approach to life and to practice meditation. Furthermore, because mindfulness meditation involves taking a non-judgment approach and perfectionism involves high levels of critical self-evaluation, we hypothesize that perfectionism will predict pre-post change in positive and negative affect and anxiety in individuals who learn mindful meditation. More specifically, we predict that higher perfectionism will predict smaller pre-post changes. Furthermore, we hypothesize that perfectionism will not predict changes in pre-post scores in the above states for individuals who undergo present-moment joy training.

METHODS

Undergraduate psychology students completed questionnaires regarding mood, anxiety, worry and attention, listened to a pre-recorded dialogue that explained either mindful meditation or present-moment joy training, and completed questionnaires again.
In the Present Moment Joy condition, diaphragmatic breathing was taught and participants practiced the technique for ten minutes. The participants were then taught how to focus on the positive aspects of the present moment including intrinsic motivation and pleasant sensory experiences (the fresh smell, softness, etc) while folding towels for an additional five minutes.
In the Mindfulness Meditation group, participants were educated about mindfulness and were led through a twenty-minute Awareness of Breath exercise, which is a form of mindfulness meditation. During this breathing exercise, participants were instructed not to judge their experience or thoughts as positive or negative.

MEASURES

Frost Multidimensional Perfectionism Scale (FMPS) The FMPS is a 35-item self-report measure that provides a multidimensional assessment of perfectionism and yields a total perfectionism score and scores for six subscales- Concern over Mistakes (CM), Doubts About Actions (DA), Personal Standards (PS), Parental Expectations (PE), Parental Criticism (PC), and Organization (O). The Total Perfectionism Score is the sum of the subscales except O.

The CM scale reflects the self-critical and self-evaluative domains of perfectionism; the DA score reflects the uncertainty in the correctness of one's decisions and actions; the PS score reflects an individual's desire to set high standards of performance for oneself; the PE and PC scores reflect parent's influences on an individual's perfectionism, PE scores reflect expectations that parents have and PC scores reflect the amount of parental criticism; the O score measures an individual's tendencies to be organized and orderly (Purdon, Antony & Swinson, 1999).

The FMPS asks each participant to rate each question from 1- strongly disagree to 5-strongly agree. Scores range from 35 to 175, with higher scores indicating higher levels of perfectionism.

Philadelphia Mindfulness Scale (PHLMS) The PHLMS is a 20-item self-report measure that assesses mindfulness on two subscales, Acceptance and Awareness. The PHLMS asks participants to rate each question from 1- Never to 5- Very Often. Scores for the Awareness subscale range from 10 to 50, with higher scores indicating higher levels of awareness. Scores for the Acceptance subscale are reverse scored and summed, the range is from 10 to 50, with higher scores indicating higher levels of acceptance (Cardaciotto et al., 2008).

Beck Depression Inventory (BDI) The BDI is a 21-item self-report questionnaire that measures the severity of depression in participants (Beck, Steer & Garbin, 1988). The BDI asks participants to rate each question on a 4 point scale ranging from 0 to 3. Scores range from 0 to 64 with higher scores indicating higher levels of depressive symptoms.

Penn State Worry Questionnaire (PSWQ) The PSWQ is a 16-item self-report questionnaire that measures the level of anxiety, or worry, in participants (Brown,

Antony & Barlow, 1992). The PSWQ asks participants to rate each question from 1- not at all typical to 5-very typical. Scores range from 16 to 80, with higher scores indicating greater worry.

Positive and Negative Affect Scale (PANAS) The PANAS is a 20-item self-report assessment that measures state positive affect and negative affect. This measure was given before and after the experimental task (Watson, Clark & Tellegen, 1988). The PANAS asks participants to rate questions from 1- very slightly or not at all to 5- extremely. Scores for both positive and negative affect range from 10 to 50, with higher scores indicating more positive and more negative aspect, respectively.

State Trait Anxiety Inventory for Adults (STAI-S) The STAI-S is a 20-item self-report assessment that has separate assesses current state anxiety in adults. This measure was given before and after the experimental task (Spielberger & Vagg, 1984). The STAI-S asks participants to rate their anxiety of a given situation ranging from 1-almost never to 4-almost always. Scores range from 20 to 80 with higher scores indicating greater anxiety.

RESULTS

The sample characteristics of the population are displayed in Table 1. No significant correlations were found between perfectionism and either of Awareness or Acceptance subscales of mindfulness. A main effect of time (pre-post) was found on the STAI-S $F_{(1,46)} = 42.07$, $p < .001$, and on the PANAS in Negative affect $F_{(1,48)} = 33.43$ $p < .001$, with both decreasing. No significant difference was found on the PANAS in Positive affect ($p > .05$). (See figures 1 and 2). A series of hierarchical simultaneous regressions were conducted with perfectionism predicting post manipulation STAI-S and PANAS scores. To control for pre-manipulation STAI-S and PANAS scores, pre- manipulation scores for the dependent variable were entered in Step 1 and paradigm (Joy or Meditation) was entered in Step 2. In Step 3, perfectionism total scores were simultaneously entered into the equation in order to examine the variance attributable to this variable (above and beyond those entered in Steps 1 and 2) (Table 2).

DISCUSSION

A significant change in STAI-S and PANAS Negative affect scores was found from pre- to post (Figure 1 & 2). Both state anxiety and negative affect decreased after the mindfulness paradigm practice. However, no significant change in PANAS Positive affect score was found from pre- to post (Figure 2), meaning that there was neither an increase nor a decrease in positive affect after partici-

pating in either mindfulness paradigm.

While there were decreases in both state anxiety and negative affect, perfectionism and paradigm were not significant predictors of pre-post change in either variable. This indicates that anxiety and negative affect decrease to similar degrees regardless of participants' perfectionism level or the paradigm to which the participants were randomly assigned (present moment joy or mindfulness meditation).

While mindfulness meditation focuses solely on Awareness of Breath breathing, the present moment joy focus training also included diaphragmatic breathing as part of the intervention. It was expected that the present moment joy condition would raise positive affect; however, because positive affect did not show a significant pre-post change, it may be concluded that the breathing techniques in both conditions were the main contributors to the decrease in anxiety and negative affect. Furthermore, heightened awareness has been associated with decreases in negative affect while focusing on positive aspects of the self (Cardaciotto et al, 2008). Because mindfulness involves both awareness and acceptance, and acceptance can be difficult to achieve, especially for individuals high in perfectionism, individuals trying to achieve mindfulness for the first time may be more successful at achieving the awareness component than the acceptance component. Thus, individuals in the present moment joy focus training may have experienced the decreases in negative affect while focusing on the positive aspects of life as described by Cardaciotto et al. Even though mindfulness has been associated with increased positive affect (Davidson et al, 2003), if individuals were not completely familiar with the practice of mindfulness, they may not have experienced the increased positive affect that should typically be expected.

One possible explanation for finding no correlation between perfectionism and pre-post change in anxiety and negative affect is that the population used in the current study did not have individually significant perfectionists. However, other studies that have used the Frost Multidimensional Perfectionism Scale have average total-perfectionism scores similar to the score in the present study. The average total perfectionism score for participants in the present study is 85.56±16.58 and other studies have average total perfectionism scores of 86.9 and 86.2 (Cox & Enns, 2008); 83.5 (OCD), 83.8 (PDA), and 66.5 (Control) (Frost & Steketee, 1997); 87 (Buhlmann, Etcoff & Wilheim, 2003). Thus, the sample of undergraduate students in the present study's population has individuals that can be considered high in perfectionism.

