Spring 5-15-2012

Effects of "Ultrasound" on Completion of Cognitive Tasks in Relation to Dolphin Assisted Therapy

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EFFECTS OF "ULTRASOUND" ON COMPLETION OF COGNITIVE TASKS IN RELATION TO DOLPHIN ASSISTED THERAPY

2012

BY

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Submitted in Partial Fulfillment of
the Requirements for the Degree
of Bachelor of Science In the
Honors Program at Coastal
Carolina University

May 2012

Abstract

In previous studies, it has been suggested that ultrasound may be the mechanism behind the success of Dolphin Assisted Therapy programs. This study was conducted to determine whether advertising these positive effects of dolphin produced ultrasound to prospective patients will elicit a placebo effect of improving cognitive function. A memory matching task was designed to measure cognitive task completion efficiency, and completion times were recorded in seconds. Participants were divided into two groups, Group A completing the task under normal, or control conditions first, and under the mock "ultrasound" condition second, while Group B received the mock "ultrasound" condition first and the control second. The results of the study suggest that the first trial, regardless of variable, elicited a placebo effect. However, the second trial regardless of variable showed that completion times improved overall, suggesting that learning occurred across trials. The hypothesis that a placebo effect would not exist was supported by the statistical comparison of trial times by variable, which was not significant (P=0.21, dependent t-test). This allows for further research into ultrasound as a potential mechanism for the success of Dolphin Assisted Therapy Programs.

Introduction

In recent years, Dolphin Assisted Therapy has become an increasingly popular alternative therapy. The interaction between dolphins and humans is believed to have life-altering therapeutic effects on individuals with a variety of diseases and disabilities ranging from mental disorders, such as depression and autism, to terminal illnesses including cancer (Williamson, 2008). Studies of Dolphin Assisted Therapy have shown changes in speech production, social interaction, and overall communication in children with autism, as well as alleviation of stress and frustration and increased concentration (Marino et. al, 2007; Breitenbach et. al, 2009). In the

short and long-term, the overall effects of Dolphin Assisted Therapy provide evidence that the interaction between dolphins and humans with diseases and disabilities yield positive effects (Brensing et. al, 2003). Despite the clear positive effects of Dolphin Assisted Therapy, the mechanism behind its effectiveness is still under speculation.

Dolphins are marine mammals and are members of the order Cetacea, along with the whales and porpoises. Cetaceans are grouped into two suborders, the mysticetes, or baleen whales, and the odontocetes, or toothed whales (Wursig, 1989). Dolphins are members of the suborder odontoceti, exhibiting a single row of cone-shaped teeth (Hoelzel, 1994). The odontocetes have over millions of years, developed an advanced and highly sophisticated sensory system called echolocation. This important adaptation sends rapid high-frequency click sequences into the surrounding environment and waits for the waves to bounce off of objects and return them back in a modified echo. This process can aid dolphins and other odontocetes in determining distance, shape, size, and texture of objects, even through three feet of mud and sand (Wursig, 1989). Echolocation also allows for odontocetes to feed when not in the presence of light, and provides an extremely efficient means of detecting predators (Wursig, 1989).

It has been hypothesized that the intense power of a dolphin's echolocation sonar has a powerful effect on other living organisms. Dolphin sonar is similar to the ultrasound waves used clinically for diagnostic imaging, to treat ailments such as cataracts, kidney stones, and gall stones. However, dolphin echolocation waves are approximately four times more powerful and precise than any types of medical ultrasound waves produced in hospitals, distinguishing a dime from a penny from a distance (Johnston et al., 1999). The simple fact that dolphins produce this ultrasound in water allows these waves to travel a great deal more efficiently than artificial sound production machines that function in dry air. As a result, it has been suggested that dolphins are

able to detect tumors, and even unborn fetuses, inside a human's body almost immediately after scanning the individual with its sonar (Johnston et al., 1999). It has also been theorized that dolphin ultrasound can not only detect unusual human tissues, but it can have a strong or even altering effect on biological tissues (Brensing et. al, 2005).

