Learning, motivation, and social interaction in modern dolphin training

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Abstract

Dolphin training is widely practiced in zoological facilities for performance, husbandry, research, and daily management, yet many of its practical principles remain insufficiently formalized in the scientific literature. This Perspective aims to provide a citable academic framework for modern dolphin training by synthesizing trainer-based practical knowledge within established concepts from learning theory and animal behaviour. Major components of modern dolphin training include reinforcement-based learning including shaping, social interaction and observational learning, and exploratory and play-like interaction. Cooperative husbandry training is also considered a welfare-oriented practice that enables voluntary participation in medical and management procedures. By organizing practical training knowledge within an academic framework, this Perspective aims to bridge the gap between field-based expertise and scientific description and to provide a foundation for future work on animal welfare, comparative cognition, and applied animal behaviour in socially complex species.

1. Introduction

Dolphin training is widely practiced in zoological facilities for performance, husbandry, and daily management. Through training, dolphins can perform complex behaviours, participate in medical procedures, and interact with trainers in structured and flexible ways. Despite its widespread use, however, the behavioural mechanisms underlying dolphin training have not been systematically described in the scientific literature. Much of the relevant knowledge remains within practical domains and is rarely formalized within established frameworks of learning theory and animal behaviour.

Although dolphin training relies primarily on operant conditioning, including shaping, conditioned reinforcement, and reinforcement schedules, it also involves broader processes such as social interaction, observational influences, exploratory engagement, and welfare-oriented applications (Pryor, 2002; Ramirez, 1999; Kuczaj et al., 2012; Lauderdale et al., 2021a). These features indicate that dolphin training cannot be fully captured by simple conditioning terminology alone.

The present paper aims to organize basic approaches and practices widely shared in dolphin training settings and to make their underlying processes more explicit within established frameworks of learning theory and animal behaviour. It is positioned not as a quantitative experimental study, but as a qualitative and practice-based synthesis. Accordingly, the examples discussed here are included not as a formal dataset for statistical analysis, but to clarify broader principles of training practice. In doing so, the paper seeks to support a more systematic understanding of dolphin training and its significance for animal welfare, comparative cognition, and applied animal behaviour.

2. Core principles of modern dolphin training

Contemporary dolphin training can be understood through a set of interconnected behavioural principles that structure learning, performance, and interaction in routine zoological practice. These principles do not function as isolated techniques, but as part of a broader behavioural system involving reinforcement, cue control, behavioural sequencing, and motivational regulation. The conceptual relationships among these components are summarized in Fig. 1.

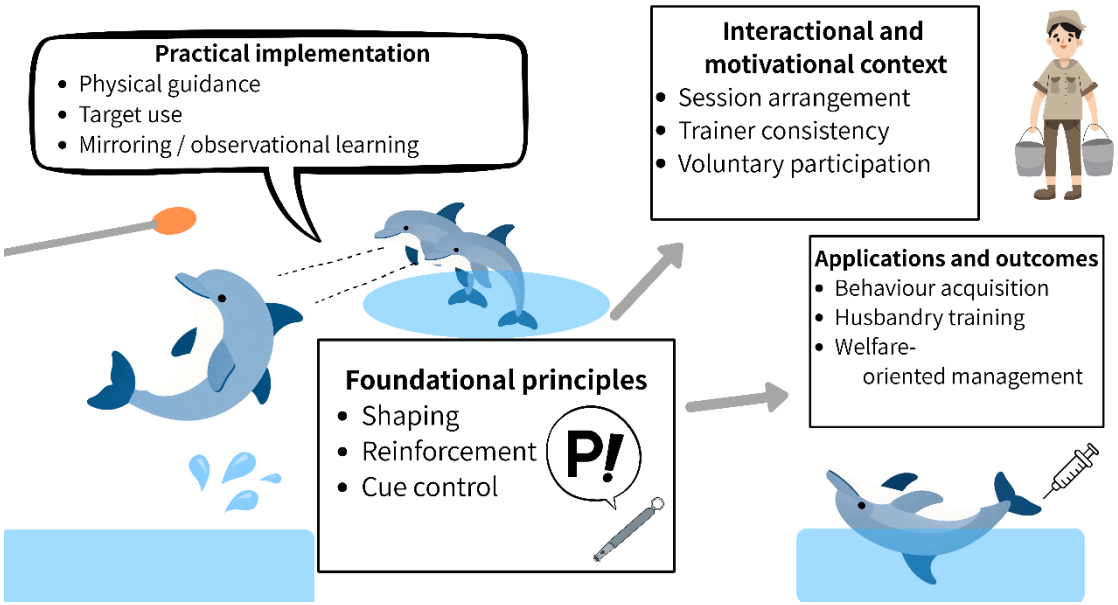

Fig. 1. Conceptual framework of modern dolphin training.

