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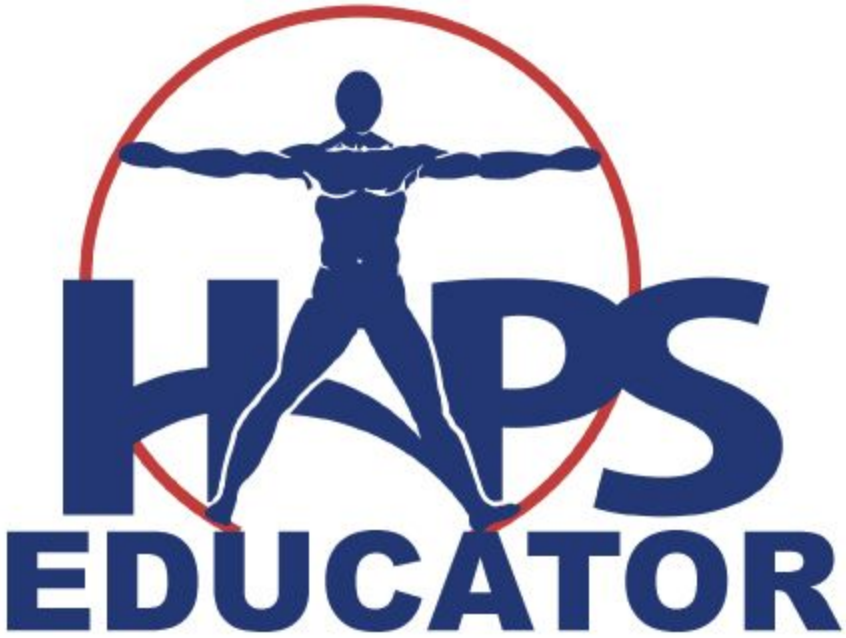

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Analysis of an Arthritis Simulation Activity Developed as a Laboratory Exercise for Allied Health Students

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Abstract

We developed an arthritis simulation learning and sensitization activity for a Human Anatomy and Physiology I laboratory. The protocol allowed 318 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. Students completed a pre-simulation survey, which assessed student knowledge about the elderly and arthritis. For the ADLs, students completed four simple tasks with and without taped hands that were 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. Most students agreed that completing each task was more difficult with the tape and that the simulation was interesting, which suggests the tape was an effective method to simulate arthritis for allied health students.

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). Unlike other prejudices, ageism has been poorly studied and there is little known about its origins and consequences (Robbins 2015). Ageism in health care professions could interfere with diagnosis and treatment of older patients. Palmore (1999) argued that health professionals share the same ageist attitudes that are present in society, compounded by a disease-oriented education. According to 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 where 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 and being ignored and patronized. They 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).

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 types 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 *et al*. 2009). In accordance with the Contact Hypothesis, stereotyping is not predicted to be higher among individuals who neither identify with nor have contact with the elderly (Hale 1998). Hale (1998) also found that 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.

During their educational career, students learn the logistics of growing old without learning how it feels to grow old. Lorraine *et al*. (1998) found that among the major roadblocks facing students 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 fears about their own aging and end-of-life issues. Many institutions have started to incorporate a geriatric curriculum into their programs. A typical program includes a one-week geriatric experience that includes an aging game, a mentoring program with healthy seniors, and the use of standardized patients, all of which have been proven to improve student relations with the elderly (Douglass *et al*. 2008, Duke *et al*. 2009). The "aging game" is a sensitization exercise that uses cards and the performance of acts of daily living (ADLs). It was inspired by an aging game created by faculty at Eastern Virginia Medical School (Douglass *et al*. 2008), which was made mandatory for fourth-year medical school students. In this sensitization exercise, students are assigned an illness common to the older population. The illness is simulated using simple techniques such as

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wearing clouded glasses to simulate glaucoma. Students are asked to perform ADLs, such as paying bills, while the appropriate simulated impairment is in place (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).

