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ABSTRACT

Individuals with autism have key deficits in the ability to gaze at moving objects and prepare and execute a motor response. The practice of visuomotor testing has the potential to provide further information regarding the challenges and limitations these individuals. This study assessed the kinematics of individuals with Autism Spectrum Disorder (ASD) and individuals with Developmental Coordination Disorder (DCD). The purpose of this research was to obtain a better understanding of deviations regarding visual and motor skills in atypical and typical development. Participants were placed in front of a giant screen, which displayed a virtual 3D environment. Reflective body markers were placed on the participant, which allowed for data to be captured through the use of a Motion Analysis System, Cortex software, D-Flow software and eye-tracking glasses. Data collected was computed to provide the average displacement of Center of Mass (COM) and average speed using the C7 and sacral marker on the participants during the body movement task and intercept task. Findings showed that during body movement task, clear differences between the participants in the ASD and DCD group were observed. However, during the intercept task, inconsistent patterns were seen which made it difficult to formulate any conclusions. Due to the evaluation of a very small sample size as well as the absence of data from a healthy control group, no statistical

analysis could be made. Although it was difficult to create any assumptions, this project provided the groundwork for additional future testing.

Study of Kinematics in Individuals with Autism Spectrum Disorder and Developmental
Coordination Disorder

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AND DEVELOPMENTAL COORDINATION DISORDER

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CHAPTER I

INTRODUCTION

In recent years, the prevalence of Autism Spectrum Disorder (ASD) has increased ^(7, 13). Causes of autism have yet to be understood but many believe that genetics as well as environmental factors seem to play a role ^(6, 9, 12, 14, 19). Over the past years, there has been an increased interest in visual and motor testing of individuals with Autism Spectrum Disorder in hopes to better understand the pathology, causes and treatment of this disorder. Individuals with ASD are known to have a delay or lack of joint attention, which is defined as coordinated looks between the individual and object of interest ^(3, 7, 8). This distinct characteristic is most likely caused by the individual's inability to accurately process visual motion, which could affect their motor preparation and execution ^(3, 7).

The use of visual pursuit is a good strategy for evaluating the functional brain connectivity in individuals because it involves the integrated actions of several areas of the brain ⁽²⁰⁾. Development of motor skills such as body coordination, spatial orientation and balance are dependent on efficient visual perception and eye muscle control ^(4, 20). An error in receiving information through the visual system will consequently cause an error in the visuomotor integration and output, which can potentially result in motor deficiencies ⁽⁴⁾.

In this study, individuals with ASD were compared to typical developing individuals as well as individuals with Developmental Coordination Disorder (DCD). The DCD participants were used as a pseudo-control group in order to show a stark difference in kinematics compared

to typical developing controls. Because individuals diagnosed with DCD are characterized to have impairments in motor execution without social, emotional or communication impairments, finding similar kinematic patterns between individuals with ASD and DCD may confirm that the motor skills of autistic individuals are compromised. Evaluating eye tracking data can further confirm if visuomotor integration may be the cause for the disturbance in motor execution. The overall purpose of this study is to gain more knowledge on how visuomotor integration differs in atypical and typical populations in hopes to support the hypothesis that individuals with ASD and DCD will have greater difficulty quickly and accurately locating and tracking an object moving in different directions across the visual field compared to healthy controls.

CHAPTER II

BACKGROUND & LITERATURE

Autism spectrum disorder (ASD) is a biological brain disorder that represents a group of disorders related to autism, which commonly affects the individual's ability to comprehend, communicate, and interact with others ⁽¹⁰⁾. According to the Centers for Disease Control and Prevention (CDC), recent findings shows that the prevalence of autism spectrum disorder has increased to 1 in every 88 children and is 3-4 times more likely seen in boys than girls ^(7, 13). The onset of ASD usually occurs early in life, before the age of 3 but can be diagnosed later in life in some cases ^(7, 12, 13). The current criteria to be diagnosed with autism requires the following: 1) qualitative impairment in social interaction, 2) qualitative impairment in communication, and 3) restrictive, repetitive and stereotypic patterns of behaviors and activities ^(3, 13). Although motor impairments are not core diagnostic characteristics of ASD, motor abnormalities have been observed in infants within the first few months of birth ⁽⁸⁾. Individuals with ASD are known to have difficulties in focusing on an object of interest, which can consequently affect their motor output ^(3, 7, 8). Researchers also found that infants with ASD may exhibit hypotonia, the loss of muscle tone ⁽⁸⁾. Due to the lack of muscle tone, the patient could experience difficulties in controlling movements in their head and neck, which may lead to a decrease in visual tracking and development in eye muscle compared to typical individuals ⁽⁸⁾. Studies using standardized measures of motor function show that autistic children displayed unusual gait such as decrease in step length, slower pace and increased knee flexion in comparison to typical developing children

⁽¹⁵⁾. But not all studies support the argument that motor impairments are part of the autism phenotype ⁽¹⁵⁾. Some researchers found that there were no significant gait difference among autism and typical developing individuals⁽¹⁵⁾. It is also unclear whether motor skills in individuals with ASD differ from those with Developmental Coordination Disorder since most studies use typical developing control groups ⁽¹⁵⁾.

There have been many theories concerning the cause of ASD. It was first thought that autism was a product of poor parenting or environmental factors such as exposure to pollutant and vaccines ⁽¹⁸⁾. However, studies have shown that this disorder may be genetically linked ⁽¹⁸⁾. A popular belief is that ASD is caused by a genetic predisposition and is later triggered by an environmental assault ⁽¹⁸⁾. Through the development of brain imaging, recent findings show that increased brain size is strongly associated with ASD ^(6, 12). It is thought that the increase in size may be due to failure in pruning, which takes place during childhood and adolescent years ⁽⁶⁾. Pruning is the process of refining the synaptic network of connections in the brain to allow different areas of the brain to develop specific functions ⁽¹⁹⁾. Synapses are the points where the neurons are able to connect and communicate among one another ⁽¹⁹⁾. Due to excess synapses, this can affect the functionality of the brain ⁽¹⁹⁾. Although strong evidence shows that genetic factors are believed to be the prime cause of ASD, its etiology still remains to be established ⁽¹⁴⁾.

With increased prevalence of ASD, a larger level of clinical attention must be used to better diagnose and treat individuals with ASD ⁽²⁾. Due to the limited information regarding the etiologies of ASD, most therapies focus on educational and behavioral interventions ⁽¹²⁾. Because of the wide range in severity of this disorder, therapy treatment is not tailored to each individual ⁽¹²⁾. Studies have found that the most effective treatment is the involvement of the individual's family, which provides teaching opportunities regarding family values and the child's strengths

and preferences ⁽¹²⁾. Family members are able to continue to teach the child in their home environment which allows for more intervention ⁽¹²⁾. This is critical considering that children with more intervention displayed significant improvements compared to those receiving less treatment ⁽¹²⁾.

Developmental coordination disorder (DCD) is a condition in which children have an impairment in developing motor coordination which consequently impedes with their daily activities ⁽¹⁶⁾. Prevalence of DCD is roughly 2-7% and is found two times more in boys than girls ^(4, 9). This disorder typically appears early in life, usually during infancy, childhood or teenage years and limitations in their physical abilities varies across individuals ⁽¹⁶⁾. Characteristics of those with DCD include impaired locomotion, excessive hip flexion, reduced upper and lower limb coordination and lack of head and trunk control ⁽¹¹⁾. Children with DCD also have marked difficulties in ball handling, which suggests that these individuals may have trouble in visual perception or difficulties in motor response ⁽¹¹⁾. Findings have also shown that children with DCD displayed a decrease ability to pursue an object traveling horizontally compared to typical individuals ⁽¹⁷⁾. Recent studies revealed that there was an overall decrease in knee extensor movements, knee power absorption and ankle power generation when comparing DCD boys versus typical developing boys ⁽¹¹⁾.

Motor deficiencies displayed by children with DCD are thought to derive from abnormalities in sensory integration ⁽⁵⁾. Some theories also suggest that deficits in visual perception may be the primary cause of poor motor coordination ⁽⁵⁾. It is widely believed that difficulties with motor coordination can arise from one or more of the following impairments: motor programming, timing, sequencing of muscle activity or proprioception ^(1, 11). Since the DCD population is a heterogeneous group, finding its etiology has proven to be difficult ⁽¹⁾. The

heterogeneity of DCD could also explain why children within this population may present a range of differences in motor deficiencies ^(1,9). The literature has presented numerous theories regarding the cause of DCD, but none have yet to be confirmed ^(1, 9, 11).

CHAPTER III

SPECIFIC AIMS

The main objective of this practicum is to compare how individuals with ASD and individuals with DCD quickly and accurately locate and track an object moving in different directions across the visual field. The specific aims to achieve this objective were to:

- Track the participant's movements while they were performing tasks in a virtual environment, which incorporated visual pursuit as well as motor response.
- Evaluate and observe differences in body movements between ASD and DCD.

SIGNIFICANCE

The purpose of this study is to observe individuals with autism spectrum disorder (ASD), Developmental Coordination Disorder (DCD) and typical-developing individuals with the goal to obtain a better understanding of deviations regarding visual and motor skills in atypical and typical development. The data collected has the potential to provide significant information regarding whether the individual had trouble: 1) directing their attention towards an object, 2) tracking an object in space by gaging the position and motion, 3) processing the visual information to plan an appropriate motor response or 4) performing the appropriate motor response. This can provide further information regarding treatment as well as early detection of

ASD. Early detection of ASD allows physicians to prescribe earlier therapy for the individual, which can greatly improve their learning and social skills.

CHAPTER IV

MATERIALS & METHODOLOGY

Screening:

To determine whether the participant was eligible to partake in the study, screening procedures were taken. A phone interview between the potential participant or their parents/legal guardians with an authorized member of the research team was conducted to provide information regarding the participant's medical and prescription drug use history. Those who have met the requirements for the phone screening were emailed the Social Communication Questionnaire (SCQ) and Developmental Coordination Disorder Questionnaire (DCD-Q). The SCQ is used to identify potential risks of ASD and is widely used as a screening tool for entry of a research study concerning ASD. The DCD-Q is a standardized test used to identify potential risk of DCD.

The scores on both the SCQ and the DCD-Q determined eligibility of the participants. To become an eligible participant in the control group, the individual had to score <8 on the SCQ as well as a lower than age-appropriate cutoff scores on the DCD-Q. The ASD individuals needed a score of >15 on the SCQ and the DCD individuals required higher scores than the age-appropriate cutoff. Healthy individuals with a SCQ score of <8 and individuals with ASD with a SCQ score of >15 then completed an IQ test known as the Wechsler Abbreviated Scale of Intelligence (WASI-II). Potential ASD participants completed the Autism Diagnostic Observation Schedule –Second Edition (ADOS-2) and the Autism Diagnostic Interview-Revised

(ADI-R) if they did not have scores within the past year. Both of these tests were used to confirm diagnoses of ASD.

