The Effects of Instructional Strategies on Adherence to a Flexibility Program and Physiological Outcomes

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The effects of instructional strategies on adherence to a flexibility program and physiological outcomes

Peter Waisala

School of Sport Science and Wellness Education

Honors Research Project

Submitted to

The Honors College

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Abstract

The purpose of this study was to investigate whether or not different instructional techniques (written material versus teacher demonstration and feedback) have an affect on the improvements in flexibility, adherence to a stretching program, and the quality at which stretches are performed. Thirty one college students were recruited from The University of Akron to follow a four week stretching routine designed for the quadriceps musculature. This was a randomized experimental study with three groups. Quadriceps flexibility was assessed during the pretest and posttest using the modified Thomas test. The control group (n= 15) completed a pretest and posttest, but did no stretching during the four weeks. The written material group (n= 9) received a packet with instruction on how to complete the stretching routine on their own time. The demonstrational group (n= 7) met with the researchers twice a week for the four weeks and were instructed and given feedback concerning execution of the stretches. Paired T-tests comparing the pretest and posttest data for the control group resulted in a p-value = 0.034, written group p-value = 0.004, and demonstrational group p-value = 0.0001. The average adherence rate between the written and demonstrational groups did not significantly differ. An $R^2 = 0.075$ indicates a very weak correlation between adherence rate and flexibility improvements for the written group. An $R^2 = 0.61$ indicates a much stronger, but still a weak correlation between adherence rate and flexibility improvements for the demonstrational group. With the current population studied, the results imply that demonstrating the stretches and providing feedback is more effective for improving quadriceps flexibility and possibly quality of stretching than providing written material alone. With limitations such as a small sample size and reliance on self-reports, this study has acted as a pilot test for future larger scale studies in this area.
Introduction

On a regular basis health care professionals develop and prescribe a variety of exercise programs for their patients and clients in order to improve their patient’s health and well-being. Most of these exercises and tasks must be completed by patients on their own, as the health care professional cannot supervise them outside of the clinical setting. While some patients may be familiar with some exercises, other exercises may be new. It is the responsibility of the health care professional to properly instruct their patients and clients on how to safely and properly perform the prescribed exercises. Therefore, proper instructional techniques must be utilized by the health care professional to insure that their patients and clients possess the required knowledge as well as self-efficacy to consistently perform these exercises on their own. This raises the question as to what an effective instructional technique consists of, in order to positively affect adherence, effectiveness, and safety of an exercise or rehabilitation program. Are quick verbal instructions along with written and illustrated handouts adequate, or is a more comprehensive approach required?

Most research regarding optimal instructional strategies assesses the effects of home based programs, pamphlets or brochures, as well as supervised exercise as a means to determine exercise adherence, quality of performance, and physiological outcomes among certain populations. Additionally, aerobic and resistance training are the most readily utilized exercise modes by the everyday population and are also the most commonly tested with regards to this topic. However, information concerning the relationship between instructional techniques and adherence to a stretching routine is limited in the literature. It is also important to evaluate the quality of performance based upon the improvements gained in flexibility if the program is adequately executed.
The aim of this study is as follows:

1. To determine if different instructional techniques affect the flexibility improvements in individuals who follow a specific flexibility program.

2. To determine if different instructional techniques affect the adherence to a flexibility program.

3. To determine if different instructional techniques affect the quality stretching.

It is hypothesized that a supervised group receiving a comprehensive instructional strategy, which includes written material and visual demonstrations, will elicit greater improvements in quadriceps flexibility, exercise adherence, and quality of stretching than those receiving only a written instructional brochure.

**Literature Review**

Whether for therapeutic or general health goals, the success of all exercise programs depends on several factors. The program must be specific to the goals of the patient and follow proper frequency, intensity, duration, and progression of the exercises. Possibly of even greater importance is that the patient performs these exercises consistently and correctly, as the benefits of a particular exercise are most likely associated with the quality of that exercise performance. Multiple instructional techniques are available for clinicians to utilize to teach proper execution of the exercise and increase the likelihood of program adherence. These include brochures, video and audiotapes, as well as supervised instruction with feedback.

