Analysis of Joint Dysfunction During an Aging- Simulation, Laboratory Exercise for Allied Health Students

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ABSTRACT

Anna O'Connor: Analysis of Joint Dysfunction During an Aging-Simulation, Laboratory Exercise for Allied Health Students
(Under the direction of Carol Britson)

The aim of this experiment was to (1) develop and assess a joint-dysfunction simulation learning and sensitization activity for a Human Anatomy and Physiology I lab on joint structure and function (Part A) and (2) quantify the range of motion experienced during the simulation (Part B). The lab protocol allowed 318 allied health students to experience some of the physical limitations of aging, specifically arthritis, by asking them to perform activities of daily living (ADLs) while wearing simulation equipment that inhibited their range of movement. In Part A, students completed a pre- simulation survey, which assessed the students' knowledge about the elderly and arthritis. Most of the students (74.8%) responded that they do have family members who have experienced joint pain or immobility, and 145 students disagreed when asked if arthritis is a problem only experienced by the elderly. When asked if older people become more confused, 118 students agreed, and then if older people don't contribute much to society, 154 students strongly disagreed. The majority of the students felt comfortable with the elderly and had positive thoughts about them. For the acts of daily living, students completed four simple tasks with and without taped hands, designed to simulate arthritis. For each task, time to completion significantly increased ($p<0.001$) with the addition of tape. Students then completed a post-simulation survey, which assessed the success of the simulation.

When asked if they experienced difficulty with the task with the addition of tape, most students agreed that it was more difficult with the tape, which suggests the tape was an effective method to simulate arthritis. Almost all of the students agreed that the simulation was interesting, which promotes the idea of future research. In part B, 21 volunteers completed the same ADLs while wearing an electronic, finger goniometer. This device electronically measured subject's degree of mobility while completing ADLs, with no constrictions and then once again with the addition of tape. Flexion and extension were observed and the change in range of motion was calculated by comparing flexion during the tasks with the value obtained while the subject performed full flexion (i.e., calibration). Increases in the time to completion of each task were similar to the data collected during the simulation in Part A, but the smaller sample size led to significant increase only when writing their name ($p=0.012$) and texting a message ($p=0.007$). Restrictions led to a decrease the subject's range of motion for each of the tasks; however, because of equipment issues resulting in a smaller sample size, it is difficult to assess an accurate change in the range of motion in terms of flexion and extension. Alternate equipment could be considered to observe the complex motions, both flexions and extensions, required for each of the tasks and how they may change with the addition of simulation materials. Future research that expands upon the idea of an arthritis simulation for allied health students could further improve the effectiveness and reality of the simulation, which will increase a student's understanding of aging and arthritis.

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INTRODUCTION

Ageism is defined as prejudice or discrimination based solely on a person's age, resulting in a stereotype specifically associated with decline and disability (Butler, 1969; Hale, 1998). For example, most of our society believes older individuals to be forgetful because they are "getting old" without considering alternative possibilities (Hale, 1998). Butler (1969), who first coined the term ageism, believes it to be the systematic stereotyping of and discrimination against people because they are old, similar to the ideas of racism and sexism with skin color and gender respectively. Calasanti (2005) believes ageism includes stereotypes, prejudice, and categorization but the most crucial aspect is exclusionary behavior. In our society, aging is not associated with an increased status or respect but instead is associated with decline and disability, resulting in oppression and exclusion (Hale, 1998). Unlike other prejudices, ageism has been poorly studied and rarely confronted. Until recently, little was known about its origins and consequences (Robbins, 2015).

As the body ages, it becomes more vulnerable to sickness, leading older people to seek healthcare more often. Ageism in the health care professions could interfere with diagnosis and treatment of older patients. Palmore (1999) argued that health professionals share the same ageist attitudes that pervade in society, compounded by a disease-oriented education. According to a study by Lorraine et al. (1998), both physicians and medical school students had negative attitudes about older patients, believing them to be inflexible, unproductive, and difficult to treat. A similar disconnect was found from the patient's point of view. The study also found that patients often complain that physicians are insensitive and lack understanding and concern for them as individuals (Lorraine et al., 1998). Survey research found that older people experience ageist attitudes such as disrespect, being ignored and patronized and had encountered assumptions by health professionals that health issues were caused by age (McGuire et al., 2008); Palmore, 2001). Health profession training schools have begun to incorporate programs in their curriculum that sensitize students to geriatric issues, which aim to teach students how to help or treat older patients (Lorraine et al., 1998). Additional resources in geriatric education are needed because of the increasing size of their demographic population. According to the latest U.S. Census Bureau brief, by 2030, one out of every five people in the United States will be 65-plus [Center for Disease Control and Prevention (CDC), 2015]. Never before in human history has there been such a high percentage of older people, and the number continues to grow because of the aging Baby Boom generation (Pirkl, 2009).

In order to reduce the prevalence of ageism in the health professions, it is necessary to understand the root of the problem. A possible explanation for these negative attitudes could be the type of exposure medical students have to the elderly. Students interact with the elderly in a hospital setting when they are acutely ill and at their most vulnerable (Duke, 2009). In accordance with the Contact Hypothesis, stereotyping is predicted to be higher among individuals who do not identify with nor have contact with the elderly (Hale, 1998). Hale (1998) also found that participant knowledge of aging and application of aging stereotypes were affected by the quality of contact experienced; those who experienced high levels of contact with elderly achieved higher knowledge scores and lower stereotype scores.

A common condition associated with growing old is arthritis; considered the nation's number one cause of disability, encompassing a wide variety of inflammatory and non-inflammatory joint disease [Arthritis Foundation (AF), 2016]. The number of Americans who live with arthritis will grow as the number of older Americans continues to increase dramatically in the next few decades. Although arthritis is not exclusively experienced by the elderly, the majority of cases occur in adults 65 years or older. An estimated one in five (22.7%) adults in the United States report having doctor-diagnosed arthritis (AF, 2016; CDC, 2015).

Osteoarthritis, also known as "wear and tear" arthritis, is a degenerative joint disease caused by a progressive loss of protective cartilage that cushions the ends of bones, causing pain and swelling (AF, 2016). Because of the breakdown of cartilage, the inner bone surfaces become exposed and rub together, and in some cases, bony spurs develop on the edges of joints, causing damage to muscles and nerves, pain, deformity, and difficulty moving (AF, 2016, CDC, 2015). Osteoarthritis is most common in the weight-bearing joints and has multiple potential causes including genetic predisposition, trauma, and obesity (AF, 2016).

Lorraine et. al., (1998) found that among the major roadblocks that students face when caring for elderly patients are personal feelings of helplessness and frustration at being unable to make a difference in the long run; these feelings often result from a combination of ignorance about what the elderly actually face on a daily basis, as well as student's fears about their own aging and end-of-life issues. In a sensitization exercise to arthritis that is emotionally oriented, students can face these feelings in a positive, educational environment, enhancing both their professional and personal lives by becoming more aware of the special needs that are needed to care for geriatric patients.

During their educational career, students learn the logistics of growing old without learning how it feels to grow old. Many institutions have started to incorporate geriatric curriculum into their programs. New interventions include a one-week geriatric experience, an aging game, a mentoring program with healthy seniors, and using standardized patients, which all are proven to improve student relations with the elderly (Duke et al., 2009; Douglass et al., 2008). The "aging game" is used as a sensitization exercise by using cards and performing acts of daily living (ADLs), inspired by an aging game created by faculty at Eastern Virginia Medical School (Douglass et al., 2008). This aging simulation was made mandatory for fourth-year medical school students. The students are assigned an illness common to the older population, which was then simulated by using various techniques, such as wearing glasses to simulate glaucoma, and then asked to perform ADLs with impairments, such as paying bills (Lorraine et al., 1998).

Even though these interventions are helping with the healthcare of the older population, the Association of American Medical Colleges still reported that 38% of graduating medical students nationally felt they had not received geriatric education during the four years of their medical school (Duke et al., 2009). I have not found any documented cases of these aging "games" used in undergraduate education, so an experimental protocol developed for undergraduates who are likely to pursue a career in the health professions could sensitize them to geriatrics issues earlier on. This simulation exercise will hopefully improve their relations with geriatric patients in their future profession and also allow students to have more impactful experiences with elderly individuals in professional school.

