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Features of Optics and Mounts that Facilitate Participation in Birding for Power Wheelchair Users: An Exploratory Study

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Abstract

Birding as a leisure task may facilitate increased quality of life and regulate the nervous system through nature-based experiences; however, there are no prior published studies that examine adaptive birding equipment, making this research a crucial addition to the field of occupational therapy. Existing birding equipment is built very heavily, making it difficult for users to apply and reposition during the act of birding. This capstone project focused on adaptive birding equipment use by power wheelchair users to determine the supportive features that best facilitated participation in birding from their mobility devices. Researchers purchased lighter weight mounts and various optics frequently used to bird. Birders were recruited to analyze the mount and optic features that best supported their ability to bird from their mobility device. Participants all agreed that grippy materials on components of both mounts and optics, lightweight designs, and ability to reposition the equipment to their own personal preferences were key features that enhanced their experiences. This research advances occupational therapy practice into non-traditional, nature-based settings, and aims to facilitate self-reflection on professionals’ pre-existing knowledge of mounting systems and physical disabilities, to connect that knowledge to the occupation of birding.

Keywords: adaptive equipment, mounts, optics, birding, disability, occupational therapy, assistive technology, power wheelchair, leisure
Features of Optics and Mounts that Facilitate Participation in Birding for Power Wheelchair Users: An Exploratory Study

Project Introduction

The population of individuals served in this capstone project were disabled birders, specifically those who utilize power wheelchairs for birding, as well as general everyday use. Because there is a myriad of diagnoses, both cognitive and physical, researchers wanted to narrow their focus on one specific population, with the potential to expand the research in future projects.

This capstone project utilized existing power wheelchair users who were interested in birding as a nature-based leisure task. Birding requires specific equipment for successful participation; however, the accessibility of the equipment has not been studied. Therefore, this project utilized research skills to examine the accessibility of birding equipment by this researcher, volunteers, and power wheelchair users. Questionnaires and interviews with virtual focus groups (Figure 7) gathered the perspectives of people who tried purchased optics and mounts during the act of birding, which then were utilized to inform the design of an accessible mounting system. As advocacy is also extremely important in this lesser recognized field, conducting this research gave the opportunity to bring forth recommendations on how professionals who are more unfamiliar with this area can use their knowledge and expertise to make an impact on disabled birders.

The individual that supervised the student through this doctoral capstone experience was Freya McGregor from Access Birding. Her career as a clinical occupational therapist specializing in low vision services began in Australia and continued through 2014. She then spent time volunteering as an occupational therapist on a United States Navy hospital ship in...
2015, before landing in the United States where she continues to live today. As an occupational therapist, her passion for public service and assisting individuals with disabilities never went away. However, her other passion for birding was strong enough to devise a career shift that connected both of these passions into one. In 2019, she co-founded a non-profit organization entitled Birdability where she created educational material, organized and lead both in-person and virtual events regarding accessibility and inclusion in parks and other recreational spaces, as well as served as an Outreach Coordinator for the podcast “Talkin’ Birds”. In late 2022, she branched out and created her own business, Access Birding, in which she provides consultative services to nature-based organizations regarding their accessibility and inclusion efforts. Another endeavor she was pursuing during this capstone was the creation of a book entitled “A Field Guide to Accessible Birding in North America,” outlining accessible parks and birding locations across the country. She was also working part time as a research associate in the Dayer Lab at Virginia Tech, and was involved in research projects related to access, inclusion, disability and birding, and using birding as a therapeutic tool.

Because the student and site mentor lived states away from each other, this capstone was completed entirely remotely. The student completed the majority of work from home but was assigned a designated workspace on Western Michigan University’s campus in which to complete any work needed to. The student utilized this workspace when trialing the adaptive equipment with wheelchairs as well as when needing to conduct meetings with their capstone coordinator or appointed faculty advisor.

**Literature Review**

Over the last 20 years, the hobby of enjoying birds has been growing in popularity for many Americans. The population of birders had increased in the United States from 12% to 33%
from the year 1980 to 2001 (Cordell & Herbert, 2002). Between the years of 2011 to 2016, there was an increase of 14.3 million Americans engaging in wildlife viewing, which was more than one-third of the adult population at that time (US DOI et al. 2016). According to Catalano (2021), the start of the COVID-19 pandemic rose the population of birders in the United States to an estimated 45 million. With restrictions in place on leaving one’s home, individuals found pleasure in viewing birds in their own backyards, thus increasing the sale of bird seed by 50 percent in several areas across the country (Catalano, 2021). Birding is now considered the 15th most popular outdoor recreational activity in the United States (Lind, 2015).

‘Birding’, instead of ‘bird watching’, is the more inclusive term to use when referring to those engaging with and enjoying birds, as most birders enjoy listening to birds just as much as seeing them (McGregor, 2021).

Participating in birding varies in terms of time allotted to the activity, the monetary expense, and the competitiveness one chooses to put towards birding. Events such as the World Series of Birding attract individuals from across the United States to engage in a 24-hour period of non-stop competitive birding to identify as many birds as possible in that time frame (Schaffner, 2009). Meanwhile, there are individuals who enjoy birding at a slower pace, and may enjoy birding in parks or in their backyards and not have a competitive edge attached to their pastime.

Spending time enjoying birds has been documented to show a positive improvement in both the physical and mental health of adults with disabilities and mobility challenges (Ramsland, 2015.; Zhang et al., 2017; Stigsdotter et al., 2018). Hearing sounds of birds and being outdoors in the sunshine can significantly increase the overall quality of life and will to live in individuals with disabilities as well as those in the older adult population (Ramsland, 2015).
Current research also connects spending time outdoors and an improvement in an individual's social life and a faster recovery from stressful life events (Zhang et al., 2017). Given that individuals with disabilities frequently encounter health-related stressors and are seldom targeted by health promotion and prevention activities, maximizing the health benefits from nature should be a high priority to combat the rising health disparities for this population (Zhang et al., 2017).

Individuals with mobility challenges are one of many populations that are served by occupational therapists (AOTA, 2020). Occupational therapy aims to utilize the everyday occupations to enhance and enable their participation in said activities (AOTA, 2020). In the case of this research, the activity of choice for our participants is birding, and the researchers are using the scope of occupational therapy to provide mounting systems and optics to determine what features best enhance and enable their participation in this occupation.

Individuals who bird from their wheelchairs may also have the potential to encounter various a wide range of environmental access challenges at desired birding locations that may not impact able-bodied birders. Such challenges could include inadequate van accessible parking spaces, inaccessible signage regarding trail and park information, and unmaintained, bumpy or rough trails (McGregor, 2022).

Rolim et al. (2021) stated that disabled birders are continuously underserved and marginalized as a population, and that birding has been developed for those with good hearing and vision. It has also been discovered that individuals with mobility challenges consider birding and wildlife watching within national parks to be a more important hobby when compared to individuals with hearing and vision loss (Chikuta et al., 2019).

Birding requires no equipment; however, for individuals who desire to view nearby birds at a closer, more detailed level, they may choose to purchase a pair of binoculars (Powell, 2022).
When birds are further away, such as being across a pond or open field, one may choose to purchase a spotting scope that offers a higher magnification option to capture a closer view than binoculars may offer (Powell, 2022). Participation in birding from a wheelchair or mobility scooter may become increasingly challenging when diagnoses such as spinal cord injury, traumatic brain injury, stroke, multiple sclerosis or Parkinson’s disease impede one’s ability to grasp equipment or sustain sitting, balanced, in an upright position – both motor skills often required to use binoculars effectively.

Products such as pan tilt heads with extendable handles, mounting systems, monopods, and phone camera attachments for optics are examples of existing adaptive equipment created for use by birders. Optics companies have created mounting systems that are compatible with binoculars, monoculars and spotting scopes that offer threaded components. Mounting systems contain various features such as screws or movable ball joints on the tips of the device that allow optics with threaded capabilities to be connected securely. Mounts such as this aim to assist with counteracting the effects of physical limitations associated with the diagnoses mentioned above.

Unlike manual wheelchairs, power wheelchairs can have different positioning features to help manage fatigue and posture maintenance, depending on the needs of the user, as well as assisting the user with pressure redistribution to limit the occurrence of pressure sores (Lange, 2021). A recline feature allows the wheelchair seat angle to adjust, whereas the tilt-in-space feature moves the entire seating system back or forwards without changing the seating angle (Lange, 2021). Additionally, some power wheelchairs have the capacity to elevate the seat, which is helpful for those who need to increase their functional reach, or expand their visual field (Lange, 2021).
Because optics come in all weights and sizes, they have potential to become difficult to carry. Additionally, individuals with decreased dexterity and upper extremity functioning may have difficulties positioning the optic in a spot that is ideal for the viewing of birds. Offering a mount that can attach to one’s wheelchair or power scooter can help to alleviate the need for the birder to hold the optic while trying to maneuver their mobility device.