Written materials offer several benefits to teaching; however, there are also some disadvantages associated with this mode of instruction. Patients may have various ranges of
literacy, requiring that written material provided by healthcare professionals be comprehensible for all levels. A study conducted by The National Work Group on Literacy and Health (1998) reveals that regardless of literacy level, people prefer simple written materials and have more success at comprehending the material. As a general guideline, materials should be written to the targeted audience; however, in a clinical setting this is not possible as patients will vary in literacy capabilities which may not be known to the health care professional beforehand. It is recommended that materials be written two to four grade levels below the average reading grade level of the patients that will be receiving the information (Boyd, 1987). In the event that the literacy level of the targeted population cannot be predetermined, the material should be written to a fifth to sixth grade level (Estey, 1991).

Another important feature of an instructional or educational brochure is the addition of illustrations. A study by Kitcihing (1990) shows that illustrations do not always contribute to improved comprehension and can even be a distraction if used inappropriately. Conversely, another study by Michielutte and colleagues (1992) indicates that brochures that included illustrations increased comprehensibility and ease of reading the material compared to brochures with only written text. However, this was only apparent in people with lower literacy levels. Despite the controversy, a study of patients participating in a focus group revealed that they appreciated illustrations in their written materials (Tang, 1998).

According to Bernier (1993), brochures and handouts offer a quick and fairly inexpensive means of providing instruction and education to a vast number of patients. These written materials also provide a consistent message that is portable, reusable, and can distributed to patients in a variety of ways, such as in person or via mail or email. Predominantly, written materials allow for a patient to refresh their memory as needed, as one third to one half of
patients seem to forget or misunderstand information that is verbally expressed to them (Ley, 1984). Additionally, studies show that patients appreciate and often request written handouts to reinforce what the health professional verbal stated (Webber, 1990).

From these previous studies, it can be suggested that if used correctly, illustrations may improve readability and comprehension of written material. If nothing else, they may make the material more appealing to patients, thus increasing the chances that the material is actually read. Besides literacy level and illustrations, Hoffman and colleagues (2004) provides other recommendations for effective written materials which will not be discussed, but include: content, language, organization, layout and typography, illustrations, and learning and motivation. The effectiveness of written materials depends on the careful planning of the materials’ design.

While having written material that is easy for patients to read and understand is essential, the material is not effective if patients do not adhere to the instruction stated in that material. A study by Jackson (1994), examined the effects of brochure use on increasing adherence to an exercise program for patients with low back pain. Two groups received a brochure from their physician with information pertaining to their injury, the therapeutic treatment plan, and rationale for the plan. One group received a brochure with “relevant cues” pertaining to this physician, which included a picture of the doctor and statements attributed to him. This was deemed the higher quality material. The other group received the brochure with the same information except the “relevant cues” were omitted. The control group received no brochure. The results showed that the group receiving the higher quality brochure showed greater exercise adherence (90%), and the control group adhered only 50%. Surprisingly, there was no significance difference between the control group and the group receiving the brochure without the relevant cues. The
The author suggests that even the impression of personal contact with a healthcare provider may increase exercise adherence. This study also analyzed pain levels among the groups, which showed no significant difference in the amount of pain that was decreased. This may suggest that even though adherence was improved, the quality at which the patients performed their exercises may not have been adequate. However, it is worth noting that the study lasted only three weeks, which may not have been enough time for notable decreases in pain levels. Yet even though the pain levels remained relatively constant, it appears that the patients receiving the higher quality brochure may have been more motivated to continue following the program.

Other instructional strategies include multimedia such as videotapes which allow patients to preview an exercise. An even more comprehensive approach involves demonstrating the exercise along with supervision from a healthcare professional, which allows for patients to actually see exercises performed correctly and receive constructive feedback. These instructional strategies offer better advantages and may ultimately be more effective than brochure usage alone.