Perfectionism may not have played a role in pre-

dicting post-scores because this study only examined participant's first attempt at either present moment joy focus or mindfulness meditation. Perfectionist individuals may have been focusing on understanding and mastering the technique rather than worrying about perfecting it. If a study examined a population of individuals practicing these techniques over a longer period of time, perfectionism may become a better predictor of pre-post change. In all but one study, which specifically examined the effects of short-term meditation training, the reviewed studies that examined the effects of mindfulness meditation on the mind and body used individuals that had practiced mindfulness for at least four weeks (Greeson, 2008). However, most of the studies examined populations that were learning mindfulness tech-

Table 1. Sample Characteristics

Variable	Mean (SD)	N	%
Age	19.04 (1.12)	50	
Female		44	88
Male		6	12
Ethnicity			
American Indian / Native Alaskan			0
Asian/Asian American			24.5
Hispanic/Latino			4.1
Pacific Islander			0
Causasian			63.3
Black/African American			2
Other			6.1
Questionaries			
PSWQ	57.26 (12.38)	50	
BDI	9.30 (6.48)	50	
FMPS	84.56 (16.58)	50	
PHMLS -Awareness	36.24 (5.31)	50	
PHMLS -Acceptance	27.04 (5.47)	50	

Table 2. Prediction of Post Manipulation STAI-S and PANAS Scores

Variable	B	SE B	β	Tolerance
STAI-State[a]				
Pre score	0.43	0.11	0.51***	0.79
Paradigm	-2.23	2.22	-0.12	0.98
Perfectionism	0.12	0.08	0.21	0.78
PANAS Positive[b]				
Pre score	0.79	0.13	0.67***	1.00
Paradigm	-1.29	1.97	-0.07	0.99
Perfectionism	0.01	0.06	0.03	0.99
PANAS Negative[c]				
Pre score	0.5	0.07	0.71***	0.80
Paradigm	-0.84	0.98	-0.08	0.99
Perfectionism	0.04	0.03	0.11	0.80

Figure 1. Change In STAI-State from Pre- to Post-Manipulation.
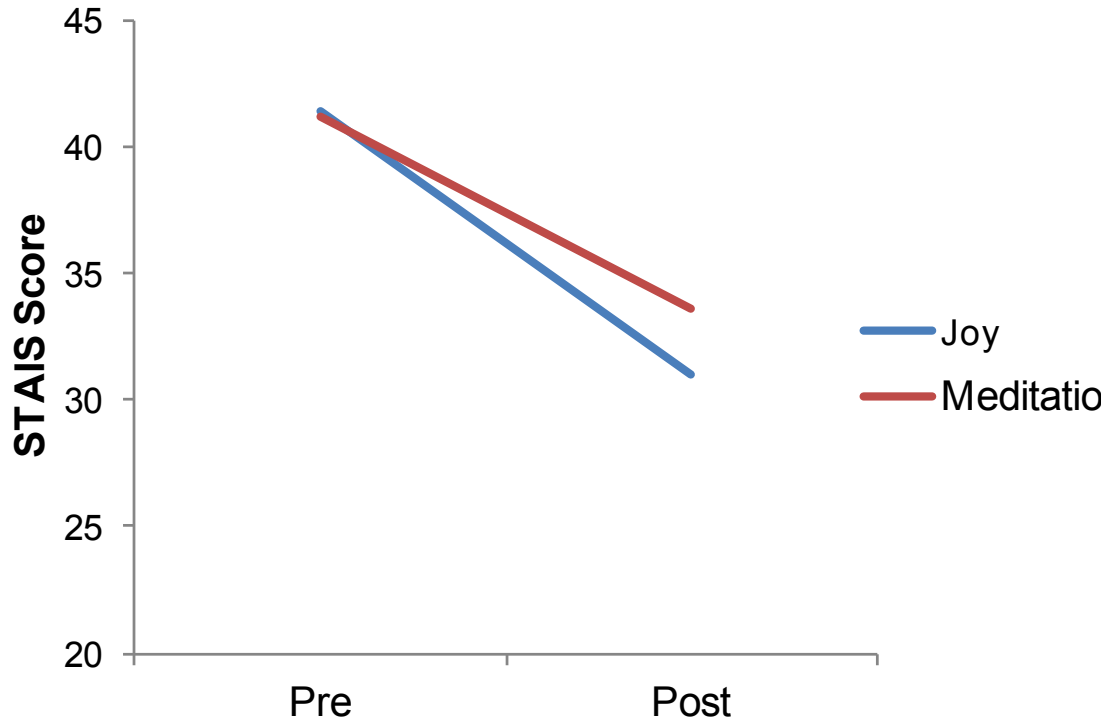
niques for at least 8 weeks. In particular, one study found that more time spent on formal meditation practices yielded increased mindfulness at the end of 8 weeks (Carmody & Baer, 2008). The study that examined short-term meditation effects examined a population of participants that had mindfulness training every day for five days (Tang et al, 2007). As illustrated by these studies, it generally takes weeks of practice in order to achieve the positive effects of a mindfulness perspective. Furthermore, as suggested previously, individuals high in perfectionism may struggle to achieve mindfulness. Thus, it may take individuals high in perfectionism longer than non-perfectionist individuals to fully understand mindfulness and reach the point where they will be fully affected by mindfulness techniques.

Another possible explanation for Perfectionism not showing any affect pre- to post- is that therapies and techniques may not benefit perfectionist individuals. Some individuals high in perfectionism may be able to view the mindfulness techniques as ways to overcome the demands for perfectionism and embrace merely striving for perfectionism, but other individuals high in perfectionism may transfer their energy toward achieving perfect acceptance in the mindfulness realm (Lundh, 2004). Striving for perfect acceptance during mindfulness may override the anticipated changes because the individual is not truly embracing the mindfulness perspective.

In addition to only looking at the pre-post changes on the first day individuals learned the stress reducing technique, another limitation of the present study is that participants were not necessarily high in anxiety. Prior to being invited to participate in the present study, individuals took a screener study that categorized individuals into different categories based on their levels of worry. While mindfulness has been shown to reduce anxiety (Davidson et al, 2003), if individuals were not clinically anxious, these effects may not be as significant. While only high worriers were invited to participate in the present study, they might not have been clinically anxious individuals, which may have affected the state anxiety and the way that the mindfulness techniques reduced their anxiety.

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Figure 2. Change in PANAS Scores from Pre- to Post-Manipulation.
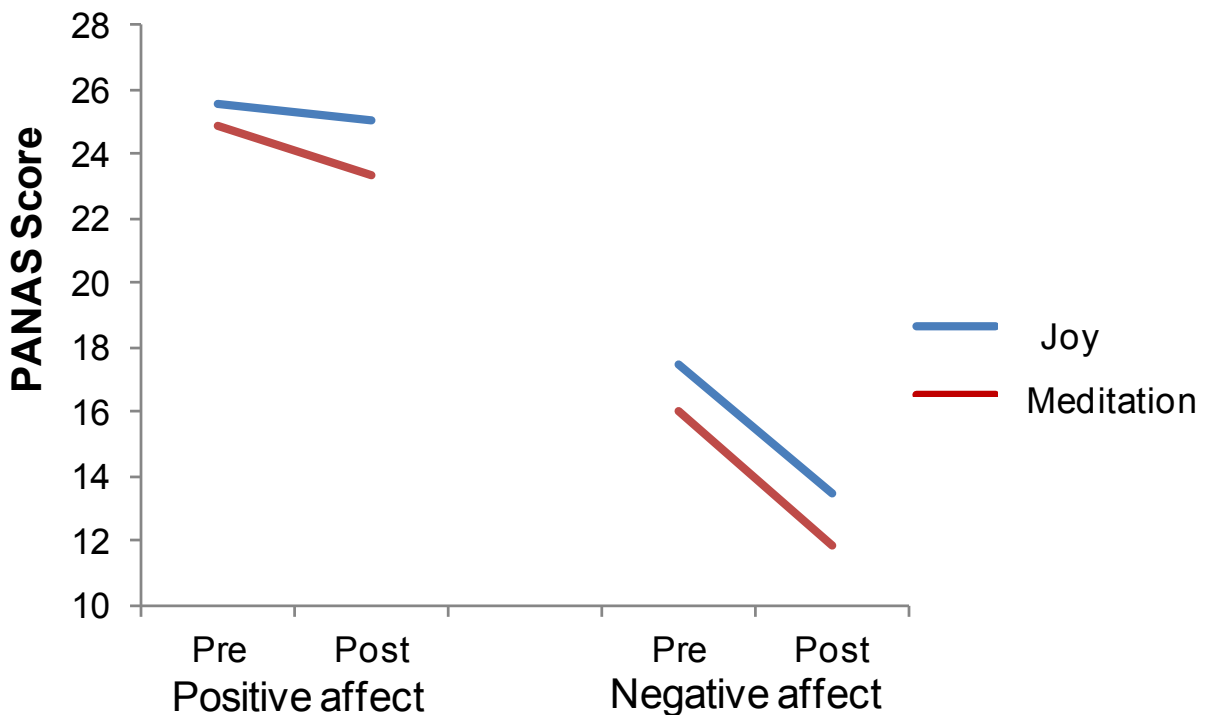
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Social support in PTSD: an analysis of gender, race, and trauma type.