The aim of this experiment is to develop and assess a joint-dysfunction simulation learning activity for a Human Anatomy and Physiology I lab on joint structure and function. A simulation in general is defined as the act of imitating the behavior of some situation or some process by means of something suitably analogous. The lab protocol will allow students to experience some of the physical limitations of aging, specifically arthritis. The lab protocol will not only be useful to collect data about how students feel about the elderly, but will also improve Anatomy and Physiology laboratory education. Previously in the lab focused on joints, students followed normal lab protocol, exploring the normal structure and function of joints. This new protocol will allow students to understand and experience the physiology of aging joints by following an aging simulation. By experiencing the physical frailties of aging first hand, students are more likely to empathize with the elderly. Having students personally experience frailties associated with aging and the functional limitations resulting from these frailties has proven to be an effective way to increase their empathy toward the elderly (Hale, 1998). Lorraine et al. (1998) also found that identifying students' fears about disability and dependency also seems to increase their degree of empathy for elderly patients.

A second experiment was also designed to quantify the results gained from the lab exercise using equipment that detects the range of flexion and extension in the hand, specifically the index finger. This quantifiable data gives insight to how parts of the index finger are recruited during these tasks and how the angle of flexion decreased with addition to the constriction used to simulate arthritis.

I hypothesize that constrictions applied to the fingers and hands will change the amount of time to complete activities. I also hypothesize that students will find the simulation interesting and a successful educational experience, allowing students to feel more comfortable with the elderly. For the joint angle quantification experiment, I hypothesize that the constrictions applied to the fingers and hands will change the amount of time to complete activities and will change the range of motion in the fingers when attempting to complete activities.

MATERIALS AND METHODS

Part A: Student Simulation Exercise

Students enrolled in Human Anatomy and Physiology I at the University of Mississippi were recruited to participate in the first part of this study (Part A). Three hundred and eighteen students participated in the study. All were typical undergraduate college students between the ages of 18 and 23, ranging in race and gender, were healthy, and did not experience any physical injury or negative side effects as a result of this study. Students were recruited in the laboratory and were informed the experiment was optional, but was incorporated into the educational portion of that week's laboratory. The experimental protocol was approved by the University of Mississippi Institutional Review Board (#15-059). Students were not compensated in any way or awarded course points for participation in the experiment.

Two surveys were given to participants: a pre-simulation survey and a post-simulation survey. The surveys were designed to allow students to put the purpose of the exercises into perspective, and to consider their own beliefs or feeling about older populations. The pre-simulation survey (Appendix A) was given to students at the beginning of their laboratory session to assess the participant's future profession and familiarity with and attitudes about the elderly. Questions were chosen to address feelings of ageism and knowledge of arthritis. While completing the survey, students could think about their relationship with the older population and associate joint pain with the older population. Responses helped to establish where this student population falls concerning ageism and how their thoughts my change following the simulation. The survey was designed mostly with questions answered using the Likert scale, which asked participants to give a rating from strongly agree to strongly disagree in response to each statement (Fowler Jr., 2009).

The protocol designed for this experiment (Appendix B) required students to work in teams with one student taking the role of Subject and the other the role of Attendant. If there were odd numbers of students in the laboratory sections, the extra student could choose to assume the role of Subject or Attendant. There were a total of 147 Subjects and 171 Attendants. The Subject was first asked to perform four tasks while the Attendant was asked to time, using a stopwatch or smartphone, the Subject from beginning to end of each task. The four tasks (tying their shoe, signing their name, opening a pill bottle, and texting a message) were chosen as acts of daily living (ADLs) because these tasks may be difficult to complete when one ages. Subjects were encouraged to perform each task as they normally would on a day to day basis. The Attendant was then asked to tape the Subject's dominant hand with self-adhesive tape, which is a cohesive elastic wrap made of nonwoven material and elastic fibers ($3M^{TM} Coban^{TM}$). In order to imitate arthritis effectively, and therefore make the simulation effective, consulting with a professional hand therapist was necessary for instruction on the method to taping hands. Dr. Robin Parish, an Assistant Professor at University of Mississippi Medical Center and certified hand therapist, gave the following description: wrap the thumb so that it is pointed slightly inwards after placing a button over the carpometacarpal (CMC) joint to reminding the student of the pain that usually occurs in that location (Figure 1). The fingers and palm of the hand were wrapped tightly enough to limit movement but not to the point of discomfort. An instructional video, picture, and teaching assistant's verbal instruction were used to help with the taping. The Subject was then asked to perform the same four tasks again while being constricted with the tape while being timed by the Attendant. There was little to no risk involved in the lab protocol except for possible numbness in the fingers as a result of wrapping the fingers too tightly with athletic tape. Stress balls were available in case of any hand distress following the experiment.

A post-simulation survey (Appendix C) was given after students completed the lab exercise. The survey was given in order to determine the success of the experiment as a sensitization exercise and a potential laboratory exercise for the future. The survey asked the participant to identify their role in the experiment, either subject or attendant, and asked them to assess their experience with simulation in accordance with how they participated (e.g., Likert survey or by a scale of percentages from 0-20% to 80-100% in response to each statement).

Part B: Joint Angle Quantification Experiment

Students at the University of Mississippi were recruited to participate in the second part of this study. The goal of this part of the experiment was to quantify the decrease in range-of-motion experienced while wearing simulation equipment. Eighteen students participated in the study. The participants were in the range of typical undergraduate college age between the ages of 18 and 23. None of the students were enrolled in Human Anatomy and Physiology I. All students who participated in the study volunteered to be a subject in this experiment, were healthy, and did not experience any physical injury or negative side effects as a result of this study. Students were recruited via email and were informed the experiment was optional. Upon arrival, the subjects were given a consent form to read that explained the experiment and risks involved and then provided written consent. The experimental protocol was approved by the University of Mississippi Institutional Review Board (#15-059). The students were not compensated in any way for participating.

The study was conducted on the University of Mississippi campus in Shoemaker Hall, and each trial lasted approximately thirty minutes, including obtaining informed consent. Prior to arrival, students were informed to wear shoes they could tie easily. A finger goniometer (Biometrics, Ltd.; F35 Finger Goniometer) was placed on the subject's pointer finger, which was used to measure the range of motion in that finger using a range within ± 2mv (ADInstruments, Inc.; Labchart 8.0.7.; Powerlab 4/20T). The subject sat away from the computer and was asked to fully flex and then fully extend their pointer finger. Then the subject was asked to perform the same four tasks involved in part A: open a pill bottle, sign their name, tie their shoes, and text a message. The subjects were encouraged to complete each task as they normally would while trying to ignore the finger goniometer attached to their finger. I recorded their time from start to completion of each task and observe the motions of their finger using Powerlab software (ADInstruments, Powerlab 4/20T). After normal completion of the four tasks, I taped the subject's dominant hand using the same method used in Part A. The subject was then asked to complete the same four tasks again, but with the hand constrictions. I recorded their time from start to completion of each task. After the study was completed, I untapped the subject's hand and removed the finger goniometer. A stress ball was offered to the subject in case of any physical distress.

After all of the trials were complete, I collected data from the files while working in LabChart. Event markers were used to tag when the subject began and ended each of the tasks, allowing precise calculation of time-to-task. The markers also created a frame of time in which the peak movement, whether flexion or extension, observed in the range of ±2mv, was identical and recorded for each of the tasks, with and without tape. This observed value was then compared with the maximum flexion subjects were asked to complete at the beginning of the trial. By comparing the subject's maximum flexion with the most extreme motion seen when performing tasks with and without tape, the potential change in the range of motion can be observed when compared to a constant variable, the maximum flexion. The total number of movements completed during each of the tasks were also recorded along with the number of flexions and extensions.

Analytical Methods

Descriptive statistics, such as mean and standard deviation, were calculated for all data collected, including the pre-simulation survey, post-simulation survey, simulation exercise, and quantitative (Part B) data. Chi-square tests (Siegel & Castellan, 1998) were used to analyze the responses for the Likert style questions asked in the pre and post simulation survey. Data from the simulation exercise (time to completion before and after tape was added to the hand) and data from Part B (time to completion before and after tape was added to the hand and range of motion in the finger) was analyzed using t-tests: Paired Two Sample for Means. Analyses were conducted using Microsoft Excel and the level of significance was set at $\alpha = 0.05$ for all tests.

RESULTS

Pre-Simulation survey data

Of the 318 students, 79.2% are pursuing a career in the health profession, aspiring to become a nurse, physical therapist, or occupational therapist (Fig 2). Most of the students (74.8%) responded that they do have family members who have experienced joint pain or immobility. When asked on a scale of 1-10 how comfortable the student is with the elderly, with 1 being not comfortable at all and 10 being very comfortable, 100 students rated their opinion with an 8. Fifty-eight students reported a 10, 54 reported a 9, and 14 students rated below a 5 (Fig 3).