The aim of this experiment is to develop and assess a arthritis simulation learning activity for a Human Anatomy and Physiology I lab exercise on joint structure and function. In an emotionally oriented arthritis sensitization exercise, students can experience some of the physical limitations associated with the arthritis of aging. Arthritis is considered the number one cause of disability in the United States. It encompasses a wide variety of inflammatory and non-inflammatory joint diseases [Arthritis Foundation (AF) 2016]. 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. It causes pain and swelling as the inner bone surfaces become exposed and rub together, which ultimately results in damage to muscles and nerves, pain, deformity, and difficulty moving (AF 2016, CDC 2015). The number of Americans who live with arthritis will grow as the number of older Americans continues to increase. At present, as estimated one in five (22.7%) adults in the United States report having doctor-diagnosed arthritis (AF 2016, CDC 2015).

We have not found any documented cases of aging "games" used in undergraduate education. Our new simulation will allow students to understand and experience the physiology of aging joints and the functional limitations resulting from arthritis. We hypothesize that simulated constrictions applied to the fingers and hands will increase the amount of time needed to complete ADLs. We also hypothesize that students will find the simulation interesting. It will be a successful educational experience, allowing students to feel more comfortable with the elderly.

MATERIALS AND METHODS

Three hundred and eighteen students enrolled in Human Anatomy and Physiology I at the University of Mississippi were recruited to participate in this study. All were traditional undergraduate college students between the ages of 18 and 23. The students, varying with respect to race and gender, were healthy, and did not experience any physical injury or negative side effects as a result of this study. The experimental protocol was approved by the University of Mississippi Institutional Review Board (IRB #15-059). Students were not compensated in any way or awarded course points for participation in the experiment.

A pre-simulation survey was given to students to identify their future profession and assess their familiarity with and attitudes about the elderly. Questions were chosen to identify feelings of ageism and knowledge of arthritis. 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 2009).

The experimental protocol (Appendix A) required students to work in pairs 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 in this study. The Subject was first asked to perform four tasks while the Attendant was instructed to time the tasks from beginning to end, using a stopwatch or smartphone. The four tasks (tying their shoe, signing their name, opening a pill bottle, and texting a message) were chosen as ADLs because these tasks may be difficult to complete as one ages. Subjects were encouraged to perform each task as they normally would. The Attendant was then instructed to tape the Subject's dominant hand with self-adhesive tape, which is a cohesive elastic wrap made of nonwoven material and synthetic elastic fibers (3M™ Coban™). In order to imitate arthritis effectively, and therefore make the simulation effective, we consulted a professional hand therapist, Dr. R. Parish; University of Mississippi Medical Center, for a concise description of the taping method. Dr Parish directed the Attendant to

Figure 1. Taped hand models used to develop joint dysfunction simulation (photos courtesy of R. Parish).

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wrap the thumb so that it is pointed slightly inwards after placing a button over the first carpometacarpal (CMC) joint to remind the student of the pain that usually occurs in that location. The remaining fingers and palm of the hand were wrapped tightly enough to limit movement but not to the point of discomfort (Fig. 1). 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 ADLs again while being constricted with the tape and 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 to help alleviate any hand discomfort following the experiment.

A post-simulation survey was given after students completed the lab exercise to assess the success of the experiment as a sensitization exercise and as a potential laboratory exercise for the future. The survey asked the participant to identify their role in the experiment, either Subject or Attendant, and to evaluate their experience with the simulation either with the Likert survey or by a scale of percentages from 0-20% to 80-100% in response to each statement.