Occupational therapists play a role in ensuring mounts are personalized for the specific needs of an individual (Lindstrom & Masselink, 2021). Physical limitations of the user need to be considered when identifying the most appropriate mount, so making sure the device is positioned so the user has the ability to reach and/or interact with the product successfully is crucial (Lindstrom & Masselink, 2021). Mounting options that currently exist for power wheelchairs are tailored for augmentative and alternative communication (AAC) devices, tablets, keyboards, and switches (Lindstrom & Masselink, 2021). They can be made from flexible material that allows the device to be put in any position necessary without needing tools, or be a fixed design, which typically remains in a static position and requires tools to adjust and change the position (Lindstrom & Masselink, 2021). Despite the variety of mounting systems that exist for individuals with disabilities, there are currently no commercially available systems specific to supporting adaptive equipment for birding from a power wheelchair. The authors are aware of a very small number of customized mounts which have been designed for or by individual birders Bohs (2012) and Miller (n.d), but in each instance this required a personal connection with a designer or engineer, which is not available for every disabled birder.

The research that exists addressing birding with disabilities is primarily focused on the health benefits of being in nature (Ramsland, 2015.; Zhang et al., 2017; Stigsdotter et al., 2018). Additionally, the accessibility challenges that complicate one’s ability to maneuver adequately
across various terrains and birding locations have been identified as potential limiting factors to participation in birding for individuals using mobility devices. (McGregor, 2022). However, no research currently exists on what features of optics or mounting systems are most beneficial in facilitating participation in birding from a mobility device. The purpose of this capstone project was to identify the supports and barriers that are present within current adaptive equipment for non-ambulatory birders, and to consolidate subjective information gleaned through focus groups and equipment trialing to create design concepts for an accessible product that enhances the birding experience for this population.

**Needs Assessment**

An initial needs assessment was completed by the student during the spring semester before the start of the capstone experience. The capstone mentor provided the student with the names of potential stakeholders to conduct interviews with, which consisted of disabled birders and a colleague she had through her former employment at Birdability. Collectively, the student and capstone mentor determined a set of questions to ask each stakeholder the student was planning to interview. Questions regarded how their perception of birding performance had changed since their injury, knowledge and/or level of experience with using current adaptive birding equipment, as well as initial comments/concerns with design concepts and barriers to participation in birding from their mobility devices. At the conclusion of the interviews, the student completed a Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis (Purby, 2023) to determine the specific areas stakeholders identified as being a hindrance to their participation in birding. Much of the information received was in relation to the mounting system designs being very clunky and unstable over rougher terrains, making it very difficult to reposition while birding or navigate around while propelling their mobility devices. Meeting
with the individuals prior to the beginning of the capstone allowed the student to focus the research on adaptive equipment designs that would be more inclusive to the disabled birding population. Additions to the needs assessment were made as the capstone experience progressed.

The student met with additional disabled birders, optics companies, nature centers, and organizations serving disabled folks to gain more knowledge on how the research could be as supportive as possible to disabled birders and those who serve them.

Conversations revealed further insight into birding for people with disabilities. The student discovered disabled birders felt their physical limitations caused a barrier to participation in birding. Optics manufacturers shared they were hoping to expand upon their offerings of outdoor recreation equipment and optics to disabled birders in terms of the features and elements to include on their products. Nature-based organizations stated their intentions were to create more accessible and inclusive activities and/or spaces for disabled birders to come and enjoy. The student then concluded there was a need to discover the ideal features and/or design concepts that would be most beneficial and well-accepted by the disabled birding population.

Objectives Completed

Three objectives were achieved throughout this experience: 1) Student will develop professional reasoning skills through scholarly exploration evident by conducting a comprehensive literature review and needs assessment to inform their specific objectives prior to the DCE, 2) Student will conduct focus groups and equipment trialing of five or more products with non-ambulatory birders’, and 3) Student will advocate for the distinct value of occupational therapy to clients, to team members, and to community members throughout participation in the doctoral capstone experience (DCE) and by dissemination of doctoral capstone project.
One objective completed during the capstone project was ‘Student will develop professional reasoning skills through scholarly exploration evident by conducting a comprehensive literature review and needs assessment to inform their specific objectives prior to the DCE.’ This objective was completed in multiple stages throughout the capstone process. Prior to beginning research, the student researched several journal articles to help inform the experience and support the reasoning behind conducting research. As the capstone progressed, the student continued researching journal articles, reading book chapters, and reviewing survey data as a way to identify how the population of birders is growing in the United States, and the value this research brings to the disabled birding population. A needs assessment was also completed prior to the start of the capstone to determine what specific factors stakeholders identified as barriers to participation and to determine the gap in research. Throughout the project, as the student met with more disabled birders and other organizations and stakeholders, there were additions to the needs assessment; more questions were asked, different opinions were given. Meeting with the individuals prior to the beginning of the capstone allowed the student to be more specific on where to focus the research. Completing additional needs assessments with disabled birders and stakeholders throughout the project allowed researchers to continue refining their thoughts and ensure the most valuable research was being collected.

‘Student will conduct focus groups and equipment trialing of five or more products with non-ambulatory birders’ was an additional objective that was completed during this project. During the first week of the capstone, the student met with Blandford Nature Center in Grand Rapids, Michigan to determine and solidify the location to host an in-person equipment trialing and focus group. During the second and third week, the student spent time reviewing and purchasing various mounting systems, in addition to the creation of registration forms, informed
consent, and photo/video release form for the event as well as questionnaires pertaining to the equipment that would be used for the session (see Figures 1 through 6). Ten mounting systems were purchased through grant funding allocated by the Sammons Center for Innovation and Research in Occupation Based Technology. The student also purchased two spotting scope options using grant funding. All additional optics and parts were donated through either Vortex, Celestron and Opticron optics companies in support of the research project (see Tables 3 through 5). Also, during this time frame, the capstone mentor was traveling across the United States to visit locations for her book. While on the trip, she had met with some disabled birders living out of state. During the week two mentor/student meeting, the capstone mentor shared the idea of hosting a virtual equipment trialing and focus group with the individuals she had connected with, and this idea was then implemented into the capstone plan. Through week four, the student had begun personally reviewing and becoming comfortable with the equipment purchased. Weeks five and six were utilized for continuing participant recruitment and refining the questionnaires with assistance from the site mentor and faculty advisor. At the conclusion of week six, there were unfortunately no registrants for the in-person event. Having already prepared for the session, the student and a volunteer used the scheduled time to complete a collective brainstorming session to gather information to share with the out of state participants for the virtual focus group. Following the brainstorming session, the student then compiled all the equipment and sent it to one of the participants. They all determined a day and time, during week seven of the capstone, to meet and then completed the equipment trialing session together. The day after, the student conducted a virtual focus group with the capstone mentor and all participants present. Due to time constraints and barriers such as inexperience with equipment and physical limitations, participants were not able to trial all equipment that was provided to
them. They were however able to trial at least five products, and thus the goal of obtaining data for five or more items had been met.

The student met a third goal outlined in the capstone; ‘Student will advocate for the distinct value of occupational therapy to clients, to team members, and to community members throughout participation in the doctoral capstone experience (DCE) and by dissemination of doctoral capstone project,’ in many different ways throughout the experience. During weeks one and two, when the student was meeting with many different stakeholders, questions regarding the specifics of occupational therapy and the distinction between the profession and physical therapy were common. The student advocated for occupational therapy by providing in-depth examples about the role we play in the healthcare system and how the research being conducted in this project correlates to the occupational therapy scope of practice. During the virtual focus group in week seven, the student had the opportunity to advocate once more to the participants on the role of occupational therapy and the correlation to adaptive birding equipment. Lastly, in week fourteen of the capstone, the student presented the research findings to a diverse group of disabled and non-disabled birders, healthcare professionals, researchers, social scientists and others who had varying levels of knowledge about occupational therapy. Disseminating the research in this platform gave the student a great opportunity to again share the importance of occupational therapy and advocate for the work we do, especially in a non-traditional setting such as seen in this capstone. The capstone presentation slides can be found in Figure 8.

**Implications**

This research will be utilized by Access Birding with many future endeavors. The capstone mentor has been using her occupational therapy background to complete this form of work for many years and will continue to do so. The focus of Access Birding is to provide
consultation to nature based organizations on how to create more accessible locations for disabled birders to attend and utilize. Therefore, she will be able to use this research as a resource to these types of organizations by providing them with information on various loaner equipment options they can have available for disabled birders that wish to utilize their parks and trails. This research could also be considered as a guide for how to teach or assist disabled birders with becoming comfortable using the adaptive equipment options as independently as possible before they take it on the trails. With there being no current mounting systems created specific to adaptive birding, Access Birding will be able to continue referencing this research when conversing with manufacturers about creating equipment with design considerations appreciated and sought-after by disabled birders. Similarly, Access Birding can utilize this research in discussions with optics companies about design features that assist disabled birders with engaging in birding more successfully.

Being that there are no prior published studies addressing adaptive birding equipment, this research is a crucial addition to the field of occupational therapy. Occupational therapists play an integral role in completing wheelchair assessments and fittings for individuals with disabilities. In addition, occupational therapists work with individuals to engage in activities they find meaningful and important, which may involve using mounts and accessories as a form of adaptive equipment. The information from this study supports occupational therapists by expanding the knowledge of mounting system capabilities for a hobby that has become increasingly popular and has health and wellness benefits associated with participation. Results from this study helps to further understand how to best support disabled birders with using adaptive birding equipment both efficiently and independently. Nature-based occupational
therapy is an emerging area of practice, so providing this research contributes to broadening the profession as a whole.

