



BFR Exercise Trainer

Usability Test Report

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Link to Undergraduate Documents Website:

<http://www.csl.mtu.edu/classes/cs4760/www/projects/s23/group2/www/>

Link to the BFR Exercise Trainer Application:

<https://bfr-exercise-trainer.csa.mtu.edu>

1 Introduction

The User Interface setup for this application was done in quite a straightforward manner such that the user would be able to navigate through the application even if they are not too technologically well-versed. From an overall perspective, the application is split into four stages with respective pages that can be reached for each stage. The Welcome page will have a set of basic instructions and directions that will help the user understand what Blood Flow Restriction (BFR) is and how this app can facilitate administering it. From here, the user can reach the second stage which would be the Medical Screening Form. The user (a medical practitioner) will select any of the listed pre-existing conditions that their client/patient may have. Based on the responses, the application will recommend types of BFR technologies that are most suitable. There is also a possibility that the pre-existing conditions make BFR unsuitable/unsafe for the user. In this case, the app will recommend against the use of BFR. The third stage will allow the user to choose from a given set of appropriate technologies. The fourth stage will give the user instructions on how that selected technology can be used and even some external links to purchase the necessary machinery. Each stage will consist of multiple possible pages that can be reached based on the user's selection. For the most part, the application follows quite a sequential approach that keeps the usage relatively simple.

The goals of usability testing are to effectively test all aspects of the application. The test will be administered over Zoom with video and audio being recorded. The users will be given several different usability testing descriptions/scenarios that they are recommended to follow closely. Each test scenario has been carefully curated to guide the users down a specific path that will allow them to test that given area of the application. Given that this application has four risk areas, there are four scenarios that will be utilized. The risk areas are "low", "moderate", "high", and "very high". Except for the "very high" risk area which will not have any options to use BFR, all the other risk areas will recommend technologies accordingly. The goal of every test scenario will be to observe how the users interact with the pages that are presented to them. For the most part, the tests will be carried out without additional guidance. The objective is to assess if the application is self-sufficient and clear enough for any potential user to use it without a developer or consultant guiding them. In situations where the user ends up in an entirely different area of the application than expected, the consultant will redirect them to the correct area and continue the test from there. This is expected to occur as every participant will not be following the scenario descriptions word-for-word. The descriptions for each scenario will be available in the Zoom chat. However, it is completely understandable if every user does not closely follow the description. When comparing a paragraph of text with the visual elements of the application, it is expected that the user will be more compelled to try out the application freely. However, this situation will be different in the real-world as a medical practitioner will not need a scenario description to fill out the medical screening form.

2.1 Usability Test – Scenario 1

- Scenario name
Athletic injury treatment by a physiotherapist

- Test Goals for the scenario
The goal of this scenario is to understand how a physiotherapist treating an athlete's injury would utilize BFR to facilitate rapid recovery. Find out if this athlete can use BFR. If so, how exactly would he go about it?

- Scenario description
Imagine that you are a sports physiotherapist. Recently, a high-performance athlete has injured his foot (twisted his ankle) and needs to undergo rehabilitation with physiotherapy to have a rapid recovery for his condition. He needs to strengthen the neighboring muscles for this injured foot so that they can support the high-performance needs of his sport. Due to the significant drop in strength after his injury, using weights training is no longer a viable option for him. His physiotherapist recommends utilizing BFR to regain muscle strength without the need to depend on heavy external weights. As he is a competing professional athlete, his body is in a healthy condition, but he has diabetes. The physiotherapist does not have any budget limitations so they can use the latest and greatest automated technologies if needed. Going through the BFR Exerciser App, find out if this candidate is truly eligible. If yes, what technologies would he use? What would the instructions be?

- Any software or equipment required for the testing
Zoom Conferencing Software

- Quantitative measurement list
 - Time taken to complete one iteration of the app from the home screen to the final screen
 - Time spent in total on the app's Help page
 - Time spent on the app's screening page
 - Time spent on any of the app's final pages:
 - Automatic Pneumatic Cuff System page with manufacturers
 - Manual Pneumatic Cuff System input page before recommended AOP result is displayed
 - Knee wrap/band instructions page

- Task list (starting from the home screen page)
 - Go to “Access Help Page”
 - Return to “Homepage”
 - Go to “Access Medical Screening”
 - Select options from the screening list (if applicable)
 - Click “Submit”
 - Only 1 option should be available to choose (automated cuff)
 - Select 1 of the several options for tools to administer BFR (on the automated cuff system - each link will take the user to a reliable manufacturer’s official page)
 - This is where 1 iteration of the application’s use would end
 - The user may either click on “Access Help Page” or return to the Homepage from this point

- Qualitative measurement list
 - Number of times the user seemed visibly confused or lost
 - Number of times the user attempted to click on areas or attempted actions that are not programmed in the app’s functionalities
 - Number of times the user attempted to go to a previous screen (either due to a mis-click or otherwise)
 - Number of times the user appeared unsure about the result of a button click