Descriptive statistics, including mean and standard error, were calculated for all data collected including the pre- and post-simulation surveys and the simulation exercise. Chi-square tests (Siegel and 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) were analyzed using paired, two-sample for means, t-tests. 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, a physical therapist, or an occupational therapist (Fig. 2). Most students (74.8%) responded that they have family members who have experienced joint pain or immobility. When asked on a scale of 1-10 how comfortable the student was with the elderly, with 1 being not comfortable at all and 10 being very comfortable, 100 students rated their comfort level with an 8, 58 students reported a level of 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). In evaluating the statement, "Older people don't contribute much to society," 154 students Strongly Disagreed and 135 Disagreed, only 7 students Agreed (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 Disagreed (X^2=332.8, df =4, p<0.001; Fig. 4).

Laboratory Exercise data

Time-to-completion data from the simulation exercise were analyzed using a two-tailed, paired t-test for each of the four tasks (Fig. 5). Times increased significantly for each task (p< 0.001 for each test) when the hands were taped as compared to when hands were not taped.

Post-Simulation survey data

When Subjects were asked if they experienced difficulty with the tasks with taped hands, 87 of 147 subjects Agreed and 38 Strongly Agreed while 15, 6, and 0 students respond with Neutral, Disagree, or Strongly Disagree, respectively. Responses to this statement were significantly different than expected (X^2=171.6, df = 4, p<0.001). Subjects estimated their decrease in mobility while performing the tasks with taped hand using percentages ranging from 0-20 % (17 Subjects), 21-40% (48), 41-60% (56), 61-80% (24), and 81-100% (1). Attendant responses to the statement, "I observed the Subject experiencing difficulty performing the tasks with taped hands," were significantly different than expected (X^2=153.8 df =4, p<0.001) with 54, 89, 13, 14, and 2 Attendants responding Strongly Agree, Agree, Neutral, Disagree, or Strongly Disagree, respectively.

When Subjects and Attendants were asked 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 6). One hundred thirty-three students Agreed that they believed this simulation would be useful in their future professions (X^2=164.5, df =4, p<0.001; Fig. 6). When students were asked if this simulation exercise increased their level of understanding of the difficulties experienced by people with joint mobility disorders, 154 students Agreed and 134 Strongly Agreed with this statement (X^2=346.0, df =4, p<0.001; Fig. 6). Most students responded Neutrally (129) when asked to evaluate the statement, "I feel more comfortable interacting with the elderly after completing this simulation exercise" (X^2=145.3, df = 4, p<0.001; Fig. 6).

DISCUSSION

As anticipated, most students have a family member who has arthritis. When a high percentage of people already possess a personal context and image of arthritis, simulation exercises can be an effective means of developing empathy for family members and potentially patients who experience immobility in their day to day

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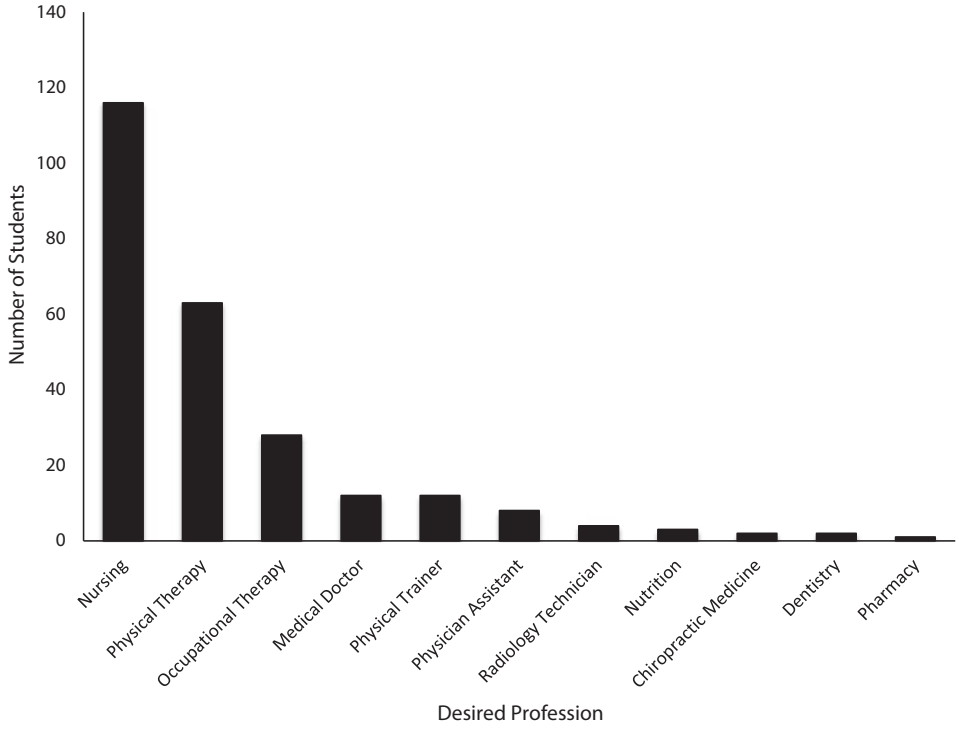