Following clinically based therapy, some patients may be instructed on how to properly perform exercises for a home based program through the use of written material with illustrations, videotape, or demonstration. Illustrations are considered a static model, while videotape and other demonstrational methods are dynamic modeling (Weeks, 2002). Research shows that viewing an action and trying to replicate that action stimulate overlapping cortical areas of the brain (Iacoboni, 1999). This suggests that observing an exercise and performing the exercise requires similar neural networks to be involved. Bandura (1997) suggested that modeling has an impact on motivating the observer to practice that observed activity. However, he did not specify which type of modeling, static or dynamic, to be the best motivator.
Several studies support Bandura’s proposal and expand upon it to show how different instructional techniques not only motivate, but improve adherence to a program and the quality of exercise performance. A study by Weeks and colleagues (2002) studied the effects of photographs versus video tape demonstration for influencing the quality of performance, motivation, and confidence in performing simple and complex exercises. The results showed that the subjects viewing the videotape were more successful in learning and being able to recall how to properly perform an exercise regardless of the complexity, compared to the group just viewing an illustration. This was shown as this group received higher rating scores on exercise form. At the end of this study, the groups were exposed to the alternate mode of instruction and completed a survey. The results showed that those receiving videotape instructions would be more motivated, more confident in properly performing the exercises, and more likely to adhere to a home based exercise program than if they had only received illustrations.

According to Friedrich (1996), who tested the effectiveness of a therapeutic exercise program for back and neck pain when instructed by brochure or therapist supervision, patients who were supervised by the therapist experienced better pain relief correlated to higher quality of exercise performance. An increased motivation, overall adherence to the program, and better quality of exercise performance was proposed to be a result of a stronger patient physical therapist relationship developed through interaction while being supervised. Furthermore, in Taheri’s (2012) study involving the use of pamphlets and therapeutic supervised exercise to improve neck pain from computer use, results revealed that individuals supervised by a health care professional had significantly higher rates of decreased chronic neck pain compared to the group receiving pamphlets as instructional guides for therapy. Another study focusing on adherence to exercise found that the key to adherence was providing the individual with frequent
and consistent feedback (Shakudo 2011). Oftentimes patients will need to do exercises on their own in between physical therapy sessions, so this study reinforces the need for health care providers to give feedback to their patients during follow up appointments in order to enhance continual adherence to the prescribed exercises.

Besides studies analyzing effectiveness of instructional strategies and supervision of therapeutic exercises for orthopedic impairments, mixed results have arisen from others investigating this matter with regards to individuals suffering from exercise limiting health conditions. A study determining the effectiveness of home based pulmonary rehabilitation versus outpatient rehabilitation for patients with chronic obstructive pulmonary disease shows that the two programs are equally successful in improving dyspnea, health status, exercise tolerance, and deemed safe (Maltais, 2008).

However, a study by Savage and colleagues (2001), explored the efficacy of home based exercise programs versus supervised hospital based programs for improving exercise tolerance in patients with intermittent leg claudication. The results reveal that those participating in a supervised exercise program had better improvements than the home based program. Although the home based group did present with significant improvements compared to the control group. This suggests that provided with proper guidance, a home based program can still be effective. It should be noted that it was not mentioned how the home based program group was instructed, just that they received adequate instructions from a nurse. A similar study by Patterson (1997) showed that both the supervised and home based exercise program participants gained significant improvements in exercise tolerance. However, the home based group met weekly with a nurse to discuss the program, while Savage’s study had the home based group discuss the program every month via telephone. Conversely, another study of similar design resulted in non-significant
improvements in exercise tolerance for the home based exercise program (Regensteiner, 1997).
While controversial studies exist, the majority of the research elucidates to the fact that the use of
demonstration and supervision as instructional techniques lead to increased levels of motivation,
higher adherence rates, favorable physiological outcomes, and safer exercise environments due
to continuous supervision and feedback compared to those receiving only written materials for a
home based program.