- Potential observations of participant
 - Visual facial cues indicating confusion
 - Time-based cues of the user being stuck or unresponsive on a given page
 - Visual cues for emotional changes that the user experiences on pages or prompts in the app

- Test set up details
 - Zoom should be installed on the user’s computer beforehand as the test will be administered over this platform
 - User shares screen before starting the test
 - Any operating system will work
 - Any browser will work

- Post-scenario Interview
 - How was your overall experience using the app?
 - Did you feel lost/confused at any point during the test?
 - Was the Help Page useful in obtaining a better general understanding?
 - Did you feel the need to access the Help Page at any point? Was it available?
 - Assuming you chose the automated cuff system path, did the information on this page meet your expectations?
 - Was sufficient information available to you about the functionality of the automated cuff system?
 - Did you understand the purpose of the automated cuff system?
 - Was your experience mostly bug-free?
 - Are there any other suggestions you have for us to improve our app?

2.2 Usability Test – Scenario 2

- Scenario name
Post-accident injury treatment by a personal trainer

- Test Goals for the scenario
The goal of this scenario is to understand how a personal trainer would treat a woman using BFR to facilitate muscle strengthening. Find out if this woman can use BFR. If so, how exactly would she go about it?

- Scenario description
Imagine that you are a personal trainer. Recently, a patient had an unfortunate bicycle accident that severely damaged her left leg (the side that she fell on). Her BMI is in the 25-30 range, and she is unable to walk without excruciating pain due to this injury. There is no skeletal damage. However, the muscles in her left leg have been severely hurt and weakened due to this accident. She needs to regain strength in this leg to be able to walk without aid and pain. Her personal trainer recommends using BFR to regain this strength without having to rely on weights training. Beyond her BMI being in the 25-30 range, she does not have any preexisting conditions. This personal trainer has used BFR before and already has some manual use technologies and tools to carry out BFR. Going through the BFR Exerciser App, find out if this candidate is truly eligible. If yes, what technologies would she use? What would the instructions be?

- Any software or equipment required for the testing
Zoom Conferencing Software

- Quantitative measurement list
 - Time taken to complete one iteration of the app from the home screen to the final screen
 - Time spent in total on the app's Help page
 - Time spent on the app's screening page
 - Time spent on any of the app's final pages:
 - Automatic Pneumatic Cuff System page with manufacturers
 - Manual Pneumatic Cuff System input page before recommended AOP result is displayed
 - Knee wrap/band instructions page

- Task list (starting from the home screen page)
 - Go to “Access Help Page”
 - Return to “Homepage”
 - Go to “Access Medical Screening”
 - Select options from the screening list (if applicable)
 - Click “Submit”
 - Select 1 of 2 options to administer BFR from the “Risk Level Evaluation Form” (mostly likely manual cuff system based on the scenario)
 - Go through the manual cuff form by filling out the patient’s details to have a recommend AOP level based on risks
 - This is where 1 instance of the application’s use would end
 - The user may either click on “Access Help Page” or return to the Homepage from this point

- Qualitative measurement list
 - Number of times the user seemed visibly confused or lost
 - Number of times the user attempted to click on areas or attempted actions that are not programmed in the app’s functionalities
 - Number of times the user attempted to go to a previous screen (either due to a mis-click or otherwise)
 - Number of times the user appeared unsure about the result of a button click

- Potential observations of participant
 - Visual facial cues indicating confusion
 - Time-based cues of the user being stuck or unresponsive on a given page
 - Visual cues for emotional changes that the user experiences on pages or prompts in the app

- Test set up details
 - Zoom should be installed on the user’s computer beforehand as the test will be administered over this platform
 - User shares screen before starting the test
 - Any operating system will work
 - Any browser will work

- Post-scenario Interview
 - How was your overall experience using the app?
 - Did you feel lost/confused at any point during the test?
 - Was the Help Page useful in obtaining a better general understanding?
 - Did you feel the need to access the Help Page at any point? Was it available?
 - Assuming you chose the manual cuff system path, did the information on this page meet your expectations?
 - Was sufficient information available to you about the functionality of the manual cuff system?
 - Did you understand the purpose of the manual cuff system?
 - Was your experience mostly bug-free?
 - Are there any other suggestions you have for us to improve our app?