Figure 2. Common future health professions for students enrolled in Human Anatomy and Physiology I at the University of Mississippi during the fall semester of 2015.

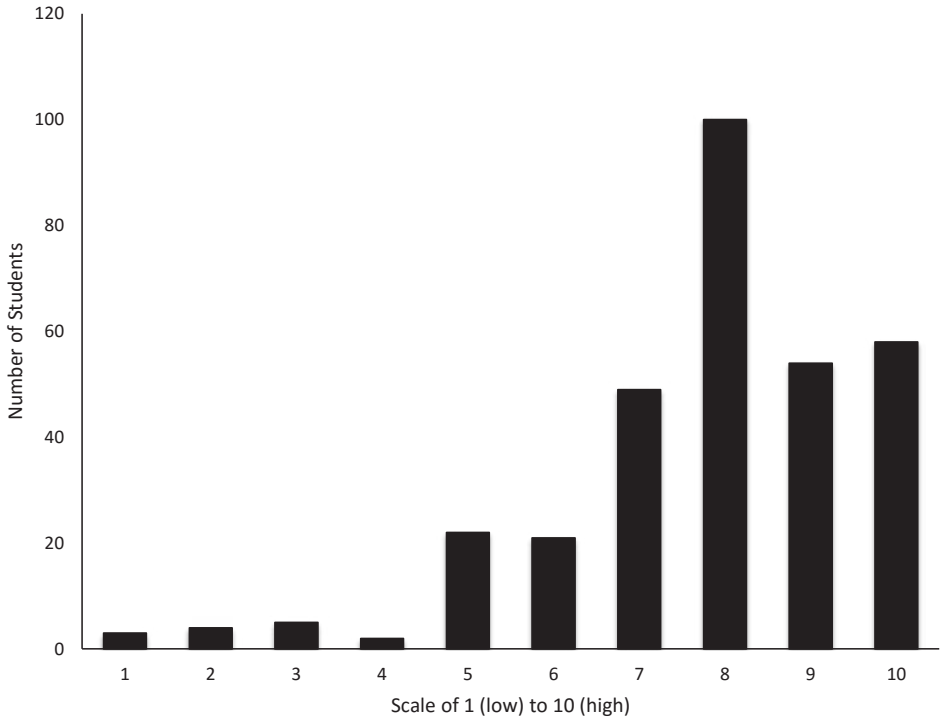

Figure 3. Student responses to Question 3 on the pre-simulation survey, "How comfortable are you with the elderly (aside from your grandparents)?"

