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## 1. General introduction

Dolphins have been used in so-called dolphin-assisted therapy (DAT) for more than twenty years. The animals primarily assist therapists in therapy with intellectually and physically disabled children. In contrast to the knowledge about swimming programs with healthy humans (Frohoff & Packard 1993; Samuels & Spradlin, 1995; Kyngdon, D.J., E.O. Minot, K.J. Stafford. 2003), there are virtually no publications concerning the behavior of dolphins in swimming programs with children with mental and physical disabilities or adult patients. Since 1981 there has been a number of publications about dolphin-assisted therapy by several psychologists: The first piece of research was a case study in which dolphins were used to motivate an autistic child to communicate (Smith 1981). A further experiment indicated that children learned two to ten times faster and with greater retention when working with dolphins (Nathanson 1989). Also significant improvements in hierarchical cognitive responses occurred when interacting with dolphins in mentally disabled children (Nathanson & de Faria 1993). An improvement of the social situation in families with disabled children could also be observed (Voorhees 1995). Analysis of EEG has shown that interaction with dolphins has a relaxing influence on humans (Cole 1996; Birch 1997). Effectiveness of short-term (Nathanson, de Castro & McMahon 1997) and long-term (Nathanson 1998) dolphin-assisted therapy for children with severe disabilities has been presented. Based on a study with approximately 1500 patients, a positive influence on children's autonomic homeostasis and psycho emotional status could be observed (Lukina 1999). Furthermore, the presence of the dolphins seemed to alleviate the pain atopic dermatitis patients experienced while bathing in seawater. It could be shown that the skin condition improved dramatically, and immunologically, while serum IL-8 levels decreased (Iikura et al. 2001). A reduction of anxiety in organized tourist swimming groups in the wild was also observed (Webb and Drummond 2001). Many common and uncommon effects of DAT and also some future perspectives which represented the therapy in a promising light have been discussed (McKinney, Dustin and Wolff 2001). However, it is important to note that there also exists severe criticism that some of the studies used flawed data resulting in flawed conclusions (Marino and Lilienfeld 1998). Additionally, there is still an open discussion about the ethical and safety concerns of using wild animals (Iannuzzi and Rowan 1991). Curtis points out that all publications were focused on humans but not

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on dolphins and possible disadvantages for these animals (Curtis 2000). The present work will support this criticism and is thus primarily concerned with the behavior of the animals during DAT.

The following section of this introduction constitutes a framework in which the individual articles are presented. Explicit examination of each individual topic is avoided as this takes place in the articles themselves. The hypotheses presented will emphasize the focal points of the respective articles. Article **A** is concerned with the possible effects ultrasound can have on biological tissue and considers more closely the behavior of a single dolphin. Article **B** describes a method of assigning acoustic signals to individual dolphin's sound sources. Article **C** investigates the behavior of dolphins towards various categories of people. Article **D** investigates the influence of humans on the behavior of the animals. Of special interest here is whether or not the swimming programs can cause stress for the animals.

**A: Can dolphins heal by ultrasound?** (page: 10)

The many positive publications on the success of DAT lead to the conclusion that therapy with dolphins is especially successful. Anecdotal descriptions often attribute this success to special behavior the dolphins exhibit toward the patients. On the basis of their observations, Cole (1996) and Birch (1997) put forward the hypothesis that the ultrasound of dolphins has a healing effect on patients. Unfortunately, it was not possible to record and measure the ultrasound directly on the human body. Nevertheless, the visually observable behavior allows one to reach a conclusion with reference to a hypothetical influence of ultrasound in the context of DAT. This article is concerned with the possibility that dolphin ultrasound can, under specific conditions, have an influence on human physiology, and verifies, in the case of observations, whether or not these conditions have been fulfilled.

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Hypothesis:

- One or more dolphins exhibit a behavior that results in patients' exposure to ultrasound in doses comparable to those in medical treatments.

To examine this hypothesis, we analyzed the behavior of dolphins. We focused especially on situations in which dolphins were positioned with the head pointed towards the patients. Furthermore, we analyzed whether this behavior was repeated over several sessions. This study was conducted in the enclosure of Dolphin Plus, Florida.

**B: Sound source location by phase differences of signals.** (page: 24)

Initially, the question "Can dolphins heal by ultrasound?" was scheduled to be answered by means of a multi-channel ultrasound recorder. This procedure should have made it possible to reach a conclusion regarding a possible influence of ultrasound on the success of therapy. Unfortunately, the development of this device was delayed so that recordings could only be made at the end of the observation period. Consequently, the recordings could not be included in the analysis.

The method was therefore published separately. The procedure can be applied in the location of clicks as well as whistles. Research into the communication of marine mammals in a social context, i.e. when several animals interact with one another, has essentially been restricted because it has not been possible to assign with certainty the signals to specific animals. The locating of whistles is therefore of special significance in research into this social interaction. In contrast to previous procedures (Janik et al. 2000), the method as described is also effective in very small spaces and is suitable to be used in tandem with a video camera. It is thus possible, for the first time, to definitely correlate visually observable behavior with acoustic signals.

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**C: Behavior of dolphins *Tursiops truncatus* towards adults and children during swim-with-dolphin programs and towards children with disabilities during therapy sessions.** (page: 34)

As described above, there is much speculation that dolphins have an active share in the success of the therapy. Unfortunately, there has not yet been a comparative study in which the various forms of therapy with animals are analyzed. Such a study is difficult to achieve because of the different conditions under which the therapy takes place, the often very small sample set, and the complicated social situation in which the parents and patients find themselves. A further approach of verifying the influence of dolphins on the success of DAT is a behavioral observation, whereby interaction of dolphins with various categories of people is analyzed. If the animals have an active part in the therapy, then they should behave differently towards the patients than towards healthy people.

Hypothesis:

- Dolphins can distinguish between different types of humans.

To examine this hypothesis, we tested whether dolphins would behave differently towards people of different ages and health conditions. This study was conducted in the enclosure of Dolphin Plus, Florida, during the therapy season between April and December, 1998.

**D: Impact of different kinds of humans in Swim-With-Dolphin-Programs.** (page: 51)

After the behavior of dolphins towards humans has been discussed in detail, the effect of various categories of people on the dolphins should now be looked into. Investigations on this subject took place in two natural water enclosures in Florida and in Israel.

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Hypotheses:

- Different kinds of swimmers such as adults, children and disabled children have a different impact on the social structure of the interacting group of dolphins at “Dolphins Plus”, Florida.
- Dolphins are attracted by humans at “Dolphin Reef”, Israel.

To examine these hypotheses, we analyzed the following behavior at "Dolphins Plus", in the context of the presence and absence of different kinds of swimmers: speed; depth of diving; breathing frequency; contact; distance between the animals. We also analyzed spatial distribution. At "Dolphin Reef" we focused only on the distance between dolphins and humans and their spatial distribution. These studies were conducted in the enclosure of "Dolphins Plus", Florida, during the therapy season between April and December, 1998 and in the enclosure of "Dolphin Reef", Israel in 2002.