**Conclusion**

**Results**

Demographic information regarding the participants can be found in Table 1 within the Appendix. All individuals who participated in this study used a power wheelchair for mobility and have been diagnosed with a physical disability that limits their ability to engage in birding to some degree. Three of the participants have had 5 or more years of birding experience and have owned or used various mounting systems, both mechanically and electrically designed. One participant had very little birding experience and was unfamiliar with the majority of equipment that was trialed during this study.

A total of fourteen themes, as well as ten additional subthemes, were identified. Using the Person Environment Occupation Performance (PEOP) model of practice, which reflects how both internal (person) and external (environment) factors of the individual impact occupational performance (Cole & Tufano, 2020). All themes and associated subthemes can also be found within Table 2.

Personal themes were: 1) understanding/experience level with equipment, 2) physical limitations impacting equipment use, and 3) mobility equipment design/mounting location. Subthemes within this section include 1a) personal/life experiences and 1b) feeling overwhelmed by the learning curve associated with this equipment. Within Environment, one theme was identified: 1) limiting factors of trialing session. Themes within the Occupational section included: 1) supporting features/functions of mounts, 2) limiting features/functions of mounts, 3) design considerations for mounts, 4) new mount design: under-cushion/foot rest monopod
SUPPORTIVE ADAPTIVE BIRDING EQUIPMENT FEATURES

support, 5) attachment design, 6) supportive features of optics, 7) limiting features of optics, 8) design considerations for optics, 9) digiscoping, and 10) difficulties of having a system that worked effectively together. Subthemes found in the Occupational section include 3a) overall ease of use, 3b) mount clamps and tightening devices, 3c) mount positioning, 3d) mount strength and stability, 8a) general design considerations, 8b) focus knob design and location, 8c) focus knob material, and 8d) electrical focus.

Personal factors

The PEOP model states that the “Person” reflects physiological, psychological, neurobehavioral, cognitive, and spiritual factors that are intrinsic in nature (Cole & Tufano, 2020). Participants shared many comments related to their experience trialing the provided equipment. Factors that were categorized within the ‘Personal’ section were related to physical and cognitive limitations that impact the user’s understanding and ability to use the equipment, as well as the supports and barriers that are present with their particular mobility device.

Understanding/experience level with equipment

Personal/life experiences

Experience levels among the four participants in this study ranged from less than one year up to 25 years of experience. When asked, participants identified themselves as either casual or serious birders based upon their own perspective. One participant stated they had only been birding one other time in their life and needed to borrow a monocular to do so. Other participants reflected on their experiences with the equipment they currently use and are familiar with, and were able to quickly realize what would and would not work for them.

P2: I got what I needed from what I saw. I mean, I knew most of the stuff wasn't going to work.
P3: I have to take my binoculars down, and I know them well enough now that I know about where I have to go, but it's kinda like, lifting them up and down a few times to really, you know, get it [focused].

**Feeling overwhelmed by the learning curve associated with this equipment**

Cognitive barriers were reported to be an issue among all of the participants’ ability to successfully use the equipment. Because some individuals had little to no experience with using adaptive birding equipment, distinguishing between what the equipment was and how it operates was a challenge in itself. Three of the participants stated there was a learning curve to using the equipment in the trial.

P2: I think an additional issue was that there was kind of a learning curve because there were so many adjustments [on the mounts].

P3: It was overwhelming but at the same time, I definitely got the opportunity to learn more about what will work for me.

P3: This really was the first time that I've thought too much about it and been able to really try out some stuff. I mean, I've thought about it, but, you know, I haven't taken the initiative, so the whole thing for me was a learning experience.

**Physical limitations impacting equipment use**

Another factor that directly impacts one’s ability to use adaptive birding equipment is their physical limitations and level of functioning. Factors such as dexterity, shoulder, elbow, wrist and finger range of motion, balance, core strength and sensation all play a role in the participants’ abilities to assemble or position mounts, attach mounts to their wheelchairs independently, and use optics. One participant whose dexterity had not been impacted stated how their experience was different from the others in the equipment trialing session.
Other participants stated that they were more severely impacted by their physical limitations when it came to using the birding equipment. Limited upper extremity range of motion and decreased dexterity made it challenging for participants to access the equipment components independently.

P2: Well, I, I'm quad and I couldn't mount anything independently, so I needed someone else to do that.

*Mobility equipment design/mounting location*

Participants stated that aside from their physical and cognitive limitations, the design of their mobility device – which was highly variable – can either support or hinder the ability to attach mounts for optimal use and viewing. Participants tried attaching mounts to various parts of their wheelchairs, with and without success.

P2: I think [Mount] A was the best because my arm rest has a tube underneath it, so you can clamp [it] on very far.

P1: There wasn't quite enough of a flat surface underneath [the manual wheelchair arm rest] because there was a cable like for the joystick, and then the second was the padding of the arm. I really had to tweak it really far down and get any type of secure. And so, between those two, none of all of the table supports [mounts], even the big beefy one [mount G], was that stable.

Also shared were proposed ideas for the best mounting locations as well as comments about designing a mount that would work for the broadest number of wheelchair users.

P2: I would think that attaching it [a mount] to the frame of the chair is going to give you better stability. And more possibility for universality. Um, and also because the padding
on the armrest – those wear out. You know, they’re foam, so some people might not want to damage them because they are expensive.

P2: Something to think about, in terms of if you're trying to come up with something, universal, is that, um, chair designs are constantly changing. And armrests are way different than what Participant 3, and I have now… so I would think that attaching it to the frame of the chair is going to give you better stability.

**Environmental factors**

As defined by the PEOP model of practice, environmental factors consist of physical, natural, cultural, societal, and social interactive factors and social and economic systems that are extrinsic in nature (Cole & Tufano, 2020). It was discussed that the physical environment, such as terrain, may have an impact on the usability and efficiency for using adaptive birding equipment. However, participants were unable to trial the equipment outdoors. As such, participants’ comments which were coded within the Environment theme were related to their experience with trialing the equipment through the constraint of being indoors.

**Limiting factors of trialing session**

Three participants commented on how their experience became limited by completing the equipment trialing indoors. Two participants stated how their ability to fully evaluate the equipment was interrupted by not trialing it while birding, or over various terrain that may impact the stability and durability of the equipment.

P3: I like the usability of the [Hummingbird] scope. But I wasn't able to test how well, I thought it worked for me when I was actually trying to spot something. Because we're literally in a small room, you know, so. But I was really excited about the possibility just based on the usability of it.
P4: So, if you're traveling, especially if somebody's traveling over grass, which is actually strangely more bumpy than anything. You would think grass would be like, really nice, but it's like, oh, my God. It's like crazy. So, the longer, you know, you have the more momentum you're going to get and so we didn't even look at that aspect of whether or not the support stays.

One participant stated time was also a hindrance to fully experiencing the equipment trialing.

P2: I didn't really play with that [pan tilt head] that much, you know, if there were maybe just two of us trying things we maybe could have gotten through but, you know, there was four of us and it just took a long time to get stuff set up.

**Occupational factors**

The ‘Occupational’ section of the PEOP model is related to what people want or need to do in their daily lives (Cole & Tufano, 2020). For the purposes of this study, this would include the act of birding. Depending on the design of the mounting system, there were certain features and functions that participants stated either supported or hindered their participation in birding. Participants discussed potential options for better mounting system design and universality of the product as well as perspectives on electronically powered options.

**Supportive features/functions of mounts**

There were a total of five supportive features of the mounts discussed by participants. The favored mount by the majority of participants was the Finnstick monopod. Participants appreciated the versatility of this monopod in terms of height and ability to support the weight of all the optics they trialed with it. This mount option did not require the participants to manage
small, intricate mount components such as turning knobs, and it gave them the ability to rest the mount in whichever position they needed for optimal viewing of birds.

P1: And then the monopod, with that being held onto it, almost everybody could get it kind of in front of them, depending upon where they put it on their lap, or they put [it on] their foot support.

P3: …definitely the monopod that was longer [Mount F] that I could use with the [Hummingbird] scope and rest it on my footrests was really great. That's what I really appreciated was just having the opportunity to work with a monopod that would be on my footrests, you know, that I wasn't having to hold up.

**Limiting features/functions of mounts**

Participants felt some of the equipment features and functions were not beneficial for successfully engaging in birding. The biggest issue brought up by the participants was that some of the mounts were not strong enough to hold any of the optics in position.

P3: I didn't even try because I knew that it [Mounts I and J] wouldn't, you know, because they weren't holding anything.

P1: We really never got to the point of using the optics because none of the mounts were strong enough to hold the optics.

There were also difficulties with specific components of the mounting systems that caused frustration and difficulty among the participants. The act of securing the mount clamps and adjusting the mount body or arms was often a struggle.

P1: So a couple of issues with that [Mount A] was, the difficulty of the tension on the ball joints, that was difficult. But the small swivels were difficult for Participant 4 and her husband to get a nice firm grip on.
P1: All of them [the mounts] were still difficult even for me to get on, and once they were on, if you move the top, it wasn't really secure, especially with the foam on there [the wheelchair arm].