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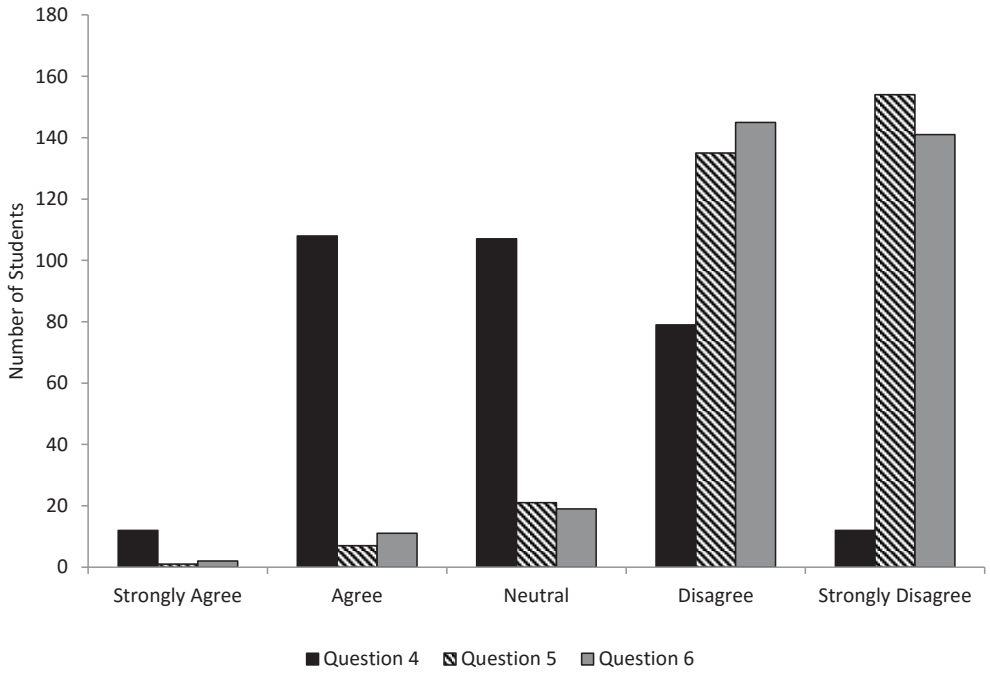

Figure 4. Student responses to Pre-Simulation Likert-style question 4 (As people grow older they become less organized and more confused), question 5 (Older people don't contribute much to society), and question 6 (Arthritis is a problem only experienced by the elderly).

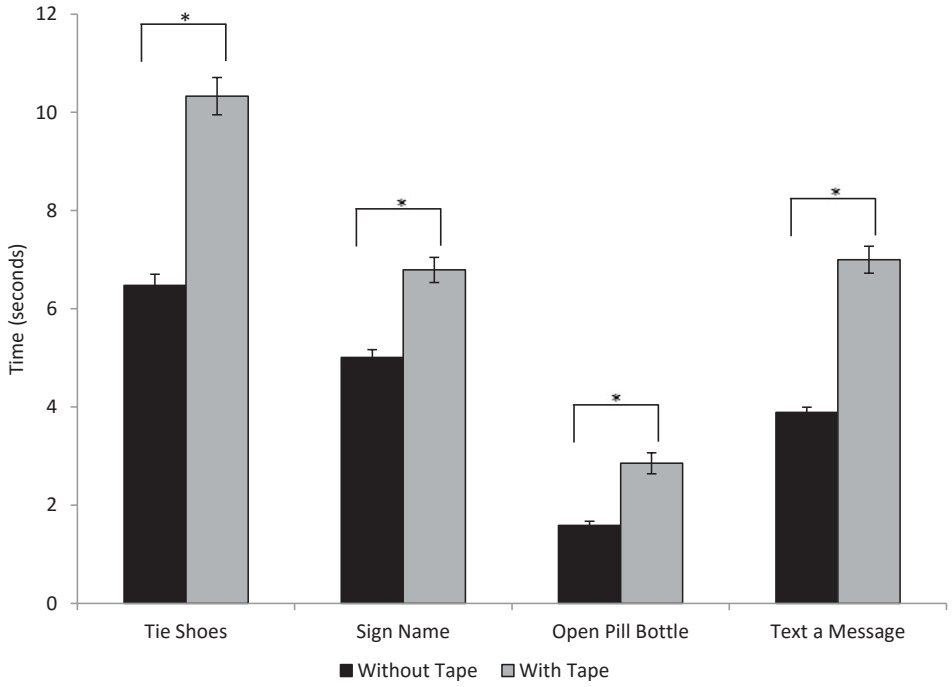

Figure 5. Mean (± 1SE) time-to-completion for four daily living tasks without and with the addition of restrictive tape on the hands. An asterisk represents a significant paired t-test result at α= 0.05 (df=151).