In response to the statement: As people grow older they become less organized and more confused, 108 students Agreed with the statement, 107 responded neutrally, and 79 students Disagreed with the statement (X^2= 148.1, df = 4, $p<0.001$; Fig 4). Next, students were asked to evaluate the statement: Older people don't contribute much to society. Most students, specifically 154, strongly disagreed and 135 disagreed with this statement. Only seven students agreed with this statement ($X^2 = 349.2$, df = 4, $p<0.001$; Fig 4). Finally, students were asked to evaluate the statement: Arthritis is a problem only experienced by the elderly. One hundred and forty-five students disagreed and 141 strongly disagreeing (X^2=332.8, df =4, $p<0.001$; Fig 4).

Laboratory Exercise data

Data gained from the simulation exercise were analyzed using a two-tailed paired t-test for each of the four tasks to identify significant differences in time-to-task. For tying the shoe, the average time to completion was 6.48 seconds and increased to a mean of 10.33 seconds when hands were constricted by tape (Fig 5; $p<0.001$). For writing their name in cursive, the average time was 5.01 seconds and increased to a mean of 6.79 seconds with the addition of tape (Fig 5; $p<0.001$). For opening a pill bottle, the average time to completion was 1.59 seconds without taped hands and increased to a mean of 2.85 seconds when constrictions were added (Fig 5, $p<0.001$). For the final task, texting a message, the average time subjects took to text a message was 3.89 seconds and increased to a mean of 7.0 seconds with the addition of tape (Fig 5; $p<0.001$).

Post-Simulation survey data

After asking the student to specify whether they acted as subject or attendant in the lab exercise, they were then asked to answer a few questions specific to their role. The remainder of the questions students answered regardless of their role. When subjects were asked if they experienced difficulty with the tasks with taped hands, 87 of the 147 Subjects agreed and 38 strongly agreed. The results to this statement were significant (X^2=171.6, df = 4, $p<0.001$; Fig 6). The second statement, also directed towards the Subject, asked them to estimate their decrease in mobility while performing the tasks with taped hand using percentages ranging from 0-100%. One hundred and twenty-eight of subjects responded within the range of 20-80% with 56 responding in the range of 40-60% (Fig 7).

The first statement directed at the Attendant asked if they observed the Subject experiencing difficulty performing the tasks with taped hand. Eighty-nine Attendants agreed and 54 strongly agreed, and the results to this statement were significant (X^2=153.8 df =4, p<0.001; Fig 6). The third statement, directed at both Subjects and Attendants, asked students if they found this simulation exercise to be interesting to which almost all students agreed or strongly agreed (X^2=419.7, df = 4, p<0.001; Fig 8). The fourth statement all students answered asked if they believed this simulation would be useful in their future professions. Responses were varied but significant with 133 students agreeing with the statement (X^2=164.5, df =4, p<0.001; Fig 8). When asked students if this simulation exercise increased their level of understanding of the difficulties experienced by people with joint disorders, 154 students agreed and 134 strongly agreed with this statement (X^2=346.0, df =4, p<0.001; Fig 8). When asked students to rate how this simulation may have allowed them to feel more comfortable interacting with the elderly after completing this simulation exercise, 129 students responded neutrally (X^2=145.3, df = 4, p<0.001; Fig 8).

Part B data

When quantifying the data using the mini-finger goniometer, there was some difficulties with the goniometer itself, leading to only a portion of the data collected being adequate to analyze. The finger goniometer was sent back for recalibration when recordings were seen outside of its normal parameter of ±2 mV. After recalibration, the finger goniometer was functional for 7 trials and then resorted back to its abnormal activity. However, the equipment abnormality did not affect time-to-task data collection, so data was collected from a total of 21 participants.

Part B data were analyzed using a two-tailed paired t-test for each of the four tasks to identify significant differences. Time to completion of each task was taken before and after the restrictions were added, similar to the exercise data collection in Part A. Data gained from the simulation exercise were analyzed using a two-tailed paired t-test for each of the four tasks to determine the significance of the results. For tying shoes, the average time subjects took to tie their shoe was 11.2 seconds and increased, but not significantly ($p= 0.663$), to a mean of 11.6 seconds when constrictions of the taped hands were added (Fig 9). For signing their name, the average time to completion was 5.72 seconds and increased to a mean of 6.64 seconds when tape was added (Fig 9; $p=0.013$). When subjects were asked to open a pill bottle, the average time took to completion was 2.77 seconds and increased to a mean of 2.81 seconds when constrictions were added (Fig 9; $p=0.931$). For texting a message, the average time subjects took to text a message was 6.53 seconds and significantly increased to a mean of 9.59 seconds when constrictions of the taped hands were added (Fig 9; $p=0.007$).

The percent change in flexion was calculated by comparing degree of flexion during a task to the subject's full flexion. The percent recorded is the percent reduction from full flexion. For the first task, tying a shoe, the subject's mean percent reduction from full flexion before tape restrictions were added was 14% and then changed to 9% when the tape was added to the hand with an average change was 5% (Fig 10; $p=0.914$). For the second task, writing their name, the percent of full flexion was averaged to be 27% without tape and then changed to 15% when the tape was added to the hand, resulting in an average change of 12% (Fig 10; p=0.655). For the third task, opening a pill bottle, the percent reduction from full flexion before any restrictions were added was averaged to be -61.7% and changed to -61.9% with the addition of tape so that the average change in the range of motion was a -0.002% (Fig 10; p=0.995). For the fourth and final task, texting a message, the percent reduction from full flexion the subjects had in their pointer finger before any restrictions were added was averaged to be -4% and then increased to 8% when the tape was added to the hand, resulting in an average increase of 12% to the subject's range of motion (Fig 9; p=0.367).

When observing the number and type of movements required for each task, tying shoes was the most involved task, requiring an average of 6 movements with equal amounts of flexion and extension while the other tasks required less movements (writing their name=2 movements, opening a pill bottle=1 movement, texting a message=1 movement). When tape was added to the fingers, the amount of movements required for each of the tasks increased, but the use of flexions and extensions remained around the same ratio.

DISCUSSION

Part A: Pre- simulation survey data

As anticipated, most of the students enrolled in Human Anatomy and Physiology I were pursuing some career in the health professions, with the most common professions being nursing, physical therapy, and occupational therapy. Furthermore, most of students have family members who have joint pain stiffness or immobility. As expected, most students have a family member who has arthritis because an estimated one in five (22.7%) adults in the United States report having doctor-diagnosed arthritis (AF, 2016; CDC, 2015). Having a high percentage of people already having a context and an image of arthritis will be effective later on in the simulation when actually experiencing the feeling of joint pain because they can emphasize with their family members who experience that feeling in their day to day lives.

The student's reported comfortableness with the elderly were not expected. I expected more students to respond with a score lower than 5, meaning that they were not very comfortable with the elderly. According to Hayslip et al. (2013), it seems clear that younger individuals tend to have more negative attitudes towards aging when comparted to their older counterparts. Students may have felt obligated to say they were comfortable with the elderly given their future profession. Another possibility could be more exposure to the elderly because of shadowing opportunities students may pursue for their future careers in the health professions. According to Hale (1998), a person's knowledge of again and application of aging stereotypes were affected by the quality of contact experienced.

Students evaluated a similar statement that states as people age they become less organized and more confused, and results were expected with low numbers in the extremes. This question allows students to gather an image of the older population and respond truthfully, but shying away from the extreme answer choices, often deemed socially unacceptable answers. A similar statement is posed to the students: Older people don't contribute much to society. It was interesting to see that more students were willing to agree with the idea that as people grown older they become less organized and more confused, but then more readily to strongly disagree with the idea that older people don't contribute much to society. Students may believe that older people become less organized and more confused because they are relying on a negative assumption instead of seeking out facts about the elderly and the aging process or considering other possibilities that could lead to the lack of organization or confusion (Hale, 1998). However, current students in college are not yet in the workforce, so their version of contributing to society may be much different than their parent's generation. Interestingly, Hayslip (2013) suggested that individuals of all ages tend to judge older people more negatively when compared to younger people in an industrial/organizational setting. A question concerning arthritis was asked in order to allow the students to start thinking about the idea of arthritis and its relation to age, and students were knowledgeable with arthritis most likely because it is the number one cause of disability in the country (AF, 2016).

The disconnect between different ages, which is evident in the responses in the pre-simulation survey, could also be described using the Social Identity Theory, which includes social categorization that fulfills the need for social identity (Hogg, 1987). Members of the in-group, e.g., younger individuals, tend to favor positive characteristics within their group and stereotype members of the outgroup, older individuals, with less favorable characteristics. This will enhance the individual's personal identity (Hale, 1998). Preventing conflict and misunderstanding between these age populations could be fixed with increased exposure, which will "increase liking and respect and decrease feelings of uncertainty and unease. "some of the bias against the elderly may be decreased by making elderly individuals less novel to the younger generations" (Hale, 1998).