In previous Dolphin Assisted Therapy session studies, it has been reported that the high amount of energy produced by dolphin echolocation can be felt as it passes through the human body. The feeling of the waves enters the body, reverberates through the bones, and migrates up the spine as the dolphin investigates the individual in the water (Blow, 1995). Through research and observation, David Cole has developed a theory regarding the effects of dolphin echolocation on the human body (Blow, 1995). Although his ideas are still being researched and have yet to be recognized, Cole theorizes that dolphin sonar passing through a human body causes a phenomenon known as cavitation. Cavitation is a kind of tearing apart of molecular structures, similar to what happens when a boat accelerates at such a rate that the boat does not move, but the propeller simply cuts the water. In the human body, the dolphin sonar waves cause cavitation of the soft tissues, which could possibly cause cavitation of cell membranes, completely altering biomolecules in the body. This process could explain how dolphins are able to boost the immune system, producing an increase in T-cell production in patients involved in Dolphin-Assisted Therapy (Blow, 1995). This rearranging of molecules in biological tissue may also explain the change in brainwave amplitude and production in the human brain while under the influence of dolphin ultrasound.

In a past study conducted at a Dolphin facility in the Florida Keys, Brensing et al. (2003) hypothesized that dolphin ultrasound potentially has positive mechanical or electro-mechanical effects on the human endocrine system. In this study, a number of patients received Dolphin

Assisted Therapy treatment over an 8 month span. The study was conducted with wild dolphins to test if the behavior of the dolphins varied when in contact with patients who had a variety of disabilities. Also, the effects of the treatment on each individual patient were also tested. The amount of ultrasound waves affecting the patient were not measured by numerical intensity due to the lack of water-safe equipment, but was observed by the act of dolphins focusing their melons toward the patient and producing the high frequency clicks. The data collected from the study showed a significant change in frequency and amplitude of human brain waves after a swimming contact experience with dolphins in comparison to measurements taken before the swim session. The ultrasound waves generated by the dolphins' echolocation clicks were shown to have an effect of the subject's brain wave function, while artificially produced medical ultrasound waves within the same physical constraints had no effect, suggesting that the effect is elicited by the ultrasound of dolphins.

Because ultrasound is used so frequently in the medical field, the possibility of negative effects on biological tissues have been taken into consideration. The safety of ultrasound exposure is dependent upon duration, frequency, and pressure. Ultrasound commonly used in medicine is far below the frequency level that may become harmful to humans (Brensing et. al, 2003). Studies have been conducted to test for developmental issues in unborn mice exposed to ultrasound throughout various fetal developmental stages. These studies concluded no developmental disorders or problems in the mice during their fetal development or after birth, while fetal activity was increased (Jensh et. al, 1994).

Many Dolphin Assisted Therapy programs inform their prospective patients via the web and other media of the potentially positive effects of ultrasound. From this, many patients form beliefs that the ultrasound produced by dolphins will have these positive effects on their child's

or their own cognitive functioning before ever having experienced it themselves. Due to the difficulty of accessing medical ultrasound equipment and the services of a qualified ultrasound technician, the experiment was simplified in terms of advertisement of the positive effects dolphin ultrasound has on patients. The purpose of this experiment is to determine whether informing prospective patients of the positive effects of ultrasound on cognitive function will result in a placebo effect whereby subjects perform better on a given cognitive memory task. It is hypothesized that informing participants that ultrasound may have positive effects on cognitive function will not lead to a placebo effect whereby participants perform more efficiently on difficult cognitive tasks when they perceive they are receiving an ultrasound treatment. If the results indicate that perceived exposure to ultrasound waves do not improve the completion of difficult cognitive tasks, it would provide a basis for more studies on ultrasound and its role in Dolphin Assisted Therapy. This, in turn, opens up possibilities in alternative medicine and therapy options for patients with mental and cognitive disorders such as Autism.

Materials and Methods

The experiment tested the effects of the "presence of ultrasound waves" on cognitive functioning in terms of difficult task performance and efficiency. Participants were chosen based on a volunteer basis. There were 8 male and 22 female participants, who were divided into two experimental groups, Group A and Group B, by partial randomization. Each group was asked to complete two trials of completing the cognitive task. Group A completed the task under normal conditions first and under mock ultrasound conditions second, while Group B completed the task under the mock ultrasound conditions first and under normal conditions second. This method tested for any possibility of a placebo effect of performing the task more efficiently due to being

under the impression that ultrasonic waves are present and that this has positive effects on cognitive function, while accounting for the potential for learning between first and second trials.