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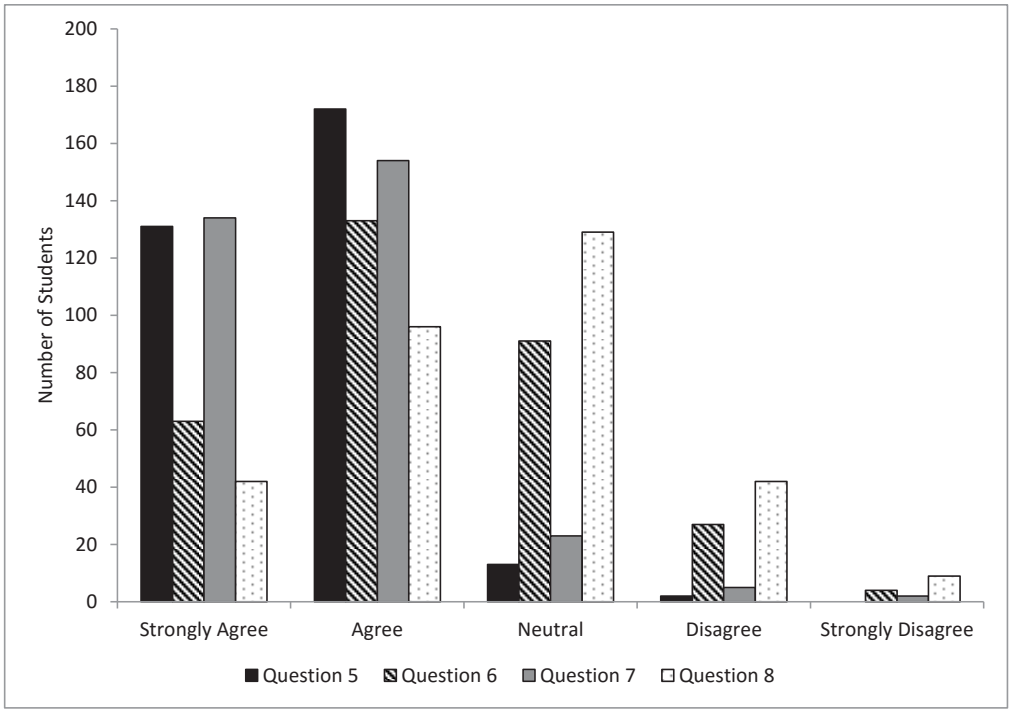

Figure 6. Student (both Subjects and Attendants) responses to Post-Simulation Likert-style question 5 (I found this simulation exercise to be interesting), question 6 (I feel that this simulation exercise will be helpful in my desired profession), question 7 (This simulation exercise increased my level of understanding of the difficulties experienced by people with joint disorders), and question 8 (I feel more comfortable interacting with the elderly after completing this simulation exercise).

lives. However, the students reported degree of comfort with the elderly was not expected. We expected more students to respond with a score below 5, meaning that they were not very comfortable with the elderly. According to Hayslip *et al*. (2013), younger individuals tend to have more negative attitudes towards aging when comparted to their older counterparts. Students in this study 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 from job shadowing opportunities students may pursue for their future careers in the health professions.

It was unexpected that more students were willing to Agree that, "as people grow older they become less organized and more confused", and more ready to Strongly Disagree 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. 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. 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 (Hogg 1987). Members of the in-group (in this case younger individuals) tend to favor positive characteristics within their group and stereotype members of the out-group (in this case older individuals) with less favorable characteristics thus enhancing the individual's personal identity (Hale 1998).