Laboratory exercise

There was a significant increase in the time it took students to complete the task with a taped hand versus when they performed the task normally, which was expected given the obvious handicap associated with the addition of tape. This is evident when observing the types of movements students used while performing the tasks in Part B of data collection. The biggest increase in time was seen when attempting to tie their shoes, which was expected because you use your fingers and move your hand the most during this motion. Some possible errors in subject participation were observed during the completion of the simulation. When students were being timed, I noticed that some of the students were not performing the daily activities at a normal pace, instead it seemed that some subjects were racing to try and get quick times from their Attendant. Also, when the tape was added to their hand, I believe some subjects were trying to compensate for the restriction by trying to go even more quickly and forcefully through the activities. Some groups at the same table were racing each other and were prompted to do the tasks as they normally would. However, the data time-to-completion collected regardless of these observations were significantly higher when the hands were taped for all tasks. When talking with and assisting students during the simulation, I noticed that most students seemed to enjoy the simulation and some expressed that it was a nice change in pace from the usual lab protocol. Interactive learning allows students to think about the activities they are doing, understanding the purpose and lesson behind each activity (Hofstein & Lunetta, 2004). By creating an engaging simulation, a valuable opportunity is presented for students to experience what their patients could feel on a daily basis.

Some students were surprised by the feeling when the restrictions were added, sympathizing with their family members who have arthritis. While the general reaction to the simulation was observed to be a positive one, there were also some difficulties in the labs during the simulation. The instructional video that was prepared for the students pixelated for many of the lab sections, and was not available to play. I think some groups had some problems with wrapping the hand with only the picture to guide them, so I, along with the help of Teacher Assistants, went around the lab and assisted the groups. Some groups seemed to go through the tasks quickly, trying to get out of lab. Also, some students may not have taken the simulation seriously because it was so different and seemed fun compared to the usual lab activities.

Post-simulation survey data

When Subjects were asked whether they experienced difficulty with the tasks performed, most of them agreed or strongly agreed, which indicates that the restrictions were successful. The restrictions weren’t meant to hinder their movements too much or too little because individuals with arthritis still have mobility in their hands, just a decrease in mobility. This frustration could stem from the decreased range of motion they experienced, making them feel less in control, but their frustration could also be a result of the obvious increase in time-to-task. The longer it took the student to complete the task, the more frustrated they became, resulting in a decrease in mobility. Similar to Lorraine et al.'s (1998) Aging Simulation, this simulation gave students a realistic look at the frustrations that elderly persons may experience and increased their awareness of what it is like to be functionally impaired.

When asked if they thought this simulation would be useful in their future professions, most students either agreed or remained neutral. There may be room for improvement in this area by trying to connect the simulation with patient relationships by including asking Subjects to perform activities associated with going to see a doctor or staying at a hospital. Most students agreed that the simulation helped them understand the difficulties experienced by individuals who experience arthritis; however, students did not respond as enthusiastically when asked if this simulation helped them feel more comfortable when interacting with the elderly. Improving the link between the arthritis simulation and the idea of interacting with older individuals in the future could be improved by applying more role-playing activities for the Subject and Attendant like visiting a hospital for instance. A major goal of the simulation exercise is to allow students to feel more comfortable with the elderly by allowing them to gain knowledge about their lives so that their attitudes toward them can increase in a positive manner (Haylsip, 2013).

Even though verbal and visual directions were given to students, there was still room for error in the consistency of taping hands, resulting in in varying degrees of constriction. Not all of the students could act as Subjects during the simulation, so not everyone had the chance to directly experience the simulation due to time constraints in the laboratory. However, they did participate in the simulation by taping the Subject's hand and by measuring time-to-task. The attendants may have not gotten as much knowledge from the simulation compared to the subject. When there were groups of three, more groups chose to have two Attendants and one Subject, which could have led to social loafing (Silverthorn, 2006) in which case the second Attendant really would have not gotten as much knowledge out of the simulation.

Part B

The average difference in time to completion with the addition of tape increased, but not significantly so two of the tasks, when compared to the exercise data obtained in Part A. This could be a result of having a smaller sample population, making the results less reliable. Future research will need a preliminary power analysis (Kabacoff, 2014) to determine the minimal sample size.

There was also room for error when obtaining the maximum peak for data analysis. A mini-finger goniometer was used to quantify the range of motion in the pointer finger by recording when the subject either extended their finger (positive direction) or flexed their finger (negative direction). During each of the task, a multitude of movements was observed, which included both extension and flexions. Tying shoes was the most involved task, requiring an average of 6 movements with equal amounts of flexion and extension while the other tasks required less movements, on average about 2. After counting the number of movements required for each task, it was interesting to see that each subject moved in similar ways to complete the task. The more involved activities like tying shoes require more movement in the hands, so it would most likely be the most difficult task to complete with arthritis.

Only the largest motion was quantified for each of the tasks. For the first task, tying a shoe, the most extreme motion observed was flexion. The degree of flexion then decreased when the restrictions were added. Similar results were seen for signing their name. However, when opening a pill bottle, the most extreme motion observed was extension and the percent range in motion did not change when tape was added.

For task 4, texting a message, the most extreme motion was extension but then changed to flexion when the restrictions were added. This is interesting because it suggests that students resorted to an alternative way of using their pointer finger to type a message when their range of motion was limited by the tape. Also, even though I directed subjects to perform the tasks normally, I observed the students avoiding using their pointer finger because of the goniometer, which felt unnatural on their finger. The goniometer itself decreased mobility in the pointer finger, which is problematic when attempting to observe normal motions.

Using other methods of movement to complete a task when normal range of motion is restricted in some way is commonly used when people sustain injuries or have issues like joint immobility. A number of studies have reported altered neuromuscular activation and movement patterns during functional activities in individuals with knee osteoarthritis (Bennell et al., 2008). Bouchouras et al.'s study (2015) found that patients with moderate knee osteoarthritis rise from a chair using greater knee muscle co-contraction, earlier and greater activation of the hamstrings which results in reduced hip and knee range of motion. Recruitment of different types of movement is a way to overcome the pain and potential muscle atrophy of knee extensor muscle without compromising overall task duration (Bouchouras et al., 2015).

Modifications and Future Considerations

I hypothesize that future experiments that change the group dynamic will allow every student to experience the simulation directly. The lab protocol could also simulate different degrees or types of arthritis by using other methods of taping not only hands but also other joints of the body that is prone to joint pain. This can be done by consulting more hand therapists or by observing individuals who actually have arthritis and their degree of motion. I hypothesize that students will gain more from the simulation and will apply it to their futures by including more questions about ageism and question if students have shadowed in an environment in which they directly have interacted with older people. More activities of daily living, specifically ones that older individuals have difficulty with, could also be added so that students can understand the connection between the simulation and ageism.

More data could be collected by attaching the mini-goniometer to more fingers to see which movements are required for activities of daily living, strengthening the comparisons between Part A data and Part B data. Alternative equipment such as motion sensing gloves could also be utilized to measure flexion and extension of the metacarpophalangeal joint of thumb, index, and middle fingers (Carbonaro et al., 2014). Alternative equipment could be a solution to the issue of the finger goniometer itself decreasing mobility. The glove was designed by Carbonaro et al. (2014) using knitted piezoresistive fabric (KPF) sensor technology and was designed for continuous monitoring of patients during their daily-life activities. It is proven to have a low angular error, so using motion sensing gloves would not only allow for multiple quantification of movements in the hand but also a more accurate representation of movement. There are other methods of quantifying movement such as photographic-based goniometry, which is made possible by the new generation of smartphones that have computer-like functionality and an integrated digital camera. $DrGoniometer^{TM}$ developed the technology to make this possible and is an additional method of goniometry (Ferriero et al., 2013). Using alternative methods such as these would allow for an increase in data collection.

The surveys were effective in analyzing the student population who completed the simulation and by getting information on the effectiveness of taping the hands and from the student's personal experience with the simulation. The surveys could have included more questions that would have allowed the students to connect the idea of arthritis, ageism, and how these two things will affect them in their future professions. When I talked with students in the laboratory and explained the research behind the simulation, they were very intrigued and began to think about the activities more thoughtfully. Sympathy to arthritis by health care professionals would help with the treatment by improving the relationship between care providers and patients, which will ultimately encourage patients to feel comfortable sharing their pains.