Design considerations for mounts

Participants identified four factors related to mount designs that would benefit disabled birders who use mobility devices. Participants’ responses related to factors of the mounting system including the product’s overall ease of use, the specific clamps and tightening devices used on each mount, the various positions they could get the mount in, and its strength and ability to remain stable when the user is in motion or repositioning the mount.

Overall ease of use

The participants all agreed that when there are too many attachments and movable parts to the mount, the device becomes difficult to manipulate and maneuver when birding. One participant mentioned that when they are birding, they try to limit the adjusting of both themselves and the mount because it negatively impacts their overall experience.

P2: I'm not doing a whole lot of adjusting when I'm out there because the birds are gone by time you make those adjustments. So, I know for my own needs I want something that I don't have to futz around with a lot.

Mount clamps and tightening devices

The mounts used in this study had a variety of clamp designs and tightening features. Participants reported that the size of these components, as well as the material used, had a direct impact on the usability of the item. It was found that attempting to tighten and secure mounts into any position became difficult due to a combination of the knobs being made of slippery
metal, and decreased dexterity. Two participants reported that a rubbery or grippy material on the adjustment components would make the mounts easier to use.

P2: They're [mount A adjustment knobs] either, well, they're slippery, so they're either metal or plastic and so if there was some grippy or material on those that also helps.

**Mount positioning**

Mounts such as D and E that moved only in a vertical plane and were limited to attaching only to the wheelchair armrest and frame, were found to be very stable and secure. However, these mount styles made it more difficult or impossible to use the attached optics, especially when compared to options such as the Finnstick monopod, which was able to be positioned closer to the body and placed at any height needed. Participants reported that a mount positioned closer to their body and nearer to their midline provided more stability of the mount, and so of the attached optics, and prevented them from having to reach far away from the body to use the optics. Dexterity and range of motion were, again, personal factors that caused difficulty for some participants when getting mounts positioned ideally for themselves.

P2: The one that fit off to the side, the straight arm that didn't have any kind of adjusting [Mount D] was very stable and clamped easily to the chair, but then it was in a horrible position to be able to view the birds.

One participant stated that although they felt the Mount B worked very well, there were issues with positioning the mount during times of rest. The added weight of the optic caused the monopod to become cumbersome and harder to manage.

P1: Because she [Participant 3] was having a real difficulty with the scope being lopsided, and as soon as she would let go of the monopod, because it was kind of angled, it would turn around and she had a really difficult time to get that.
Mount strength and stability

Many factors contributed to the level of strength and stability the mount provided during use. Mount strength is defined as the ability of the mount to support the weight of optics and attachments whereas mount stability is defined as the ability of the mount to maintain its position in space and without the need to constantly readjust. One participant shared that certain mounts had difficulties holding any of the optics and was drawn away from trialing them on their chair.

P3: I didn't even try because I knew that it [Mounts I and J] wouldn't, you know, because they weren't holding anything and we had so much to do, it just wasn't something that we wanted to spend our time on.

Dexterity was also a factor that impacted the strength and stability of mounts. One participant shared they use the palm of their hands to focus their optics due to limited finger mobility and range of motion, which creates added force on the mount and limits the usefulness of the equipment. Participants found the mounts were unable to withstand this added force and would collapse.

P1: There's additional force being put on the optic with the need to push a palm to get it to focus, which again, that goes back to the support [of the mount].

New mount design: Under-cushion/footrest monopod support

Based on their experiences trialing the equipment provided in this study, along with comparing that to personal adaptive birding equipment some participants currently use, participants shared many different perspectives on specific mount features and functions that would best support birders with disabilities. One participant provided specific detail about a design concept that could act as a supporting device for a monopod and keep it secured in one
position at all times and without needing to support it during wheelchair steering or propulsion. Another participant shared they used a device similar to this in the past.

P1: …design something you sit on or something that slips underneath your existing cushion that has, is a support in some way for the monopod that would keep it from twirling. So, one thing you could do is just have a bottom support that has a little V so you can, if you have a little, you know, something that attaches, to just rest in it so it [the monopod] can't swivel.

P2: I had one, I don't know what I did with it, but this, it was a plate that flipped between the seat pan and the bottom of the cushion. And, um, it's not a permanent thing, so you just use it when you need it.

Another participant stated the ideal mounting system for their personal use would be similar to the Finnstick monopod.

P3: If I had a monopod and the binoculars were pretty much where I needed them, height wise and, you know, I could adjust wherever I'm looking, then I might be able to do that semi-successfully.

Attachment design

Participants were given seven different attachment pieces to trial. Each piece of equipment was meant to be used to assist with connecting the mount to the optics. Of these seven items, all the participants stated they spent the most time trialing the pan tilt head attachment, which allows the optic to move in all planes of movement while supporting the birder with not needing to grasp the optic for use. Two participants commented on the pan tilt arm, a small pole that extends from the body of the attachment, saying it was an inconvenience to them. One
participant suggested modifications to the arm and the other removed it from the device altogether.

P1: The arm on it [pan tilt head] is it better if that's taken off so that there isn't an arm sticking toward you. It actually gets in the way. So, you can use your hands to adjust the pan tilt as opposed to having a hold on to the arm.

P2: A shorter [pan tilt head] arm [would help], because some people don't have the twisting motion [in their wrists].

One participant shared comments related to one of their personal mount attachment pieces and the impact it has on their birding experience, as well as a design feature they felt was a hindrance to use. Their limited dexterity creates difficulties with supporting optics using their hands, and so this particular attachment helps to eliminate the need for that.

P2: I put the attachment [own personal attachment], you know, to put on a tripod. But it's shaped so that I can wrap my hand around the attachment to hold the binocular [in position]. So, I don't even need anything else other than this to hold the binoculars and I can actually focus while I have them up.

Supportive features of optics

The favored choice of optic among all participants was the Celestron Hummingbird scope. All participants agreed this scope served the needs of each individual in their group in one of two ways. One participant shared that due to lack of range of motion in the neck, having an angled eyepiece allowed for easier access to viewing through the scope.

P3: It [angled eyepiece scope] really worked well for Participant 4 because um, she has limited range of motion in her neck and so it really helped with that.
Another participant commented on the Hummingbird scope magnification power being a supporting factor in their ability to view their surroundings.

P1: That 9 power [magnification] that, you know, I can, the field of view is wider and the magnification is lower, so it's easier to see things.

Limiting features of optics

A major difficulty that participants faced with the optics was focusing. Individuals who were more severely limited in finger and hand dexterity were challenged to successfully refocus the optics without disrupting their viewing.

P1: I found that, I mean, I've got finger dexterity. I didn't have an issue with it, but as I was viewing the others I realized that the focusing was a huge obstacle that everybody had with the [Hummingbird] scope.

Design considerations for optics

Considering the experiences each participant had with trialing the optics, three participants shared their perspectives on what optic design concepts would be most beneficial to this population of birders. The four categories that were identified by the participants were general design considerations, focus knob design and location, focus knob material, and electric focus.

General design considerations

Two optic design considerations were identified by participants. One participant stated that their current pair of binoculars were too heavy and hard to use. Simpler, more lightweight equipment would be most helpful for this participant.

P2: I have found that I have tried to make all as equipment and it's gone from really bulky, heavy to lightweight… but I tend to go less is more, I find that I go to this first.
One participant mentioned the angled eyepiece feature to be a design consideration that would create easier access to the equipment when birding.

P3: [angled eyepiece scope] a really good solution for those of us that really need to have something in front of us.

Focus knob design and location

Participants identified two focus knobs designs that challenged their ability to use the optics efficiently. One participant reported that due to their dexterity limitations, binocular focus knobs are sometimes difficult to access because they are placed between the barrels of the binoculars and can be tucked into the center. This participant found that by using a monocular, the focus knob is completely exposed and easier to access. Another participant said that on their personal pair of binoculars, the focus wheel is quite stiff and difficult to manipulate. Decreasing the stiffness would allow the optics to refocus easier and support the user in birding.

P3: If I had one [focus knob] that was less stiff on these, it would be much easier. I love these binoculars, but yeah, it, it takes an amount of effort to, um, turn it, so I would love to have one that is just a little bit looser.

Focus knob material

Focus knobs that were made of plastic became slippery and made it difficult for participants to use successfully. Similar to the mount components, participants all agreed that focus knob material would be easiest to use if the material was rubberized and grippy. One participant reflected on their personal adaptive equipment and shared how the design of their mount clamp tightening knob is similar to the design of a focus knob, and how modifying the material of the mount clamp component would correspond to a focus knob.
P2: I have on mine [mount], I don’t know, you probably won’t be able to see it, but it does have lines in this part [tightening knob]. It’s plastic and so it’s slippery. So, if that was also grippy and ribbed [it would help].

**Electric focus**

Two participants shared that due to a lack of dexterity they had difficulties with the mounting systems maintaining their stability while focusing the optics. As a result of a lack of finger function, they use their hypothenar eminence instead of their fingers to focus optics, which requires more downward force compared to the force required to focus an optic with a finger. They reported the mounting systems would quickly fall over when this added pressure was put on them. Because of this, all participants agreed that the option which would provide the most assistance to non-ambulatory birders would be an electric focusing system.