Inclusion/Exclusion criteria:

Individuals in the ASD group were included in the study if they meet the following requirements: 1) aged 8 to 50 years old, 2) male or female, 3) received a diagnosis of ASD, Autistic Disorder, Asperger's Syndrome, or any related developmental disorder according to the DSM-IV or DSM-V criteria, 4) received scores above cutoffs (>8) on both the ADOS-2 and ADI-R obtained by a professional within one year of the screening OR, 5) received scores above cutoffs (>8) on both the ADOS-2 and ADI-R obtained by an authorized member of the research team, and 6) had receptive/expressive language that was sufficient to complete the study which were determined from language samples obtained from the phone screening. Individuals in the ASD group were excluded from participating in the study if they met any of the following requirements: 1) received a prior diagnosis of a genetic disorder other than ASD, 2) have a neurological disorder or abnormality in brain structure, 3) brain injury or tumor, meningitis or encephalitis, 4) motion sickness, 5) neurofibromatosis, 6) seizure disorder, 7) head injury or concussion with loss of consciousness, 8) any psychiatric diagnosis, 9) movement disorder, 10) intellectual disability or mental retardation, 11) conduct disorder or oppositional defiant disorder, 12) current aphasia or language difficulty, 13) current alcoholism or substance dependence, 14) oculomotor disorder, 15) currently using benzodiazepines, or other medications that are known to affect motor functioning, 16) received a non-verbal IQ score of <70 on the WASI-II test that was conducted by an authorized personnel of the research team, or 17) weigh over 400 lbs.

Individuals were included in the control group if they meet the following criteria: 1) aged 8 to 50 years old, 2) male or female, 3) had no diagnosis of ASD, Autistic Disorder, Asperger's Syndrome, DCD, or any related developmental disorder, 4) Received a score <8 on the SCQ, 5) received a score below the age-appropriate cutoffs on the DCD-Q, and 6) healthy. Individuals were excluded from the control group if they met any of the following criteria: 1) received a diagnosis of ASD, Autistic Disorder, Asperger's Syndrome, DCD, or any related developmental disorder, 2) received a prior diagnosis of a genetic disorder other than ASD, 3) have a neurological disorder or abnormality in brain structure, 4) have first-degree relative with a diagnosis of ASD, Asperger's Syndrome, DCD, or any related developmental disorder, 5) have brain injury or tumor, meningitis or encephalitis, 6) motion sickness, 7) neurofibromatosis, 8) seizure disorder, 9) head injury or concussion with loss of consciousness, 10) any psychiatric diagnosis, 11) movement disorder, 12) intellectual disability or mental retardation, 13) conduct disorder or oppositional defiant disorder, 14) current aphasia or language difficulty, 15) current alcoholism or substance dependence, 16) oculomotor disorder, 17) currently using benzodiazepines, or other medications that are known to affect motor functioning, 18) received a non-verbal IQ score of <70 on the WASI-II test that was conducted by an authorized personnel of the research team, or 19) weigh over 400 lbs.

Individuals were included in the DCD group if they met all of the following criteria: 1) aged 8-17 years old, 2) male or female, 3) have no diagnosis of ASD, Autistic Disorder, or Asperger's Syndrome, 4) have scores above the age-appropriate cutoffs on the DCD-Q obtained within a year of screening, or 5) received scores above the age-appropriate cutoffs on the DCD-Q during screening, and 6) scored <8 on the SCQ. Individuals were excluded from the DCD group if they met any of the following criteria: 1) received a diagnosis of ASD, Autistic Disorder,

Asperger's Syndrome, or any related developmental disorder according to the DSM-IV or DSM-V criteria, 2) have a prior diagnosis of a genetic disorder other than ASD, 3) have a neurological disorder or abnormality in brain structure, 4) have first-degree relative with a diagnosis of ASD, Asperger's Syndrome, DCD, or any related developmental disorder, 5) have brain injury or tumor, meningitis or encephalitis, 6) motion sickness, 7) neurofibromatosis, 8) seizure disorder, 9) head injury or concussion with loss of consciousness, 10) any psychiatric diagnosis, 11) intellectual disability or mental retardation, 12) conduct disorder or oppositional defiant disorder, 13) current aphasia or language difficulty, 14) current alcoholism or substance dependence, 15) oculomotor disorder, 16) currently using benzodiazepines, or other medications that are known to affect motor functioning, 17) received a non-verbal IQ score of <70 on the WASI-II test that was conducted by an authorized personnel of the research team, or 18) weigh over 400 lbs.

Consent:

Prior to joining the research study, participants were required to undergo a process of consenting. During this process, an authorized lab personnel sat down with the participant and/or their parents/legal guardians and went over the research study's protocol. The participant signed, initialed, and dated the consent document stating that they understood the protocol and agreed to participate in the study. In addition, the participant signed and dated a HIPPA form, which protects the privacy of the participant's health information. The authorized lab personnel answered any questions or concerns that the participant had regarding the study. The participant was able to choose whether they wanted to stop participating in the study at any point in time.

Experiment preparation:

A. Marker set

Each participant wore a fitted suit with 23 body markers that were carefully placed on specific anatomical landmarks, as seen in Appendix A. These body markers are reflective which allows a 12 camera Motion Analysis System (Motion Analysis Corp., Santa Rosa, CA) to capture the 3D positions of the markers. The information was sent to Cortex Software, which built a kinematic model and recorded the movements of the participant in real time. The kinematic model is shown in Appendix B. This allowed us to collect data regarding the 3D body movement, joint position and posture data of the participant. The data collected was further examined to provide us information concerning the kinematic patterns and statistics of each individual.

B. Eye-tracking glasses

Throughout the study, subjects were asked to wear eye-tracking glasses (MobileEye-XG), which contain 2 cameras that recorded both the scene and the individual's eye. These glasses were able to capture data regarding the position, acceleration and velocity of the eyes. The data can then be computed to calculate the subjects eye position and speed relative to the object of interest and can be further analyzed to show whether that individual was able to accurately track the object of interest. An image of the eye-tracking glasses can be viewed in Appendix C.

C. Safety harness

Because the participant was stepping and moving on the treadmill, a safety harness was used to support the participant in the chance that they stumble or fall during the study. An authorized lab personnel standing nearby the participant proctored the study and monitor the participant throughout the duration of the experiment

Experiment:

Participants stood on a stationary dual-belt treadmill while they completed a variety of tasks in a virtual environment displayed before them on a 180-degree wrap around screen. The treadmill has built-in force plates beneath each belt, which provides data concerning the center of pressure. The screen projected objects such as moving dots and balls, depending on the type of task that the participant must complete.

Data collected from the body movement task and the intercept task were analyzed. In the body movement task, the participant stood in the center of the treadmill, which was represented on the screen as a crosshair. This was referred to as the “start position”. A blue ball projected on the screen represented the participant’s body and mimicked the movement of their body. A rectangular bar, referred to as the “safe zone”, randomly appear on the screen at 1 of 4 different positions for a total of 16 trials. The goal is for the participant to step or lean their bodies so that the blue ball reaches the safe zone before a given time limit. The participant has successfully entered each safe zone if there is an 80% overlap between the safe zone and the blue ball. Small fireworks appeared on the screen to confirm that participant reached the safe zone. After each trial, the participant was asked to return to the starting position before they continue the next trial. This ensured that the participant was starting in the same position for each trial, which allowed us to collect accurate data concerning the total distance the participant moved during each trial. . Refer to Appendix D for illustration of the body movement task and the target values of the safe zones.

In the intercept task, a blue ball on the screen represented the participant’s body. A red ball randomly rolled towards the participants on 1 of 9 different trajectories for a total of 90 trials. The participant was asked to step or lean their bodies to intercept/catch the red ball moving

towards them. The subject has intercepted the ball if there is at least an 80% overlap between the blue and red ball. Like the body movement task, the participant was asked to begin at the start position and return to this position after each trial. Refer to Appendix E for an image of the intercept task trajectories.

ANALYSIS

Cortex Software (Motion Analysis Corp, Santa Rosa, CA) recorded the 3-dimensional vectors (x, y, and z) of the participant's motion in real-time throughout the study. This software displayed a kinematic model of the participants and allowed for the filling of any missing data from each reflective marker that the Motion Analysis System was unable to track during data collection. Once data from each participant was fully tracked, files were exported which contained values of each reflective body marker on the x, y, and z-axis. D-Flow Software (Motek Medical, Amsterdam, The Netherlands) allowed for real-time data stream and recorded the time stamp on the start and completion of each trial.

The data collected was further computed to obtain the displacement and speed of each participant using the C7 marker. Displacement and speed of the sacral marker was also calculated as extrapolated Center of Mass (COM). The two data sets were compared to determine if participants used similar or different movement type strategies.

CHAPTER V

RESULTS

For this research study, two participants were observed, one ASD and one DCD. Due to limitations with recruitment, there were no data collected from healthy controls. Given the small sample size in each group, no formal statistical analysis could be conducted. Table 1 outlines the participant's average displacement of COM, average speed, and standard deviation for the four safe zones in the body movement task. Figure 1 & 2 depicts the graphs based on the values in Table 1. Refer back to Appendix D for an illustration and target values of the safe zones.

Table 1. Body Movement: Participant Displacement and Speed for C7 and Sacrum.
Displacement = meters, speed = meters/second.