2.3 Usability Test – Scenario 3

- Scenario name
Muscle strengthening by a performance coach
- Test Goals for the scenario
The goal of this scenario is to understand how a performance coach would help his athlete grow his muscles incrementally in the middle of a season without altering his weights training program. Find out if this athlete can use BFR. If so, how exactly would he go about it?
- Scenario description
Imagine that you are a performance training coach for an athlete in their 40-50s age. You have realized mid-season that your athlete is lacking lower body strength as they play basketball, and this is preventing them from achieving a sufficient vertical jump on rebound shots. As the team’s season is ongoing, changing his weights training program would be unadvisable. Instead, you want to incrementally promote muscle growth while continuing with the same program. This athlete is competing at a professional level with no known preexisting health conditions that would prevent him from using BFR except for his age. You are considering using the most mobility friendly tool from BFR technologies that could be utilized even during regular training sessions. Using high-tech machines or needing wires leading from the tools would not be helpful. Using a wrap or a band would likely be an ideal way to go about this situation. Going through the BFR Exerciser App, find out if this candidate is truly eligible. If yes, what technologies would he use? What would the instructions be?
- Any software or equipment required for the testing
Zoom Conferencing Software
- Quantitative measurement list
 - Time taken to complete one iteration of the app from the home screen to the final screen
 - Time spent in total on the app’s Help page
 - Time spent on the app’s screening page
 - Time spent on any of the app’s final pages:
 - Automatic Pneumatic Cuff System page with manufacturers
 - Manual Pneumatic Cuff System input page before recommended AOP result is displayed
 - Knee wrap/band instructions page

- Task list (starting from the home screen page)
 - Go to “Access Help Page”
 - Return to “Homepage”
 - Go to “Access Medical Screening”
 - Select options from the screening list (if applicable)
 - Click “Submit”
 - Select 1 of 3 options to administer BFR from the “Risk Level Evaluation Form” (mostly likely knee wrap/band based on the scenario)
 - Go through the instructions given on the knee wrap/band page
 - This is where 1 instance of the application’s use would end
 - The user may either click on “Access Help Page” or return to the Homepage from this point

- Qualitative measurement list
 - Number of times the user seemed visibly confused or lost
 - Number of times the user attempted to click on areas or attempted actions that are not programmed in the app’s functionalities
 - Number of times the user attempted to go to a previous screen (either due to a mis-click or otherwise)
 - Number of times the user appeared unsure about the result of a button click

- Potential observations of participant
 - Visual facial cues indicating confusion
 - Time-based cues of the user being stuck or unresponsive on a given page
 - Visual cues for emotional changes that the user experiences on pages or prompts in the app

- Test set up details
 - Zoom should be installed on the user’s computer beforehand as the test will be administered over this platform
 - User shares screen before starting the test
 - Any operating system will work
 - Any browser will work

- Post-scenario Interview
 - How was your overall experience using the app?
 - Did you feel lost/confused at any point during the test?
 - Was the Help Page useful in obtaining a better general understanding?
 - Did you feel the need to access the Help Page at any point? Was it available?
 - Assuming you chose the knee wrap/band path, did the information on this page meet your expectations?
 - Was sufficient information available to you about the functionality of the knee wrap/band system?
 - Was the UI facilitating your experience as a user?
 - Was your experience mostly bug-free?
 - Are there any other suggestions you have for us to improve our app?

2.4 Usability Test – Scenario 4

- Scenario name
Muscle growth for a female client with blood clotting

- Test Goals for the scenario
The goal of this scenario is to understand how a personal trainer would help his client grow her muscles incrementally. Find out if this athlete can use BFR. If so, how exactly would she go about it?

- Scenario description
Imagine that you are a personal trainer for a female client who wishes to grow her muscle mass. She has had the goal of strengthening her muscles for several years now. However, she does not enjoy or thrive with weights training. She also has a bad memory of an accident with weights that occurred in her gym several years ago. As a personal trainer, you know that BFR could propose a solution to her goals and limitations. She can ultimately achieve her goal without needing to use heavy weights at all. She is young and healthy overall, but she does have a family history of clotting disorders such as hemophilia and high platelets. Going through the BFR Exerciser App, find out if this candidate is truly eligible. If yes, what technologies would she use? What would the instructions be?

- Any software or equipment required for the testing
Zoom Conferencing Software

- Quantitative measurement list
 - Time taken to complete one iteration of the app from the home screen to the final screen
 - Time spent in total on the app's Help page
 - Time spent on the app's screening page
 - Time spent on any of the app's final pages:
 - Automatic Pneumatic Cuff System page with manufacturers
 - Manual Pneumatic Cuff System input page before recommended AOP result is displayed
 - Knee wrap/band instructions page

- Task list (starting from the home screen page)
 - Go to “Access Help Page”
 - Return to “Homepage”
 - Go to “Access Medical Screening”
 - Select options from the screening list (if applicable)
 - Click “Submit”
 - No options should be available here based on the user’s high risk (based on the scenario)
 - Return to the home screen
 - This is where 1 instance of the application’s use would end
 - The user may either click on “Access Help Page” or return to the Homepage from this point

- Qualitative measurement list
 - Number of times the user seemed visibly confused or lost
 - Number of times the user attempted to click on areas or attempted actions that are not programmed in the app’s functionalities
 - Number of times the user attempted to go to a previous screen (either due to a mis-click or otherwise)
 - Number of times the user appeared unsure about the result of a button click

- Potential observations of participant
 - Visual facial cues indicating confusion
 - Time-based cues of the user being stuck or unresponsive on a given page
 - Visual cues for emotional changes that the user experiences on pages or prompts in the app

- Test set up details
 - Zoom should be installed on the user’s computer beforehand as the test will be administered over this platform
 - User shares screen before starting the test
 - Any operating system will work
 - Any browser will work

- Post-scenario Interview
 - How was your overall experience using the app?
 - Did you feel lost/confused at any point during the test?
 - Was the Help Page useful in obtaining a better general understanding?
 - Did you feel the need to access the Help Page at any point? Was it available?
 - Assuming you chose all the preexisting conditions as suggested in the scenario, did the information on this page meet your expectations?
 - Was the UI facilitating your experience as a user?
 - Was your experience mostly bug-free?
 - Are there any other suggestions you have for us to improve our app?