P1: And so, I brought up that I had actually created some electric, you know, focus equipment and, uh Participant 2 had somebody else that was working on that. So, there was, the eyes were bright up and, like, oh, my God. And we could have electric focus? That’d be great. Who makes that? And I said nobody.

P3: Automatic focus that Participant 2 and Participant 1 have on some of their equipment is really going to be, um, most, maximum ability.

**Digiscoping**

Digiscoping is a method to birding that utilizes specific attachments to connect phones and tablets to a spotting scope, making the viewing size for the birder larger and easier to see for individuals with low vision and dyskinesia caused by Parkinson’s disease (McGregor, 2022). Two participants stated this method could benefit disabled birders. One participant shared that because of their limitations in dexterity, digiscoping would allow them to continue viewing the
bird on their screen while they refocus, instead of their current method of lowering the binoculars to refocus and having to relocate the bird after.

**Difficulties of having a system that worked effectively together**

Participants had challenges with finding a system that worked well together and fit their needs. There were individual issues with the various equipment, which have been identified in previous sections. However when putting the components together, one participant commented on the fact that the combinations of mounts, optics, and attachment parts they trialed were not able to withstand the additional weight when attached to the wheelchair.

P1: I got the pan tilt, we put the pan tilt on it [Mount A] and that was kind of holding that.

And then we got the Celestron Hummingbird. And it just, it wasn't strong enough.

**Lessons Learned**

Through this capstone the student learned many technical skills that are applicable across a variety of professional platforms. Conducting this research created many networking opportunities for the student, leading to prolonged communication through email and phone discussions, as well as some face to face discussions. Balancing these connections and staying up to date on communication became very important in order to best collaborate with the stakeholders and site mentor as well. Time management was another lesson the student learned through this capstone. With many objectives activities to complete throughout the weeks, keeping a schedule and sticking to it became crucial to completing all tasks in an efficient and timely manner. The most crucial skill that was refined in this capstone was teamwork. Working alongside the capstone mentor and faculty advisor allowed the student to learn from two different perspectives and mesh the thoughts and opinions of all parties to form an agreed upon best final result. Going forward, the capstone mentor and student will remain in contact as they prepare a
manuscript for publication to a research journal. Their shared passion for this area of occupational therapy will surely be a means for them to continue as professional colleagues moving forward.
References


Table 1.

Table depicting demographic information obtained from the sample population.

<table>
<thead>
<tr>
<th>Participant</th>
<th>Years of Birding Experience</th>
<th>Mobility Device Make &amp; Model</th>
<th>Mobility Device Power Options</th>
<th>Diagnosis/Physical Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>Magic Mobility</td>
<td>Recline</td>
<td>FSHD* muscular dystrophy; limited range of motion in both upper extremities; and limited mobility</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>Invacare Storm</td>
<td>Tilt in space and elevate</td>
<td>C5-6 SCI*</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>Quickie S-646 SE</td>
<td>Tilt in space</td>
<td>C5-6 SCI*</td>
</tr>
<tr>
<td>4</td>
<td>&lt;1</td>
<td>Combination Amy System and Invacare</td>
<td>Seat elevator</td>
<td>Dwarfism</td>
</tr>
</tbody>
</table>

*Note. FSHD: Facioscapulohumeral, *SCI: spinal cord injury*
Table 2

All themes and subthemes identified for each category of the PEOP model of practice.

| **Personal Factors** | 1) Understanding/experience level with equipment  
|                      | a. Personal/life experiences  
|                      | b. Feeling overwhelmed by the learning curve associated with this equipment  
|                      | 2) Physical limitations impacting equipment use  
|                      | 3) Mobility equipment design/mounting location  
| **Environmental Factors** | 1) Limiting factors of trialing session  
| **Occupational Factors** | 1) Supporting features/functions of mounts  
|                      | 2) Limiting features/functions of mounts  
|                      | 3) Design considerations for mounts  
|                      | a. Overall ease of use  
|                      | b. Mount clamps and tightening devices  
|                      | c. Mount positioning  
|                      | d. Mount strength and stability  
|                      | 4) New mount design: under-cushion/footrest monopod support  
|                      | 5) Attachment design  
|                      | 6) Supportive features of optics  
|                      | 7) Limiting features of optics  
|                      | 8) Design considerations for optics  
|                      | a. General design considerations  
|                      | b. Focus knob design and location  
|                      | c. Focus knob material  
|                      | d. Electrical focus  
|                      | 9) Digiscoping  
|                      | 10) Difficulties of having a system that worked effectively together |
Table 3

All mounting system options utilized in the research study.

<table>
<thead>
<tr>
<th>Mount Name and Letter</th>
<th>Product Image</th>
<th>Weight</th>
<th>Maximum Height</th>
<th>Load Capacity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mount A</td>
<td></td>
<td>1.1 lb / 0.5 kg</td>
<td>22”</td>
<td>1.1 lb / 0.5 kg</td>
<td>$30</td>
</tr>
<tr>
<td>YAYOYA Super Clamp with 360° Ball Head</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mount B</td>
<td></td>
<td>0.75 lb / 0.34 kg</td>
<td>31”</td>
<td>20 lb / 9.1 kg</td>
<td>$64</td>
</tr>
<tr>
<td>Foto Fennica Finnstick</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mount C</td>
<td></td>
<td>1.26 lb / 0.57 kg</td>
<td>21.3”</td>
<td>3.3 lb / 1.5 kg</td>
<td>$21</td>
</tr>
<tr>
<td>iFongsh 360° Rotatable Desk Mount</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mount D</td>
<td></td>
<td>0.96 lb / 0.44 kg</td>
<td>20”</td>
<td>6.6 lb / 3.0 kg</td>
<td>$86</td>
</tr>
<tr>
<td>Opticron BC-2 Hide/Blind Mount Clamp and Center Column</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mount E</td>
<td></td>
<td>1.9 lb / 0.85 kg</td>
<td>17.7”</td>
<td>4.4 lb / 2 kg</td>
<td>$105</td>
</tr>
<tr>
<td>Opticron Universal II Hide/Blind Mount</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Mount F
Neewer Carbon Fiber 5 Section Monopod

- _Weight:_ 0.75 lb / 0.34 kg
- _Height:_ 64”
- _Capacity:_ 22 lb / 10 kg
- _Price:_ $44

### Mount G
Neewer Tabletop Camera Mount

- _Weight:_ 3.51 lb / 1.6 kg
- _Vertical Height:_ 47”
- _Horizontal Distance:_ 14.2”
- _Capacity:_ 2.2 lb / 1 kg
- _Price:_ $44

### Mount H
Obeamiu Camera Desk Mount

- _Weight:_ 2.13 lb / .97 kg
- _Height:_ 41”
- _Capacity:_ 2.2 lb / 1 kg
- _Price:_ $46

### Mount I
SAIJI Gooseneck Bed Phone Holder

- _Weight:_ 0.88 lb / 0.39 kg
- _Length:_ 29.5”
- _Capacity:_ 1.5 lb / 0.68 kg
- _Price:_ $18

### Mount J
Modular Gooseneck Holder

- _Weight:_ 0.5 lb / 0.22 kg
- _Length:_ 14”
- _Capacity:_ 1.5 lb / 0.68 kg
- _Price:_ $40
Table 4

All optics utilized in the research study.

<table>
<thead>
<tr>
<th>Optic Name and Number</th>
<th>Product Image</th>
<th>Weight</th>
<th>Length</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Optic 1</strong></td>
<td></td>
<td>1.5 lb / 0.68 kg</td>
<td>6.25”</td>
<td>$190</td>
</tr>
<tr>
<td>Vortex Crossfire HD 8x42 Binoculars</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Optic 2</strong></td>
<td></td>
<td>0.79 lb / 0.36 kg</td>
<td>4.7”</td>
<td>$120</td>
</tr>
<tr>
<td>Vortex Vanquish 8x26 Binoculars</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Optic 3</strong></td>
<td></td>
<td>0.6 lb / 0.27 kg</td>
<td>4”</td>
<td>$26</td>
</tr>
<tr>
<td>Hontry 10x25 Binoculars</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Optic 4</strong></td>
<td></td>
<td>0.35 lb / 0.16 kg</td>
<td>4.4”</td>
<td>$99</td>
</tr>
<tr>
<td>Vortex 8x25 Monocular</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Optic 5</strong></td>
<td></td>
<td>0.60 lb / 0.27 kg</td>
<td>4.9”</td>
<td>$170</td>
</tr>
<tr>
<td>Vortex 8x36 Monocular</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Optic 6</strong></td>
<td></td>
<td>0.58 lb / 0.26 kg</td>
<td>4.9”</td>
<td>$180</td>
</tr>
<tr>
<td>Vortex 10x36 Monocular</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Optic 7</strong></td>
<td></td>
<td>0.95 lb / 0.43 kg</td>
<td>7”</td>
<td>$700</td>
</tr>
<tr>
<td>Vortex Recon Tactical Scope</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Optic 8</strong></td>
<td>Vortex Razor HD Spotting Scope</td>
<td>1.56 lb / 0.71 kg</td>
<td>10.3”</td>
<td>$999</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------</td>
<td>-------------------</td>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td><strong>Optic 9</strong></td>
<td>Celestron Hummingbird Scope</td>
<td>1.3 lb / 0.58 kg</td>
<td>7.6”</td>
<td>$260</td>
</tr>
<tr>
<td><strong>Optic 10</strong></td>
<td>Opticron MM4 50 11-33x Spotting Scope</td>
<td>1.8 lb / 0.81 kg</td>
<td>10.2”</td>
<td>$858</td>
</tr>
<tr>
<td><strong>Optic 11</strong></td>
<td>Gosky 20-60x80 Spotting Scope</td>
<td>4.4 lb / 2.0 kg</td>
<td>16.5”</td>
<td>$190</td>
</tr>
</tbody>
</table>
Table 5

All attachment piece options utilized in the research study.