	Participant 08				Participant 10			
	Avg. Displacement	Stdev.	Avg, Speed	Stdev.	Avg. Displacement	Stdev.	Avg. Speed	Stdev.
C7 Marker								
Left short	0.06	0.047	0.413	0.172	0.096	0.123	0.416	0.304
Left long	0.20	0.048	0.365	0.089	0.263	0.126	0.755	0.300
Right short	0.17	0.024	0.494	0.051	0.125	0.074	0.913	0.036
Right Long	0.23	0.084	0.403	0.074	0.376	0.065	0.988	0.068
Sacral Marker								
Left short	0.02	0.03	0.230	0.06	0.03	0.08	0.47	0.42
Left long	0.04	0.03	0.214	0.05	0.17	0.13	0.89	0.38
Right short	0.07	0.05	0.279	0.04	0.13	0.06	0.94	0.10
Right long	0.06	0.02	0.276	0.11	0.29	0.06	1.11	0.12

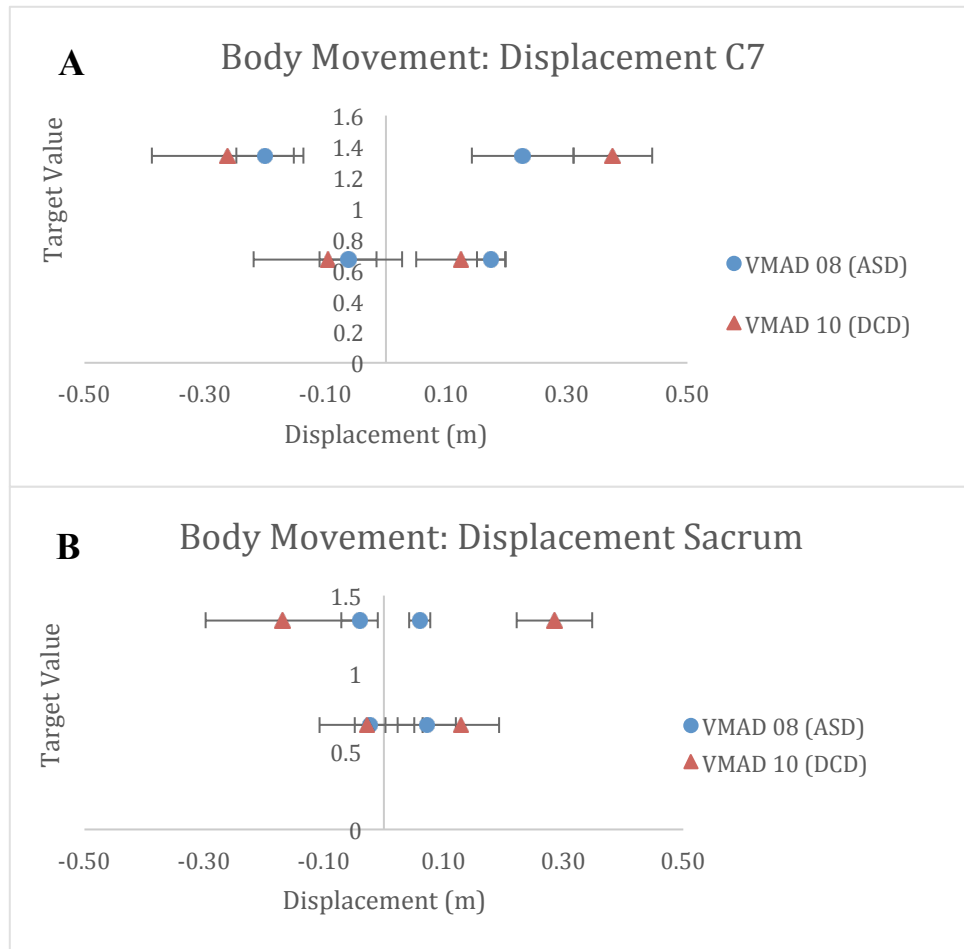


Figure 1, A – B. The average displacement of short and long, left and right positions for the body movement task of the C7 and sacral markers. Note that the displacement values for the left long and left short were given a negative for graphing purposes to differentiate between the right long and short trials. (Left long = upper left data points, left short = lower left data point, right long = upper right data points, and right short = lower right data points)

In the body movement task, the participant with DCD had an overall higher C7 displacement than the participant with ASD. In the left long and right long trials, difference in displacement was more obvious. During the left short trials, the participant with DCD displayed a slightly larger displacement but values between both participants were comparable. The participant with ASD had a marginally higher displacement in the right short trials. Similar

patterns were also observed with the sacral marker with the exception that all trials showed the DCD participant with larger displacement.

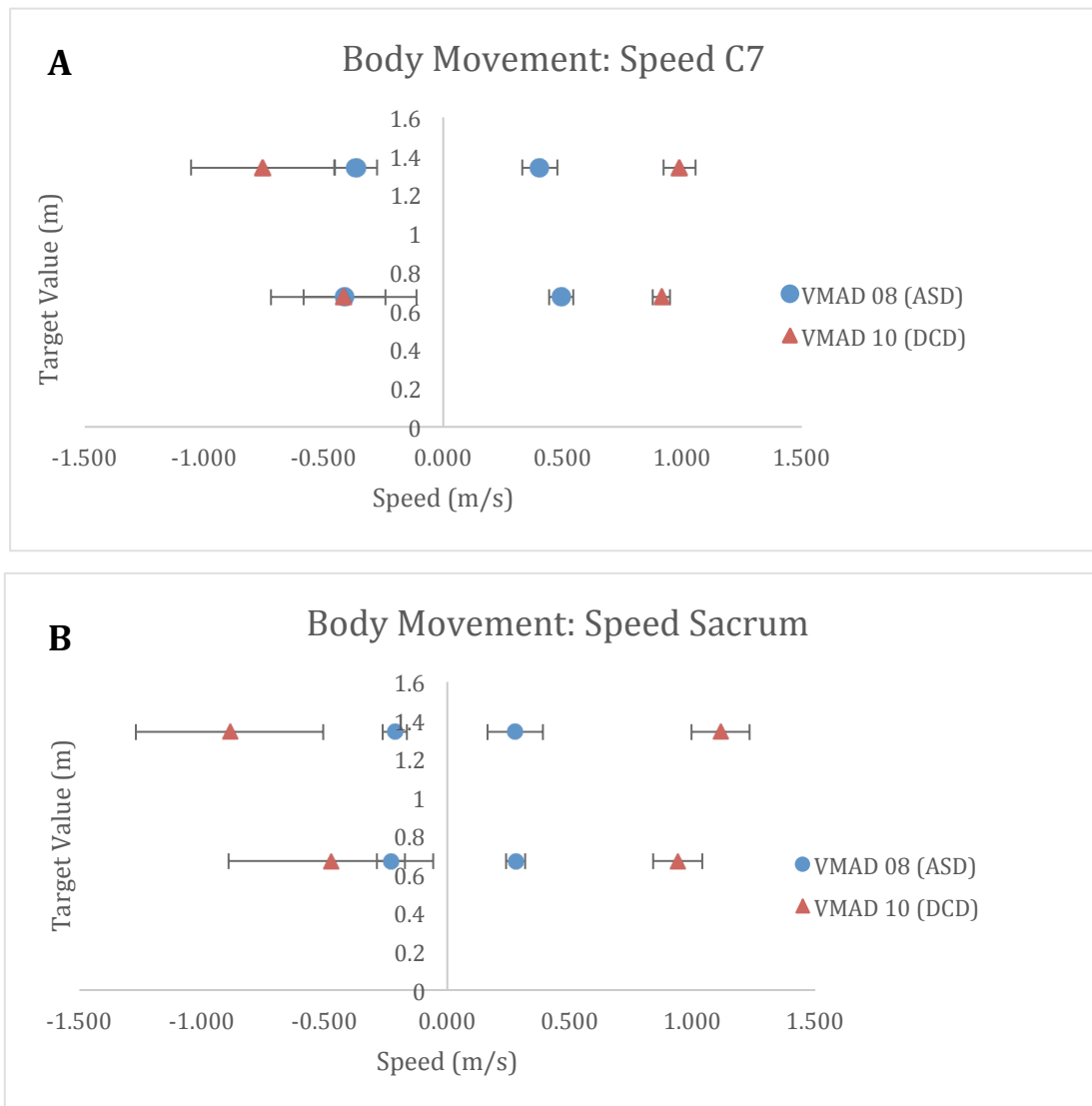


Figure 2, A-B. The average speed for body movement task. (Left long = upper left data points, left short = lower left data point, right long = upper right data points, and right short = lower right data points)

Figure 2 illustrates the average speed of the C7 and sacral markers as the participant is moving their COM into the “safe zone” during the body movement task. In the left long, right short, and right long trials for the C7 marker, the participant with DCD had a higher average

speed compared to the ASD participant. For the left short trials, the average speeds for both participants were fairly equal. Differences amongst both participants were more obvious with the sacral marker. In the left short and long and the right short and long trials, the participant with DCD presented a greater average speed.

Table 2 outlines the participant's average displacement, average speed, and standard deviation for the 9 trajectories in the intercept task. These trajectories are displayed in Appendix E. Figures 3 & 4 depicts the graphs based on the values in Table 2.

Table 2. Intercept: Participant Displacement and Speed for C7 and Sacrum. Displacement = meters, speed = meters/second.

Trajectories	Participant 08				Participant 10			
	Avg. Displacement	Stdev	Avg. Speed	Stdev	Avg. Displacement	Stdev	Avg. Speed	Stdev
C7 marker								
1	0.16	0.069	0.714	0.320	0.209	0.062	0.891	0.225
2	.02	0.115	0.519	0.285	0.055	0.069	0.436	0.231
3	0.27	0.110	0.913	0.213	0.242	0.075	0.839	0.248
4	0.18	0.064	0.800	0.281	0.239	0.039	0.780	0.209
5	0.02	0.123	0.547	0.270	0.027	0.035	0.342	0.247
5	0.22	0.078	0.898	0.155	0.280	0.065	0.826	0.227
7	0.27	0.097	0.902	0.295	0.196	0.063	0.625	0.156
8	0.07	0.110	0.607	0.235	0.008	0.053	0.541	0.295
9	0.3	0.086	1.090	0.320	0.280	0.076	0.945	0.217
Sacral Marker								
1	0.10	0.07	0.72	0.34	0.17	0.07	0.93	0.26
2	0.02	0.10	0.48	0.25	0.05	0.05	0.44	0.23
3	0.18	0.12	0.78	0.26	0.17	0.10	0.81	0.32
4	0.15	0.07	0.77	0.25	0.18	0.06	0.75	0.19
5	0.01	0.08	0.48	0.25	0.02	0.03	0.35	0.23
6	0.14	0.09	0.77	0.18	0.20	0.08	0.74	0.19
7	0.22	0.07	0.83	0.26	0.13	0.08	0.61	0.24
8	0.06	0.09	0.54	0.21	0.01	0.05	0.56	0.30
9	0.18	0.11	0.84	0.36	0.19	0.10	0.85	0.29