A memory matching task was designed to measure the cognitive abilities of each participant. The memory task was in the format of a typical memory matching game, where each card in the arrangement on the table has an exact match. Two separate decks of cards were used, which were divided into suits and the face cards and aces were removed, leaving only numbers 2-10 in the deck. Next, the corresponding suits from each deck were combined and then paired with an opposite colored suit to form a new deck of 36 cards. Each new deck had one red suit and one black suit, and the decks were assigned to either the mock ultrasound condition trial, or the normal conditions trial, and remained consistent throughout the entire experiment, regardless of trial order. Before each trial, the cards were shuffled thoroughly and were arranged in a 6 x 6 layout on the table in the testing room. The task required that only two cards be turned over at a time while searching for pairs, and that each pair should be removed from the card arrangement and placed to the side to avoid confusion. Cognitive task efficiency was measured by the length of time between the turning over of the first card and the removal of the final pair of cards from the arrangement.

Because of the difficulty of acquiring an actual ultrasound producing device, in order to conduct this experiment, a mock ultrasound producing device was required, which was created using an obscure black electronic device in the shape of a box. In reality, the device was an out-of-date subwoofer of a no-longer-functioning stereo system. The device was plugged into the wall and covered with a white terry cloth covering to prevent further investigation of the machine. The other supplies used in the experiment were placed on top of the covering to give the impression that the covering was to protect the machine from being damaged by the items.

Electrodes typically used for electro-stimulation therapy of muscles were used as a mock medium for ultrasound transmission. The electrodes were soft-gelled and self-adhesive, but medical tape was also used to fully secure the electrodes to the back of each participant's neck, close to the ear. Before each mock ultrasound trial, an alcohol cleansing pad was used to clear the area behind the ear of any surface oils, as well as to sanitize the gel electrode.

The experiment was conducted in a testing room on Coastal Carolina University's campus in order to eliminate distractions such as outside sounds and outside interactions with people. Subjects were randomly divided into two separate trial-ordered groups, and participants from each group were tested individually in the testing room with only the experimenter present. Once in the testing room, each individual participant was read information regarding the ethics, privacy, and the overall experimental process by the experimenter and was asked to sign an Informed Consent Form. Participants in Group A were read the Informed Consent Form A, while participants in Group B were read the Informed Consent Form B, which both catered specifically to the corresponding groups' trial order in relation to the procedure (Appendix B; Appendix C). Each participant was asked to complete a brief demographic survey for experimental records (Appendix A). Both groups were informed that they would be under the influence of ultrasound for one of the trials and not the other. Next, each group was given an informational pamphlet advertising testimonials of ultrasound's positive effects on cognitive functioning through Dolphin Assisted Therapy programs, and was asked to read it through carefully (Appendix D). To ensure that the packet was fully read, small questions about their ideas, feelings, and most-liked sections of the pamphlet were asked.

Next, the participants were informed of the rules and asked to complete the memory matching task trials. For the mock ultrasound trial, participants were exposed to the presence of

the inactive placebo "ultrasound producing device," which was actually switched on at the start of each of these trials because of the humming sound the machine produced. The gel-electrode was then placed behind the pre-cleared spot behind the ear and was taped off. The participants then completed the memory task under the impression that they were actually under exposure of ultrasound waves during the completion of the given task. For the control trials, the same memory task with the same format was completed by participants, all of whom were detached from the placebo apparatus with the machine switched off. Trial times were recorded in seconds for all participants in all groups. If any participants did not complete the task or quit at any point during their trial time period, the experimenter stopped the timer and record the completion time or time taken before quitting. Participants were thanked for their participation and time, and were given information about the actual nature of the study experiment, informing them that they were at no point during the experiment under the influence of ultrasound waves. They were also informed of how to receive any results of the experiment once the study was completed.

The averages were calculated for Trial 1 and Trial 2 regardless of variable. The averages for trial times were calculated for the Control and "Ultrasound" variable. The average for trial times were also calculated for each gender. Statistical analyses were completed using a Dependent T-test to determine any significant differences between variables or in trial order. .