<table>
<thead>
<tr>
<th>Attachment Piece Name</th>
<th>Product Image</th>
<th>Weight</th>
<th>Load Capacity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opticron Balance Plate</td>
<td></td>
<td>0.2 lb / 0.09 kg</td>
<td>6.6 lb / 3.0 kg</td>
<td>$24</td>
</tr>
<tr>
<td>Opticron L-Mount</td>
<td></td>
<td>0.06 lb / 0.03 kg</td>
<td>N/A</td>
<td>$18</td>
</tr>
<tr>
<td>Opticron Binocular Tripod</td>
<td></td>
<td>0.3 lb / 0.14 kg</td>
<td>N/A</td>
<td>$55</td>
</tr>
<tr>
<td>Smallrig Double Ball Head</td>
<td></td>
<td>0.44 lb / 0.2 kg</td>
<td>3.3 lb / 1.5 kg</td>
<td>$13</td>
</tr>
<tr>
<td>Neewer Ball Head</td>
<td></td>
<td>0.44 lb / 0.20 kg</td>
<td>11 lb / 5 kg</td>
<td>$16</td>
</tr>
<tr>
<td>Universal Velcro Strap Binoc</td>
<td></td>
<td>0.18 lb / 0.08 kg</td>
<td>5+ lb / 2.2+ kg</td>
<td>$27</td>
</tr>
<tr>
<td>Product</td>
<td>Weight (lb)</td>
<td>Weight (kg)</td>
<td>Price</td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>-------------</td>
<td>-------------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td>Fapend Binocular Tripod Attachment</td>
<td>0.17 lb</td>
<td>0.07 kg</td>
<td>$15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5+ lb</td>
<td>2.2+ kg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avella Pan-Tilt Head</td>
<td>0.66 lb</td>
<td>0.30 kg</td>
<td>$36</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.77 lb</td>
<td>0.35 kg</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 1

Registration form used to recruit participants for the in-person event virtual event.

In-Person Event Information
My name is Alex Field. I am a doctoral occupational therapy student at Western Michigan University completing my capstone project. I fell in love with birding three years ago and never looked back! I love sharing this hobby with others and hope to see you there!

Thank you for considering to register for this event! Your participation helps with identifying the supports and barriers that exist with adaptive birding equipment! The event will include trialing mounting systems for binoculars, monoculars and spotting scopes and assessing the usability of each item. Findings will be shared with disability and rehabilitation organizations and published in a research journal.

Participation in this event is limited to 10 individuals with mobility challenges. Each participant must use a wheelchair or mobility scooter while birding and must be over the age of 12. Each participant is also welcome to bring one guest to the event if they choose to. There will also be up to four volunteers present at this event to answer questions about equipment and assist as needed with attaching equipment to your mobility devices. Up to two Blandford Nature Center staff members will also be present to assist with set up and tear down of equipment before and after the event.

The event will take place indoors, with an optional opportunity to trial the equipment outside on Blandford's accessible birding trail afterwards. Please bring appropriate clothing for both indoor and outdoor activities if you would like to participate in the outdoor component. Please see below for general information on Blandford Nature Center's accessibility features.

Parking
Blandford Nature Center will block off the front row of parking for this event. Additionally, there are 8 accessible parking spaces, 2 of which accommodate vans. The parking lot is well maintained, paved surface with minimal cracks and bumps. Snow removal will be provided as needed.

Entrance
Curb cuts are present to provide access from the parking lot to the sidewalk. The main entrance to the Visitor Center has a push button automatic door entry with a 0.5 inch metal slope threshold. Entryways have been measured to ensure mobility devices can easily fit through them.

Restrooms
There is one accessible stall in both the men's and women's restrooms. Stall size, toilet and sink heights, and entryway widths have all been measured to ensure ease of access for visitors. All-gender bathrooms are not provided at this location.
Feel free to email me at alexander.r.field@wmich.edu with any questions or concerns about this event!

- Please note that both participants and guests attending the event must fill out their own individual registration form*

Registration Form – (in-person)

1. Name (First, Last)
2. What is your experience level with birding?
   a. None
   b. A little
   c. Moderate
   d. A lot
3. Do you use a manual or power wheelchair or mobility scooter?
   a. Manual wheelchair
   b. Power wheelchair
   c. Mobility scooter
   d. Other
4. If you selected "Other" for the above question, please specify below what mobility device you use?
5. What is the make and model of your wheelchair or scooter?
6. What power options are available on your device?
   a. Tilt in space
   b. Recline
   c. Standing
   d. None of the above
   e. Other
7. If you selected "Other" for the above question, please specify below what power options are available on your device.
8. What diagnosis, or diagnoses, have you received that limit your mobility? Please describe any physical restrictions that are present.
9. Do you have any specific access needs? We will accommodate your needs so you can better participate in the event.
10. Do you have any dietary restrictions? We will be providing snacks and refreshments during the event.
11. Do you plan on bringing a guest to the event? You are welcome to bring a guest! Us knowing this ahead of time will help with catering and seating arrangements.
12. Please provide E-mail address and phone number for updates.
Virtual Event Information

My name is Alex Field. I am a doctoral occupational therapy student at Western Michigan University completing my capstone project. I fell in love with birding three years ago and never looked back! I love sharing this hobby with others and hope to see you there!

Thank you for considering to register for this event! Your participation helps with identifying the supports and barriers that exist with adaptive birding equipment! The event will include trialing mounting systems for binoculars, monoculars and spotting scopes and assessing the usability of each item. Findings will be shared with disability and rehabilitation organizations and published in a research journal.

To participate in this event you must use a wheelchair or mobility scooter while birding and be over the age of 12. Each participant is also welcome to bring one guest to the event if they choose to. Given the nature of this event, neither myself nor any volunteers will be present to answer questions about equipment and assist as needed with attaching equipment to your mobility devices. If any questions or concerns come about during equipment trialing, please do not hesitate to reach me via phone at 517-262-5206 or email me at alexander.r.field@wmich.edu and I will be happy to assist you in any way I can.

Registration Form – (virtual)

1. Name (First, Last)
2. What is your experience level with birding?
   a. None
   b. A little
   c. Moderate
   d. A lot
3. Do you use a manual or power wheelchair or mobility scooter?
   a. Manual wheelchair
   b. Power wheelchair
   c. Mobility scooter
   d. Other
4. If you selected "Other" for the above question, please specify below what mobility device you use?
5. What is the make and model of your wheelchair or scooter?
6. What power options are available on your device?
   a. Tilt in space
   b. Recline
   c. Standing
   d. None of the above
   e. Other
7. If you selected "Other" for the above question, please specify below what power options are available on your device.
8. What diagnosis, or diagnoses, have you received that limit your mobility? Please describe any physical restrictions that are present.
Informed consent form given to participants prior to start of equipment trialing.

Western Michigan University
Department of Occupational Therapy
and Access Birding, LLC

Principal Investigator: Cara Masselink
Student Investigator: Alex Field
Capstone Site Mentor: Freya McGregor

You are invited to participate in this research project titled "Features of optics and mounting systems that facilitate participation in birding for people who use mobility devices: An exploratory study"

STUDY SUMMARY: This consent form is part of an informed consent process for a research study. It will provide information that will help you decide whether you want to take part in this study. Participation in this study is completely voluntary. You may choose to not answer any question, or to stop participating at any time.

The purpose of the research is to identify supports and barriers with current adaptive birding equipment, including mounts and optics, for wheelchair and mobility scooter users, and to use this information to create a new piece of equipment that makes birding more accessible. This project serves as Alex Field’s doctoral capstone project with Access Birding, LLC, for the requirements of his occupational therapy degree at Western Michigan University.

You may participate in an in-person event or virtually. During registration, you will be asked to provide information regarding your experience level with birding, which mobility device you typically use, the make and model of your wheelchair or mobility scooter, power options available on your device, and state any physical diagnoses you have as well as any physical restrictions that are caused by the diagnoses in open ended response questions. In-person participants will also be asked about any specific access challenges and needed accommodations for the event, dietary restrictions and if you will be bringing a guest to the event; however, this information will be used for event planning only. Upon arrival to the in-person event you will be asked to sign a photo/video release form. If you are participating virtually, the photo/video release forms will be emailed to you ahead of time to complete.