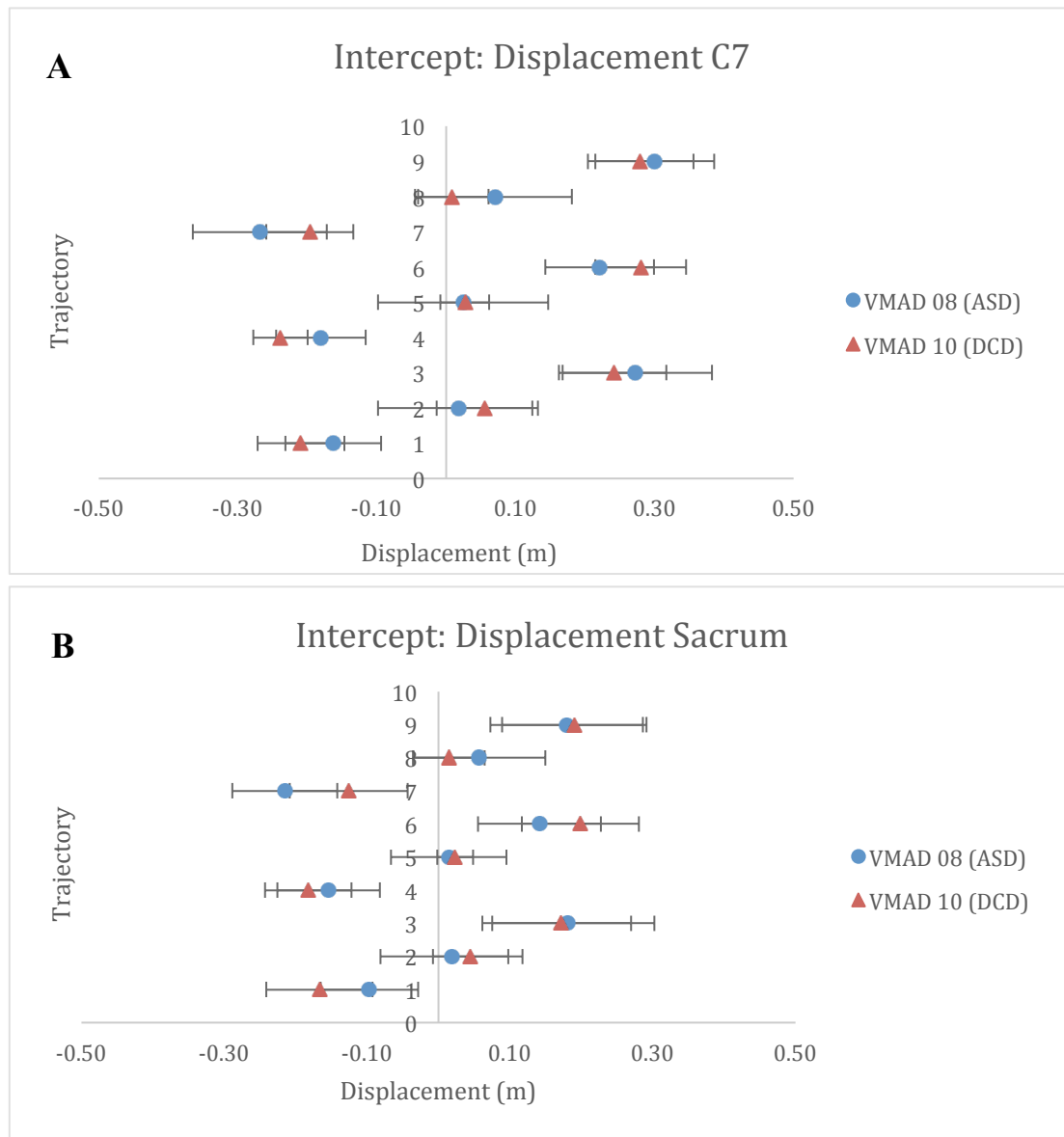


Figure 3, A – B. The average displacement of the C7 and sacral markers along the 9 trajectories in the intercept task. Note that the displacement values for the left-left, neutral-left and right-left trials were given a negative for graphing purposes. (Key: 1 = Left-left, 2 = Left-neutral, 3 = Left-right, 4 = Neutral-left, 5 = Neutral-neutral, 6 = Neutral-right, 7 = Right-left, 8 = Right-neutral, 9 = Right-right)

In the intercept task, the participant with DCD showed a slightly higher displacement for the left-left, left-neutral, neutral-left, and neutral-right trials. The participant with ASD exhibited a larger displacement value for the right-left, right-neutral, and right-right trials. In the neutral-

neutral trials, both participants displayed the similar average values for displacement. The general displacement trend as mentioned above was also seen in the sacral marker.

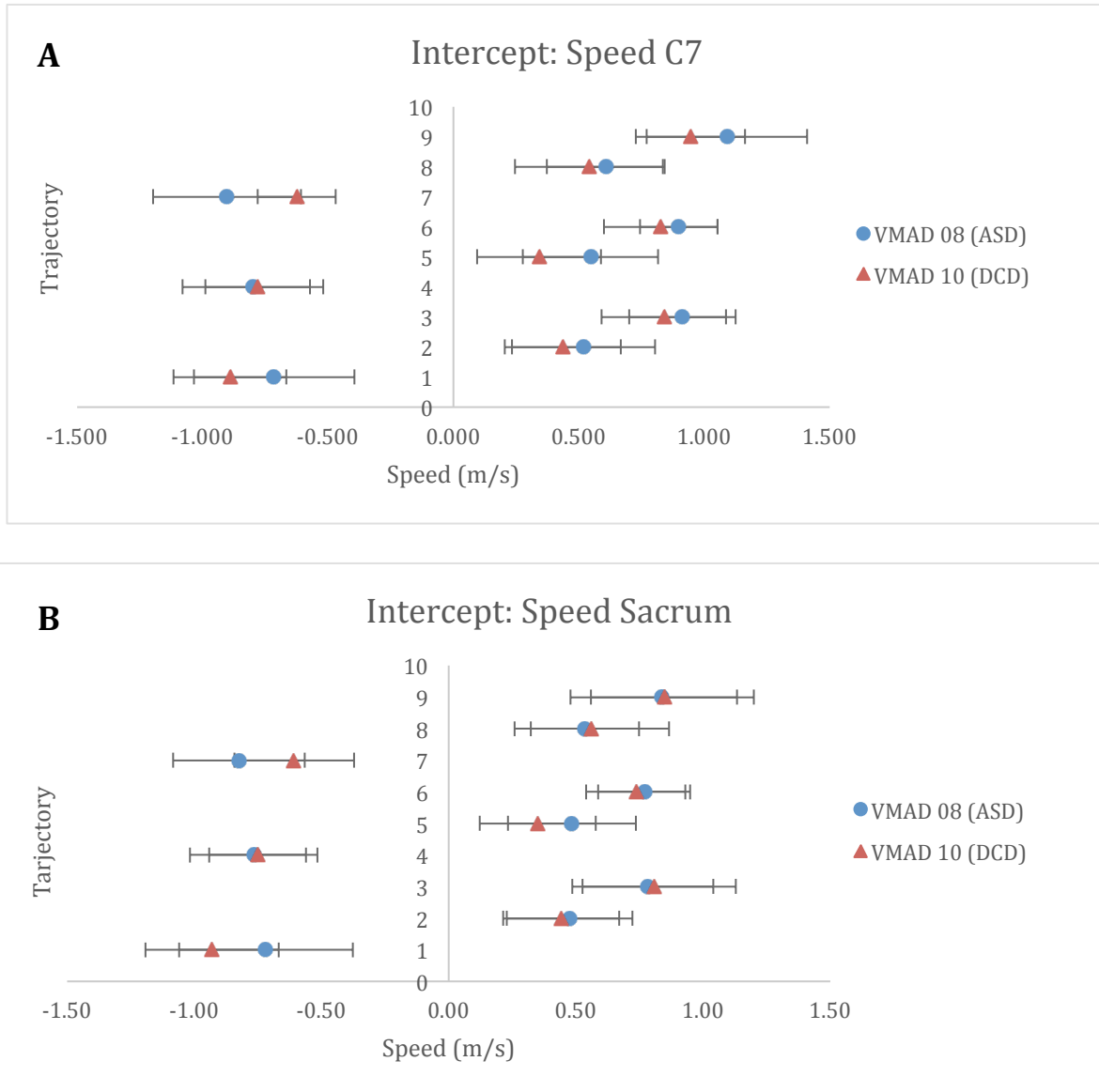


Figure 4, A-B. The average speed for the intercept task. (Key: 1 = Left-left, 2 = Left-neutral, 3 = Left-right, 4 = Neutral-left, 5 = Neutral-neutral, 6 = Neutral-right, 7 = Right-left, 8 = Right-neutral, 9 = Right, right)

Figure 4, illustrates the average speed of the participants during the intercept task. When analyzing the C7 marker, the participant with ASD showed an overall higher average speed during all trials except for the left-left trajectory. Patterns between the C7 and sacral markers

differed. The sacral marker indicated that both participants displayed similar values of average speeds during 6 of the trajectories; left-neutral, left-right, neutral-left, neutral-right, right-neutral, and right-right. The participant with ASD displayed a greater average speed during neutral-neutral and right-left while the participant with DCD revealed a greater speed in the left-left trials.

CHAPTER VI

DISCUSSION

Due to the small sample size, findings from this study cannot be generalizable to the population. When observing the body movement task, analysis showed that the participant with DCD typically displaced their C7 and sacral marker further than the participant with ASD. This finding is consistent with previous research and literature because these individuals are characterized to have excessive hip flexion. Similarly, when evaluating the speed the participants, the participant with DCD consistently had an overall average speed greater than that of the participant with ASD. Although individuals with DCD are found to have a decrease ability to pursue an object traveling horizontally, other factors such as the difficulties in being able to control and slow down body movements may account for the larger average speed.

When comparing both participants in the intercept task, differences in results were not as apparent. The participant with DCD showed a slightly higher displacement for the left-left, left-neutral, neutral-left, and neutral-right trials while the ASD participant showed a higher displacement for the right-left, right-neutral, and right-right trials. Based on these observations, the participant with ASD exhibited trouble intercepting when the ball started from the right and moved in any direction. This may indicate that they have trouble visually tracking from their right side, which consequently affected their visuomotor integration and ultimately their motor output. When analyzing the average speed of the markers, the participant with ASD presented an

overall higher speed than the participant with DCD, which is what we would expect since individuals with DCD have trouble with horizontal pursuit.

Findings when comparing the body movement with the intercept task were inconsistent. In the body movement task, the participants exhibited evident differences in the average displacement of the COM and speed with the participant with DCD having higher averages in both variables. In the intercept task, the DCD and ASD participants showed a slightly higher displacement depending on which side the ball started on but the averages were very similar to one another. Furthermore, the average speeds of both participants were comparable along each trajectory. A reason behind these findings can be due to the participant's ability to better anticipate during the intercept task. Throughout the intercept task, a grid is displayed on the virtual screen, which was used as a reference to the area of where the task will be performed. The ball will either start on the top left, middle and right position of the grid and roll down to the bottom left, middle or right positions. In contrast, during the body movement task, the safety zones just appeared on a black background with no given indication on where it will appear on the screen. Another advantage is that the intercept task has a total of 90 trials while the body movement task has 16 trials total. There is a strong possibility that the participants were able to adapt to the conditions in the intercept task and better anticipate where the ball would start and end.