ABSTRACT

The current study discusses social support systems and the ways in which they impact persons diagnosed with posttraumatic stress disorder (PTSD). This study analyzes three different variables (race/ethnicity, gender, and trauma type) in a group of 200 adults diagnosed with PTSD. Three measures, the Social Support Questionnaire (SSQ), the Inventory of Socially Supportive Behaviors (ISSB), and the Social Reactions Questionnaire (SRQ) will be utilized to compare differences in the three variables: race/ethnicity, gender, and trauma type. These variables will be analyzed using means-descriptive analysis, and basic ANOVAs on SPSS software. Several studies have shown that social support is crucial to the effectiveness of treatment after the development of PTSD. Some support has been found indicating that certain populations (women, minorities, and those who experienced childhood sexual assault) may be more vulnerable to experiencing low or negative social support. The current study will compare social support within these variables to discover which populations may be particularly vulnerable to a lack of social support.

INTRODUCTION

Posttraumatic stress disorder (PTSD) is a mental disorder that millions of people are diagnosed with each year (Kessler, 2005). Prevalence rates indicate that approximately 3.5% (or 7.7 million people) of Americans age 18 and older currently have PTSD (Kessler, 2005). According to figures collected in 2000 by the National Comorbity Survey (NCS), 56% of Americans experience trauma in their lifetime, and 8% go on to develop PTSD from that trauma (Perkonigg et al., 2000). According to the Diagnostic and Statistical Manual of Mental Disorders, (*DSM-IV-TR*) criteria for PTSD includes a "stressor" (or a traumatic event); intrusive recollection of the trauma that can include dreams or flashbacks; persistent avoidance of stimuli (like thoughts or activities) that may be related to the trauma; hyper arousal, which includes difficulty sleeping, hyper-vigilance, or exaggerated startle response; and the duration of the disturbance must be longer than one month (American Psychological Association, 2000).

Risk

Though PTSD is one of the most common difficulties among those who experience trauma, most trauma victims do not develop PTSD (Charney, 2004). Risk factors for PTSD are varied. Several meta-analyses concluded that prior trauma, perceived life-threat during trauma, trauma severity, additional life-stress, and adverse childhood events were all predictors of a person developing PTSD after experiencing trauma. (Brewin, Andrews & Valentine, 2000; Ozer et. al, 2003). The largest risk factor, however, was

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lack of social support (Brewin et al., 2000). Conversely, the presence of social support is seen as one of the best protective factors against developing PTSD (Lazarus & Folkman, 1984) as well as a predictor of better treatment outcomes (Thrasher et al., 2010). Because of the importance of the factor, social support, in the development and treatment of PTSD, many studies have examined its impact.

Social Support

The impact of social support on treatment outcome can be significant. One study (Thrasher et al., 2010) examined the role of social support in treatment utilizing exposure therapy, cognitive restructuring, a combination of both, or a relaxation control. This randomized, controlled trial assessed 87 men and women with chronic PTSD for their level of intensity in diagnostic symptoms on a Clinician Administered PTSD Scale (CAPS). The same sample was also administered the Significant Others Scale (SOS) to assess their level of social support. This study found that social support predicted greater symptom improvement on the CAPS test, after treatment, more than any other variable, including trauma severity, age, trauma duration, and number of life events pre- and post-trauma. They also found that, although all types of treatment were effective, those who reported less social support received less therapeutic benefit than those who reported greater social support. In essence, social support was a contributing factor in treatment outcome.

Another study (Yuan et al., 2011) examined the kinds of protective factors that were exhibited in a cohort of police officers. A sample of 233 police officers were assessed for PTSD symptoms during their training in the police academy and again after 2 years of service. They found that a number of variables acted as protective factors against developing PTSD, including race (Caucasian), less exposure to trauma prior to service, and greater self-worth. They found, however that greater social adjustment (or socialization) was a protective factor both prior to service as well as after 2 years of service.

Many studies have shown that low levels of social support are met with negative health outcomes (Berkman & Syme, 1979; Cohen & Wills, 1985; House, Landis & Umberson, 1988). In one study, specifically, a sample of over 1000 New Yorkers were evaluated on their levels of social support post-9/11. Those who reported high levels of social support were much less likely to develop PTSD and depression than those with low levels of social support (Galea et al, 2002). Based on the protective factor of social support, as well as the increased efficacy of treatment that occurs when a patient has high levels of social support, we can conclude that social support is a significant variable to discuss in the realm of mental health. Social support, as a whole, has been proven to be significant, but is *all* social support positive?

Facets

The facets, or components, of social support have also been examined in various studies. The differences between the quality and quantity of social support were observed in several studies, noting that quantity did not denote quality when examining social support (Barrera, 1981; Sarason, Levine, Basham & Sarason, 1983). Social support is characterized in one model, the social networks model. This model describes *how many* people one interacts with, and *how often* they interact. Another way of to analyze social support is to look within the context of the *quality* of the relationships a person has. For example, a person may only have one close relationship, but this relationship is mutually understanding, empathetic, and rewarding for both parties. Studies (Kessler, Price & Wortman, 1985; Sarason, Shearin, Pierce, & Sarason, 1987) have compared the effectiveness of both types of support in predicting psychopathology. They found that the quality of social support was much more important in predicting protective effects of social support rather than the quantity of social contacts a client may have. Because some groups may lack sufficient quality of social support, practitioners may need to focus on certain "target" groups that are susceptible to lower levels of quality social support.

Another important factor to discuss when considering social support is whether the support is perceived as negative or positive by the patient or client. Positive support is similar to quality support in that both kinds of support have beneficial effects and are perceived by a person as "supportive." Both positive support and quality support can include empathetic or understanding reactions, as well as offering continuing support and reassurance. However, a person may have a support system in place (quantity) but is receiving negative or hurtful feedback after a traumatic event. Despite a perceived system of support, such as a family, spouse, or Church group, negative social support or reactions can play a role in impeding recovery. (Zoellner, Foa & Bartholomew, 1999).

One study (Ullman & Fillipas, 2005) examined how social reactions to trauma differed in a sample of men and women, and also looked at how social reactions could affect PTSD symptom severity. A sample of 733 college students took a survey on sexual abuse experience, history and details of disclosure. Of this sample, 22% reported having experienced childhood sexual abuse (CSA),

and 66.5% of those who experienced CSA disclosed their abuse to someone else. The study found that in both men and women, positive social reactions to disclosure were more common and related to less PTSD symptom severity, while negative social reactions were related to greater PTSD symptom severity. Women were more likely to experience greater PTSD symptom severity, and the mean number of negative reactions were nearly twice that of the men in the study. This is perhaps supportive of the idea that women may be more vulnerable, after trauma, especially CSA, to develop PTSD because of their risk of experiencing negative reactions to their trauma.

A different study by the same researchers (Ullman & Fillipas, 2001) examined how the effect of social reactions may or may not predict PTSD symptom severity, and also compared demographic variables. A sample of 323 sexual assault victims were assessed for PTSD and demographic factors like socioeconomic states, race, and gender. Social support was assessed using various methods, including the Inventory of Socially Supportive Behaviors (ISSB), Social Reactions Questionnaire (SRQ), and asking about frequency of social contact. They found that having an ethnic minority race was significantly related to receiving more negative social reactions; however, they found that there were no racial differences in PTSD symptom severity.

Disclosure of a traumatic event plays a major role in the receipt of social support. If a person does not disclose his or her traumatic event, the likelihood of him or her receiving any sort of support regarding that event is, consequently, very low. Childhood sexual assault is one type of trauma that is consistently underreported and seldom disclosed (Herman, 1981; Russell, 1983; Summit, 1983). Even when children do disclose the sexual abuse, they reported facing greater physical abuse and use of violence during abuse than those who disclosed childhood sexual assault during adulthood (Jonzon & Lindblad, 2004). More severe abuse was also related to negative reactions from a child's social network (Jonzon & Lindblad, 2004). This may indicate that victims of childhood sexual abuse may be particularly vulnerable to the development of PTSD, as social support may not have been available at the time of the abuse.