Your participation in the study will take approximately two hours, with approximately one hour for active engagement in equipment trialing and approximately one hour of open discussion about the products you interacted with. For each piece of equipment trialed, you will be asked to provide feedback on the usability of the equipment through questionnaires.
Possible risk and costs to you for taking part in this study may include discomfort from answering questions related to your diagnosis or physical capabilities. Additionally, for the in-person event you may be traveling to the event in potentially cold, snowy conditions, and for the virtual event the student researcher will not be present during the equipment trialing portion to answer questions or assist. Potential benefits of taking part may include being introduced to a new activity, or personally identifying ways to improve your experience with birding, and to help further research in this under-researched area. There is no financial benefit to participating. Your alternative to taking part in the research study is not to take part in it.

The following information in this consent form will provide more detail about the research study. Please ask any questions if you need more clarification, or to assist you in deciding if you wish to participate in the research study. Questions may be directed to alexander.r.field@wmich.edu. You are not giving up any of your legal rights by agreeing to take part in this research or by signing this consent form. After all of your questions have been answered and the consent document reviewed, if you decide to participate in this study, you will be asked to sign this consent form.

What are we trying to find out in this study?
This study will explore the physical supports and barriers that exist with current adaptive birding equipment when used by wheelchair and mobility scooter users.

Who can participate in this study?
Participants must be over the age of 12 and would require the use of a mobility device when birding. This includes people who use manual wheelchairs, power wheelchairs, and mobility scooters.

Where will this study take place?
The in-person event will take place at Blandford Nature Center in the auditorium at 1715 Hillburn Ave NW, Grand Rapids, MI 49504. Participants engaging in the virtual research study will complete equipment trialing on their own and will meet for the focus group on Google Meet.

What is the time commitment for participating in this study?
The time commitment for this research study is approximately two hours, plus any travel time. Data for the in-person study will be obtained only on the day of the focus group and equipment trialing event.

What will you be asked to do if you choose to participate in this study?
During event registration, you will be asked to provide information regarding your experience level with birding, which mobility device you typically use, the make and model of your wheelchair or mobility scooter, if there is a tilt in space function, and state any physical diagnoses you have as well as any physical restrictions that are caused by the diagnoses. In-person participants will also be asked to describe any accommodations you may need during the event, and any dietary restrictions. In both the in-person and virtual events, you will be asked to sign a photo/video release form. You will be asked to trial various binoculars, monoculars, and spotting scopes along with various mounting systems while birding, then complete product questionnaires related to the usability of the products. The in-person event will conclude with an
audio-recorded semi-structured discussion with all participants about your experience during the equipment trialing; for virtual participants, Google Meet will be used for this focus group following equipment trialing and will be video recorded.

**What information is being measured during the study?**
Information about your experience with birding, type of mobility device you use (manual, scooter, or power wheelchair), and diagnosis will be gathered along with how easy the equipment was to use, how much assistance you needed to use it, and other product features (weight, ‘feel’ etc). The written comments on the questionnaire and verbal comments in the discussion will also be recorded and analyzed.

**What are the risks of participating in this study and how will these risks be minimized?**
You are providing information about yourself, including your diagnosis and mobility device, to the researcher and at the event, participants will be called by the name provided. At the in-person event, you will travel in potentially cold, snowy conditions, and the geographic location will be disclosed in the study results. Virtual participants will not have the student researcher present to answer questions or for assistance with equipment trialing. In the publication of the study, the researchers will not use participant names, or brands/models of mobility devices. These risks will be minimized by you not having to answer questions you are uncomfortable with and freedom to withdraw from this study at any time.

**What are the benefits of participating in this study?**
By taking part in this study, you will potentially learn to enjoy a new activity or identify ways to improve your experience with birding. You may trial various equipment at no cost and interact with others in a pleasant atmosphere. You will also help further research in this under-researched area and inform future product development. There is no financial benefit to participating in this study.

**Are there any costs associated with participating in this study?**
There are no costs associated with participating in this study.

**Is there any compensation for participating in this study?**
There is no monetary compensation awarded for participating in this research study; however light refreshments and snacks will be provided as an expression of our gratitude for the in-person research participants.

**Who will have access to the information collected during this study?**
The results gathered for the study will be accessed by the student researcher, Alex Field, as well as the principal investigator, Dr. Cara Masselink, and capstone site mentor, Freya McGregor. Results are intended to be presented at a university-wide conference, in a live virtual webinar, and be submitted for publication in a research journal. The student investigator may also present the research at additional occupational therapy related conferences. Only the three individuals named above will have access to information about participants’ names and other identifying features. This information will be kept confidential whenever sharing about the study or any findings.
What will happen to my information or biospecimens collected for this research project after the study is over?
The information you provide on the registration form, answers to questionnaires, and what you say in the focus group will be transcribed onto an Microsoft Excel spreadsheet. During transcription, your name will be removed from all data to protect your identity. The registration information will be downloaded onto a password-protected thumb drive and deleted from Google Forms. Once the questionnaire information has also been transcribed into the Microsoft Excel spreadsheet, the registration form information will be deleted from the thumb drive. The paper questionnaires and the password-protected thumb drive will be kept in Cara Masselink’s locked office at Western Michigan University for three years after the conclusion of the focus groups. A second password protected thumb drive with the registration forms, scanned copies of the paper questionnaires, and notes taken by the researcher/s during the focus groups will be kept on a password-protected thumb drive at the locked office of Access Birding, LLC for three years after the conclusion of the focus groups, then deleted.

What if you want to stop participating in this study?
You can choose to stop participating in the study at any time for any reason. You will not suffer any prejudice or penalty by your decision to stop your participation. You will experience NO consequences if you choose to withdraw from this study.

The investigators can also decide to stop your participation in the study without your consent.

The de-identified (anonymous) information collected for this research may be used by or distributed to investigators for other research without obtaining informed consent from you.

Should you have any questions prior to or during the study, you can contact the principal investigator Cara Masselink at cara.masselink@wmich.edu or the student investigator Alex Field at alexander.r.field@wmich.edu. You may also contact the Chair, Institutional Review Board at Western Michigan University at 269-387-8293 or the Vice President for Research and Innovation at 269-387-8298.

This consent has been approved by the Western Michigan University Institutional Review Board (WMU IRB) as indicated by the stamped date and signature of the board chair in the upper right corner. Do not participate in this study if the stamped date is older than one year.

Participating in this survey online indicates your consent for use of the answers you supply.

Add buttons to click:
I agree to participate in this research study (Survey following upon clicking)
I do not agree to participate in this research study (Browser closes)
Figure 4

Photo/video release form given to participants prior to start of equipment trialing.

PHOTO/VIDEO RELEASE

By executing below, permission is hereby granted to Alex Field, Western Michigan University, Blandford Nature Center, and Freya McGregor at Access Birding, LLC to do the following:

Record, edit, use, reproduce and distribute by way of photograph, video, television and all other media (electronic or otherwise) the visual and/or audio likeness of Releasee. Alex Field, Western Michigan University, Blandford Nature Center, and Freya McGregor at Access Birding, LLC are further granted permission to use such likeness for news, educational, marketing, advertising, fundraising or other reasonable purposes.

By executing this Release, it is agreed that Alex Field, Western Michigan University, Blandford Nature Center, and Freya McGregor at Access Birding, LLC will be held harmless from any liability resulting from the statements and actions captured as set forth above and are hereby released from any claims relating to the rights granted above.

I understand that this Release is entered into on behalf of the Releasee and each of Releasee’s heirs, agents, successors and assigns. I further understand that Releasee will not receive any compensation for this release; however, this Release is a condition of and a part of the consideration for my participation in the associated program. I further understand that although this Release is granted, Alex Field, Western Michigan University, Blandford Nature Center, and Freya McGregor at Access Birding, LLC are under no obligation whatsoever to use my audio or video likeness.

I represent that I am 18 years of age or older, or the parent or legal guardian for the Releasee, have read and understand the content of this release, and agree to the terms hereto.

Name of Participant: ____________________________ (Releasee)

Signature: ____________________________

(Parent’s signature if Participant is a minor)

Participant Address: ____________________________
Figure 5

*Questionnaire used to collect data on mounting systems.*

**MOUNT QUESTIONNAIRE**

1) **Indicate, from ‘strongly disagree’ to ‘strongly agree’, your experiences with this mount.**
   - *Stable:* Didn’t need constant readjusting to maintain one position
   - *Secure:* It felt like it would stay attached; it did not feel like it would fall off

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>It was easy to attach this mount firmly to my wheelchair or scooter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I needed someone else’s help to attach this mount firmly to my wheelchair or scooter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This mount felt secure* when it was attached to my wheelchair or scooter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This mount felt stable* when it was attached to my wheelchair or scooter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This mount was complicated and/or difficult to manipulate or reposition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This mount did not stay in position when I tried Optics 1, 2, 3, 5, 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>This mount easily supported the weight of the Optics 7, 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>It was difficult to remove this mount from my wheelchair or scooter on my own</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2) **What location(s) did you try to attach the mount to your wheelchair or scooter?**

- [ ] Frame
- [ ] Arm Rest
- [ ] Seat
- [ ] Back Rest
- [ ] Unable to attach

3) **A) Which location(s) worked the best and why?**

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

B) **If you were unable to attach this mount to your wheelchair or scooter, what was the difficulty you encountered?**
4) A) Is this mount one that you could use successfully for birding?  Yes ☐  No ☐
B) Please share why or why not.