CHAPTER VII

LIMITATIONS

Recruitment:

The most evident limitation regarding this research study was the inability to recruit participants. By comparing only two individuals, one in the ASD and DCD group, we are unable to formulate sound reasoning regarding the results. Work as well as school hours could have played a role in the lack of participant recruitment. Although necessary, the large list of inclusion and exclusion criteria to participate in the study could also account for low recruitment rates.

Body marker set:

The Motion Analysis System must have 3 of the 12 cameras capturing each body marker in order for the marker to be displayed on the kinematic model in the Cortex software. There were many instances where the participant would move in a way where 3 cameras were not able to pick up the markers, which showed up as an unlabeled marker or missing data. Although Cortex Software provided functions to help fill in missing data, there were some cases where data could not be tracked which ultimately affected our results.

CHAPTER VIII

SUMMARY/CONCLUSION

Based on the data collected thus far, I was able to compare one individual in the ASD group and one in the DCD pseudo control group. Although the results displayed clear differences in kinematics in the body movement task, the inconsistent patterns seen in the intercept task made it difficult to formulate any conclusions. Due to the very small population size as well as the absence of a control group, there were no significant findings. In order to gain a better understanding regarding the kinematics in individuals with ASD and individuals with DCD, further investigation must be conducted. In addition, healthy controls must be tested and compared against both groups in order to better differentiate between pathological versus normal motion. Recruitment of participants in all groups must occur to allow for formal statistical analysis to be conducted, which provide p -values confirming whether or not the results would be statistically significant.

CHAPTER IV.

DESCRIPTION OF INTERNSHIP SITE AND INTERNSHIP EXPERIENCE

This internship was conducted in the Human Movement and Performance Lab at the University of North Texas Health Science Center in Fort Worth under the supervision of Dr. Nicoleta Bugnariu. During this period, a qualified research team consisting of Dr. Nicoleta Burganriu, Dr. Haylie Miller, Dr. Rita Patterson, Dr. Carolyn Garver, Dr. Priscila Cacola, Robert Longnecker, Carolyn Young, Lindsay Appleby, and Cherly Glosup were investigating the visuomotor integration of individuals with Autism Spectrum Disorder and individuals with Developmental Coordination Disorder compared to typical developing individuals. I was later added to the team.

JOURNAL SUMMARY

The main focus of my internship centered on familiarizing myself with the research study, observing data collections, training and operating the Cortex Software and help assisting with continuing reviews and grants. Carolyn Young, a member of the research lab team and specialist in using the Cortex Software, spent weeks training me in this program. Through Carolyn's guidance, I was able to track and fill in missing data obtained from the participants during the study. Using this program was a very long process that required patience and attention

to detail. Mislabeling one body marker for any given time may ruin a portion of the data, which may ultimately lead to inaccurate results.

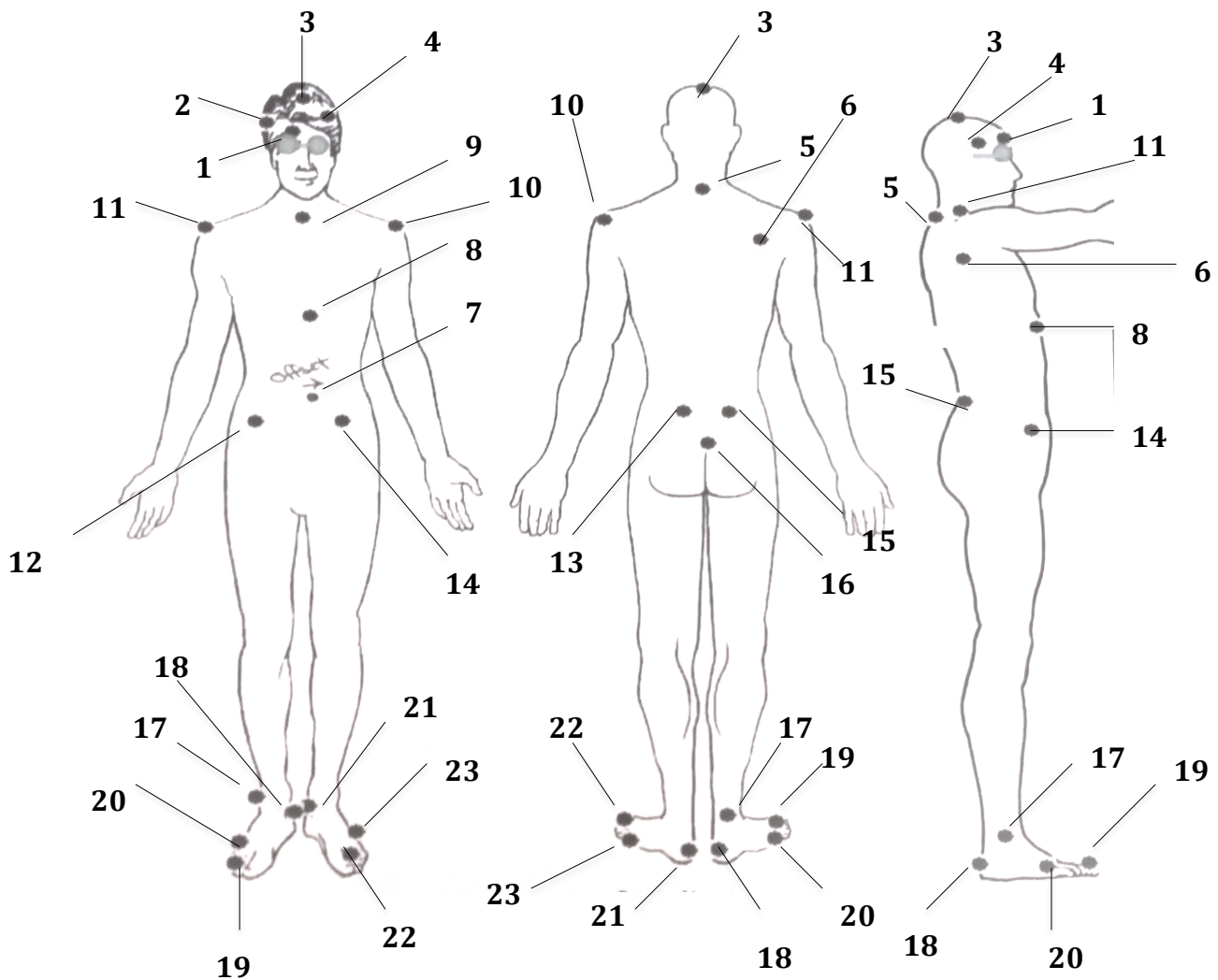
To increase my knowledge regarding the process of IRB approval for future and on-going clinical research studies, I assisted Lindsay Appleby in multiple continuing reviews as well as putting together a grant for the IRB approval of a new research study. This was a very tedious and time-consuming process. After each year that a clinical research study has been active, a continuing review must be submitted for the approval of the IRB committee in order for the research study to remain active for another 12 months. For the continuing reviews, each IRB approved document must be carefully reviewed and any changes must be tracked and documented. Copies of the tracked, clean and stamped versions of each document must be printed and organized. A progress report must be filled order to keep the research study open, otherwise the study will be suspended and no active participant recruitment and data collections can occur. The progress report requires information regarding the status of the research study, subject enrollment, participant consent, any documented serious adverse events that occurred, as well as other information regarding the members of the research team involved in the study. I also got the opportunity to attend an IRB board meeting in which members of the board agreed on the motion to approve or reject the continuation of research studies. After compiling a couple of continuing reviews, it's interesting to see the process that comes afterwards.

During my internship, I was also trained by Dr. Haylie Miller to use BeGaze, a software designed to track eye-movement data. Like the Cortex Software, this program was a time-consuming process and the user must be accurate when tracking data. When tracking the participant's gaze in this program, 2 views are displayed; a reference view which is a still image of the scene and the recorded scene of the entire data collection while it was occurring in real

time which exhibited a gaze marker that indicated the area the participant was looking at each given moment. The goal was to go through the recorded video and mark the approximate area where the participant gazed in the still image. There was a constant need to offset the participant's gaze due to their constant movement that caused the glasses to move.

Overall, I enjoyed my time here at the Human Movement and Performance Lab. Not only did the entire research lab team welcome me, but their willingness to teach further enriched my experience. Throughout my internship, I gained knowledge regarding different aspects as well as the tedious process and efforts put forth in order to prepare and execute a research study.

APPENDIX A

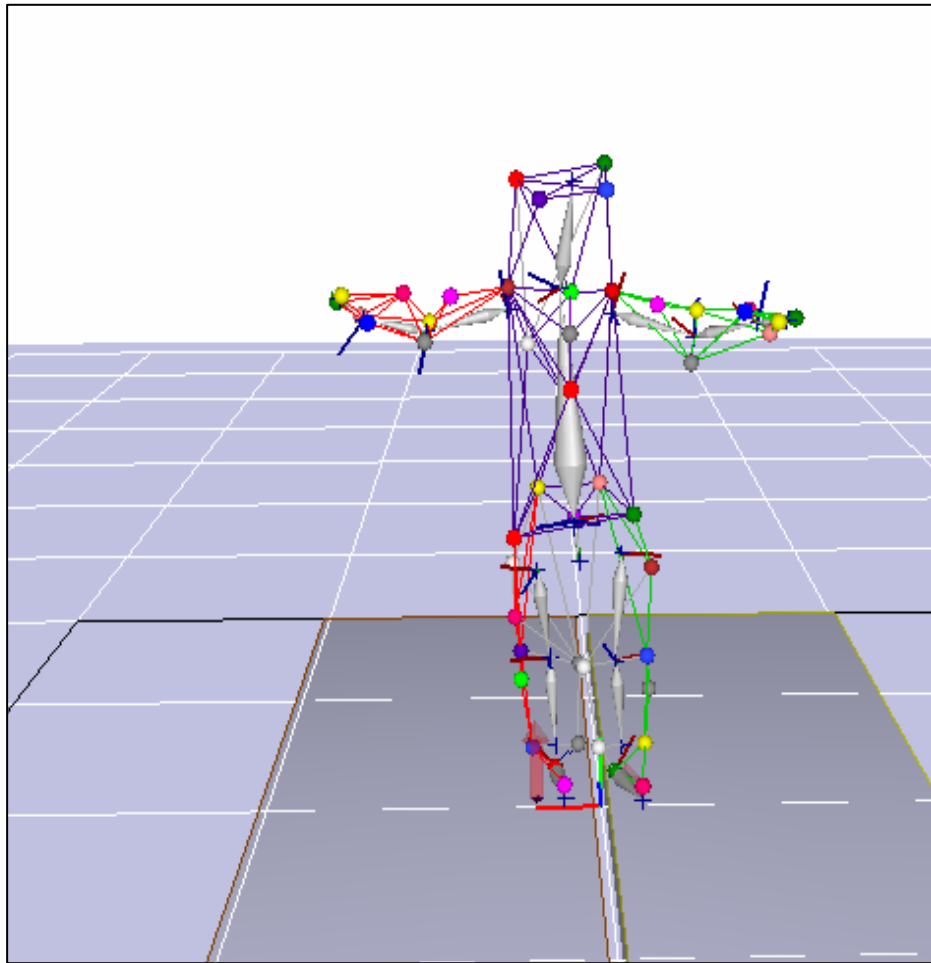


Body Marker Set

Key:

- | | |
|---|--------------------------------------|
| 1) Front head (located on eye-tracking glasses) | 12) Left ASIS |
| 2) Right head (located on eye-tracking glasses) | 13) Left PSIS |
| 3) Top head (on headband or hair clip) | 14) Right ASIS |
| 4) Left head (located on eye-tracking glasses) | 15) Rights PSIS |
| 5) C7 spine | 16) Sacrum |
| 6) Right scapula | 17) Right lateral malleolus |
| 7) Offset navel (shifted left) | 18) Right Heel |
| 8) Xiphoid | 19) Right toe |
| 9) Sternum | 20) Right 5 th Metatarsal |
| 10) Left shoulder | 21) Left Heel |
| 11) Right shoulder | 22) Left toe |
| | 23) Left 5 th metatarsal |

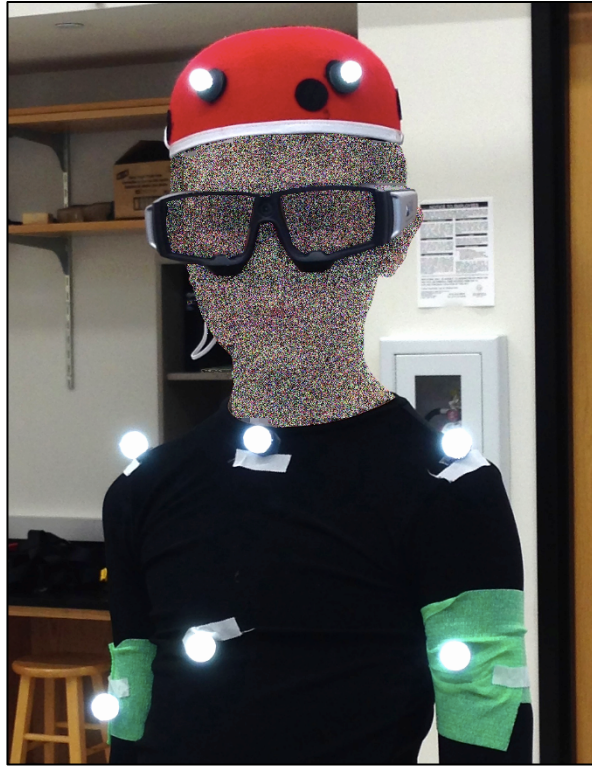
APPENDIX B



Kinematic Model

This depicts the “Skeleton view” of the participant’s body in the Cortex Software. The colored dots represent the body markers. Please note that this illustration shows more markers than what is actually used for this research study.

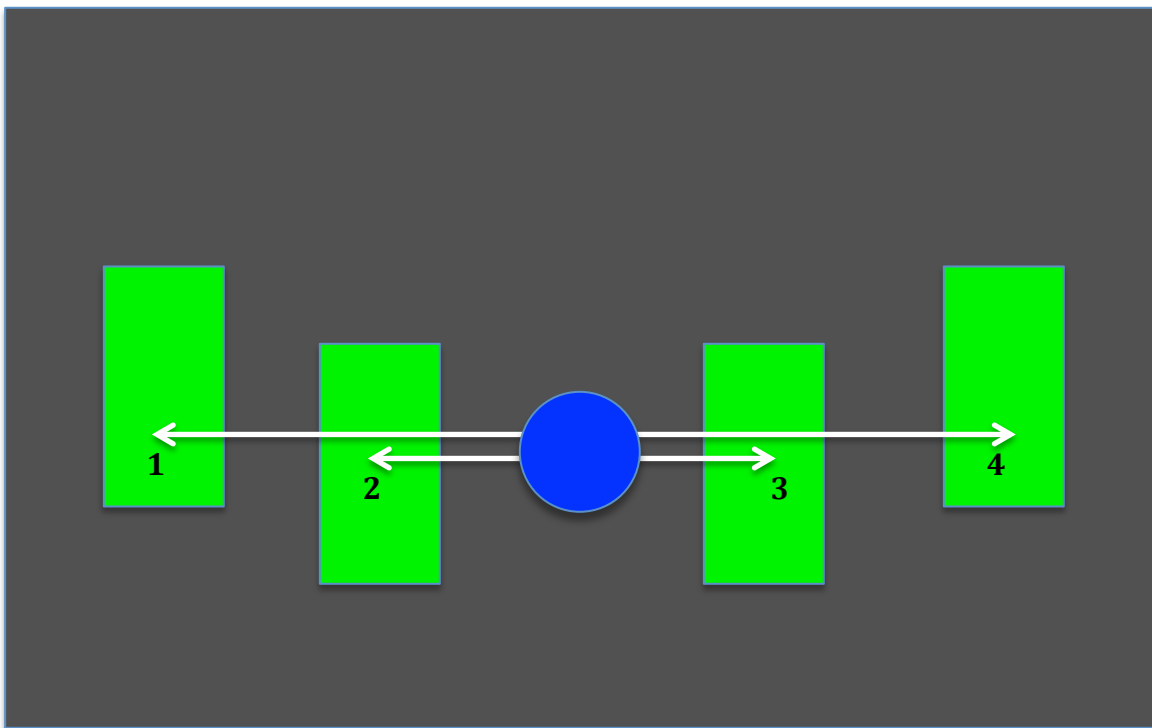
APPENDIX C



Eye-tracking Glasses

This image displays the glasses that each participant will wear throughout the study. Please note that this does not show the 3 body markers that will be placed on the glasses to represent the right head, left head, and front head.

APPENDIX D

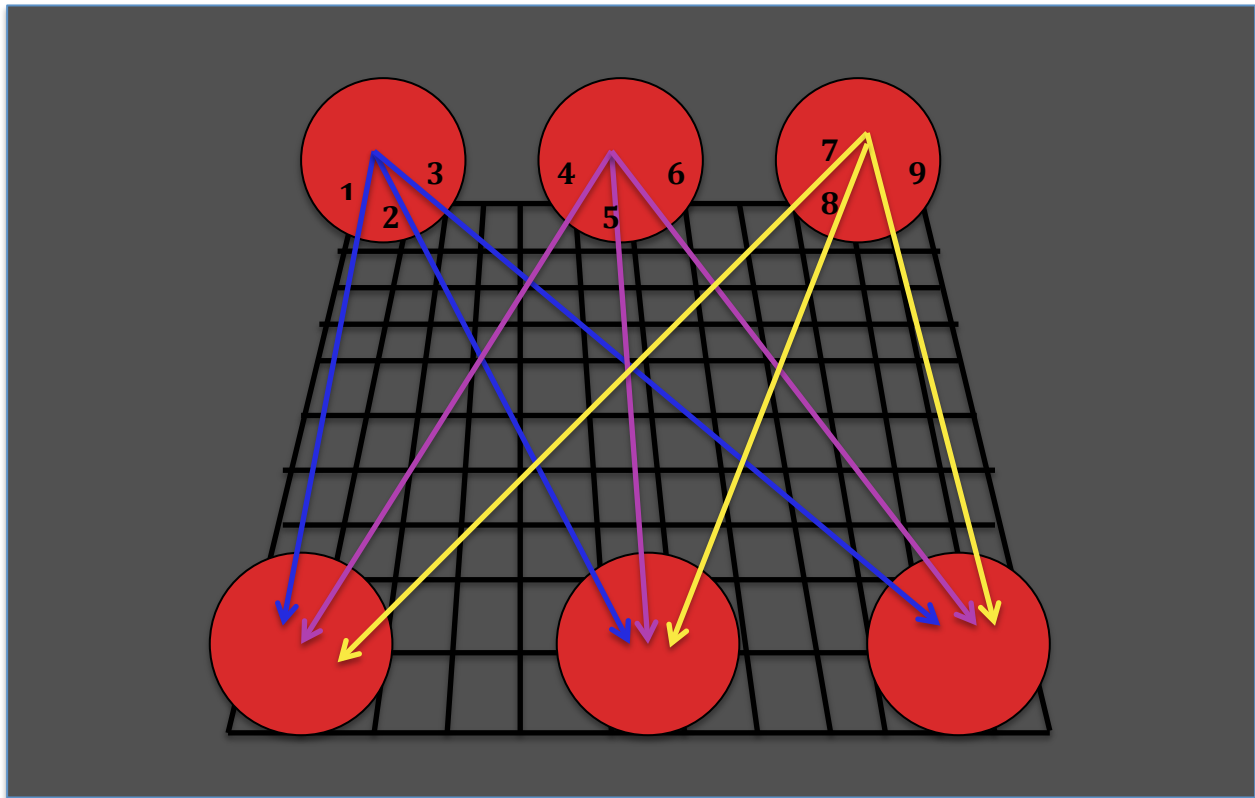


Body Movement Task

Key:

- 1: Left-long, target value = 1.34 meters
- 2: Left-short, target value = 0.67 meters
- 3: Right -short, target value = 0.67 meters
- 4: Right long, target value = 1.34 meters

APPENDIX E



Trajectories of the intercept task

Key:

- 1 = Left-left
- 2 = Left-neutral
- 3 = Left-right
- 4 = Neutral-left
- 5 = Neutral-neutral
- 6 = Neutral-right
- 7 = Right-left
- 8 = Right-neutral
- 9 = Right-right

APPENDIX G
DAILY JOURNAL

Monday June 1st

- Briefly went over my intended project with Dr. Bugnariu and Dr. Patterson
 - Both Dr. Bugnariu and Dr. Patterson were really nice and excited to have Ryan and I working in the lab. Ryan and I were assigned different projects that we will be writing our thesis over.
- Reviewed the IRB approved grant and synopsis for the VMAD study
 - After reading most of these documents, I am really excited about my intended project. This study will virtually capture the movements of the participants in real time and use an eye-tracking device. I have never used advanced technology such as these and I honestly cannot wait to learn more.