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APPENDIX A

Pre-Simulation Survey

- Are you preparing to enter into a profession where understanding joint dysfunction would be important?

  YES NO

  If YES, which profession ____________________________

- Do you have family members who have joint pain stiffness/immobility?

  YES NO

- On a scale of 1-10 how comfortable are you with the elderly (aside from your grandparents)?

  1 2 3 4 5 6 7 8 9 10

- Please evaluate this statement by circling the response closest to your opinion: As people grow older they become less organized and more confused. (SA = strongly agree, A = agree, N = neutral, D = somewhat disagree, SD = strongly disagree)

  SA A N D SD

- Please evaluate this statement by circling the response closest to your opinion: Older people don't contribute much to society. (SA = strongly agree, A = agree, N = neutral, D = somewhat disagree, SD = strongly disagree)

  SA A N D SD

- Please evaluate this statement by circling the response closest to your opinion: Arthritis is a problem only experienced by the elderly. (SA = strongly agree, A = agree, N = neutral, D = somewhat disagree, SD = strongly disagree)

  SA A N D SD

APPENDIX B

Arthritis Simulation Exercise

1. Work in groups of two, one of you will be doing the activities (Subject), the other will be assisting (Assistant)

2. The Subject will do the following tasks and the Assistant will time from beginning to completion of each task (e.g. time-to-completion). The Assistant will need to get a watch or phone ready to time the Subject as they are performing acts of daily life.

Task	Time *from beginning to end of task* (sec)
Tie your shoes	
Write your name in cursive	
Open a pill bottle	
Text "hey, how are you?" on your phone	

3. Now, open https://youtu.be/Madsk3N1ilI on your computer. The Assistant will now tape the subject's dominant hand with self-adhesive tape using this instructional video. Only the dominant hand should be taped.

It may be helpful have the video open on your computer for the rest of the exercise. You will need to cut 5 short pieces of tape (3") and a long one (12"). Wrap **each** finger first with a small piece of tape and then place a button (shown as a quarter in the video) on the subject's hand above the thumb as seen in the video. The purpose of the button is so that there is some discomfort in the CMC joint, which a common occurrence with arthritis. Next, use the longer piece of tape to wrap along the base of the hand and around the knuckles so that the thumb is tucked tightly in. The tape should be tight enough to restrict mobility but not tight enough to stop blood flow.

4. Repeat the tasks previously performed and time them from beginning to completion. After each task, check the tape to make sure it did not loosen. If it did loosen, re-tape the hands as descripted in step 3.

Task with taped hands	**Time *from beginning to end of task* (sec)**
Tie your shoes	
Write your name in cursive	
Open a pill bottle	
Text “hey, how are you?” on your phone	

5. Remove the tape from the Subject’s hands. If the Subject feels any soreness in the hand, he/she should squeeze the manual therapy ball provided until soreness is relieved.
6. Both Assistant and Subject will complete the post-simulation survey

If you are interested in participating in a continuation of this experiment to quantify the decreased range of motion in the fingers, email aeoconno@go.olemiss.edu Thank you!

APPENDIX C

Post-Simulation Survey

- What was your role in the simulation? Subject Attendant
- If you were the Subject, please evaluate this statement by circling the response closest to your opinion: I experienced difficultly with the tasks performed with taped hands. (SA = strongly agree, A = agree, N = neutral, D = somewhat disagree, SD = strongly disagree)

  SA A N D SD
- If you were the Attendant, please evaluate this statement by circling the response closest to your opinion: I observed the subject experiencing difficultly performing the tasks with taped hands. (SA = strongly agree, A = agree, N = neutral, D = somewhat disagree, SD = strongly disagree)

  SA A N D SD
- If you were the Subject, please estimate you decrease in mobility while performing the tasks with taped hand.

  0-20% 20-40% 40-60% 60-80% 80-100%
- Please evaluate this statement by circling the response closest to your opinion: I found this simulation exercise to be interesting. (SA = strongly agree, A = agree, N = neutral, D = somewhat disagree, SD = strongly disagree)

  SA A N D SD
- Please evaluate this statement by circling the response closest to your opinion: I feel that this simulation exercise will be helpful in my desired profession. (SA = strongly agree, A = agree, N = neutral, D = somewhat disagree, SD = strongly disagree)

  SA A N D SD
- Please evaluate this statement by circling the response closest to your opinion: This simulation exercise increased my level of understanding of the difficulties experienced by people with joint disorders. (SA = strongly agree, A = agree, N = neutral, D = somewhat disagree, SD = strongly disagree)

  SA A N D SD
- Please evaluate this statement by circling the response closest to your opinion: I feel more comfortable interacting with the elderly after completing this simulation exercise. (SA = strongly agree, A = agree, N = neutral, D = somewhat disagree, SD = strongly disagree)

  SA A N D SD

Figure 1. Images used as models to develop joint dysfunction simulation. Received from Dr. Robin Parish, Assistant Professor at University of Mississippi Medical Center and certified hand therapist.

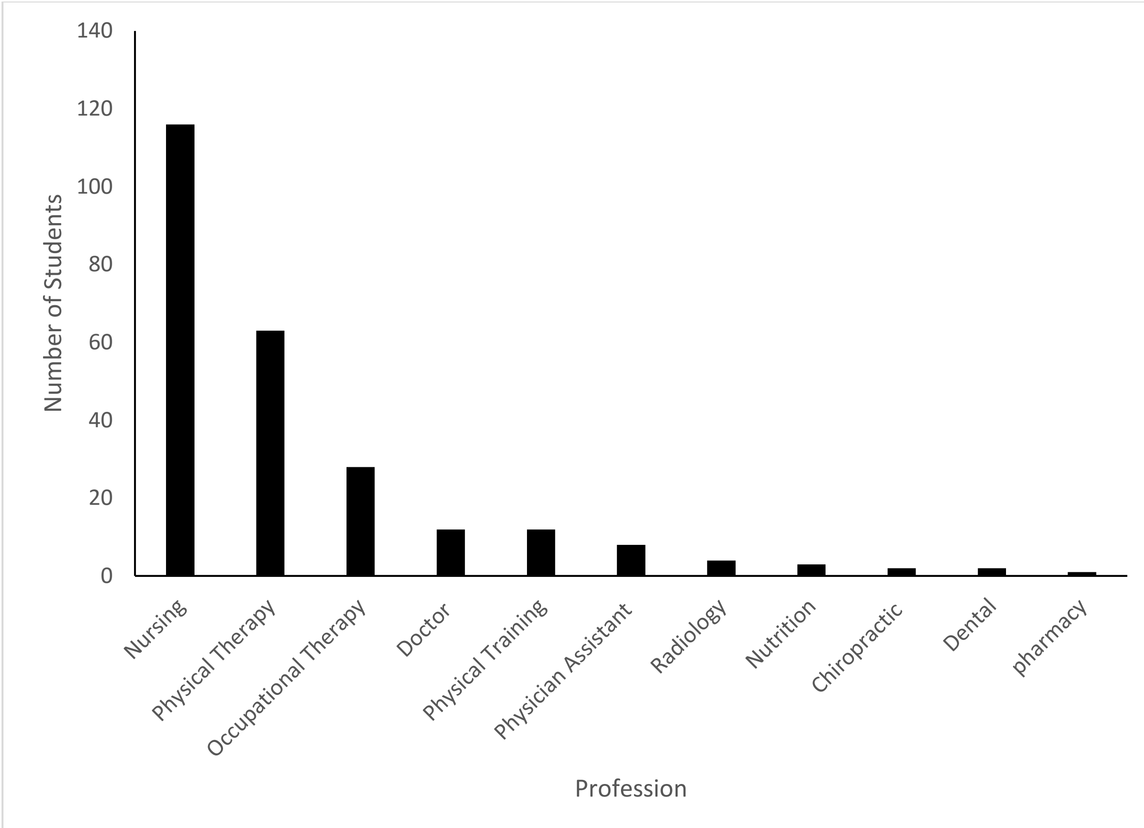

Figure 2. Common future health professions for students enrolled in Human Anatomy and Physiology I. Students who responded to this question believe their future profession will require an understanding of joint dysfunction.