Social support and its relation to PTSD is undeniable through the vast amount of research that has been conducted over the past few decades. However, there is a significant lack of research that discusses the demographic variables that exist within social support for those diagnosed with PTSD. Though it is clear that lack of social support plays a role in the risk of developing PTSD, we

know little about how facets of social support vary among those diagnosed with PTSD. The current study seeks to evaluate a sample of chronic PTSD sufferers and to examine the demographics of those who receive social support. The study will compare men and women, minorities and non-minorities, and trauma type (specifically CSA vs. non-CSA), and examine any significant differences that exist in social support within these variables. Based on the literature reviewed, the current study hypothesizes that in a sample of people diagnosed with PTSD, minorities, women and survivors of childhood sexual assault will have less social support (or more negative social support) than that of Caucasians, men, and those who did not experience childhood sexual assault.

METHODS

Participants

Participants for this study included 200 men (24.5%, n=49) and women (75.5%, n=151) that were recruited from a PTSD treatment-outcome study at two sites. Participants were recruited via referrals and advertising around the community. Exclusion criteria for this study included: (a) current psychosis, unstable bipolar disorder, substance dependence, or high suicide risk and, (b) in assault cases, an ongoing relationship with the perpetrator. Thirty-five percent of participants who were evaluated for this study did not have a primary diagnosis of PTSD, and therefore were excluded. The average age of participants in this study was 37.1 years (SD=11.3); average time since trauma was 11.9 years (SD=11.0). Trauma varied within this sample, including adult sexual assault (30.9%), childhood sexual assault (17.8%), adult non-sexual assault (22.0%), accident (motor vehicle, or natural disaster; 14.1%), childhood non-sexual assault (6.8%), death of or violence towards a loved one (5.8%), and military combat (2.6%). The sample also included 21.5% African Americans, 65% Caucasians, and 13.5% other.

Measures

The Inventory of Socially Supportive Behaviors (ISSB; Barrera, Sandler & Ramsey, 1981) is a 40-measure assessment used to measure the participants' objective levels of social support. Questions include, how often someone in their life gave them money, assisted them in setting goals, expressed respect, or looked after a family member while they were away, etc., within 2 weeks prior to the time of the survey. Higher scores on this scale indicate higher levels of social support. This measure has been established as showing good reliability and validity (Barrera et al., 1981).

The Social Reactions Questionnaire (SRQ; Ullman, 2000) is a 48-item measure that assesses objective trauma-related support on a Likert Scale from 1-4. Questions are intended to determine the frequency of positive social support (i.e., how often someone comforted the participant or told him or her that "it would be all right") as well as negative social support (or how often someone focused on his/her own needs and neglected the participant). Two scores are identified on the SRQ, higher scores indicating either higher levels of positive or negative social support. The SRQ has been established as having demonstrated adequate reliability (Ullman, 2000).

The Social Support Questionnaire (SSQ; Sarason, Levine, Basham & Sarason, 1983) is a 27-item measure that evaluates the number of perceived social supports in a person's life. The scale consists of questions that ask the participant to list the people involved in a certain socially supportive task (i.e., "Whom can you really count on to listen when you need to talk?" or "Who do you feel really appreciates you as a person?"). The participant is then required to report how satisfied they are with the level of support they received, within a certain category, on a scale of 1 to 6, with 1 being "very dissatisfied" and 6 being "very satisfied." The SSQ was established as being a stable measure and also had high internal consistency among items.

The PTSD Symptom Scale- Interview (PSS-I; Foa, Riggs, Dancu, & Rothbaum, 1993) was used to establish a primary diagnosis of PTSD in all participants. The PSS-I is a 17-item semi-structured interview that requires the participant to focus on one specific traumatic event, and the scale then evaluates the symptom severity and presence of PTSD symptoms according to the DSM-IV-TR. Symptoms are measured on a four-point scale where 0 indicates "not at all" and 3 indicates "5 or more times per week/very much." Only symptoms occurring within the two weeks prior to the interview are assessed. The PSS-I has been established as a reliable and valid measure used to assess diagnostic criteria for PTSD.

Procedure

Participants were required to sign forms that indicated that they consented to the policies and procedures of the study. Once informed consent was obtained, participants were required to answer a series of assessments (including the ISSB, SSQ, and SRQ). Participants were also administered the PSS-I in order to determine their eligibility for the study (a primary diagnosis of PTSD). Once results were obtained, we analyzed the data using SPSS, utilizing standard ANOVA tests, a descriptive analysis, and a means comparison of all variables.

RESULTS

After performing standard ANOVAs and means comparisons for all three dependent variables (gender, minority status, and trauma type) against the independent variables (the ISSB, SRQ, and SSQ scores), it was found that there were several significant relationships between the variables.

Gender

ISSB scores were significantly lower (p= .017) for women ($\bar{x}$=86.46) than for men ($\bar{x}$=89.87), indicating that women had lower levels of objective social support. Women also had significantly less positive support (SRQ; p=.001; men $\bar{x}$=39.14; women $\bar{x}$=36.97); had significantly less available social support (SSQ; p=.015; men $\bar{x}$=13.49; women $\bar{x}$=12.42), and were less satisfied with the support they did have than men (SSQ; p=.079; men $\bar{x}$=22.33; women $\bar{x}$=21.54). (See Table 1).

CSA vs. non-CSA

Interestingly enough, those who experienced trauma, who did not have a history of childhood sexual assault, had significantly higher levels of negative social support than that of trauma survivors who did experience childhood sexual assault (SRQ; p=.015; Non-CSA $\bar{x}$=35.23; CSA $\bar{x}$=30.99). No data was found to support the hypothesis that survivors of childhood sexual assault had significantly different levels of social support than that of survivors of other trauma. (See Table 2).

Minority Status

Finally, there was no evidence that supported the hypothesis that minorities had significantly less social support than Caucasians. In fact, minorities scored slightly higher (though not statistically significant) in both social availability (SSQ; minority $\bar{x}$=13.15; Caucasian $\bar{x}$=12.42) and satisfaction (SSQ; minority $\bar{x}$=21.65; Caucasian $\bar{x}$=21.54), and also slightly higher in positive support (SRQ; minority μ=; Caucasian μ=36.97). Implications for this finding will be evaluated in the discussion. (See Table 3).

DISCUSSION

The current study revealed three main findings after analyzing data from a sample of 200 men and women diagnosed with PTSD. 1) Women reported significantly lower levels of social support than men; 2) the differences between non-CSA and CSA trauma were negligible; in fact, those reporting a trauma that did not involve childhood sexual assault had higher levels of negative social

Table 1. Means comparisons of social support inventories and Gender

		ISSB	SRQ		SSQ	
		Total Score	Negative Total Score	Positive Total Score	Availability Subscale	Satisfaction Subscale
Total	**Mean**	77.71	30.1	30.36	9.12	19.12
	SD	30.63	18.29	15.72	10.93	11.1
	N	48	48	48	49	49
Male	**Mean**	89.88	31.26	39.15	13.5	22.33
	SD	32.33	15.25	16.05	10.95	11.39
	N	146	147	146	151	151
Female	**Mean**	86.86	30.97	36.97	12.43	21.55
	SD	29.55	19.22	15.04	10.75	10.93
	N	194	195	194	200	200

support and 3) Minority status was a non-significant factor in social support; actually, there was some evidence that minority status slightly correlated (though not significantly) with higher levels of social support.

We found that womens' low levels of social support were congruent with our hypothesis and previous research that alludes to the idea that women have a harder time finding positive social support than men. This study further supports the idea that women may be more vulnerable after trauma, due to their lack of positive social support (and increased levels of negative social support), than men, are after trauma. This could also allude to the different kinds of trauma men and women generally face; with women more likely to face sexual assault (17.6% of women vs. 3% of men), and men more likely to face trauma from

combat exposure (57.1% of men developed PTSD; 27.8% of women developed PTSD) (U.S. Dept. Justice, 2005; Pereira, 2002). Victims of combat may be more likely to receive positive support (family, friends, and the VA) after having experienced trauma than victims of sexual assault. Therefore, it is possible that, because men are more likely to experience combat trauma and women experience sexual trauma, the levels of social support for men and women may be markedly different. Because two of the assessment instruments used only measured perceived social support, this may have altered the data outcomes. It is possible that women perceive social support more negatively than men, but we did not find research to support this hypothesis.