Methods

Subjects

Thirty one students from The University of Akron were recruited as participants for this
study; however, two participants dropped out during study leaving thirty one subjects. Subjects
were between the ages of 18 and 37 with the average age being 22 years old (SD = 3.4), with an
average height of 66.7 inches (SD= 2.9) and an average weight of 163 pounds (SD= 41.1). All
subjects were apparently healthy. Those who were excluded included any individuals with a pre-
existing health or orthopedic condition that compromises their safety and wellness during an
aerobic warm up and/ or stretching. All participants filled out a Physical Activity Readiness
Questionnaire (PAR-Q) and an informed consent form prior to participation.

Procedure

This was an experimental designed study with the participants randomly assigned to one
of three groups. Fifteen (n=15) people were assigned to the control group. This group was
instructed to maintain their current lifestyle; this included any regular exercise that they may
have been performing.
Nine (n=9) subjects were assigned to the second group, which was the written
instructional group. This group received an instructional brochure (Shown in Appendix A) that
described how to perform three yoga stretches that targeted the quadriceps, and three stretches
that focused on the hamstrings. Quadriceps stretches that involved knee flexion and hip
extension were similar to ones that Peeler and Anderson (2007) found to produce significant
improvements in flexibility for individuals with patellofemoral joint pain syndrome. A picture of
each stretch was included in the handout. The only instruction that this group was given was to
perform the stretches at least twice a week for a consecutive four weeks and to record the
number of times they completed the stretching routine.

The third group was the demonstrational group that was comprised of seven participants
(n=7). This group met with the researchers twice a week over the four weeks to perform the
stretches, thus following the American College of Sports Medicine (ASCM) minimum
recommended guidelines for improvements in flexibility. They were given the same instructional
brochure as the written group, but were also shown how to perform the stretches and given
feedback on correct body positioning as needed.

An initial pretest of quadriceps flexibility for all participants was conducted on the first
day. Hamstring flexibility was also tested at this time; however, another researcher analyzed the
data pertaining to hamstring flexibility and is not further mentioned in this paper. The
participants warmed up on a cycle ergometer for 5-10 minutes pedaling at a rate between 50-
60rpm with a resistance of 1.0kp. Using the modified Thomas test, knee flexion was measured
with a goniometer. For this test, the subject sat on the end of a table, rolled back on to the table,
and held both knees to the chest. This ensured that the lumbar spine was flat on the table, and the
pelvis was in a posterior tilt. The subject held the non-dominant hip in maximal flexion with the
arms, while the tested limb was lowered towards the floor. To eliminate any inter-rater reliability, the same researcher performed the modified Thomas test on all subjects.

After all measurements were acquired, the written group received their instructional brochure to perform without any guidance from the researchers. They were only instructed to perform some type of aerobic or dynamic warmup before stretching, complete the stretching routine a minimum of two times per week for a consecutive four weeks, and to record the number of times they completed the stretching sequence. The control group was directed to continue with their typical daily activities and maintain any current exercise regimens. The demonstrational group members were provided with the same instructional brochure as the written group and were instructed to meet with the researchers twice a week to perform the stretching routine. These subjects were allowed to miss one session as long as they performed the stretches on their own time and contacted the researcher reporting that they completed the routine. They were also instructed to complete the regime independently other times during the four weeks; however, they needed to keep a record of the total number of times that they performed the stretches. When they met with the researchers to stretch, they performed the same warm up as done for the pretesting. After the warmup, participants were shown proper technique to execute the various poses. After the pose was shown and any relevant cues expressed, such as body part alignments or modifications to make the stretch more intense or easier, the participant attempted the proper position. Any errors in positioning were corrected by the researchers. Once in proper position, the subject held the stretch for 30 seconds and then switched legs when applicable. The researcher used a stopwatch to keep track of time for the participants. This process was done for all of the stretches.
After completion of the four weeks, a post test for quadriceps flexibility was conducted for all participants. This was accomplished in the same manner as the pretest, a proper warmup followed by knee flexion being assessed using the modified Thomas test. The subjects in the written and demonstrational groups also turned in their logs which contained the number of times they completed the stretching routine over the course of the four week.