Tuesday June 2nd

- Worked on internship proposal
 - For the first two weeks of my internship I will be working on my proposal as well as me presentation to my IRB committee. I am slowly reading all the documents of the research study to get a better idea of what I will be doing in the upcoming months.
- Attended the bi-weekly lab meeting
 - I was able to meet everyone working in the lab, especially Carolyn and Lindsay, who I will be working closely with. Every other week a lab meeting is held. Each member will give a brief update on what they are working on and additional tasks may be assigned to the members.

Wednesday June 3rd

- Worked on internship proposal
 - Since my research study will involve individuals with Autism and Developmental Coordination Disorder, I am reading a lot of articles related to ASD and DCD to get an overall better understanding of these disorders.
- Helped Robert move equipment out of the lab room
 - Apparently our lab is somewhat of a storage area and there are some equipment that are not being used. I helped Robert pack equipment into his car. We then drove the equipment to the campus healthcare center, unloaded then carried it up.

Thursday June 4th

- Conducted background research for internship proposal

Friday June 5th

- Summarized research information for internship proposal
- Created citations for my resources

Monday June 8th

- Finalized proposal for internship
- Observed visuomotor testing for a participant with DCD

Tuesday June 9th

- Turned in final proposal draft to Dr. Bugnariu
- Made finalized changes to proposal
- Started working on my PowerPoint presentation for committee meeting

Wednesday June 10th

- Worked on PowerPoint presentation for committee meeting
- Filled out and printed required CRM paperwork
- Emailed the committee members my proposal

Thursday June 11th

- Finalized PowerPoint presentation for committee meeting
- Observed visuomotor testing for a participant with DCD
- Practiced for committee meeting presentation

Friday June 12th

- Practiced for committee meeting presentation
- CRM committee meeting
 - Nerve racking experience. Received a lot of great feedback. Overall got a sense of direction to where my project was headed towards.
- Turned in required forms for CRM program to GSBS office
- Emailed VMAD participant recruitment flyers to Dr. Gwartz and Dr. Guttmann

Monday, June 15th

- Looked over ForcePlate documents
- Robert explained in more detail about Ground Reaction Force, Center of Pressure and ForcePlate
- Completed ForcePlate lab and turned in lab write up with graphs to Robert
 - Now that my first committee meeting is done, I have begun training. The purpose of this lab is to get familiar with the concept of force plates and how calculations will be used to analyze data for not only my research study but also other ongoing studies in the lab. This lab was not too difficult but I definitely had to refresh my memory from physics as well as relearning how to use excel.

Tuesday, June 16th

- Attended lab meeting
- Went over upcoming project/assignments that I will be responsible for (IRB protocol)
- Read over cortex lab documents to familiarize myself with the program and how to read the results
- Complete required training to get access to the lab's shared drive

Wednesday, June 17th

- Self study for Cortex program
 - Looked over the documents regarding the Cortex program and tried to familiarize myself with functions of the keys.
- Made copies of informed consent for Lindsay

Thursday, June 18th

- Lab tour
 - Test subject for hill lift project during journalist tour to our lab room
 - I did a couple of the tasks that individuals enrolled into the heel lift study would have completed.
- One on one session with Carolyn over Cortex program
 - Carolyn went over the lab that I completed myself. She opened up a new file to track and I watched her as she tracked the data while explaining what she was doing. Tracking data in cortex is pretty tedious and it's essential to pay attention to detail because it is very easy to make a mistake.

Friday, June 19th

- Packaged data files
 - Carolyn taught me how to package the VMAD files according to each subject
- Worked on cortex program
 - I was given a trial file to track in Cortex. It is taking me a long time to track and I am still getting use to the control keys and its functions.

Monday, June 22nd

- Captured and exported TRC files
- Tracked data in Cortex program

Tuesday, June 23rd

- Cortex training raining with Carolyn
- Tracked data in cortex program

Wednesday, June 24th

- Tracked data in cortex program

Thursday June 25th

- Tracked data in Cortex program
- Read over NSF grant and related documents

Monday, June 29th

- Started to track new data collected from 2 patients over the weekend
- Exported TRC files and Force files

Tuesday, June 30th

- Lab meeting
- Meeting with Haylie and Lindsay over NSF IRB
 - Discussed timeline and briefly discussed protocol over the intended research study.
- Read over documents on how to fill out an IRB form

Wednesday, July 1st

- Tracked data in cortex program
- Exported TRC files and Force Files
- Started working on IRB for NSF

Thursday, July 2nd

- Looked over past IRBs
- Worked on IRB for NSF
- Finished tracking the new data
- Exported TRC and Force files

Friday, July 3rd

- UNTHSC campus closed

Monday, July 6th

- Reviewed proposal for internship practicum proposal
- Worked on IRB for NSF

Tuesday, July 7th

- Made changes in internship practicum proposal
- Worked on IRB for NSF
- Meeting with Dr. Patterson, Carolyn, and Lindsay over upcoming tour with high school students

Wednesday, July 8th

- Added more background info to internship practicum proposal
- Helped Robert review an eye tracking game from VMAD study in order to trouble shoot a glitch in the game.

Thursday, July 9th

- Started and completed tracking VMAD 01

Friday, July 10th

- Lab tour with high school students
- Learned how to calibrate
- Placed markers on the student

Monday, July 13th

- Finished tracking VMAD 01
- Started tracking VMAD 02

Tuesday, July 14th

- Input lab notes into shared drive
- Lab meeting
- Continued tracking VMAD 02

Wednesday, July 15th

- Continued tracking VMAD 02
- Meeting with Dr. Guttman over proposal

Thursday

- Finished tracking VMAD 02
- Started tracking VMAD 05
- Marker set up training with Carolyn
- Cortex training with Carolyn

Friday, July 17th

- Hill Lift testing with female patient
- Taped markers on patient
- Copied signed HIPPA form for patient
- Continued tracking VMAD 05

Tuesday, July 20th

- Tracked data for VMAD

Wednesday, July 21st

- Tracked data for VMAD
- Ran errands for Lindsay
 - Scanned and stapled copies of HIPPA and informed consent forms.

Thursday, July 22nd

- Tracked data for VMAD

Friday, July 23rd

- Tracked data for VMAD

Monday, July 27th

- Finished tracking data for VMAD
 - Waiting for new data to track once Carolyn returns from vacation
- Worked on NSF protocol
 - Re-read documents that Haylie sent me and continued to fill out the protocol template provided by the UNTHSC website.

Tuesday, July 28th

- Tracked data for VMAD
- Input lab notes into share drive
- Lab meeting
- Discussed upcoming meetings and deadlines for continuing reviews and grants.

Wednesday, July 29th

- Worked on TROM continuing Review with Lindsay
 - Lindsay is slowly introducing me on how to do the continuing reviews since we have a lot to complete in the upcoming months.
 - Made changes to documents: removed and added key personnel

Thursday, July 30th

- Worked on TROM Continuing Review with Lindsay
 - Printed tracked, stamped and cleaned copies
 - Filled out progress report
- Started working on Asthma Continuing Review with Lindsay
 - Made changes to documents

Friday, July 31st

- Worked on Asthma Continuing Review with Lindsay
 - Printed tracked, stamped and cleaned copies
 - Filled out progress report
- OMM resident tour
- Organized and turned in continuing Review for TROM and Asthma research studies

Monday, August 3rd

- Meeting with Lindsay to go over NSF protocol
 - We went over what we have each completed for the grant and split the rest of the sections amongst each other.
- Worked on NSF protocol

Tuesday, August 4th

- Lab meeting
- Meeting with Lindsay regarding the TxMRC
 - Since TxMRC protocol is taking precedence, Lindsay assigned me to familiar myself with this research study so that we can start working on it ASAP.
- Started to read over documents on TxMRC

Wednesday, August 5th

- VMAD testing
- Read over TxMRC
 - Finished reading documents over this research study
- Tracked VMAD data

Thursday, August 6th

- Meeting with Lindsay
 - Discussed upcoming continuing reviews and other assignments
- Looked over the continuing reviews
 - Checked old participant folders for dates of participation and made sure it matched our documented records

Friday, August 7th

- Worked on continuing reviews
- Meeting with Lindsay,
 - Made a timeline for completion and deadlines for continuing reviews, TxMRC and NSF grant

Monday, August 10th

- Tracked data in cortex

Tuesday, August 11th

- Tracked data in cortex

Wednesday, August 12th

- Tracked data in cortex
- Meeting with Lindsay over TxMRC
- Started to work on sections E-G of the TxMRC protocol

Thursday, August 13

- Finished filling out sections E-G in TxMRC IRB
- Filled out TxMRC application form
- Picked up approved continuing review from office

Friday, August 14th

- Tracked data in VMAD
- Worked on TxMRC
- Copied COI's for the continuing reviews

Monday, August 17th

- Tracked data in cortex
- Went over NSF grant and made a list of questions to ask Haylie

Tuesday, August 18th

- Lab Meeting
- Help Robert trouble shoot the glitch in CAREN program
- Worked on continuing reviews with Lindsay

Wednesday, August 19th

- Worked on Limb Loss continuing review
 - Made tracked changes and clean documents

Thursday, August 20th

- Attended Gabby's summer project presentation
- Worked on continuing reviews

Friday, August 21st

- Test subject for PREFER pilot
 - Had a full marker set put on with a harness and walked on treadmill at various speeds while being perturbed
- Worked on continuing reviews with Lindsay and Cheryl
 - Printed and organized clean, tracked and stamped documents

Monday, August 24th

- Worked on continuing reviews
 - Printed and organized clean, tracked and stamped documents

Tuesday, August 25th

- Worked on continuing reviews
 - Printed and organized clean, tracked and stamped documents
 - Filled out Sensory Conflict Progress Report and Memo

Wednesday, August 26th

- PREFER pilot with Dr. Bugnariu's mother and mother-in-law
 - My job was to help tape down the body markers and record the study on videotape as it occurred. It was interesting to be a spectator instead of the test subject for a change. There were some instances where I felt that the machine perturbed Dr. Bugnariu's mother with much more intensity than when I was the test subject. After a couple of trials, Dr. Papa found the desired walking speed and power for his research study.