Trauma-type did not appear to be a significant factor in the levels of social support. We did find that those

Table 2. Means comparison of social support inventories and Trauma History

		ISSB	SRQ		SSQ	
		Total Score	Negative Total Score	Positive Total Score	Availability Subscale	Satisfaction Subscale
Total	**Mean**	87.29	28.56	35.97	12.49	21.63
	SD	30.7	18.27	15.69	10.99	11.13
	N	121	122	121	125	125
No	**Mean**	85.42	35.23	37.98	12.12	21.09
	SD	31.61	16.56	16.5	11.25	11.3
	N	70	70	70	72	72
Yes	**Mean**	86.61	30.99	36.71	12.36	21.43
	SD	29.26	20.34	14.21	10.58	10.89
	N	191	192	191	197	197

Table 3. Means comparisons of social support inventories and minority status

		ISSB	SRQ		SSQ	
		Total Score	Negative Total Score	Positive To- tal Score	Availability Subscale	Satisfaction Subscale
Total	**Mean**	89.39	31.62	36.17	11.07	21.34
	SD	30.63	18.29	15.72	10.93	11.1
	N	67	68	68	70	70
Minority Status	**Mean**	85.53	30.63	37.41	13.15	21.65
	SD	29.52	20.84	15.88	10.64	12.59
	N	127	127	126	130	130
Caucasian	**Mean**	86.86	30.97	36.97	12.43	21.55
	SD	31.24	16.84	15.67	11.06	10.26
	N	194	195	194	200	200

who experienced trauma, that was *not* childhood sexual assault, experienced significantly higher levels of negative social support than those who did experience childhood sexual assault. The data found in this study challenges the conventional notion that survivors of childhood sexual assault receive less social support. Research shows that childhood sexual assault is consistently underreported and seldom disclosed (Herman, 1981; Russell, 1983; Summit, 1983). Because children may not disclose or report their trauma to others, they may not receive the negative social support that may come with other kinds of trauma that people disclose more readily. Additionally, this study only examined whether or not the participant reported childhood sexual assault; we did not examine if childhood sexual assault was the primary trauma that caused their PTSD diagnosis. We also compared childhood sexual assault to all other traumas. Consequently, this pitted CSA against adult sexual assault survivors, perhaps concealing data patterns that showed that sexual assault survivors, in general (whether it occurred in childhood or adulthood), may experience lower levels of social support or higher levels of negative social support.

Although we found no statistical significance in the relationship between social support and minority status, we did find that minorities scored slightly higher in social availability and satisfaction (SSQ), and also slightly higher in positive support (SRQ). However, they did score slightly lower on the ISSB. Several factors may be contributing to these results. Minority families have higher feelings of collectivism than do white families, thus stressing the importance of social support rather than dealing with a stressor

or trauma on an individual level (Plant, 2004). Additionally, minorities are more likely to face hardship than whites, leading them to then seeking out social support from others (who are also facing hardship) and developing close social bonds (Gump, 1997). Minorities also tend to have larger families than whites, therefore increasing the trauma survivor's "natural" source of social support (Taylor et al., 1996). The strength of racial and ethnic identity was not measured in this data; however, studies have shown that ethnic minorities gain a sense of their racial or ethnic identity earlier and stronger than Caucasians. This is due to the realization that they do not fit into the cultural "White paradigm," which results in the identification of their status as non-whites (Chaves & Guido-DiBrito, 1999). A stronger sense of identity could perhaps have been a factor in developing positive social support.

The data from this study suggests that women, in treatment for PTSD, may need more attention paid to them in order to improve their social support and their perceptions of social support, as well. This "specialized" treatment may involve routinely assessing female trauma survivors' social support and analyzing whether or not they feel they are receiving adequate support, both in the therapeutic relationship and in their personal lives. The results of the current study failed to support the idea that minorities and survivors of childhood sexual assault require extra care. However, future studies may be interested in expanding these results by examining the relationship between sexual vs. non-sexual trauma to determine if sexualized trauma, in general, may be more indicative of lower levels of social support. Additionally, future studies may consider examin-

ing the levels of social support in minority families, on a more specific level, in order to find out what kinds of support exist in different races or ethnicities. It is quite likely that there is fluctuation between levels of social support between minority races or ethnicities rather than the assumption that all minorities receive the same levels of social support.

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Discrepancy between parent report and clinician observation of symptoms in children with autism spectrum disorders

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ABSTRACT

The Center for Disease Control and Prevention defines Autism Spectrum Disorders (ASD) as pervasive developmental disabilities in which individuals have language impairment, social impairment and stereotyped behaviors. At this time there are no required assessments for a diagnosis. Diagnosis is often made with almost exclusive reliance on parent report of symptoms. The purpose of this research is to examine the consistencies between parent report and clinician observation of symptoms using the commonly used measures to diagnose ASD (ADOS & ADI-R). Previous research has shown diagnosis is more reliable and valid when using both ADOS (clinician observation) and ADI-R (parent interview). It is hypothesized that parents will score their children as less affected in the domains of social deficits and communication and more affected on restricted interests and stereotypies than clinicians. This discrepancy is expected based on the unique relationship between parents and their children and the resulting difference in social interactions and communication parents have with their children compared to an individual with whom the children are less familiar. This research included 12 individuals diagnosed with an ASD who ranged between the ages of 9 to 22 years old (mean age = 15.8). Results from the present study indicate a discrepancy between parent and clinician report on percent agreement on comparable items from the ADI-R and the ADOS. Such findings are crucial as they can help determine how different sources should be considered during the process of diagnosis and creating treatment plans for individuals with ASD.

INTRODUCTION

Parents and professionals provide crucial information during the diagnostic and treatment planning processes for individuals with special needs. Parents typically spend the most time with their child and are the main informants regarding their child's behaviors and needs. Parents provide valuable information about social behavior, obsessions, compulsions, self-injury, sensory needs, and other atypical behaviors. These observations however can lack objectivity, which becomes especially relevant when the child is being formally assessed for a developmental disability. Autism Spectrum Disorders are a group of pervasive developmental disorders characterized by difficulties in nonverbal and verbal communication, social interaction, and repetitive behaviors or restricted interests (Rice 2010). The Center for Disease Control reports that 1 out of every 110 children in the United States has an ASD (Rice, 2010). Some disabilities,

including ASD, do not have a known genetic foundation or physical features and therefore diagnosis relies heavily on the identification by parents and professionals of atypical behaviors. Sources of data need to be examined for the best quality of assessment for ASD, this is now particularly important as the number of children being diagnosed with ASD is rising.

According to the American Psychiatric Association in the Diagnostic and Statistical Manual IV (DSM IV) in order to be given a diagnosis of ASD, a child must have impairments in all three areas and symptoms must appear in the first three years of life (American Psychiatric Association, 2000). Many people with ASD have language delay but are able to learn spoken language with therapy, or sign language; others are nonverbal. Poor eye contact, disinterest or discomfort in social situations and lack of theory of mind are social challenges faced by individuals with ASD. This disorder is pervasive in that it impacts children in many ability areas, and individuals are often unable to live independently as adults. With a proper diagnosis at the earliest signs, children can receive the most effective services and parents can become educated on the disorder. Because ASD is such a prevalent disorder and symptoms of it are detectable when a child is young, investigating parents' abilities to report behavior is important.

Physicians regularly check all pediatric patients for meeting developmental milestones by looking for abilities like eye contact, responding to their name, and language use. When a child is suspected of having an ASD, the child's pediatrician evaluates the child personally or refers them to a child psychologist. If the child is not developing typically, a developmental psychologist or pediatrician specializing in development will make a formal diagnosis based on the specific behaviors of the child using the DSM IV criteria for ASD. No test, survey or interview is required for diagnosis.. There are several standardized surveys and assessments that can be used when diagnosing and evaluating a person with an ASD. The results from these assessments are also used later when developing an Individualized Education Plan (IEP) for the child's education. The most commonly used assessments for a child with an ASD are the Autism Diagnostic Interview-Revised (ADI-R) (Rutter, Le Couteur & Lord, 2005), The Child Behavior Checklist (CBCL) (Achenbach, 2000), and the Social Communication Questionnaire (SCQ) (Rutter, Bailey & Lord, 2003). All three assessments are based on? parent interviews but content differs on each. Because there is no policy requiring the use of certain assessments, there are inconsistencies for individual children and for people with ASD as a group in the information that is provided for

their health care, schooling and therapeutic providers. It is rare that children have a standardized clinical assessment and observation paired with a comprehensive parent interview. Because ASD is a disorder in which individuals have a variety of needs and symptoms, a detailed assessment is of the utmost importance. Over the last decade clinicians have been investigating the reliability and validity of commonly used diagnostic measures and behavioral assessments. The currently regarded "gold standard" for diagnosing a child with an ASD is the Autism Diagnostic Observation Schedule (ADOS) (Lord, Rutter, DiLavore & Risi, 2006), which is performed by specially trained objective professionals in a semi-structured environment (Bishop, 2002). This test uses direct observation from the tester in a standardized format of play in which they observe interaction, communication and any atypical repetitive behaviors (Sikora, 2008). Research has been performed to identify the reliability and validity of parent questionnaires and surveys (Lord, 2006; Sikora, 2008;). However, research is lacking in investigating any potential discrepancy between parent-report and objective clinician findings using standardized measures and the possible causes of such discrepancies. Parents often think their children are more or less capable than they may in fact be as they aren't with their children in school or therapy settings. In contrast, clinicians only see the children in clinical settings which limits the behaviors they may observe. It is likely that a discrepancy exists given these differences.