2.5 Pre-Testing Questionnaire

- 1) What is your level of education?
 - 1st Year
 - 2nd Year
 - 3rd Year
 - 4th Year
 - 4+ Year
 - Graduate

- 2) What gender would you identify yourself as?
 - Man
 - Woman
 - Prefer not to say
 - Other

- 3) Do you know what is Blood Flow Restriction (BFR)?
 - Yes
 - No

- 4) I am interested in participating in this usability test.
 - Strongly agree
 - Agree
 - Neutral
 - Disagree
 - Strongly disagree

2.6 Post-Testing Questionnaire

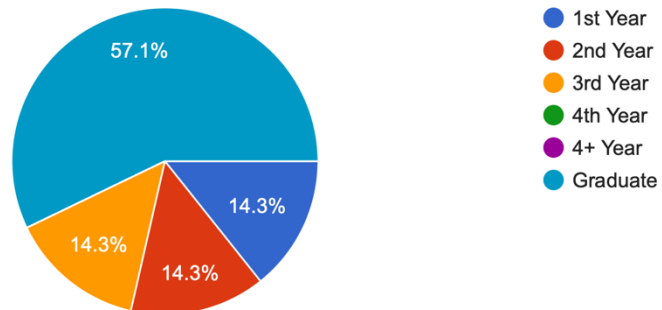
Please indicate your level of agreement to the following statements with 1 being “strongly agree” and 5 being “strongly disagree”. This will be available as a Google form or given to fill out via email.

- 1) Overall, this application was easy to use for the intended task.
- 2) Overall, I enjoyed using this application.
- 3) I would use this application again.
- 4) I understood the purpose of this application.
- 5) Imagining that I am the intended user, this application would be useful for me.
- 6) The application appears to solve a problem or facilitate an inconvenience.
- 7) The application appeared professional.
- 8) Without additional guidance, the application itself was clear to use.
- 9) I would recommend this application to a medical practitioner who may need such a technology.
- 10) The user interface and experience were well thought out even for people who may not have a technical background.

3.1 Results: Pre-Testing Questionnaire

What is your level of education?

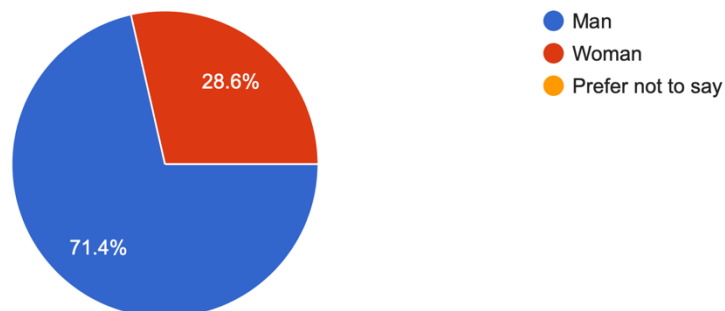
7 responses



The level of education was surveyed to have a statistic on the spread of our participants' age and possible experience with using applications.

What gender would you identify yourself as?

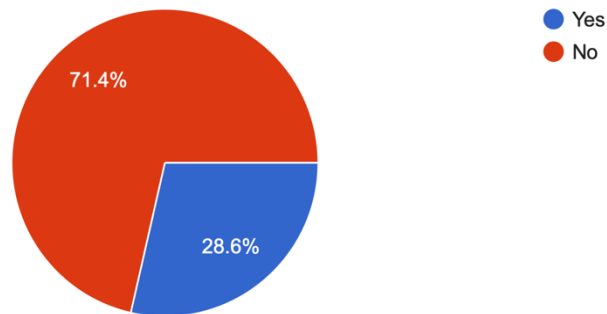
7 responses



The gender was asked to have a basic demographics data collection in hopes to ensure that there was a good spread of contestants for the usability tests. There was no representative connection between the gender and the results of our tests.

Do you know what is Blood Flow Restriction (BFR)?