Statistical Results

<table>
<thead>
<tr>
<th>Pretest &amp; Posttest Measurements &amp; Flexibility Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
</tr>
<tr>
<td>Control (n=15)</td>
</tr>
<tr>
<td>Mean (˚)</td>
</tr>
<tr>
<td>Pre-test</td>
</tr>
<tr>
<td>Post-test</td>
</tr>
<tr>
<td>Gains</td>
</tr>
</tbody>
</table>

Table 1: Each group’s average pretest, posttest, and flexibility improvements.

The control group had an average pretest measurement of 66.5˚ (SD = 4.95 ˚) and posttest value of 67.5˚ (SD = 4.4 ˚). Paired T-test for means of pretest and posttest data results in a P-value = 0.034, showing significant difference between the means of the pretest and posttest measurements for the control group. The written group had an average pretest measurement of 60.7˚ (SD = 8.03) and posttest value of 64.0˚ (SD = 7.1 ˚). A paired T-test for means results in a P-value = 0.004, showing significant difference between the means of the pretest and posttest measurements for the written group. The demonstrational group had an average pretest measurement of 66.9˚ (SD = 4.6 ˚) and posttest value of 72.1˚ (SD = 4.6 ˚). Paired T-test for
means results in a P-value = 0.0001, indicating significant difference between the means of the pretest and posttest measurements for the demonstrational group. The tables shown below are the results of these paired T-tests.

T-TEST

<table>
<thead>
<tr>
<th></th>
<th>Paired Samples Statistics</th>
<th>Paired Samples Test</th>
<th>Paired Samples Correlations</th>
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<tr>
<td></td>
<td>Mean</td>
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<td>Std. Deviation</td>
</tr>
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<td></td>
<td></td>
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<tr>
<td>Pair 1</td>
<td>Control PRE &amp; Post</td>
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<td>1.534</td>
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<tr>
<td>Pair 2</td>
<td>Written PRE &amp; Post</td>
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<td>2.550</td>
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<tr>
<td>Pair 3</td>
<td>Demo PRE &amp; Post</td>
<td>-5.286</td>
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<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Correlation</th>
<th>Sig.</th>
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<td>.000</td>
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<td>Pair 2</td>
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<td>.951</td>
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<tr>
<td>Pair 3</td>
<td>7</td>
<td>.940</td>
<td>.002</td>
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Table 2: Paired t-test results comparing means of pre & post-test data for all three groups.
<table>
<thead>
<tr>
<th>Control (°)</th>
<th>Written (°)</th>
<th>Demonstration (°)</th>
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</thead>
<tbody>
<tr>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
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<td>8</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>4</td>
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<tr>
<td>0</td>
<td>2</td>
<td>5</td>
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<td>-1</td>
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<td>1</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Mean       | 0.933333333 | 3.333333333 | 5.285714286 |
| SD         | 1.533747356 | 2.549509757 | 1.603567451 |
| SE         | 0.396011865 | 0.849836586 | 0.606091527 |
| 95% CI     | 0.849360975 | 1.959726681 | 1.48305254  |

**Table 3:** Data for flexibility improvements for the three groups.

Table 3 shows the average improvement in flexibility (difference between posttest and pretest measurements). The control group had an average improvement of 0.9° ± 0.8°, written group 3.3° ± 1.9°, and demonstrational group 5.3° ± 1.5°. Below Figure 1 graphically depicts the averages of the three groups.
An ANOVA test could not be used to compare the means of the three groups as the
groups did not contain equal sample sizes. As a result, one sample t-tests were conducted as an
additional way to analyze the data. These tests show the same results as the paired t-tests
comparing the mean pretest and posttest measurements. The results are shown in Table 4 below.
To estimate whether or not the quality of stretching had a factor in the flexibility improvements of the written and demonstrational groups, a regression analysis was conducted to determine if there was a correlation between the number of stretching sessions and the flexibility improvements. For instance, if subjects completed the same amount of stretching sessions but had different flexibility improvements; it could be possible that the quality at which they performed the stretches differed. The data, results, and figures are shown below.