Results

The demographic information given by each participant at the beginning of the experimental period was compiled at the end of the data collection phase. This data showed that of 30 total participants, 8 being male and 22 being female, the age range was between 19 and 45 years old. Out of 30 participants, 7 claimed to have ever undergone a medical ultrasound

procedure, 4 have a relationship to someone who is an ultrasound technician, and none of the participants had ever had personal experience operating medical ultrasound equipment.

The maximum trial time for the control trials was 615 seconds (s), the minimum trial time was 165 s, and the average trial time was 305.03 s (~ 5 min, 4.8 s) ± 116.3580927. For mock "ultrasound" trials, the maximum trial time was 760 s, the minimum trial time was 143 s, and the average trial time was 323.4 s (~ 5 min, 23.4 s) ± 106.9159, (Figure 1). Although the average time for the "ultrasound" trials was longer than the control trials' average by about 18 seconds, the difference was not statistically significant (P = 0.21, dependent t-test).

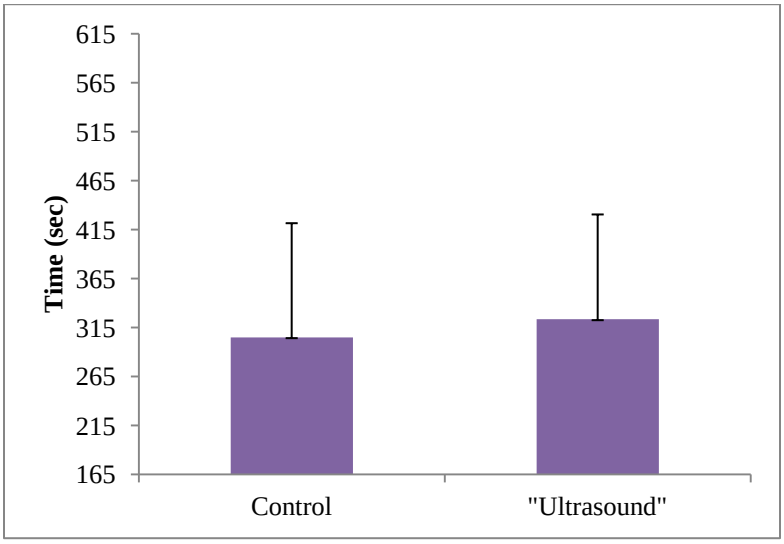

Figure 1: Average trial completion times for the Control condition and the "Ultrasound" condition. Error bars represent one standard deviation.

Once the data were analyzed by variable, it was then analyzed in terms of the trial order, disregarding which variable the trial was conducted under. For all of the participants' Trial 1, the maximum trial time was 760 s, the minimum trial time was 176 s, and the average trial time was 346.57 s (~5 min, 46 s) ± 126.9376. For the participants' second trial, Trial 2, the maximum trial time was 431 s, the minimum trial time was 143 s, and the average trial time was 281.87 s (~4 min, 42 s) ± 82.8633,

(Figure 2). The difference between Trial 1 and Trial 2 average completion times was slightly greater than one full minute, and this difference was significant (P = 0.00, dependent t-test).

Because of this significance, a second statistical analysis was performed to analyze the differences between the Trial 1 control condition and Trial 1 "ultrasound" condition, and another for the differences between the two Trial 2 conditions. The difference between Trial 1 control condition and Trial 1 "ultrasound" condition was statistically significant (P=0.00, independent t-test), with the average completion time for the Trial 1 "ultrasound condition" being significantly faster than the Trial 1 control condition. The difference between Trial 2 control condition and Trial 2 "ultrasound" condition was not statistically significant (P=0.24, independent t-test).