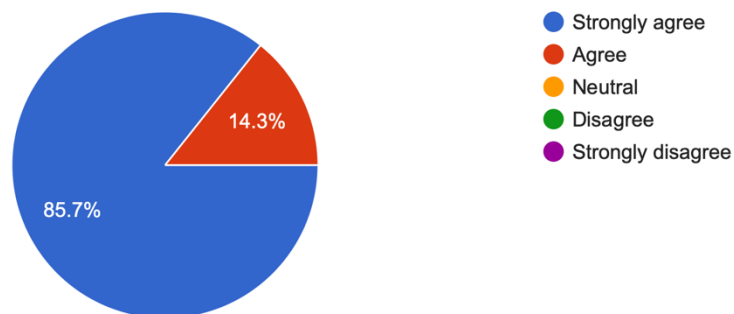
7 responses



There was a hope to establish a connection between the base knowledge of BFR and the results of our tests. No significant correlation was detected between prior knowledge of BFR and performance on the tests.

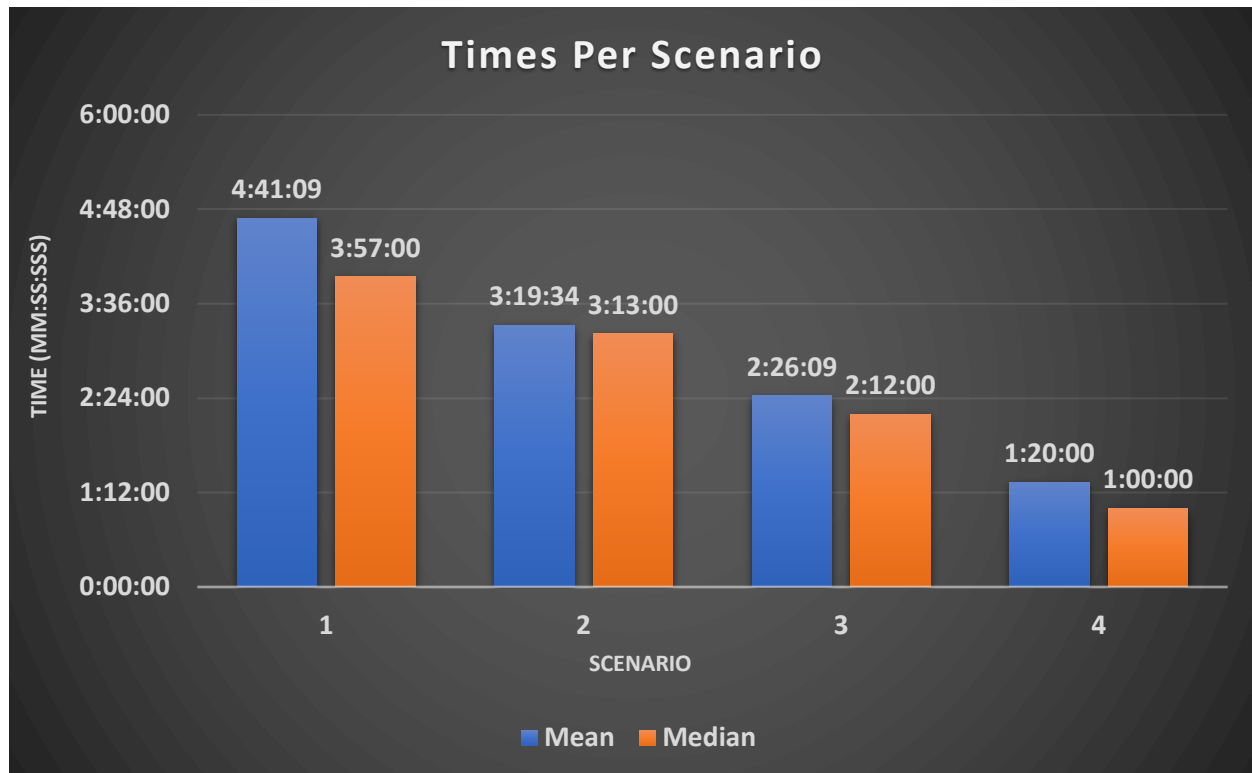
I am interested in participating in this usability test.

7 responses



We wanted to ensure that our participants were mostly interested in helping us with usability testing. If there were any participants who were not interested, we expected to find some connection between that data and the performance in the tests. However, all our users were interested, so there was no connection to find here.

3.2 Results: Testing Run Times



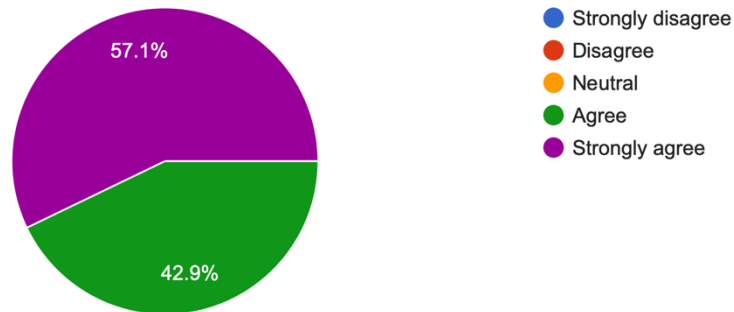
Throughout the four usability test scenarios, the time taken by each user to complete each iteration was recorded. The idea was that the required time to complete each scenario should decrease in mean and medium numbers across the participants. This understanding was established on the hypothesis that with each iteration of the application, the user will become more familiar with the application. We were expecting these numbers to decline. However, if this would not have happened, we would have received alarming signs of the application being potentially too complicated to understand and use.