### Table 4: T-test comparing mean difference of the groups.

<table>
<thead>
<tr>
<th></th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
<th>95% Confidence Interval of the Difference</th>
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<td>.93333</td>
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<tr>
<td>Written</td>
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<td>.004</td>
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<td>Demo</td>
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<td>.000</td>
<td>5.28571</td>
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### Table 5: Data for written group’s regression analysis

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<th>Sessions</th>
<th>Improvement (˚)</th>
<th>Written Group</th>
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<td>Mean</td>
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<td>SD</td>
<td>4.226240778</td>
<td>2.549509757</td>
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Table 4: T-test comparing mean difference of the groups.

Table 5: Data for written group’s regression analysis
Table 6: Regression analysis results for the written group.

<table>
<thead>
<tr>
<th>Regression Statistics</th>
</tr>
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<tbody>
<tr>
<td>Multiple R</td>
</tr>
<tr>
<td>R Square</td>
</tr>
<tr>
<td>Adjusted R Square</td>
</tr>
<tr>
<td>Standard Error</td>
</tr>
<tr>
<td>Observations</td>
</tr>
</tbody>
</table>

Figure 2: Written Group’s Stretching Quality

Note: Scatter plot with line of best fit pertaining to the written group’s regression data in Table 4. An R-squared value of 0.075 indicates a very weak correlation.
### Demonstrational Group

<table>
<thead>
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<th>Sessions</th>
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</table>

Mean: 8, SD: 0

| Mean | 5.285714286 |
| SD   | 1.603567451 |

**Table 7:** Data for demonstrational group’s regression analysis.

### Regression Statistics

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<td>Standard Error</td>
<td>1.097488889</td>
</tr>
<tr>
<td>Observations</td>
<td>7</td>
</tr>
</tbody>
</table>

**Table 8:** Regression analysis results for the demonstrational group.
Figure 3: Demonstrational Group’s Stretching Quality

![Graph showing the relationship between flexibility improvements and number of completed routines for the demonstrational group. The R-squared value is 0.61.]

Note: Scatter plot of the demonstrational group’s regression data from table 6. An R-squared value of 0.61 indicates a weak correlation.

Figure 4: Adherence Rate vs. Flexibility Gains

![Bar chart showing adherence rate versus flexibility gains across control, written demonstration, and demonstrational groups.]

Adherence Rate Vs. Flexibility Gains

- Average Gains (˚)
- Completed Sessions

Groups: Control, Written, Demonstration
Discussion

The aim of this study was to investigate whether different instructional techniques affected the flexibility improvements in individuals who followed a specific flexibility program. Secondly, to determine if different instructional techniques affect the adherence to the flexibility program, and the quality of how the stretches were performed. It was hypothesized that a supervised group receiving a comprehensive instructional strategy, which included written material and visual demonstrations, would elicit greater improvements in quadriceps flexibility and exercise adherence than those receiving only a written instructional brochure.

Comparing the average improvements and the average measurements for the pretest and posttest of each group shows that all three groups had significant differences. However, differences can easily result from a small sample size, and a closer inspection of the groups’ respective p-values allows for a more accurate conclusion. The control group had a p-value = 0.034. The written group had a much smaller p-value = 0.004, and the demonstrational group had an even smaller p-value = 0.0001. Analyzing these p-values reveals that the written group showed more improvements in flexibility than the control group. Furthermore, the demonstrational group had more improvements in flexibility (5.3°) than both the control (0.93°) and written (3.3°) groups. With this population studied, the results indicate that demonstrating the exercises was more effective for improving quadriceps flexibility than written material alone. However, providing only written material was still a beneficial instructional strategy for improving flexibility, but to a lesser extent than by demonstration and providing feedback.