Modern dolphin training can be understood as an integrated system linking foundational learning principles, practical implementation, interactional and motivational context, and applied outcomes. Foundational principles such as shaping, reinforcement, and cue control support practical training procedures, including physical guidance, target use, and mirroring or observational learning. These processes are further influenced by session arrangement, trainer consistency, and voluntary participation, and may contribute to behaviour acquisition, husbandry training, and welfare-oriented management.

2.1 Reinforcement, shaping, and cue control

Training in dolphins is primarily based on operant conditioning principles. New behaviours are acquired through successive approximations, with trainers reinforcing incremental improvements toward a target response. During shaping, trainers may focus on one behavioural criterion at a time, such as height, posture, or timing, so that the target of reinforcement is made clear at each stage. This allows complex behaviours to be built gradually and systematically (Pryor, 2002; Ramirez, 1999).

A bridge signal, typically a whistle, is used to mark the precise moment at which the target criterion is achieved. This helps dolphins associate a specific component of their behaviour with reinforcement. Reinforcement is not applied uniformly, but is adjusted according to behavioural context. Larger or more energetically demanding behaviours may be followed by larger or more frequent food rewards, whereas smaller or less

demanding behaviours may receive reduced reinforcement. Reinforcement may also be modulated through both the size and number of food items. In addition, social reinforcement, including tactile interaction and vocal praise, may be used alongside food rewards, suggesting that multiple forms of reinforcement contribute to maintaining both behaviour and engagement.

Once behaviours have been shaped, they are placed under stimulus control. Cue-behaviour associations are established by presenting a cue immediately before eliciting the target behaviour. Reliable cue control is essential because trained responses must occur predictably and consistently across contexts. In practice, cue generalization may also be promoted by ensuring that multiple trainers can elicit the same response using the same signals. In some training contexts, trainers may also use more open-ended interactive periods in which dolphins are allowed to freely produce a range of behaviours, from which selected behaviours may then be marked and reinforced.

2.2 Continuous, intermittent, and variable reinforcement schedules

Reinforcement schedules in dolphin training mainly include continuous and intermittent reinforcement. Continuous reinforcement refers to consistently reinforcing correct responses, whereas intermittent reinforcement involves reinforcing correct responses only on some occasions, often in the context of a variable schedule (VS). Continuous reinforcement may often involve both food reward and social reinforcement, whereas intermittent reinforcement may also be maintained through social reinforcement alone, such as tactile interaction and vocal praise. Because dolphins may come to expect regular food provision, participation in training may not be understood simply as behaviour driven by immediate food necessity, but rather as part of an interaction shaped by reinforcement and trust.

In practical settings, such variable reinforcement does not necessarily follow rigid laboratory schedules, but may instead function as a flexible training strategy that helps sustain engagement, maintain behavioural reliability, and reduce dependence on continuous reward. At the same time, the use of variable schedules requires careful adjustment. If reinforcement becomes too sparse, poorly timed, or inconsistent relative to the animal's expectations, motivation and behavioural precision may decline. Thus, the practical use of variable reinforcement schedules depends on balancing behavioural stability, response quality, and continued participation. In this sense, reinforcement schedules are not merely technical details of reward delivery, but a core part of how trainers regulate learning, performance, and motivation in everyday practice.

2.3 Motivation as an actively regulated process

In modern dolphin training, the maintenance of motivation is supported by the trainer's adjustment of session structure, reinforcement, and task difficulty according to the dolphin's responses and condition. Of these, the composition of each training session may influence both the dolphin's motivation and the degree of achievement reached within that session.

When a session includes a new or more challenging behaviour, trainers may structure the sequence of tasks so as to maintain motivation, for example by placing such behaviours earlier in the session and following them with familiar behaviours associated with success. Trainers may also aim to end the session with a successful response, so that the dolphin finishes on a positive experience that may support motivation for the next training session.

Trainer behaviour also appears to play an important role in this process. Dolphins show sensitivity to trainer consistency and may occasionally exhibit testing behaviour, such as gradually disengaging while monitoring the trainer's response. Inconsistent reinforcement or premature cueing in such situations may reduce compliance in subsequent sessions. These patterns suggest that the maintenance of motivation depends not only on reward itself, but also on the clarity, timing, and consistency of trainer responses.

Training progress is not always linear, and even when a behaviour has been achieved in a previous session, it may not remain stable in the next one. In such cases, trainers may temporarily return to an earlier stage and rebuild achievement step by step before progressing again. Such progress depends not only on the dolphin's ability, but also to a large extent on trainer judgment, including the setting of criteria and the timing of reinforcement.