Based on the collected results as displayed in the comparative bar chart above, it can be observed that there was a steady decline in the mean and medium times across all seven participants through the four testing scenarios. This data was representative of our goal that the application became incrementally easier to use each time the user returned to use it. Although the mean and median times were close to each other for every scenario, we saw a slightly higher time in the mean numbers. This resulted from some outlier times taken by participants for each scenario. One such example was for scenario 1 where a participant took over 7 minutes to complete the task. This was about 3 minutes more than the second longest time taken to complete the same scenario. To ensure that such outliers did not influence our results too much, a comparison with median times was also utilized.

3.3 Results: Post-Testing Questionnaire

Overall, this application was easy to use for the intended task.

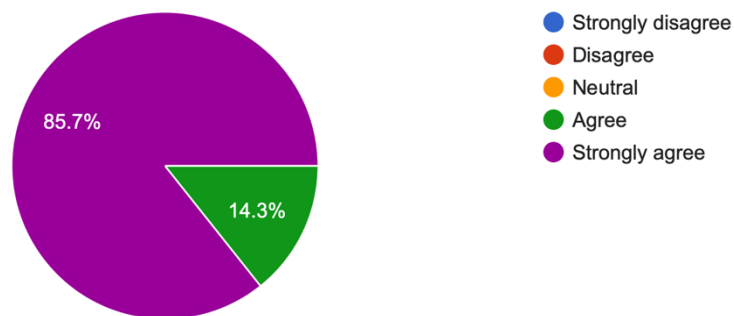
7 responses



Overall, we expected the results of this question to be mostly positive as we had designed the app with ease of use as a priority. The feedback indicated that we were successful in this goal. We had expected maybe a participant or two to think that the app may have been slightly tough to use simply because of the technical terminology involved. However, this was not the case either.

Overall, I enjoyed using this application.

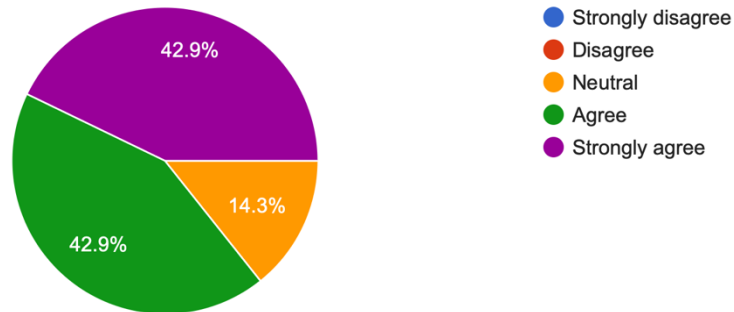
7 responses



Although this was not our primary goal, we were glad to learn that our app was enjoyable to use as it accomplished its functionalities.

I would use this application again.

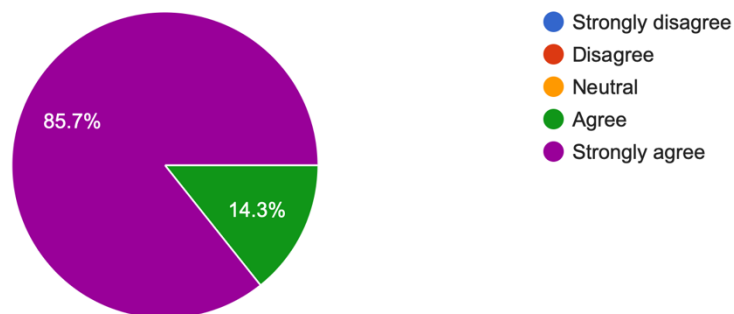
7 responses



This was one such question where we were hoping to see mostly positive results. While this was the case for the most part, we did observe one response where our participant did not think that they would use it again. As the questionnaire was entirely anonymous, our best guess is that this “neutral” response probably came from the technical language used in the application with slightly insufficient explanation. Or perhaps, this was due to some of the minor bugs encountered during our tests.

I understood the purpose of this application.

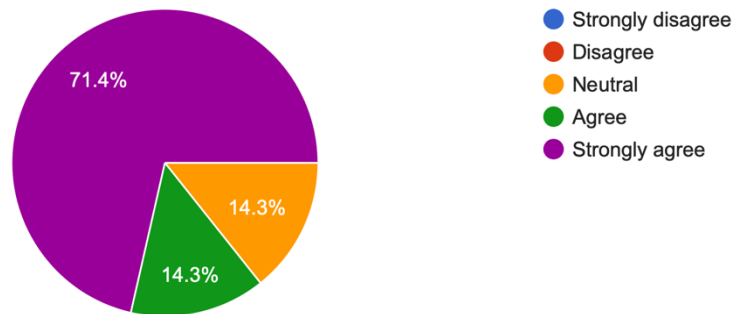
7 responses



We were delighted to learn that almost all our participants strongly agreed that they understood the purpose of this application. Regardless of how easy or hard the application was to use, we hoped to create a product that at least clearly communicated its purpose.