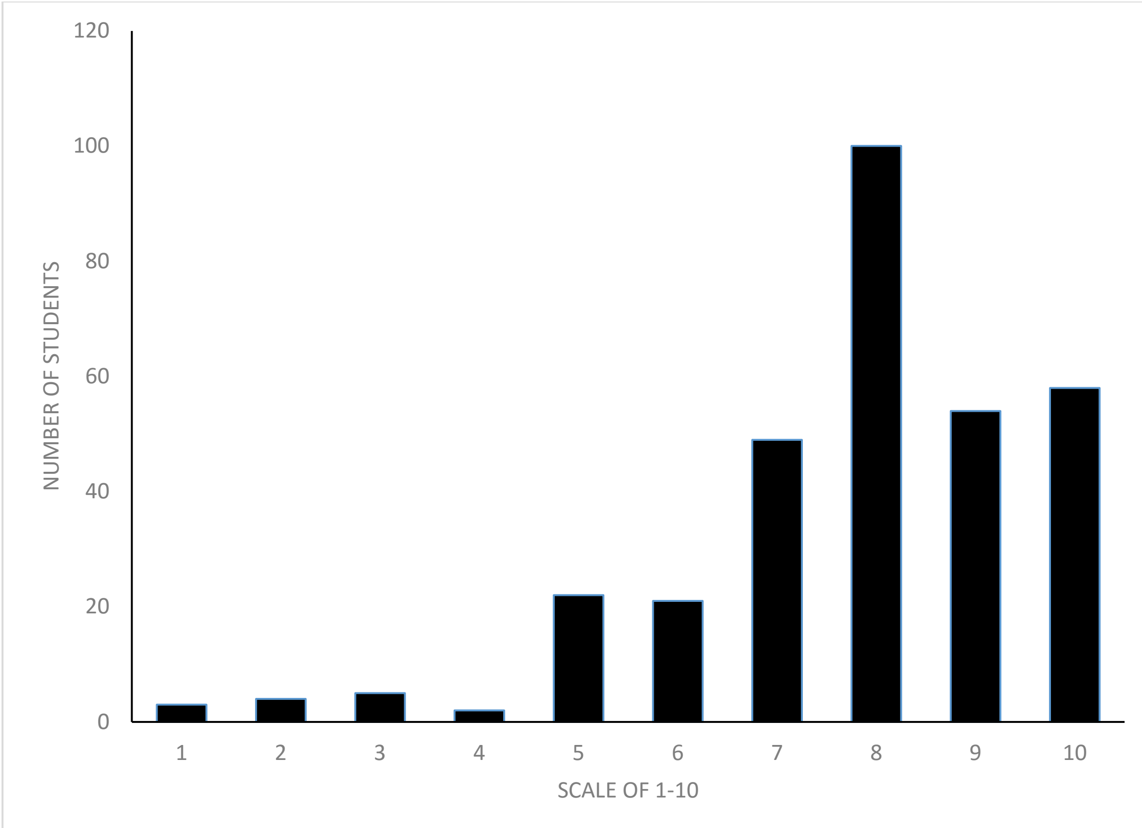

Figure 3. Student responses to Question 3 on the pre-simulation survey: How comfortable are you with the elderly (aside from your grandparents) with 10 being high and 1 being low.

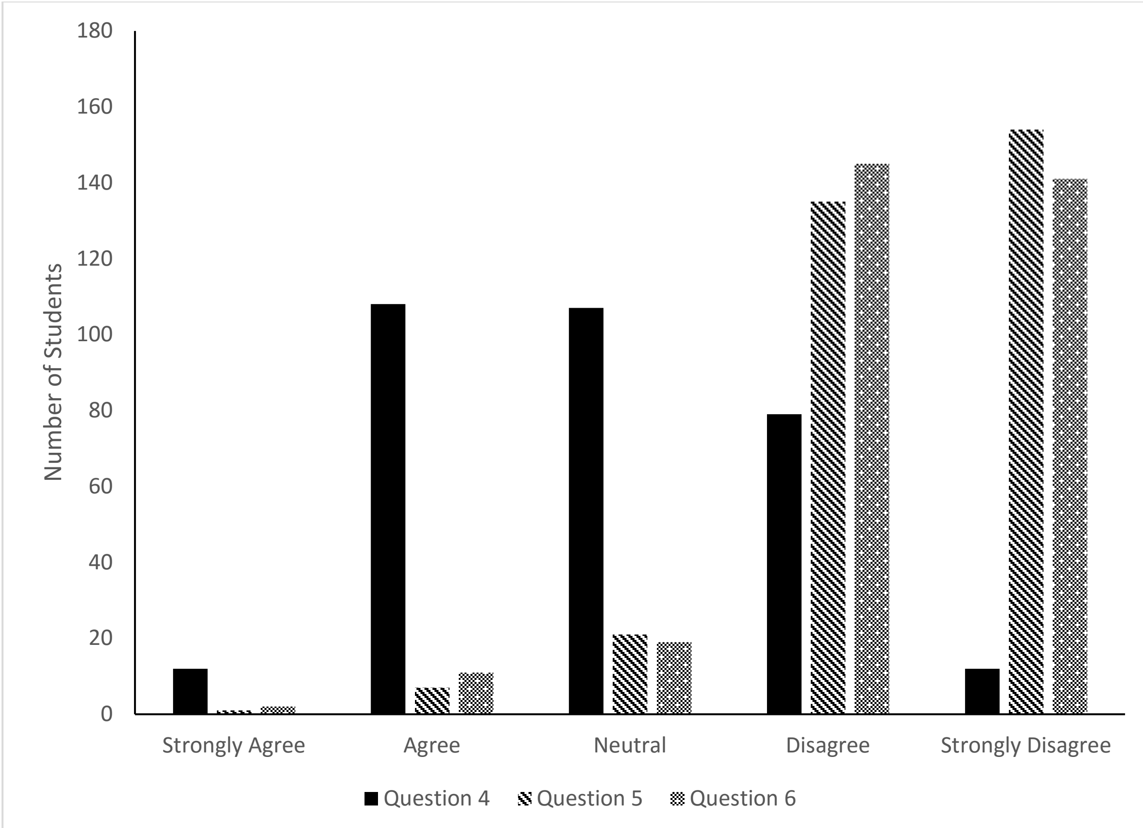

Figure 4. Student Responses to Pre-Simulation questions 4-6. Question 4: As people grow older they become less organized and more confused. Question 5: Older people don’t contribute much to society. Question 6: Arthritis is a problem only experienced by the elderly.

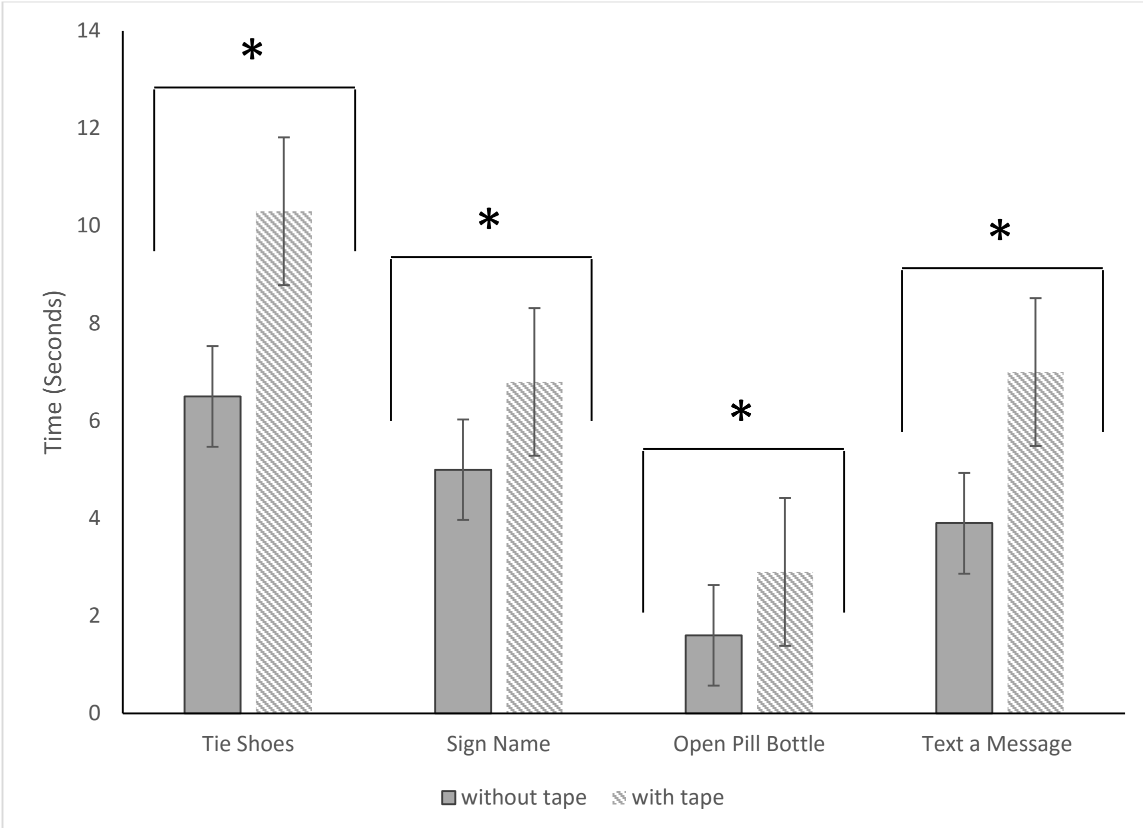

Figure 5. Difference in time to complete tasks without the addition of tape and then with the addition of tape during the simulation exercise. The simulation asked subjects to complete four tasks. Task 1: Tie shoes. Task 2: Sign name. Task 3: Open a pill bottle. Task 4: Text a message on a phone. An asterisk represents a significant result at $\alpha = 0.05$