Moreover, dolphins may voluntarily approach trainers outside of structured training sessions, further indicating that participation is not solely driven by immediate food reinforcement.

2.4 Behavioural sequencing and cognitive demands

Modern dolphin training may extend beyond the shaping of single behaviours to the organization of multiple actions into structured behavioural sequences. Once individual behaviours have been established through shaping and placed under cue control, they may be combined into more complex tasks.

One such form, presented by Alex Cruz at IMATA, involves the successive presentation of multiple cues, with the dolphin required to remember and perform the corresponding

behaviours in the correct order (Cruz, 2014). Another form involves placing a fixed sequence of behaviours under a single cue, so that the dolphin performs the entire sequence continuously as one set. In this case, the bridge signal may function not only as a conditioned reinforcer, but also as a signal to move on to the next behaviour in the sequence.

These tasks are more complex than performing a single behaviour once, and may place greater demands on memory, anticipation, and behavioural control. In this sense, such performances should not be understood simply as spontaneous displays of intelligence, but as the result of stepwise training processes built upon previously acquired behaviours.

3. Social interaction and voluntary participation in dolphin training

Dolphin training is not shaped solely by reinforcement contingencies directed toward isolated individuals. Because dolphins are highly social animals, training often takes place within a context of interaction involving both trainers and conspecifics. Social processes may therefore influence behavioural acquisition, performance, motivation, and engagement. In addition, dolphins may disengage from training and selectively participate in interactions, indicating that training involves an element of voluntary engagement rather than simple behavioural control. Their responses further suggest that training is better understood as a bidirectional process than as a one-way sequence of cue delivery and reinforcement.

3.1 Social learning and observational processes

Social learning may contribute importantly to dolphin training, particularly when new behaviours are introduced in group settings. When a new behaviour is introduced to a single individual, other dolphins observing the process often acquired the behaviour more rapidly when later trained. In some cases, dolphins appeared to reproduce behaviours of trained individuals, suggesting that observational learning and imitation may contribute to behavioural acquisition (Yeater and Kuczaj, 2010; Kuczaj et al., 2012; Nakamura et al., 2025). In practical terms, this kind of learning may also be related to imitation-based approaches such as the “Do as I Do” method in dog training (Fugazza and Miklósi, 2017). These observations suggest that training does not occur only through direct trainer-animal reinforcement, but may also be facilitated by the presence and behaviour of conspecifics. Social facilitation and observational processes may therefore play an important role in how behaviours are learned and performed in group settings.

3.2 Exploration, play-like interaction, and intrinsic motivation

In addition to structured training, dolphins may engage in interactions that are not limited to the execution of previously established responses.

In some contexts, they may approach tasks in a more exploratory manner, working through behavioural challenges while maintaining motivation through both successful task resolution and the reinforcement obtained thereafter.

This perspective is consistent with reports that bottlenose dolphins can engage in problem solving with novel interactive apparatuses and may continue to participate even when food reward is not immediately consumed (Lauderdale and Miller, 2019).

Dolphins may also engage in spontaneous interactions with trainers that resemble play behaviour.

These interactions can include repeated presentation of body parts, object exchange, and repeated solicitation of continued social engagement.

Such patterns suggest that training contexts may sometimes involve intrinsic motivation as well as food-based reinforcement.

They also indicate that trainer-dolphin interaction can extend beyond the execution of trained responses and may include forms of engagement that are socially maintained.

These observations are also relevant to enrichment.

In accredited facilities, training and enrichment are often embedded within the broader management environment rather than functioning as wholly separate domains (Lauderdale et al., 2021a, 2021b).

From this perspective, some training tasks may overlap with enrichment-like processes by providing opportunities for exploratory engagement, challenge resolution, and reward through successful performance.

Similarly, reports from other marine mammal species suggest that increasing engagement in play-like tasks and novel learning opportunities may keep the animal occupied, function in an enrichment-like manner, and contribute to the reduction of problematic behaviour (Joury et al., 2013).

Modern dolphin training may therefore involve not only behavioural control, but also interactional and task-based processes that are rewarding in themselves.

3.3 Multi-individual training and practical complexity

In dolphin training and presentations, it is also common for a single trainer to work with two or more dolphins at the same time.