Research suggests that standardized parent questionnaires alongside objective clinical assessment lead to the most stable diagnosis in ASD (Risi, 2006; Lord, 2006; Sikora, 2008). Risi, Lord, Gotham, Corsello, Chrysler, Szatmari et. al investigated multiple sources used in diagnosis of autism using the ADI-R and the ADOS (2006). Their data suggest that both the ADI-R and the ADOS should be used, but this study does not investigate the domains of autism and settles on using both instead of examining the reasoning behind possible discrepancies (Risi et. al, 2006). Bender, Auciello, Morrison, MacAllister and Zaroff (2008) found the same to be true for children with epilepsy. In a study using both the ADOS and ADI-R to examine the stability of the diagnoses of ASD at age two and age nine, Lord et. al found that clinicians were the group that had the higher percentage of agreement in accurate diagnosis as compared to parents (2006). De Bildt, Sytema, Ketelaars, Kraijer and Volkmar compared parent and clinician agreement. De Bildt et. al (2003) used the ADI-R, ADOS, Autism Behavior Checklist (ABC) (parent report), and the Scale of Pervasive Developmental Disorder in Mentally Retarded Persons (PDD-MRS) (clinician observation). The partici-

pants all had intellectual disability and the authors were assessing the developmental disorder component of the participants' disabilities. De Bildt et. al (2003) found that the two parent report measures had good agreement with each other. Clinician observation measures also had good agreement with each other, but the parent report with the clinician observation had poor agreement. De Bildt et. al (2003) did not further investigate the discrepancy between clinicians and parents however, and only noted that it might be the facility and environment that may create these differences. The results from these studies suggest that parents and clinicians are reporting different behaviors.

The ADI-R and ADOS are very expensive diagnostic measures, as they require trained professionals, are expensive, and require large amounts of time compared with other diagnostic measures. In an effort to determine if diagnosis can become less expensive and time consuming, newer diagnostic tools have been developed. One such measure is a shortened version of the ADI-R, the developmental, diagnostic and dimensional interview (3Di) designed by Santosh, Mandy, Puura, Kaartinen, Warrington and Skuse (2009). Santosh et. al's (2009) found their 3Di had a strong agreement with the ADI-R. This is an important study that compares two parent-report diagnostic measures but includes no clinician evaluation thus providing no comparison to clinician observation.

In contrast, a study that used both parent and clinician assessment investigated the validity of the Children's Social Behavior Questionnaire (CSBQ)(Rutter, Bailey, Lord, 2008), a parent questionnaire for children with intellectual disability (de Bildt, 2009). In comparison to the ADOS and ADI-R, de Bildt et. al found much higher correlations of the various subscales with the CSBQ and the ADI-R than with the ADOS (2009). The authors attribute this to the ADOS test requiring a short amount of time so that only a limited number of behaviors may be observed. Other research performed by Bishop and Norbury (2002) compared the Social Communication Questionnaire (SCQ), another questionnaire for parents, with the ADOS and the ADI-R and had similar results; a good agreement between the SCQ and the ADI-R but poor agreement between both of those and the ADOS (Bishop, 2002). The authors also noted that categorization on the ADI-R is much closely related to the diagnostic information from school records than the ADOS and stated that the ADI-R is unlikely to be informed by the school staff and is strictly a parent report (Bishop, 2002). However, this literature does not discuss the fact that the parents communicate with the school staff and unlike the objective clinician, the parents may be biased on that communication. As the literature lacks this

discussion, the ADI-R may be representing more than just home life and parents could be influenced by information from the school that the parent may not have observed first-hand.

Educators are providing different information than parents as they do not see the child at home and also do not have the same ASD specific training as clinicians who perform the ADOS. Comparing teacher and parent reports of communication skills in children with ASD, Bishop (2001) found significant differences in the parent versus teacher reports, $p<0.05$ for speech scores, $p<0.01$ for inappropriate initiation, stereotyped language, and social relationships, $p<0.001$ for pragmatic composite scores. Teachers were more accurate in diagnosis than parents when compared with the official diagnosis on record. These results indicate that teachers significantly scored more accurately than parents (Bishop, 2001). Additionally, parental ratings of the child's social rapport had significant differences within the parent group unlike the professional ratings which were consistent (Bishop, 2001). The findings show that parents do not give the same responses as trained professionals, however the results may have been confounded since some of the teachers included mainstream general education teachers with no special education training.

In an effort to improve the reliability of ASD diagnoses, Tomanik, Pearson, Loveland, Lane and Shaw (2007) used the ADI-R, ADOS and the Vineland Adaptive Behavior Scales (VABS)(Sparrow 2005) to examine the importance of parent-report. VABS is a parent interview which includes questions about daily living skills, socialization and adaptive functioning (Tomanik et. al, 2007). Results indicated a concordance rate of diagnoses of ASD of 75% between the ADI-R and the ADOS and including the VABS the accuracy improved to 84% (Tomanik et. al, 2007). This study provides insight on the value of parent report, as the addition of VABS further improved the accuracy.

Wiggins and Robins (2007) also investigated the ADI-R, and ADOS in their use of diagnosis. They brought in 142 toddlers, 60 with no disorder, 42 with Autistic Disorder, and 30 with another spectrum disorder to see the validity of diagnosis. Using a double-blind study Wiggins and Robins had clinicians perform the ADI-R, ADOS, and the Child Autism Rating Scale (CARS), which is an observation measure, on the participants (2007). They found disagreement between the parent report of ADI-R with the CARS and ADOS, and when controlling for diagnosis of Autism alone rather than including other ASD diagnoses, they found that the ADI-R under-diagnosed according to the diagnoses that the toddlers came in with. When they removed the behavior domain there was much greater

agreement between the measures, which shows that the behavior domain may need further analysis (Wiggins & Robins, 2007).

Stone, Hoffman, Lewis and Ousley have investigated parent report and clinician observation in their research on early recognition of autism (1994). Stone et. al used the Childhood Autism Rating Scale (CARS) and the Parent Interview for Autism (PIQ) as the parent assessments and evaluated the child directly using either the Bayley Scales of Infant Development or the Merrill Palmer Scale of Mental Tests, and a motor imitation task (1994). They directly compared the parent reports with the clinician reports of behaviors in the domain of Rutter's criteria for a clinical diagnosis and compared the agreement on items within each domain for children under the age of four (Rutter, 1987). They found that agreement was strongest for the absence of behaviors rather than the presence, and only three of the twenty six participants had an acceptable level of agreement between clinicians and parents on the items of abnormal social play, stereotyped body movements, and restricted interests (Stone et. al, 1994). Low agreement was found on the items of impaired imitation, lack of awareness of others, impaired peer friendships, no mode of communication, abnormal nonverbal communication, absence of imaginative play, and preoccupation with parts of objects (Stone et. al, 1994). Their study is incredibly relevant to diagnosis, but because the age range is limited, information is lacking on whether the parent's knowledge of the child's behaviors at different ages can affect their assessment on current behaviors. Additionally, since this study no one has performed a comparative analysis of these using updated measures such as the ADI-R and ADOS.

Stone et. al's (1994) research shows the discrepancy between parent report and clinician observation but more research is needed. Some research indicates that parents can be a reliable source of information regarding their child's development (Glascoe, 2003). Little research has indicated whether clinician report is more accurate than the parent's or if it is offering information that the parent cannot provide. The research of Lord et. al (2006), Bender et. al (2008), Sakora et. al (2008) and Tomanik et. al (2007), lends itself to the study of parent versus clinician assessment. Using the ADI-R and the ADOS these clinicians have found discrepancies between the different kinds of tests and further investigation should follow up by comparing the differences in the subtests and if the results are different because of the reporters or because of the tests. The subtests are categorized based on the DSM IV criteria for diagnosis, and questions are coded and included on the subtests in each assessment. The assessments include subtests on social skills, restricted interests, behavior, and communication. This may be valuable information for the healthcare provider, educator, and therapeutic intervention service providers who will need specific details on a child's diagnosis. It could provide information to help them determine if they should rely more heavily on a specific test or reporter or give them equal weight in the diagnostic process.