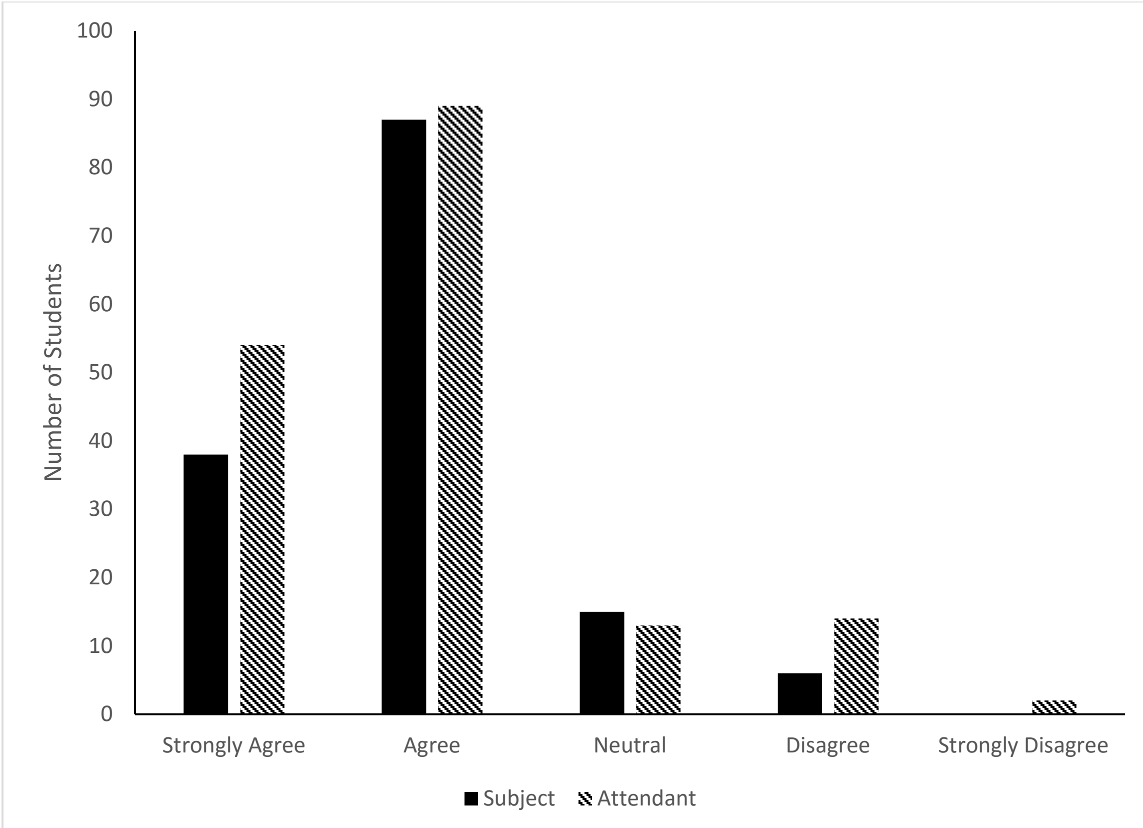

Figure 6. Student responses to question 1 of the post-simulation survey, which were individually directed towards the Subject or Attendant. The Subject responded to the statement: I experienced difficulty with the tasks performed with taped hands. The Attendant responded to the statement: I observed the subject experiencing difficulty performing the tasks with taped hands.

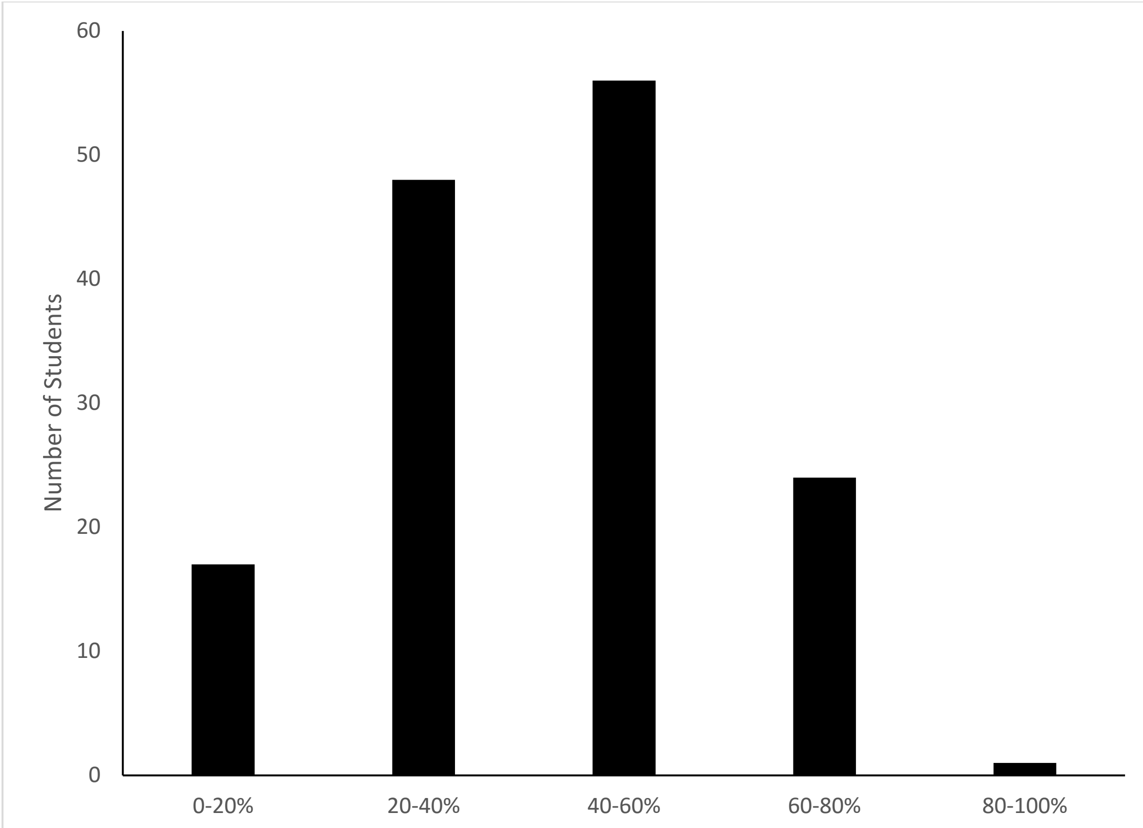

Figure 7. Subjects were asked to estimate their decrease in mobility while performing the tasks with taped hands