Thursday, August 27th

- Continuing review
 - Printed and organized clean, tracked and stamped documents

Friday, August 28th

- Continuing review
 - Printed and organized clean, tracked and stamped documents

Monday, August 31st

- I helped Robert diagnose an issue with the CAREN program that is used for the research study. Every now and then there will be a glitch in which a red ball moving across the virtual environment will skip or before deformed along the edges. I monitored the virtual screen while Robert watched the movement of the ball on a computer desktop. We ran the program a couple of time and we did not find any more issues with the system.
- Continuing Review
 - Today is the last day to submit 3 of the IRB continuing reviews. Lindsay, Cheryl, and I spent the afternoon compiling the documents. The process is a lot quicker with 3 sets of hands. Once we took it downstairs to turn it in, the front desk personnel taught us the correct way to organize the continuing reviews. There should be 6 piles each with one stamped, clean and tracked documents.

Tuesday, September 1st

- Attended an IRB Board meeting
 - Before the start of the meeting, I was to sign a form of confidentiality. After compiling a couple of continuing reviews, it's interesting to see the process that comes afterwards. If there were any key personnels in the room that are involved in the research study that was being discussed, they were to exit the room due to conflict of interest and later return once a motion was passed by the board. Dr. Gladue was very funny and although this meeting was formal, it was also very laid back and I enjoyed the experience.
- Lab meeting
- Helped Carolyn refocus cameras
 - Carolyn placed a few body markers on me. I walked to different positions of the treadmill while Carolyn observed my movements on the computer. Cameras were adjusted accordingly to better focus and capture the positions of the markers.

Wednesday, September 2nd

- Finished refocusing cameras with Carolyn
- Made a list of all the VMAD subjects that I tracked as well as the files that I needed help tracking in Cortex

Thursday, September 3rd

- Re-writing my daily journal
 - Originally, I only listed activities and duties that I did during my internship. Now I am going back and including my experience and thoughts.

Wednesday, September 9th

- Test Subject for PREFER
 - Dr. Papa invited a couple of colleagues into the lab to demonstrate his new research study. I was used to briefly demonstrate the tasks that participants undergo during his research study and how data was collected. His colleagues even decided to try some of the tasks and made it into a competition to see who completed the tasks the best. Overall it was fun and laid back. Dr. Papa's colleagues seemed really interested in the PREFER research study.
- Test subject to test out the new D-FLOW software
 - Briefly went through 4 of the research studies that require the D-flow software. The whole idea was to test and see if the new software will function correctly when running each research study. I have only been a test subject for the VMAD and PREFER research studies so it was interesting to have a first hand experience on completing the other studies which mostly had to deal with walking and weight distribution on my legs.

Thursday, September 10th

- Met with Lindsay to help prep for the Audit over the RLCB study
 - Looked through participant's files to make sure that all paperwork and signatures were present. Marked missing paperwork and signatures. We realized that there were a lot of violations with this study. Multiple files were missing the last page of the HIPPA form that required signatures. We realized that when copying the HIPPA form, the copier machine did not print out the last page which was why many participants were missing that document. Unfortunately this mistake was not caught until now.
- Went over the NSF grant with Lindsay and made corrections and notes to ask Haylie for tomorrow's meeting

Friday, September 11th

- Briefly worked on methodology section for thesis
- Met with Haylie and Lindsay to go over questions and concerns regarding NSF grant and RLCB audit
 - We presented Haylie with all the violations that we found from the RLC-Balance Study. Haylie and Dr. B discussed the best way to fix and present the violations to the auditor who will be coming in next Tuesday. Most of the violations occurred when consenting the participant. This goes to show that we need to take extra precaution in making sure that we give out all necessary documents and that the participants are filling them out correctly.

Monday, September 14th –September 17th

- Worked on my thesis
 - I am working on my methodology section first since I have yet to analyze my data. I am using both my proposal and approved IRB documents from the VMAD research study as guidelines. I am finding it difficult to word my thesis in a way that is concise and clear without being difficult to comprehend. Maybe I am just being too picky but this is actually taking longer than expected. In addition, I have been using the Scholarly repository to look as past dissertations as a reference. I want to get a better idea on how I want to format and title my chapters and sections.

Thursday, September 17th

- Heel Lift Data Collection
 - We had a data collection with an elderly lady for the Heel Lift Study. For some reason the system was lagging so the data collection took longer than expected. Unfortunately the participant had fibromyalgia and was very sensitive when we removed tape from the body markers that were placed all over her body. I felt very compassionate towards her because it does hurt to remove the body markers from the arms and since she has a medical condition, that pain intensifies even more.
- Looked over TXMRC protocol, phone scripts and consent forms to make sure there were no errors.
 - The target deadline for the TxMRC grant is tomorrow. I am looking over and making sure that there are no grammatical errors and that the protocol and consent forms match up.

Friday, September 18th

- Worked on methodology section of thesis
 - I am continuing to work on my methodology section of my thesis. I have finished writing the screening process and halfway done with the actual data collection procedure.

Monday September 21st

- Helped Robert diagnose CAREN
 - Robert displayed the different tasks from the VMAD study on the virtual screen. My job was to look at the rolling ball to see if there were any glitches as the program played. We did catch a few glitches here and there but it is a better improvement from the last time we diagnosed this program.
- Worked on thesis
 - Finishing up the methodology section of my thesis.
- Continued to go back into my daily journal and expand upon my experience.

Tuesday, September 22nd

- Worked on thesis
 - I am beginning to work on the introduction. I have been doing some research and reading literature to gather more information about ASD and DCD regarding motor development.

Wednesday, September 23rd

- Lab tour
 - I was used as the model for our lab tour. I briefly did a couple of tasks in the virtual environment. One of the tasks was new to me and I had a hard time with it. I was walking in a virtual environment with hills and I had to hit bugs and birds that were flying at me. I found this tasks pretty hard considering the fact that I missed most of the objects.
- Feet marker set crash course
 - After the lab tour, since I already had markers placed on me, Carolyn used me to teach other lab personnel how to apply foot markers.

Thursday, September 24th

- Worked on thesis
 - Read a lot more articles and continued to gather information for introduction section.

Monday, September 28th

- Worked on thesis
 - Writing the introduction section using the information that I have been researching over the last couple of days.

Tuesday, September 29th

- Worked on thesis
 - Finished writing up the introduction section. Now I am doing more research to write my background and literature section. I have decided to split this section up and write about ASD (what it is, prevalence, causes, symptoms and treatment) then write about DCD.

Wednesday, September 30th

- Worked on thesis
 - Gathered more information about ASD and started filling out the sections that I am breaking down this section into.

Thursday, October 1st

- Worked on thesis
 - Read more literature and continued to write for background and literature section.

Friday, October 2nd

- Cortex Live Training
 - Carolyn is teaching all the lab personnel about cortex and how to use the program to collect data. I was used as a test subject
- Meeting with Carolyn regarding VMAD tracking
 - I was assigned to export all TRC and Force files and package the captures of all VMAD files. In addition, I will be tracking the ducks file for some of the participants.

Monday, October 5th

- Eye tracking training with Haylie and Lindsay
 - Haylie gave Lindsay and I a quick crash course on how to use BeGaze to track data for the RLC Balance study. In addition, we watch 2 short tutorial videos to further get an idea on how to use the program. This program is different from Cortex but just as tedious. It will take me a couple of days to adjust and familiarize myself with this program.
- Exported TRC and Force files of the VMAD participants

Tuesday, October 6th

- Lab meeting
 - During the lab meeting, we discussed upcoming events and new assignments. I will be in charge of tracking all the eye data for the RLC Balance study over the next 2 weeks.
- Lab tour
 - I was used as the body marker to demonstrate a couple of tasks in the virtual environment.
- Leg marker training
 - After the lab tour, Carolyn taught everyone in the lab how to place leg markers on a participant. We each took turns placing leg markers in one another.

Wednesday, October 7th

- Eye tracking with Lindsay
 - Lindsay and I tracked the next 2 files in BeGaze. We ran into a couple of difficulties because we didn't remember all the functions of the program. We were eventually able to figure it out.
- VMAD tracking
 - Started to track the duck files for the participants
- VMAD data collection
 - A female participant came in for the VMAD study. I helped tape markers onto the participant.

Thursday, October 8th

- VMAD tracking
 - Finished tracking the all ducks files for the VMAD participants
- Trouble shooting with Robert
 - During yesterdays VMAD data collection, the duck shooting game was malfunctioning and we were unable to collect meaningful data. I helped Robert trouble shoot the program by pressing and releasing the trigger of the gun and playing the duck game multiple of times until it was finally fixed.

Friday, October 9th

- Finished packaging all of the VMAD files and exporting TRC and force files
- Looked over vision and proprioception for postural control article
 - There is a journal club meeting in the afternoon today. I looked over the article again to refresh my memory since this article will be the topic of today's journal club.
- Journal club
 - This is my first time attending the journal club and I enjoyed it a lot. There were great discussions concerning the article, which also brought up some techniques/ideas that we can incorporate to our research studies in the lab. Everyone was very open to each other's thoughts and I am excited to lead next month's journal club.
- Meeting with Dr. Miller and Lindsay regarding eye tracking
 - Dr. Miller wanted to check in on how we were doing with the eye tracking program. We addressed a few questions/concerns and also set up a time line to finish all the eye tracking.

Monday, October 12th - Friday, October 23rd

- Tracked eye data using BeGaze
 - For the duration of 2 weeks, I tracked the gaze of participants for the RLC Balance study. After spending some time with this program, I was able to familiarize myself to a point where I felt comfortable with using its functions. There were a few issues with the last 8 files where I was unable to import the files into the program. Other than that, I was able to successfully track the remaining participants.
- Meetings with Dr. Haylie Miller
 - I had frequent meetings with Dr. Miller regarding my progress with eye tracking. I discussed a couple of issues concerning some of the participant's files and she then gave me advice on how she wanted me to proceed with these problems.

Monday, October 26th – Friday, October 30th

- Worked on internship practicum
 - Carolyn was able to provide me with data regarding my research project. I am now able to continue writing the second portion of my thesis.
- Helped Carolyn with TxMRC
 - Carolyn was diagnosing the best way to collect data for the new research study. Reflective markers were placed along my right hand. I was instructed to perform a couple of hand movements in the virtual environment while Carolyn ran the Cortex software to capture and analyze whether the Motion Analysis System was able to record each marker.
 - For the TxMRC study, the participant will be sitting in a virtual environment with their hands resting on a table. The table legs are reflective which would hinder the data collection. My job was to completely tape each leg of the table using black tape to prevent future obstruction during data collection.

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