Although the written group showed fewer improvements, their average improvement was only 2 degrees less than the demonstrational group. One possible explanation is provided by Wulf and Shea (2002) who conducted a literature review on the learning of simple and complex
tasks. This field of study has many contradictory study results. However, they were able to conclude that observational learning was more effective for learning complex motor skills rather than simple skills. While the literature is not clear on a definition of simple or complex skill, it would be reasonable to assume that static stretching is a simple task because it is not a dynamic movement involving the coordination of multiple body parts which would require complex cognitive processes. Therefore, in this population studied, demonstrating the stretches for the demonstrational group may not have been considerable more effective than only providing written material. A second possible reason for these results pertains to the participants’ literacy level and prior knowledge about stretching. All the participants were well educated college students, so comprehending the written material was most likely not an issue for them. Additionally, several of the subjects in the written group were majoring in athletic training or exercise science. While some unique stretches were incorporated into the stretching routine, these participants should have had prior knowledge about the general aspects of stretching such as technique, duration, and intensity. Lastly, improvements for both the written and demonstrational groups were relatively small as the participants were only required to complete ACSM’s minimum requirements for flexibility improvements. All these reasons may have attenuated any large differences seen in flexibility improvements between the two groups.

It was also hypothesized that the demonstrational group would have a higher adherence rate; however, both the written and demonstrational group had about the same average number of completed sessions. One explanation for similar adherence rates is the short length of the study. Sluijs (1993) reports a thirty percent decrease in exercise adherence after being unsupervised for six months. A four week period may not be adequate time to show declines in program adherence. Additionally, complex routines result in decreased adherence compared to simple routines (Becker, 1985). The stretches were fairly simple and did not take very long to complete.
which would make compliance easier. Furthermore, the participants were able to perform these stretches almost anywhere even at home, and convenience of the regime has been shown to play an important role in exercise adherence (Sluijs, 1993). While the majority of the participants were female, Sluijs (1993) reports that gender did not affect adherence rates in a physical therapy setting. Contrary to this study, Kilpatrick’s (2005) study on college age students’ motivation and adherence to exercise and sports shows that reasons for exercising are different between males and females and can lead to different adherence rates. However, these may not be entirely applicable for adherence to a stretching routine.

Although the average adherence rates between the written and demonstration group do not differ significantly, a closer examination of the written group reveals a large amount of variation in the number of stretching sessions that they completed compared to the demonstration group. Each member of the demonstration group completed eight sessions. Whereas, the written group’s reported adherence ranged from zero to twelve completed sessions with an average of seven sessions. It is important to note that the number of completed sessions for the written group were self-reported and may not accurately reflect the actual number of sessions that the participants completed. With this in mind, the written group’s adherence did not have a significant effect on flexibility gains, as the regression analysis revealed a very weak correlation ($R^2 = 0.075$). Looking at the data in Figure 2 shows that the subjects that reported completing the most sessions did not have the greatest improvements. The individuals with the greatest improvements reported to complete six to nine sessions, while one person who reported eight completed sessions had no change in flexibility. This could suggest that some of individuals in the written group were not adequately performing the stretches, or could just be a result of inaccurate self-reports.
The demonstrational group members all completed the stretching routine eight times with the researcher, which is one more session than the average for the written group. The demonstrational group showed a much stronger correlation than the written group, but was still relatively weak ($R^2 = 0.61$). Compared to the written group, it was expected that the demonstrational group would have greater flexibility improvements as they completed more sessions because their stretching was monitored and their technique corrected as needed. Looking at Figure 2 shows that the members of the written group who completed more than eight sessions had lower improvements than the average demonstrational group member. These results could suggest that the demonstrational group performed the stretches with better quality. A larger sample size and better valid test is needed to obtain a more accurate correlation.