Imagining that I am the intended user, this application would be useful for me.

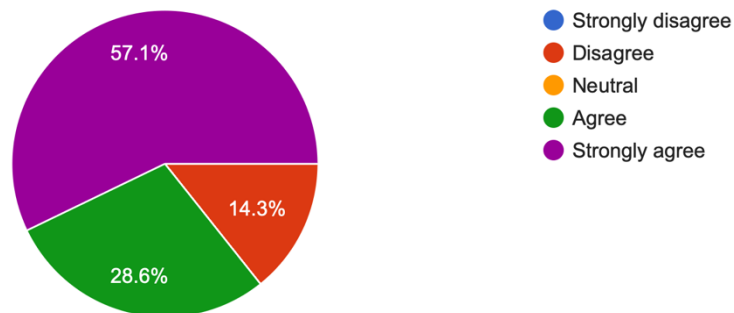
7 responses



From a questioning perspective, this one might have been a little difficult to imagine as we were asking our participants to put themselves in the place of our intended users (medical practitioners). We were expecting a little more mixed opinions as responses for this question. However, as our responses were mostly positive, we were glad to learn that our participants did agree with the usefulness of our app.

The application appears to solve a problem or facilitate an inconvenience.

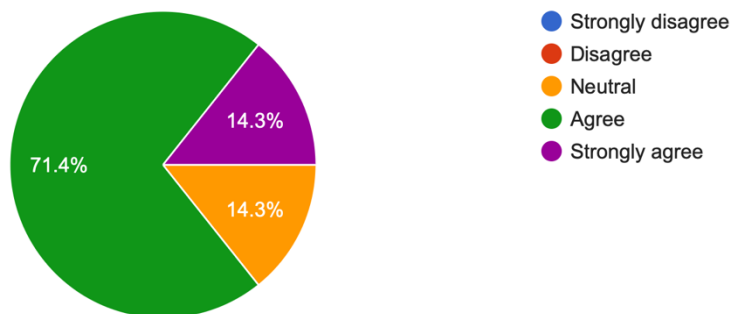
7 responses



This is an area of the questionnaire where we were hoping to receive only positive responses. After all, the idea of building an application like this was to facilitate an inconvenience or solve a problem. However, we did have one participant disagreeing. We will continue to work on encountered bugs and improve our application to yield only positive responses in the future.

The application appeared to be professional.

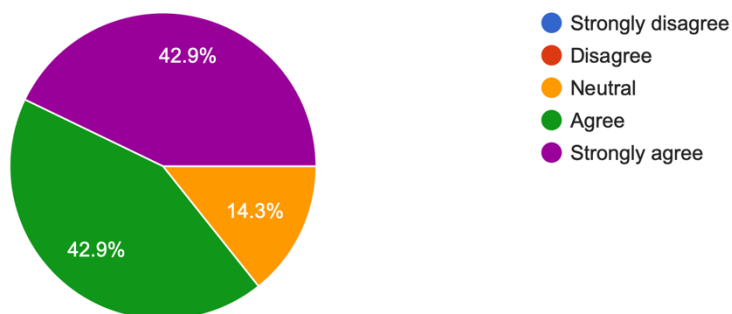
7 responses



For the most part, we had positive responses here. Seeing some of the bugs that were encountered during the usability tests, the expectation was to see a result just as we received. As one unexpected 404 Error was found, it is justified to see more responses as “agree” and even “neutral”.

Without additional guidance, the application itself was clear to use.

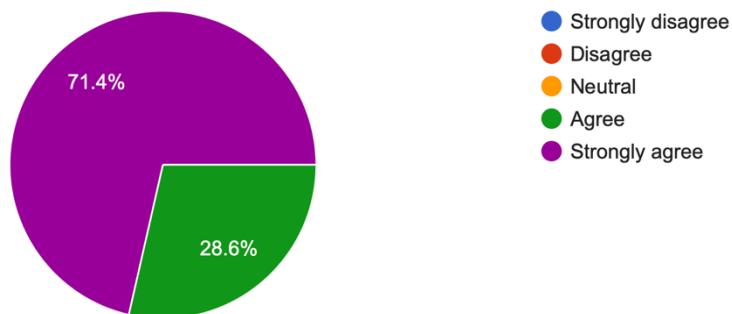
7 responses



Receiving mostly positive responses here was a good sign for the team. However, we can understand why the application did not receive more “strongly agree” responses. The application was built more from the perspective of a medical practitioner being the user. Having users who were more technologically inclined but not medical practitioners may have impacted how clear the app appeared to be for use.