Laboratory exercise

There was a significant increase in the time it took students to complete the ADL with a taped hand versus the time it took students to perform the task normally,

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which was expected given the obvious handicap associated with the addition of tape. The biggest increase in the length of time required to perform a task was seen when students attempted to tie their shoes with tape on their hand. This was expected because of the multiple finger and hand motions used in this ADL. Some possible errors in Subject participation were observed during the completion of the simulation. When students were being timed, we noticed that some of the students were not performing the 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, 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 even after prompting to perform the tasks as they normally would. However, the time-to-completion data collected were still significantly higher when the hands were taped for all tasks. When talking with and assisting students during the simulation, we noticed that most students seemed to enjoy the simulation and some expressed that it was a nice change in pace from the usual lab activities. Interactive learning allows students to think about the activities they are doing and to understand the purpose of each activity (Hofstein and 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 for the proper way to wrap the hands was not consistently available for student viewing and as a result, some groups had problems with hand wrapping using only a picture to guide them. When this occurred, the course instructor and Teaching Assistants provided assistance in hand wrapping. Some groups seemed to go through the tasks quickly, trying to leave lab early and some students may not have taken the simulation seriously because it was different and seemed to be more entertaining that the usual lab activities.

Post-simulation survey data

When Subjects were asked whether they experienced difficulty with the tasks performed, most Agreed or Strongly Agreed, which indicates that the restrictions were successful. The restrictions were not meant to hinder hand movements too much because individuals with arthritis still have mobility in their hands. The difficulty and frustration experienced by the Subjects could stem from the decreased range of motion they experienced, making them feel less in control. It could also be a result of the obvious increase in time-to-task completion. Similar to the Aging Simulation developed by Lorraine *et a*l. (1998), 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.

Most students either Agreed or remained Neutral when asked if they thought this simulation would be useful in their future profession. Improvement may be made in this area by simulating activities associated with going to see a doctor or activities associated with a hospital stay. 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 ability to interact with older individuals in the future could be improved by applying more patient-to-provider role-playing activities for the Subject and Attendant. A major goal of the simulation exercise was to allow students to feel more comfortable with the elderly by allowing them to gain knowledge about the everyday lives of the elderly in the hope that student attitudes toward the elderly might increase in a positive manner (Hayslip *et al*. 2013).

Modifications and Future Considerations

Even though verbal and visual directions were given to students, there was room for error in the consistency of hand taping that resulted in varying degrees of hand and finger constriction. Due to the time constraints of the lab, it was not possible to allow all of the students to play the role of Subject during the simulation. Consequently there were some students in each lab who did not have a chance to directly experience the simulation activity. However, these students did participate in the simulation by taping the Subject's hand and by measuring time-to-task. The Attendants may have not have gotten as much knowledge from the simulation as the students who played the Subject did. 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 would not have had a rich simulation experience.

When we spoke 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. If health care professionals are more sympathetic to people who have arthritis, it might help with patient treatment by improving the relationship between care providers and patients and encourage patients to feel more comfortable sharing their pain with

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their care provider. Enhancements to the lab protocol could be made to simulate different degrees or types of arthritis by using other methods of taping not only hands but also other joints of the body. This can be done by consulting more hand therapists or by observing individuals who actually have arthritis and their degree of motion. More activities of daily living, specifically ones that older individuals have difficulty with, could also be added so that students can more fully understand the connection between the simulation and the aging process.

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APPENDIX A

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 have 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. Open the instructional video on your computer. You will need to cut 5 short pieces of tape (3") and a long one (12"). The Assistant will tape the subject's dominant hand with self-adhesive tape using the instructions contained in this instructional video. 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. The purpose of the button is to add some amount of discomfort in the first carpometacarpal joint, which a common occurrence with arthritis. Next, use the long 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 and re-tape the hands as descripted in step 3 if necessary.

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

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