Research indicates that using both the ADI-R and the ADOS gives the most accurate results (Risi et. al, 2006; Lord, 2006). Because both have been shown to be reliable and valid, further investigation should be done using the subtests to isolate current behaviors, past behaviors, adaptive behavior, communication skill, imaginative play, and other components of the child's activities to determine whether parents or objective clinicians have a more accurate rating of the activities. The purpose of this study is to investigate if parent and clinician report differ on the sub-scores of communication abilities, stereotyped behavior and restricted interests for children with ASD. It is hypothesized that parents will over report symptoms in the social domain, and under-report symptoms in the domains of interests and communication compared to the clinician. This should also be done to investigate if there is a deficit in the DSM IV criteria that parents and clinicians do not report the comparable scores. This may lead to the inclusion of not only the ADOS and the ADI-R in an official diagnosis but other assessments that may be aimed towards one particular deficit area. By doing this more specific analysis, future research can lead to finding why there may be discrepancies. If results indicate a discrepancy, programs can be created to help parents learn how to observe and analyze their child's behavior and clinicians to gather full information from their assessments.

METHODS

Twelve participants who had previously received diagnosis of autism spectrum disorder including Pervasive Developmental Disorder- Not Otherwise Specified (PDD-NOS), Autism, or Asperger's syndrome and their parents participatedin the study . Participants' parents provided verification of diagnosis from a physician or psychologist. The parents acted as informants and are the persons who are most familiar with the person with daily behaviors of ASD

INCLUSION/EXCLUSION CRITERIA

All participants were individuals with ASD, PDD-NOS, or Asperger's Syndrome who have an IQ of less

than 100. Those with additional diagnosis of genetic neurodevelopmental disabilities or major mental or psychological disorders were excluded from this study. Eligibility was determined by the most recent IQ test results provided to the study, and their ability to communicate verbally being present,. Participants were between the ages of 7 and 40 years old, have aparent or guardian as an informant that is familiar with their behavior, have an IQ of 100 or below, are verbal and use English as their primary language. The age range for this study was 9 to 22 years old (mean age = 15.8) and Participants also had Performance IQ's that ranged from 45 to 117 with a mean of 86. All of the participants lived with the person acting as the informant.

Participants were recruited through the Autism Society of Greater Cleveland, "Walk Now" for Autism Speaks and Northeast Ohio schools and camps for children with ASD. Participants and informants signed the Consent and Assent forms before beginning any part of the study. They were compensated for their participation, travel, and parking when they traveled to Case Western Reserve University's Neurodevelopment Research Lab in Cleveland.

PROCEDURE
Measures

The Autism Diagnostic Observation Schedule (ADOS) is the "gold standard" for assessing individuals with PDD-NOS and ASD for toddlers through adults (Lord, Rutter, DiLavore, Risi, 2006). It is a 30 to 45 minute standardized observation measure designed to assess autistic behaviors. Scoring yields cutoffs for fitting diagnosis of categories of ASD and for fitting diagnostic criteria for each domain. The ADOS involves the participant and a trained clinician and consists of four modules, which are divided based on developmental and language level. The developmental and language level of each participant was matched to the proper module, and only that module was administered to that participant. In this study Modules 2, 3 and 4 were administered given the verbal level of participants recruited. During the ADOS the clinician presented many opportunities for the participant to exhibit behaviors of interest in the diagnosis of ASD through "standard 'presses" for communication and social communication (Lord, 2006). These presses are used in the different portions of the test, and are similar to psychoeducational or developmental tests such as the Psychoeducational Profile by Shopler and Reichler (1980). The ADOS uses structured activities and materials that provide standard contexts for social interaction, communication, and any atypical behaviors. The presses refer to the "immediate environment that has direct implications for the subjects behavior" (Lord,

1989). The environment includes the toys, tools, and the clinician who attempts to interact during play with the child. The ADOS domain for language and communication, variable ADOS Communication, includes : overall level of non-echoed language, speech abnormalities associated with ASD (intonation, volume, rhythm, rate), immediate echolalia, stereotyped/idiosyncratic use of words or phrases, offering information, asking for information, reporting events, conversation, and descriptive, conventional, instrumental or informational gestures. The domain for reciprocal social interaction, variable ADOS Social, includes; unusual eye contact, facial expressions directed to others, language production and linked nonverbal communication, shared enjoyment in interaction, empathy/comments on others emotions, insight, quality of social overtures, quality of social response, amount of reciprocal social communication, and overall quality of rapport. The domain for stereotyped behaviors and restricted interests, variable ADOS Behaviors, includes; unusual sensory interest in play material/person, hand and finger and other complex mannerisms, self-injurious behavior, excessive interest in or references to unusual or highly specific topics or objects or repetitive behaviors, and compulsions or rituals.

Scoring for most tasks in the ADOS are on a three-point scale. Beginning with 0= *within normal limits*, to 1= *infrequent or possible abnormality*, to 2 = *definite abnormality* (Lord, 1989). The same aspect of a behavior cannot be coded as abnormal more than once but different aspects of that behavior can be coded more than once (Lord, 1989). An algorithm based on the tasks and items was used to determine the number of participants who meet diagnostic criteria in each domain. Lord et. al (1989) found the discriminant validity of the algorithm as quite good for social and communication criteria. Using intraclass correlations, Lord et. al (1989) assessed the interrater reliability of the algorithm and found no changes in classification with different clinicians as raters. The ADOS was also videotaped and another trained clinician watched the video and scored for reliability.

The Autism Diagnostic Interview-Revised (ADI-R) is a diagnostic measure used for individuals of all ages and administered in interview format to informant (Rutter, Le Couteur, Lord, 2005). The informant is asked questions about the participant's family and education, diagnosis, and medications, informant's concerns and introductory questions that help to create a general picture of the participant's behavior, early development and key developmental milestones, language history, communication and language functioning, social development and play, interests and behaviors, and general behaviors of clinical impor-

Table 1. Items compared from ADI-R and ADOS

ADI-R	ADOS
Range of Facial Expressions Used to Communicate	Facial Expressions directed at others
Quality of social Overtures	Quality of Social Overtures
Appropriateness of social responses	Quality of Social Response
Conventional/instrumental gestures	Descriptive, conventional, instrumental, or informational gestures
Social verbalization/chat	Amount of reciprocal social communication
Reciprocal conversation	Conversation
Neologisms/idiosyncratic language	Stereotyped/idiosncratic use of words or phrases
Unusual preoccupations	Excessive interest in unusual or highly specific topics or objects
Circumscribed interests	Excessive interest in unusual or highly specific topics or objects
Hand and finger mannerisms	Hand and finger and other complex mannerisms
Unusual sensory interests	Unusual sensory interest in play material/person
Seeking to Share Enjoyment with Others	Shared Enjoyment in Interaction
Compulsions/Rituals	Compulsions/Rituals

tance (aggression, self-injury, epileptic features). The ADI-R is divided into three domains when interpreting results. These domains correspond to ASD diagnostic criteria in the DSM IV: Qualitative abnormalities in reciprocal social interaction ("A"), Qualitative abnormalities in communication ("B"), and restricted, repetitive, and stereotyped patterns of behavior ("C"), and if these signs of ASD were evident before the age of 36 months ("D")(Rutter, 2005). The interviewer obtains specific and detailed responses from the informant. There are nine codes for responses from the informant. These codes begin at one with behaviors not being present, progress to abnormal behaviors being present at varying degrees, and the question being non-applicable. The algorithm for scoring conversion was created based on the maximum likelihood of ASD according to clinical consensus that participants would score above the cutoff. The Current Behavior Algorithm is used in scoring so as to get a direct comparison between the current be-

havior that is observed in the ADOS. The Current Behavior Algorithm does not have cutoffs, but can be compared with ADOS scores on items endorsed and when scores are normalized with the ADI-R using z-scores (Noterdaeme et. al, 2002).