I would recommend this application to a medical practitioner who may need such a technology.

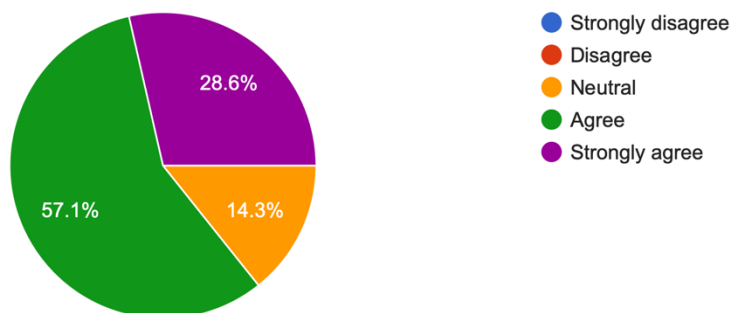
7 responses



We were happy to receive overwhelmingly positive responses for this question. The application was built to serve medical practitioners as the primary users. With that understanding, we were glad to learn that all our usability testers agreed that our app was worth recommending.

The user interface and experience were well thought out even for people who may not have a technical background.

7 responses



This is an area where we expected to receive only positive responses primarily because the app was made with ease of use in mind. Although it received mostly positive responses, we did receive a “neutral” response. We are hoping that fixing all the bugs and slightly modifying the UI will help us obtain this goal.

4 Usability Problems and Suggestions for Improvement

The following recommendations are provided in addition to the consideration that all reported bugs will be fixed by default from Appendix B. Suggested solutions for those bugs are also provided below for convenience.

Bug Suggestions:

- Make input values for the form a requirement on the Manual Cuff page
- Add input validation for entries on the Manual Cuff page form (it should only allow numbers, not alphabets)
- The submit button should be at a reasonable distance from the input form on the Manual Cuff page
- There is a 404 Not Found Server Error on the High-Risk page when “Back to Screening Form” is clicked (this is a faulty URL that needs to be fixed)
- The Help Page should open on a new tab by default (inconsistencies should be fixed and it should never open on top of the user’s progress in the application)

Additional Recommendations:

- Consistency of button sizes for all pages
- Provide some hints on every page to help the user with their options and the application’s workflow
- The Help Page should have more comprehensive information for every reachable page
- Back buttons and Homepage buttons should be available on all pages
- Temporarily save screening form responses if the user uses the application’s Back button
 - o This can be tough to do given the sensitivity of medical data. However, as the responses are anonymous and we are discussing a temporary save for every iteration of the application, this feature could be considered and implemented.

5 Appendix A: Undergraduate Team Attendance

Date	Time	Team Members	Absences
Friday, April 7	1 pm	Dane, Tony, Seth, Akshay	
Friday, April 7	5 pm	Akshay, Connor, Ben	<u>Ben</u>
Saturday, April 8	12 pm	Ben, Akshay, Conner	<u>Ben</u>
Monday, April 10	12 pm	Ian, Seth, Dane, Akshay	<u>Dane</u>
Monday, April 10	5 pm	Ben, Tony, Ian, Dane, Seth	<u>Ben</u>
Tuesday, April 11	5 pm	Ben, Tony, Ian	<u>Ben</u>
Wednesday, April 12	5 pm	Conner, Seth, Dane	<u>Participant No-show</u>
Thursday, April 13	12 pm	Conner, Ian, Tony	

- Participant No-shows: 1

- Development Team Absences:
 - Ben: 4
 - Dane: 1

6 Appendix B: Bug Reports

Bug Number	Number of Occurrences	Bug Name	Bug Description	Steps to Reproduce
1	3	Input Values	The Systolic, Diastolic blood pressures and limb circumference options should made mandatory. The website is loading the exercise page even when input is not provided.	On Manual Pneumatic Cuff page, just neglect the three input boxes after selecting cuff width option and click on the submit button.
2	1	Input Validation	The Systolic, Diastolic blood pressures and limb circumference is taking alphanumeric responses when it should only be accepting numbers.	On Manual Pneumatic Cuff page, the form can be filled with alphabets when only numbers should be allowed.
3	7	Submit Button	Too much scrolling is needed to see the submit button after entering the Manual Cuff input. The user misses the submit button altogether.	On the Manual Pneumatic Cuff page, the submit button is at the very bottom of the page, usually with lots of blank space.
4	4	404 Not Found Error	Clicking on the "Back to Screening Form" button returns in a 404 Not Found Error (The requested URL was not found on this server).	On the High-Risk page, clicking on the "Back to Screening Form" button results in an error.
5	3	Help Page does not open in a new tab every time	Accessing the Help Page opens in a new tab at times, and in the same tab at other times.	Spread out across Welcome Page, and several other pages.

7 Testing Challenges

The tests were administered over Zoom audio and video meetings. Throughout the seven usability tests, no testing technical challenges were reported by the participants.