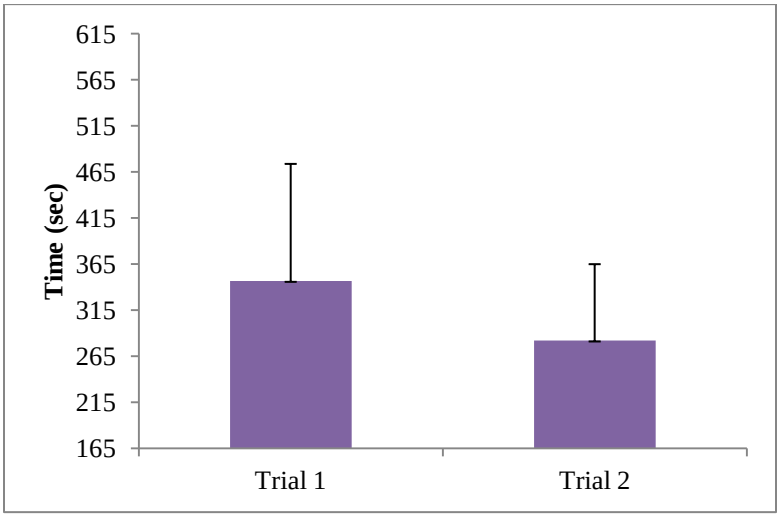

Figure 2: Average trial completion times in terms of trial order, Trial 1 and Trial 2, disregarding all variables. Error bars represent one standard deviation.

Finally, the data were analyzed for differences in trial time completion in males and females. The averages for both genders were calculated in terms of control trials and "ultrasound" trials. For female participants, the average control trial time was 323.41 s (~5 min, 23.4 s) ± 123.63, and the average "ultrasound" trial time was 331.23 s (~5 min, 31.2 s) ± 122.46. For male participants, the average control trial time was 254.5 s (~4 min, 14.4 s) ± 79.12558, and the average "ultrasound" trial time was 301.88 s

(~5 min, 1.8 s) ± 40.5619, (Figure 3). Overall, it was observed that males completed the matching task in less time than females under both variable conditions. There was a slight observed difference in male trial completion times, where males took more time to complete the "ultrasound" trial in comparison to the control trial, whereas females illustrated very little difference across both trials by variable. Because of the uneven distribution of male and female participants, a statistical analysis was not performed to test for significance in these differences.

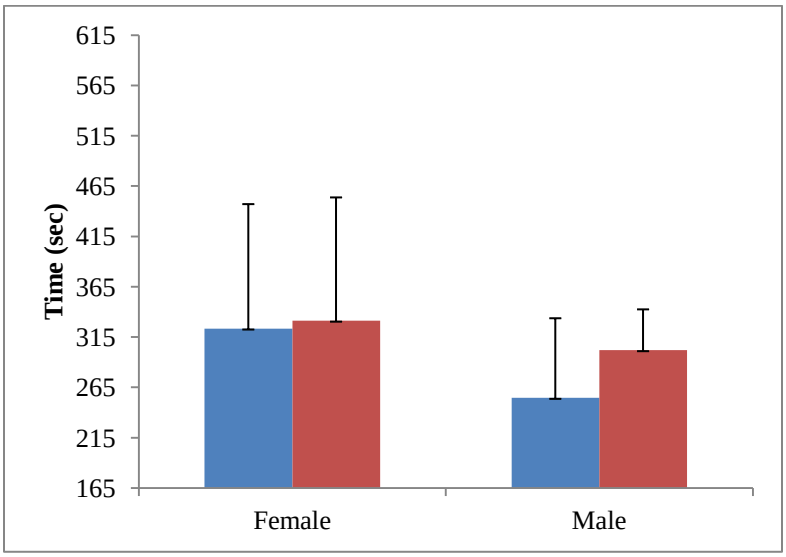

Figure 3: Average trial completion times in terms of gender. Average trial times for the "Ultrasound" condition are shown in red, and those for the Control condition are shown in blue. Error bars represent one standard deviation.

Discussion

There was no significant difference in completion time between the control trials and the mock "ultrasound" trials. This supports the hypothesis that advertising the positive effects of dolphin produced ultrasound on cognitive function would not elicit a placebo effect. The results from the dependent T-test performed on the trial times by their order showed that there was a statistical significance between the order of trials and the length of time they were completed. The second trial, Trial 2, was found to be completed more than a full minute faster than the first trial, Trial 1, on average. Based on the statistical significance of the statistical analysis

performed on differences in Trial 1 by variable, it appears as though a placebo effect was present, which suggests that variable did have an effect on completion time. However, the results of the statistical analysis performed on differences in Trial 2 by variable being insignificant suggests that there was learning between Trials 1 and 2. This trend can be referred to as the practice effect, where there are observed "improvements in cognitive test performance with repeated exposure to the testing materials" and procedure (Duff et. al, 2007). In the case of the memory matching task in this study, the first attempt at completing the task serves as practice for the second attempt, causing the second attempt to be completed with slightly more efficiency than the first. The possibility of this occurring was taken to account in the designing of the study in the randomizing of the order of variable presentation by separating participants in to two groups, Groups A and B. However, a more effective way of accounting for the practice effect, which requires a greater number of participants, is to use a between subjects design rather than a within subjects design. In other words, instead of having each participant tested under both conditions, have each participant perform the task a single time under either the control or the "ultrasound" condition by randomly assigning them into two independent study groups (Erlebacher, 1977).