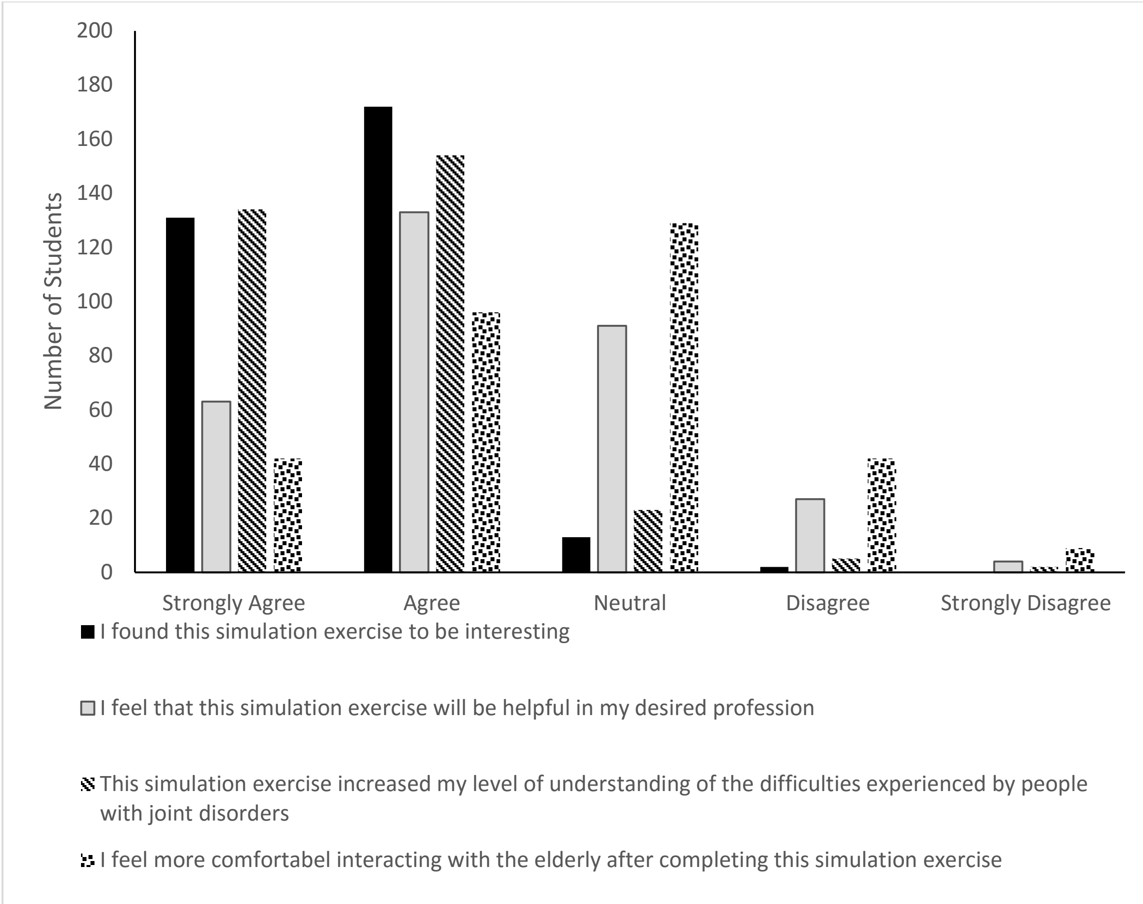

Figure 8. Student responses to question 3-6 in the post-simulation survey. Questions were answered by both Subjects and Attendants.

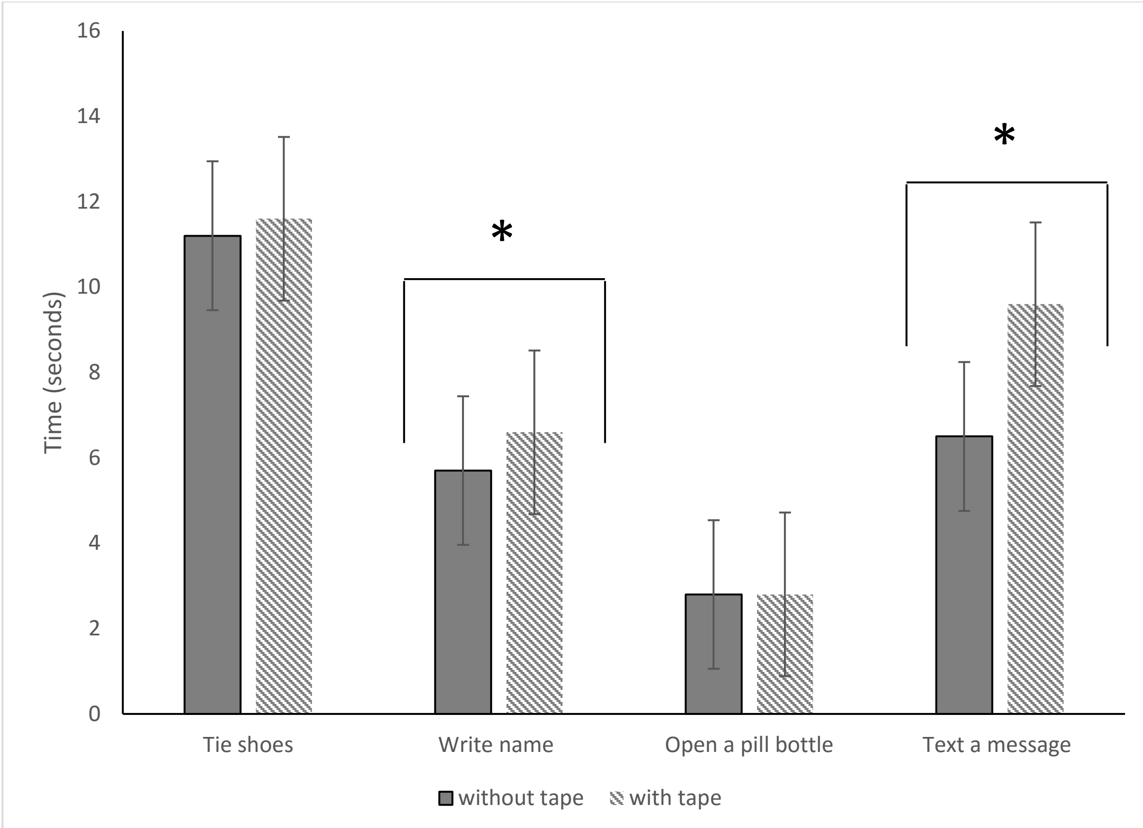

Figure 9. Difference in time to complete tasks without the addition of tape and then with the addition of tape during Part B of quantitative analysis. An asterisk represents a significant result at α= 0.05

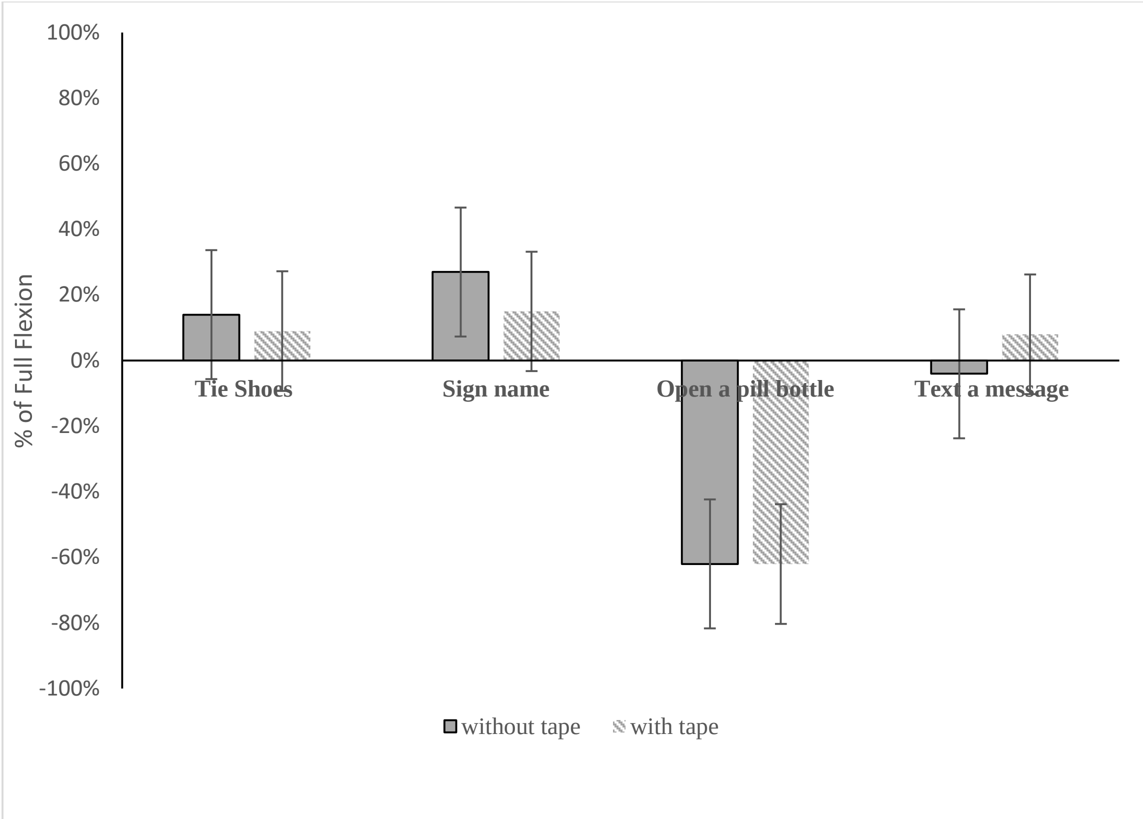

Figure 10. Quantitative measurements of the range of motion in the pointer finger during each of the four tasks with and without tape. Positive values indicate flexion, negative values indicate extension, and zero indicates resting position.