Under such conditions, training is shaped not only by cue delivery and reinforcement,

but also by learned conventions of spatial order and by social relationships among individuals. For example, if three dolphins have been trained to line up in the order A-B-C in front of a trainer, that relative order may be maintained as a behavioural convention, and if only A and C are present, they may still line up as A-C.
In multi-individual groups, relative social hierarchies are often present and may appear in threat-related interactions or in differences in how easily particular combinations of individuals can be managed. Spatial positioning may also be influenced by such dynamics. For example, if one individual shows threatening or dominance-related behaviour, the others may retain the same basic order while increasing their distance.
Even when one dolphin attempts to draw disproportionate attention or seek priority in receiving cues, trainers may avoid responding in ways that allow the animal to control cue allocation. Instead, cues may be distributed as evenly as possible, sometimes with the aid of gaze and other subtle nonverbal signals, so that aggressive or demanding behaviour is not reinforced.
If one individual repeatedly receives most of the cues while another is made to wait, the waiting animal may lose concentration or disengage from the session. In some individuals, particularly older animals, longer waiting periods may also be used intentionally to limit activity level according to physical condition. In presentation settings, the predictability of a pre-structured programme may sometimes lead to more habitual performance and reduced motivation. For this reason, some practices introduce variation by alternating among multiple programme patterns or by adjusting the structure more flexibly in the moment.
These features highlight the practical complexity of dolphin training in a social species.

3.4 Illustrative examples from practice

The example below provides one practical illustration of how shaping, reinforcement, cue control, and social learning may interact in the acquisition of a novel jumping behaviour.
In this case, one dolphin was first trained individually through multi-stage shaping. The target posture and endpoint were initially taught through repeated physical guidance in front of the trainer, after which the behaviour was transferred to a target cue presented at the water surface.
As the behaviour became more stable, it was gradually extended from the trainer's immediate position to performance across the wider pool space, and was then placed under formal cue control.
Once this first dolphin had reliably acquired the behaviour, a second dolphin was

positioned alongside the trained individual in front of the trainer, and the same cue was presented simultaneously to both animals.
Although the second dolphin had not been directly trained on that cue, it followed the trained individual and produced an approximate version of the same jump.
The finer details of the movement were then shaped individually, while continued practice alongside the trained dolphin appeared to facilitate more rapid acquisition.
Even when the same target behaviour is being established, there is no single training process by which it is reached. In practice, what appears to be important is adjusting the process according to the characteristics and responses of individual dolphins while maintaining motivation and accumulating stepwise success.
Although reinforcement practices may vary across facilities in terms of reward type, item size, and reward presentation, the underlying behavioural principles remain shared.

4. Welfare-oriented applications: husbandry training

A major practical application of modern dolphin training is husbandry training, in which animals are trained to voluntarily participate in medical care, body inspection, and other management procedures. Such training may reduce the need for forceful handling and is closely linked to welfare-oriented management (Brando, 2010; Kuczaj and Eskelinen, 2014).
Because husbandry procedures may include experiences that are not necessarily comfortable for the animals, gradual habituation and desensitization—that is, stepwise familiarization with stimuli and handling—are often required. For example, in training for blood collection, a dolphin may first be trained to present and hold the tail fluke in a designated position, after which the area around the vein is gradually desensitized through repeated tactile stimulation, so that the animal can eventually remain still even when a needle is inserted.
These procedures may involve reinforcement not only for the final response but also for intermediate behaviours such as maintaining immobility or accepting handling. In addition, reinforcers may sometimes be delivered in advance in order to support the continued maintenance of such behaviours.
By establishing such behaviours in advance, blood collection, examinations, and other medical procedures can be carried out more quickly and safely when needed. In this sense, husbandry training can reduce burden and physical risk for both animals and staff, and support welfare-oriented management.

5. Discussion

Modern dolphin training is a practice involving reinforcement, learning, interaction, voluntary participation, and welfare. Complex behaviours and advanced performances are not achieved simply because dolphins immediately understand and perform what is asked of them, but are formed through stepwise learning accumulated within repeated nonverbal interaction with the trainer. These behaviours are also not performed through coercion, as the animals retain the ability to choose whether to respond.

These interactions and learning processes may play important roles in eliciting the capacities, curiosity, and continued engagement of animals under human care. As a supplementary point, excessive demands may become a source of stress, and training therefore needs to be conducted in accordance with the condition of the animal and the circumstances of its implementation. Welfare-oriented practice can be supported only when field-based knowledge is shared with the management organization and appropriately reflected in operational decisions.

At the same time, the present paper is primarily conceptual and practice-based, and the processes discussed here remain to be tested through systematic empirical research, including their relationships with motivation and affective states.

5. Conclusion

Appropriate dolphin training can support welfare through trainer–animal relationships, cognitive engagement, and voluntary participation in health management. As practice develops, emphasis may gradually move from food rewards toward social reinforcement, allowing a more flexible, choice-based form of interaction.

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