The results of the gender task completion time analysis do suggest a slight difference between male and female performance on completing the task efficiently across both variables, as well as suggesting that males performed more efficiently under the control condition in comparison to the "ultrasound" condition. However, because of the extremely uneven ratio of female to male participants in the study, no conclusions of significance can be drawn from the results. To gain a better understanding of the possible differences in the task completion

efficiency between males and females, as well as differences in male trial times by variable, a more even ratio or a larger sample size of each gender should be attained.

The methodology of the experiment could be improved if repeated in the future. One of the primary concerns observed during the experimental procedure was that the attached gel electrode appeared to restrict movement in some participants. The electrode was placed behind the left ear of the participant and was connected to the back of the mock ultrasound device by a thin, loosely hanging wire. It was observed that a number of participants struggled with achieving the range of motion necessary to complete the task efficiently because they were highly focused on keeping themselves from getting caught up in the wire. Many participants did not move their necks, lean nearer to the table, or use their left arm during the "ultrasound" trial because of the sense of it being in the way, and the fear that too much contact with it would remove the electrode from their skin completely, disrupting the experimental process. This confound could be removed by simply standardizing both the control trial and the "ultrasound" trial. Instead of using the connection to the device as a method for making the participants aware of "being under the influence of ultrasound," simply informing them between trials of when the machine is being turned on or off while keeping them connected to the device could be used to induce awareness. Keeping the participants connected to the device throughout the experiment would still restrict movement, but the same restriction would be experienced regardless of the variable they receive.

The three final questions on the demographic survey were designed to investigate each participant's personal experiences with medical ultrasound devices in order to determine whether their prior knowledge of ultrasound procedures and equipment would influence trial completion times under the "ultrasound" condition (Appendix A). If participants had enough prior knowledge of the true equipment used in medical procedures, it would be highly likely that they would quickly become aware

that they were not truly being exposed to ultrasound waves during the study. Even those who had little knowledge of the equipment may have become somewhat skeptical of the real nature of the study, which could potentially affect their trial completion times and, therefore, skew the study's results. The question asking "Have you ever undergone a medical ultrasound procedure?" received a "Yes" response from a mere 23.3% of participants, only 13.3% of participants responded "Yes" to the question asking, "Do you have a relationship to someone who is an ultrasound technician?," and 0% of the participants responded "Yes" to the question asking, "Have you ever had personal experience operating medical ultrasound equipment?" Due to these small percentages of "Yes" responses to the questions that were vital to the experiment's success, it does not appear as though any of the participants had enough previous knowledge to skew the results.

The supporting of the hypothesis allows for further research on ultrasound as a mechanism for the success of dolphin assisted therapy programs. In other words, the public advertisement of dolphin assisted therapy programs and the positive effects of ultrasound as an effective alternative therapy for patients with various disabilities does not appear to provide a basis for success in itself. In order for dolphin assisted therapy to be successful, there must be a separate mechanism other than the predisposition to succeed. However, it is likely that the participants in the study lacked any type of motivation to succeed on the matching task. In a dolphin assisted therapy scenario, those who are being treated exhibit high levels of motivation, hope, and faith that the treatment will be successful and allow them to lead a better life. The positive advertisements and testimonials focused on these patients provide added motivation, and therefore may elicit a placebo effect in these patients as opposed to healthy, unmotivated volunteer participants. For a potential future study, the simple recruitment of real patients on a volunteer basis instead of healthy student volunteers would allow for a more focused, relevant

study to possibly further research in the direction of ultrasound as a mechanism for the success of dolphin assisted therapy programs.