Several limitations exist with this study. The biggest limitation is the small sample size available for this study. As a result of the small sample size, results can only be associated with the population studied at this time. Another limitation of the study was the length of the study which was only four weeks. Longer duration studies may provide more significant results as greater improvements can be attained, and adherence rates to the program may show more variation as people stop following the program. Furthermore, the subjects themselves may have been limitations to the study. The majority of the participants were females, and many of them were majoring in exercise science or athletic training. As stated early, literacy level and prior knowledge of stretching could have affected the results. An additional limitation exists with the modified Thomas test which was used to measure quadriceps flexibility. There is only a moderate degree of inter-rater and intra-rater reliability among experienced orthopedic clinicians when using the modified Thomas test to examine rectus femoris flexibility (Peeler, 2008). As the researcher conducting the modified Thomas test was not a professional clinician, the margin of error may be large resulting in inaccurate measurements.
To my knowledge, no other studies have examined the effects of instructional techniques specific to flexibility improvements and adherence to a flexibility program. Friedrich’s (1996) and Taheri’s (2012) research reports that therapist supervision is more effective for improving back and neck pain and increasing adherence and quality of exercise compared to patients being instructed by brochures. Although a different population was studied, the results of this study support the current literature that supervision and demonstrational instructional techniques result in greater physiological improvements. With a small sample size and several other limitations, this study has acted as a pilot test for future larger scale studies in this area.

Future research should be aimed at using larger sample sizes with equal number of male and female participants who vary in age and literacy levels. Studies should change variables such as frequency and duration of stretches and conduct the research over longer periods of time, such as eight or twelve weeks. Additionally, a valid and reliable design to quantitatively analyze the quality of stretching should be developed. This could include a rating scale to judge how well participants perform the prescribed stretches at the end of the study.

Appendix A

Quadriceps and Hamstring Yoga Stretch Routine
Perform stretch routine after a 5-10 minute warm up. Warm up may consist of jogging, biking, or any other type of dynamic warm up to prepare the muscles for stretching and avoid injury. All stretches should be taken to the point of slight discomfort, but never any pain. Do this 2-3 times per week for four weeks.

1) Go onto your knees and bring one foot forward with the front knee over the heels.

2) Place both hands on the front thigh and push yourself away as you lean backwards. You should feel this in the front of your leg that is on the floor.

3) Stretch as far as you can comfortably go and hold for 30 seconds. Perform stretch on both legs.

1) Get into the starting position of the first stretch, but move your front leg a little to the side.

2) Lean forward and place both hands on the floor to the inside of your front leg. If your quads are tight you will feel this right away. Hold for 30 seconds and repeat on the other leg.

3) If you need to get a deeper stretch bend your elbows or even place your elbows on the floor.
1) From the second stretch position, keep one hand on the floor and reach back with the other hand (Right hand reaches back to left foot).

2) Twist your body toward your front leg and look up. Hold for 30 seconds and repeat on opposite leg.

3) If you feel that you can stretch farther, then bring your front hand onto your elbow.

1) Release hand from foot and reach both hands to front of the mat, shoulder width apart.

2) Bring both legs back and out from underneath the body and place soles of feet as flat as possible onto ground.

3) Lift hips into the air until you feel a slight but comfortable stretch in your posterior leg muscles. Hold for 30 seconds.
1) Stand with feet shoulder width apart and toes pointing forward.

2) Gently let the head, arms, and torso bend forwards over the hips in a comfortable stretch. Bend knees slightly for more comfort.

3) Release arms and continue to bend further if you feel you can. Hold position for 30 seconds.

1) Stand with feet shoulder width apart and both toes pointing forward. Bring left foot back to a comfortable place and point toes laterally (or outward to the left).

2) While bending over place right hand inside right foot (use a weight or block if reaching to the floor is too difficult. Left hand should point to ceiling.

3) Hold stretch in comfortable position for 30 seconds. Repeat for opposite leg.
References