The ADI-R variable ADI-R Social includes failure to use nonverbal behaviors to regulate social interaction, failure to develop peer relationships, lack of shared enjoyment, and lack of socioemotional reciprocity in the domain of qualitative abnormalities in reciprocal social interaction. Included in the domain of qualitative abnormalities in communication, variable ADI-R communication is; lack of, or delay in, spoken language and failure to compensate through gesture, relative failure to initiate or sustain conversational interchange, stereotypes, repetitive idiosyncratic speech, and lack of varied spontaneous make-believe or social initiative play. Included in domain of restricted, repetitive and stereotyped patterns of behavior, variable ADI-R Behavior

is; encompassing preoccupation or circumscribed pattern of interest, apparently compulsive adherence to non-functional routines or rituals, stereotyped and repetitive motor mannerisms, and preoccupations with part of objects or non-functional elements of material.

The ADOS and ADI-R do not use the same metrics in their scoring, but have been reliably converted and compared (Lord et. al, 2006; Bender et. al, 2008; Sakora et. al, 2008; Tomanik et. al, 2007; Noterdaeme et. al CITE). The domains correspond with one another and the scores can be compared directly after the conversion.   In this study z-scores were created to directly compare the ADI-R and the ADOS. Many of the items on the ADI-R and the ADOS are also directly comparable and can be used to examine percent agreement.

Procedure

Participants and informants came to the Neurodevelopment Research Lab at Case Western Reserve University on the day of their appointment. The procedures were explained to them and informed consent was obtained. Then the participant was administered the ADOS. Later, a trained professional or research assistant interviewed the informant by administering the ADI-R. Once both assessments were completed the participants were compensated for their time.

Analyses and Results

The three domains from the ADI-R were compared with matching domains from the ADOS. Z-scores were created for each domain for ADOS Communication and ADI-R Communication, ADOS Interests and ADI-R Interests, ADOS Social and ADI-R Social and were compared. A paired t-test showed no significant differences on these items. Correlations showed no significant relationships between the items for the domains.

Twelve items from the ADOS and ADI-R were directly comparable. These items were coded for endorsement, if the behavior was marked as present (a response of 1, 2, or 3 on the ADI-R or the ADOS) the item was coded as "1," if not present (a response of 0 on the ADI-R or the ADOS) the item was coded as "0."   Table 1 shows the items that could be directly compared were: Range of facial expressions used to communicate, Quality of social overtures, Appropriateness of social response, Conventional or instrumental gestures, Social verbalization or chat, Reciprocal Conversation, Neologisms or idiosyncratic language, Unusual preoccupations or circumscribed interests, Compulsions and rituals, Hand and finger mannerisms, Unusual sensory interests, and Seeking to share enjoyment with others.

Table 2. Percent agreement on items

	Agreement	Both	Neither	Agreed
Communication Domain				
Conversation	91.7%	10	1	11
Quality of Social Response	75.0%	7	2	9
Gesture	75.0%	3	6	9
Restricted Interests and Stereotypies Domain				
Enjoyment Interaction	66.7%	3	5	8
Hand & Finger Mannerisms	58.3%	1	6	7
Facial Expressions Directed at Others	58.3%	3	4	7
Stereotyped & Idiosyncratic Use of Words or Phrases	58.3%	0	7	7
Social Domain				
Chat (8 participants inc.)	50.0%	0	4	4
Compulsions (11 participants inc.)	45.5%	0	5	5
Unusual Sensory Interests	41.7%	1	4	5
Excessive/Unusual Interests or Preoccupations	33.3%	4	0	4
Quality of Social Overture	25.0%	2	1	3

Table 3. Percent endorsement on ADI-R and ADOS

	Assessment	Cases Endorsed
Communication Domain		
Chat	ADI-R	8.3%
	ADOS*	58.3%
Stereotypies & Restricted Interests Domain		
Compulsions	ADI-R*	63.3%
	ADOS	0.0%
Unusual Sensory Interests	ADI-R*	50.0%
	ADOS	25.0%
Excessive/Unusual Interests or Preoccupations	ADI-R*	83.0%
	ADOS	50.0%
Social Domain		
Quality of Social Overture	ADI-R	33.3%
	ADOS*	83.3%

*indicates assessment was more often endorsed for the item

Percent agreement between parent responses on ADI-R items and the comparable items on the ADI-R was calculated using the codes for endorsement. Only 3 items (Conversation 91.7%, Quality of social response 75%, Gesture 75%) showed an agreement of 75% or more of the participants. In contrast, 5 items showed agreement 50% or less of the time, these were Chat at 50%, Compulsions 45.5%, Unusual sensory interests 41.7%, Excessive/unusual interests or preoccupations 33.3%, and Quality of social overture 25% (Table 2). The five items fall in all three domains of ASD. The item in the communication domain, Chat, and the item in the social domain, Quality of social overture, showed more endorsement, meaning the behavior was more often present by the clinician on the ADOS. In the domain of restricted interest and stereotypies parents consistently endorsed the items, Unusual sensory interests, Excessive or unusual interests or preoccupations, and Compulsions more often (See Appendix: Table 3).

Discussion

At this time the ADOS and the ADI-R are the most comprehensive diagnostic assessments for ASD. Presently they are not required for an official diagnosis of ASD and are not consistently used by clinicians in the process of diagnosis. Given that they are not both required for diagnosis, schools, therapeutic services and other intervention services are receiving only partial information, most often just parent report information, like that of the ADI-R. One study (Pilowsky, Yirmiya, Shulman, & Dover, 1998) report-

ed that the Childhood Autism Rating Scale (Cars: Schopler, Reichler, De Vellis, & Daly 1980; Schopler, Reichler, & Renner, 1998) and the ADI-R disagree and this could be due to the source of information and time and place limits on both measures.

Results indicate that there is a difference between parent and clinician reports of symptoms in children with ASD. As hypothesized, parents reported their child as having more behaviors in the domain of restricted interests and stereotypies and clinicians reported more behaviors in the social and communication domains. These results suggest that parents and clinicians are both missing information when they report symptoms. Clinicians are not seeing all the restricted interests and behaviors while parents are not seeing the social and communication challenges.

These results can be due to a number of differences in relationships clinicians have with the child with ASD and parents have with their child, and further research should investigate these differences and their causes. One of the causes of the discrepancy is that parents don't see their child in school or group therapy sessions so they may think their child is more social. One Explanation for parents saying their child has stronger communication may be that parents often learn their children's idioms, i.e. "wa wa" meaning water, and can understand their child's speech best because they are present for every step of development.

The discrepancy between parent report on the ADI-R and clinician observation on the ADOS in the domains of Communication, Social and Interests will help clinicians in diagnosis, school and therapy settings, and describe parent perspective versus that of an objective clinician. By investigating the domains, on the ADI-R and the ADOS, crucial detail is provided on the child with ASD's abilities, symptoms, and needs. In the future, the study could be expanded with more participants, which could provide for more generalizable data. A limitation is that even though we are able to convert the data from the ADI-R to the ADOS metrics they aren't on the exact scale as the original scores.

Further research could study specific tasks or questions within those domains, i.e. social reciprocity, with parents and clinicians. This research creates a greater body of literature on parent knowledge and clinician evaluation abilities. Future research could also compare ages, spectrum diagnosis and level of functioning of the children and the agreement on these domains between the ADI-R and the ADOS. It is expected that with increasing age agreement will also increase. This could be due to the parents having knowledge of their child's diagnosis and having spoken with experts in the school system or intervention services. In regard to the level of functioning, if a parent has been told over the years that their child is "low" or "high-functioning" this information may impact how they analyze their child's behavior in response to the questions in the ADI-R. Clinicians who administer assessments themselves may not be impacted by previous assessments but may also spend a limited amount of time with the child as compared to the parents.

By investigating the three criteria of ASD and determining where a discrepancy between parent and clinical report lies, policy could be created regarding which tests should be required in order to gain the most comprehensive assessment of the needs of a child with ASD. [transition word] Future policy and programs could be created to educate parents on how to better understand and analyze their child's behavior. Also, physicians and psychologists who perform the diagnosis could hold greater value in certain information that the parents provide. As so much development occurs during the ages that children with ASD begin showing symptoms and are diagnosed, early intervention is crucial. This research could be the basis for future policy which would require both the ADOS and the ADI-R for a diagnosis and children receiving early intervention services, already provided by the state, that are most appropriate for their individual needs and they could receive specific intervention based on a comprehensive diagnosis when they need it the most.

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