5) A) If money were no object, would you choose to buy this mount for birding?  Yes ☐  No ☐
B) Please share why or why not.

6) What changes would make this mount easier to use?

7) Indicate either ‘yes’ or ‘no’ to these safety considerations related to this mount.

<table>
<thead>
<tr>
<th>Safety Consideration</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>This mount obstructed or interfered with my ability to propel my wheelchair</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>I had to lean too far forward to use this mount</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>This mount design created a pressure point on my legs, hip or abdomen</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>This mount obstructed my vision or otherwise caused a safety hazard</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Please share any other thoughts or feedback you have about this mount

Note. A questionnaire was prepared for each individual mount provided during the trialing phase (A through J).
**OPTIC QUESTIONNAIRE**

1) Which mount(s) did you trial this optic with?

<table>
<thead>
<tr>
<th>Mount A □</th>
<th>Mount E □</th>
<th>Mount I □</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mount B □</td>
<td>Mount F □</td>
<td>Mount J □</td>
</tr>
<tr>
<td>Mount C □</td>
<td>Mount G □</td>
<td></td>
</tr>
<tr>
<td>Mount D □</td>
<td>Mount H □</td>
<td></td>
</tr>
</tbody>
</table>

2) How difficult was it for you to hold and/or manipulate the optic before you attached it to the mount?

<table>
<thead>
<tr>
<th>Very Difficult</th>
<th>Somewhat Difficult</th>
<th>Neutral</th>
<th>Somewhat Easy</th>
<th>Very Easy</th>
<th>Unable to hold optic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3) A) What features of the optic made it **EASY** to handle and/or control? Check all that apply.

- [ ] The texture or ‘feel’ of the outside of the optic
- [ ] The weight of the optic
- [ ] The size of the optic
- [ ] The overall balance of the optic
- [ ] The shape of the optic
- [ ] Another factor

B) Please explain any of the options checked.

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

4) A) What features of the optic made it **DIFFICULT** to handle and/or control? Check all that apply.

- [ ] The texture or ‘feel’ of the outside of the optic
- [ ] The weight of the optic
- [ ] The size of the optic
- [ ] The overall balance of the optic
- [ ] The shape of the optic
- [ ] Another factor

B) Please explain any of the options checked.

____________________________________________________________________________________
____________________________________________________________________________________

5) Please rate the level of ease with changing the focus.
SUPPORTIVE ADAPTIVE BIRDING EQUIPMENT FEATURES

6) A) What about the focal wheel made it EASY to use? Check all that apply.

☐ The focal wheel was small
☐ The focal wheel was heavily textured
☐ The focal wheel was large
☐ The focal wheel was stiff/difficult to move
☐ The focal wheel was easy to reach
☐ The focal wheel was very sensitive/moved easily

B) For the options checked, please explain why they made it easy for you to use.

________________________________________________________________
________________________________________________________________
________________________________________________________________

7) A) What about the focal wheel made it DIFFICULT to use? Check all that apply.

☐ The focal wheel was small
☐ The focal wheel was heavily textured
☐ The focal wheel was large
☐ The focal wheel was stiff/difficult to move
☐ The focal wheel was easy to reach
☐ The focal wheel was very sensitive/moved easily

B) For the options checked, please explain why they made it difficult for you to use.

________________________________________________________________
________________________________________________________________
________________________________________________________________

Additional Comments:

Note. A questionnaire was prepared for each individual optic provided during the trialing phase (1 through 11). Mounts that were not compatible with the current optic were crossed out to minimize potential challenges of getting the optic secured.
Figure 7

*Interview questions used during focus group.*

1. What was your favorite mount and why?
2. What was it about the mounts that made it challenging to set them up? Specify the mounts.
3. What mounts were the easiest to use/enhanced the birding experience? Why?
4. What mounts were the hardest to use/limited the birding experience? Why?
5. Which adjustment knob styles were easiest to use? (Stiff/loose? Big/small?)
6. What clamp styles were the easiest to attach to your wheelchair?
7. Of the three categories (hinge, ball in socket, and flexible) which was the easiest style to use and why?
8. What modifications to the mounting systems would make them easier to use/set up on your wheelchair?
9. Were there any mount features that made them unsafe to use?
10. Which tripod attachments worked the best for…? Why?
    a. Binoculars:
    b. Monoculars:
    c. Scopes:
11. What tripod attachments did not work well with…? Why?
    a. Binoculars:
    b. Monoculars:
    c. Scopes:
12. What was your favorite optic and why?
13. Were the optics with angled eyepieces helpful? Why or why not?
14. Did the rotating ring on the Opticron and Gosky spotting scopes help? Why or why not?
15. What are the best features of the optics?
    a. Binoculars:
    b. Monoculars:
    c. Scopes:
16. What features are the least useful about the optics?
    a. Binoculars:
    b. Monoculars:
    c. Scopes:
17. Please share any final thoughts and/or comments about the equipment trial or topics discussed in this meeting with the group.
**Figure 8**

*Depicting slides created for the student capstone presentation completed during Week 14.*

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**Features of optics and mounts that facilitate participation in birding for power wheelchair users: An exploratory study**

**Presenter:** Alex Field, OTS  
**Site Mentor:** Freya McGregor, OTR/L

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**Study Purpose**
- No research currently exists
- Marginalized and underserved population

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**Study Objectives**
- Assess features of existing products
- Recruit disabled birders to trial the equipment
- Identify supportive and limiting equipment features

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**Introducing occupational therapy**

**What we do?**

**Who we serve?**

**Where do we do it?**

---

**Mount Purpose**
- Limits need to hold the optics
- No products currently exist
- Challenges with material, strength, stability

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**Methods**
- Recruited four participants and sent equipment
- Equipment was trialed together
- Collaborative focus group with all participants

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**Table 1: Demographic data of the sample population**

<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
<th>Employment Status</th>
<th>Mobility Impairment</th>
<th>Sensory Impairment</th>
<th>Diagnosis/Physical Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>Full time</td>
<td>Wheelchair</td>
<td>Visually impaired</td>
<td>Cerebral Palsy</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>Part time</td>
<td>Scooter</td>
<td>Hearing impaired</td>
<td>Multiple Sclerosis</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>Retired</td>
<td>Manual</td>
<td>Tactile impaired</td>
<td>Stroke</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>Student</td>
<td>Manual</td>
<td>Hearing impaired</td>
<td>Muscular Dystrophy</td>
</tr>
</tbody>
</table>

---

**Participant Demographics**

**Equipment Trialed**
- Mounts
- Binoculars
- Monoculars
- Spotting Scopes

**Attachment Pieces:**
- Mounts
- Binoculars
- Monoculars
- Spotting Scopes
<table>
<thead>
<tr>
<th>Supportive features of mounts</th>
<th>Using Binoculars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tightening devices:</td>
<td>• Functional skills</td>
</tr>
<tr>
<td>• Textured for easier grip</td>
<td>• Vision</td>
</tr>
<tr>
<td>• Long/wise enough to manipulate</td>
<td>• Coordination</td>
</tr>
<tr>
<td>Strong, stable, and lightweight material</td>
<td>• Trunk control</td>
</tr>
<tr>
<td>clamp that can grip tightly to flat or round surfaces</td>
<td></td>
</tr>
<tr>
<td>Large ball joints to increase strength and decrease the need to tighten</td>
<td></td>
</tr>
<tr>
<td>Three joints for maximum positioning flexibility</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mount design ideas</th>
<th>Supportive features of binoculars</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Under cushion plate</td>
<td>Focus knob highly textured for easy manipulation &amp; ability to adjust stiffness level</td>
</tr>
<tr>
<td>• Foot rest monopod support</td>
<td>Hinge not too stiff</td>
</tr>
<tr>
<td></td>
<td>Rubber material to increase grip</td>
</tr>
<tr>
<td></td>
<td>Lightweight design</td>
</tr>
<tr>
<td></td>
<td>Threaded attachment capabilities</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Supportive features of monoculars/spotting scopes</th>
<th>Takeaways</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angled eyepiece at 45-degrees for easy viewing</td>
<td>• Expands knowledge of mounting systems for disabled birders</td>
</tr>
<tr>
<td>Lightweight design</td>
<td>• Provides information on ideal loaner birding equipment for disabled birders</td>
</tr>
<tr>
<td>Rotating sleeve for maximal positioning flexibility</td>
<td>• Using the identified design concepts to create more accessible and inclusive optics and mounts</td>
</tr>
<tr>
<td>Highly textured focus knobs/rings for easy grip</td>
<td></td>
</tr>
<tr>
<td>Exposed focus knob for easy access</td>
<td></td>
</tr>
<tr>
<td>Grippy exterior material</td>
<td></td>
</tr>
<tr>
<td>Wider field of view capabilities</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Digiscoping</th>
<th>Future Research</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Create prototypes of the mount design ideas</td>
</tr>
<tr>
<td></td>
<td>• Trialing with more participants</td>
</tr>
<tr>
<td></td>
<td>• Explore a wider variety of optic/mount options</td>
</tr>
</tbody>
</table>
Thank you!

We will now have time for Q & A