The study would be more effective if actual medical ultrasound equipment could be used to test the original hypothesis. If cognitive task completion efficiency was shown to have a significant correlation to the true presence of ultrasound waves, this would provide an avenue for further studies using dolphin produced ultrasound to elicit similar, and possibly even stronger positive effects. In addition, because of the difficulty and expense of using dolphin assisted therapy as an alternative treatment, this would open the possibility and purpose for developing more precise, dolphin-like medical ultrasound equipment that would be more readily accessible to patients seeking these positive effects (Blow 1995; Brensing et. al, 2003).

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Appendix A

Demographic Survey

Please circle your response or provide your response for every item.

Age: _____

Gender: Male Female

Class Standing: Freshman Sophomore Junior Senior Other _____

Cumulative GPA (approximate): _____

Race: a) American Indian or Alaska Native b) Asian c) Black or African American
d) White e) Hispanic or Latino f) Other (please specify):_____

Academic Major: _____

Academic Minor (if applicable): _____

In what state did you spend most of your life? _____

How many years did you live there? _____

Have you ever undergone a medical procedure involving ultrasound or ultrasonic imaging? Yes No

Do you know anyone who is an ultrasound technician? Yes No

If yes, what is their relation to you? :

_____ Parent _____Sibling _____Friend _____Aunt/Uncle _____Cousin _____Grandparent

_____Other (please specify): _____

Do you have experience operating ultrasound equipment? Yes No

Appendix B

INFORMED CONSENT FORM A

Thank you for agreeing to participate in my research. The purpose of this study is to investigate the effects of ultrasound on cognitive task completion in college students. I will first ask that you complete a brief demographic survey. I will then provide you with a pamphlet of information on the positive effects of ultrasound in relation to dolphin assisted therapy programs. Then I will ask you to complete the memory matching task. The goal of this task is to simply match the cards in front of you from memory. Your task will be completed once you have matched all of the pairs of cards in front of you. I will record how long it takes you to complete the memory task. I will then administer small amounts of ultrasonic waves through a small patch which will be gently placed behind your ear and then ask you to complete a second memory matching task. This activity should take about 15 minutes. There is no risk or harm involved in this study and all of your data will be confidential. I will be analyzing and reporting on group data only. Your participation in this study is voluntary and you may withdraw from this study at any time so if you feel as if you do not want to continue participating in my study, just say so and we'll stop data collection. If you would like to obtain the results of my study just let me know and I'll be happy to contact you via email later in the semester once my data are collected and analyzed. Hopefully my study will allow us to have a better understanding of human problem solving. Do you have any questions? Please ask them now before we begin data collection. For future reference you many contact me, Carrie Wein via email at cawein@coastal.edu. For your information, Dr. Robert Young in the marine science department is supervising my research, and you may also contact him if you have questions. His phone number and email address are: 843 349-2277, ryoung@coastal.edu.

Thank you so much for helping me with my research.

I have read this informed consent and have been fully advised of the purpose of the study. I understand that there are no risks or potential harm involved in this study and I voluntarily agree to serve as a participant in this study. Upon request I may receive a copy of this informed consent form for my records.

Participant's signature_____ Date_____

Appendix C

INFORMED CONSENT FORM B

Thank you for agreeing to participate in my research. The purpose of this study is to investigate the effects of ultrasound on cognitive task completion in college students. I will first ask that you complete a brief demographic survey. I will then provide you with a pamphlet of information on the positive effects of ultrasound in relation to dolphin assisted therapy programs. I will then administer small amounts of ultrasonic waves through a small patch which will be gently placed behind your ear and then ask you to complete a memory matching task. Next, I will remove the apparatus and ask you to complete the memory matching task a second time. The goal of this task is to simply match the cards in front of you from memory. Your task will be completed once you have matched all of the pairs of cards in front of you. I will record how long it takes you to complete the memory task. This activity should take about 15 minutes. The ultrasound administration procedure is guaranteed to have absolutely no immediate or long term negative or harmful effects. There is no risk or harm involved in this study and all of your data will be confidential. I will be analyzing and reporting on group data only. Your participation in this study is voluntary and you may withdraw from this study at any time so if you feel as if you do not want to continue participating in my study, just say so and we'll stop data collection. If you would like to obtain the results of my study just let me know and I'll be happy to contact you via email later in the semester once my data are collected and analyzed. Hopefully my study will allow us to have a better understanding of human problem solving. Do you have any questions? Please ask them now before we begin data collection. For future reference you many contact me, Carrie Wein via email at cawein@coastal.edu. For your information, Dr. Robert Young in the marine science department is supervising my research, and you may also contact him if you have questions. His phone number and email address are: 843 349-2277, ryoung@coastal.edu.

Thank you so much for helping me with my research.

I have read this informed consent and have been fully advised of the purpose of the study. I understand that there are no risks or potential harm involved in this study and I voluntarily agree to serve as a participant in this study. Upon request I may receive a copy of this informed consent form for my records.

Participant's signature_____ Date_____

The Impressive Effects of Dolphin Ultrasound

Dolphin Assisted Therapy, commonly abbreviated DAT, is an alternative medicine therapy program developed in the early 1970's that has become increasingly more popular over the past few decades. DAT was developed under the theory that human interaction with dolphins can have a life-altering effect on people with terminal illnesses and mental disabilities, and has since been shown to accelerate the learning process and strengthen the immune system in patients of varying ages and disabilities. DAT Programs have shown that interacting with dolphins has several positive effects on patients suffering from autism, depression, Down's syndrome, attention deficit disorder, and muscular dystrophy (Blow, 1995; Johnston and Bourne, 1999).

Scientist Dr. David Cole believes that dolphins can affect a human mentally and physically on a highly scientific level. His theory states that dolphin sonar, or echolocation, is what causes the changes expressed when undergoing DAT. With special equipment, David Cole tested the effects of dolphin sonar on the human brain. There was "a far greater harmony between the left and right sides of the brain after a subject swam with dolphins," which suggests "that the brain was functioning more efficiently than normal" (Blow, 1995).

Dolphin sonar is thought to be responsible for many of the results of patients undergoing Dolphin Assisted Therapy. It has been hypothesized that the intense power of a dolphin's echolocation sonar has a powerful effect on other living organisms. Dolphin sonar is similar to the ultrasound waves used clinically for diagnostic imaging, to treat ailments such as cataracts, kidney stones, and gall stones. However, dolphin echolocation waves are approximately four times more powerful and precise than any types of sonar found in hospitals. The sonar dolphins create is a

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concentrated blast of ultrasound vibrations powerful enough to penetrate through almost three feet of sand, with a resolution so high that it can determine the difference between a dime and a penny (Johnston and Bourne, 1999). A dolphin's sonar is precise enough to allow for it to echolocate a shark within one half of a mile radius, and detect whether its stomach is full or empty (Blow, 1995). Because of the strength and power of their sonar, it is believed that dolphins can examine the inside of the human body as if it were looking at a sonogram or ultrasound image (Johnston and Bourne, 1999).

Dolphin Assisted Therapy has provided families around the world with a sense of hope and optimism. For both adults and children that were unaffected by traditional therapy and medical treatments, Dolphin Assisted Therapy has served as a remarkable, successful alternative treatment. Dolphin Assisted Therapy is a favorable program for children suffering from Cerebral palsy, Autism, learning disabilities, phobias, emotional stress, depression, spinal cord injuries, mental retardations, stammering, and developmental disabilities (Blow, 1995; Johnston and Bourne, 1999; "The Dolphin Assisted Therapy Results"). Children suffering from a wide range of developmental disabilities have shown significant improvement in areas of concentration, learning, communication, relating to other children, and cognitive abilities (Johnston and Bourne, 1999). According to

studies that have been taken by Dr. Lukina of the Ukraine, “In children between 87 and 10 years of age, the therapeutic effect was also manifested in decrease of headaches” (“The Dolphin Assisted Therapy Results”).

A large number of patients suffering from depression and serious illnesses have expressed impressive, positive changes in their emotional state almost immediately after undergoing DAT (Johnston and Bourne, 1999). One tremendous example of the psychological, mental, and emotional effects of Dolphin Assisted Therapy is one told by DAT specialist, Horace Dobbs. Dobbs told an incredible story of a man who suffered from chronic depression for over 12 years, leaving him unable to work or interact with anyone at all. After swimming with a dolphin for just a few moments, the man began to speak as if the two were old friends. Soon after the swim, the man slowly came out of his seemingly permanent depression that lasted an entire decade (Carwardine et al, 1998).

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