ABSTRACT

In this review, we present a new conceptual framework for the study of play behavior, a hitherto puzzling array of seemingly purposeless and unrelated behavioral elements that are recognizable as play throughout the mammalian lineage. Our major new functional hypothesis is that play enables animals to develop flexible kinematic and emotional responses to unexpected events in which they experience a sudden loss of control. Specifically, we propose that play functions to increase the versatility of movements used to recover from sudden shocks such as loss of balance and falling over, and to enhance the ability of animals to cope emotionally with unexpected stressful situations.

To obtain this “training for the unexpected,” we suggest that animals actively seek and create unexpected situations in play through self-handicapping; that is, deliberately relaxing control over their movements or actively putting themselves into disadvantageous positions and situations.

Thus, play is comprised of sequences in which the players switch rapidly between well-controlled movements similar to those used in “serious” behavior and self-handicapping movements that result in temporary loss of control. We propose that this playful switching between in-control and out-of-control elements is cognitively demanding, setting phylogenetic and ontogenetic constraints on play, and is underlain by neuroendocrinological responses that produce a complex emotional state known as “having fun.” Furthermore, we propose that play is often prompted by relatively novel or unpredictable stimuli, and is thus related to, although distinct from, exploration.

We argue that our “training for the unexpected” hypothesis can account for some previous puzzling kinematic, structural, motivational, emotional, cognitive, social, ontogenetic, and phylogenetic aspects of play. It may also account for a diversity of individual methods for coping with unexpected misfortunes.

THE "TRAINING FOR THE UNEXPECTED" HYPOTHESIS OF PLAY

The Adaptive Value of Play

We hypothesize that a major ancestral function of play is to rehearse behavioral sequences in which animals lose full control over their locomotion, position, or sensory/spatial input and need to regain these faculties quickly. Animals learn how to improvise their behavior by chaining conventional movements with atypical movements to get themselves back into a standard position. Sequences that link highly efficient species-typical motor patterns and standard body positions with atypical movements necessary for recovery from awkward positions often occur in biologically significant situations. For example, when fleeing a predator, an animal tries to use the most efficient pattern of flight, but may be disoriented or interrupted unpredictably by rapid changes in visual input, actions of the predator, or collisions with other herd members or inanimate obstacles. The ability of the animal to recover rapidly using atypical movements could mean the difference between life and death in a predator attack. Similar mishaps may occur during intraspecific interactions and during pursuit of prey. The opponent (or the prey) adds significant unpredictability to the environment. Skilled movements often cannot be completed or properly sequenced because of interruption by the other animal.

Besides the development of locomotor versatility in unanticipated situations, we hypothesize that animals in play learn how to deal with the emotional aspect of being surprised or temporarily disoriented or disabled. Loss of control in a serious situation, despite active attempts to cope, will normally result in activation of both sympathetic-adrenal-medullary and pituitary-adrenocortical systems (von Holst 1998). These systems prepare the animal for immediate action, but can have long-term costs, especially in suppressed immunocompetence (Apanius 1998). In adverse social situations, emotional overreaction may lead to undue escalation of conflicts. In the presence of a predator, emotional overreaction leading to aimless panic will decrease an animal’s chance of survival. In general, adaptive responses in serious situations depend upon the animal’s ability to avoid incapacitation via negative emotions. We propose that the experience of “self-induced” mishaps during play helps animals to avoid emotional overreaction during unexpected stressful situations.
The ultimate benefits obtained from play are probably low, judging from the fact that play is dropped from the behavioral time budget under harsh conditions (Baldwin and Baldwin 1974; Berger 1980; Barrett et al. 1992). However, it may be that individual differences in retaining play during harsh times were beneficial during evolution. All in all, play could probably be counted among “opportunity behaviors” (a term coined by Fraser and Duncan 1998); that is, those behaviors that bring low ultimate benefit and are therefore actuated at moments when the cost of performing them drops to an even lower level.

In short, we propose that play: (i) results in increased versatility of movements used to recover from sudden “gravitational,” “kinematic,” or “positional” shocks such as losing ground underfoot, falling over, being knocked over, being pinned down, or being shaken vigorously; and (ii) enhances the ability of animals to cope emotionally with unexpected situations. These may include both “locomotor” shocks as described above, and “psychological” shocks such as suddenly being faced with frightening or dangerous stimuli, unexpectedly meeting a stranger, or experiencing a sudden reversal in dominance.

SELF-HANDICAPPING—SEEKING AND CREATING THE UNEXPECTED IN PLAY

If play has the function of training for the unexpected, then unforeseen situations should occur frequently in play. We suggest that mammalian play is a sequential mixture of: (a) well-controlled vigorous locomotor movements similar to those used in “serious” behavior that load heavily on fitness traits such as escape from predators, intraspecific agonism, or hunting fast or dangerous prey; and (b) movements during which postural control is compromised, or the chance for random factors to influence movement is increased so that the animal is more likely to be knocked off balance, fall over, lose control of a play object, or fail to counter the actions of another animal.

Animals can actively seek and create unexpected events in play through self-handicapping; that is, deliberately relaxing control over their movements or actively putting themselves into disadvantageous positions and situations. For example, animals may self-handicap by moving in a way that is less than fully stable or efficient, or by performing object manipulation while positioned in a way not best suited for full control over the object. They may also impair their sensory and spatial orientation through high-speed angular and rotary movements of the head, putting their head into unusual positions in relation to gravity or horizon, or twisting their body in an unusual way. By using physical properties of the environment such as deep soft snow, a slippery slope, or gravity-attenuating water, animals can enhance the probability that they will be thrown off balance into unusual positions. They can also increase the probability of experiencing unexpected events by playing with or among relatively novel environmental features or among features that are moving in unpredictable ways (e.g., due to wind). In social interactions, animals can self-handicap by using positions and movements that impair their competitive ability and enable their playmates to gain the “attack” position. For example, they may inhibit the force of their bites and pushes, and allow themselves to be pushed over and chased, even when they have the ability to harm or dominate a playmate. They may also put themselves at a self-induced disadvantage by playing with larger, stronger, or more experienced play partners, or even with animals of a different species. Because play is only performed when its costs remain low, however, there is an upper limit of unpredictability and loss of control above which animals will not play.
THE RELATIONSHIP BETWEEN EXPLORATION AND PLAY

Exploration can be viewed as a serious counterpart to play. During an initial encounter with a novel environmental feature, animals first investigate it through “serious” exploration, examining whether it is dangerous and whether it has any resource value to them. If they find the novel feature to be relatively non-threatening, play may follow. Through their playful behavior the animals seem to address the question, “What if it really were dangerous?” Although exploration is often temporally associated with play, it differs from play in three important aspects. First, a function of exploration may be to learn how to avoid getting into trouble (by gathering information), whereas we propose that an important aim of play is to learn how to get out of trouble (through enhanced improvisation skills). Second, there is no deliberate self-handicapping in exploration. Third, whereas play is associated with a relatively relaxed and secure state, exploration is more closely associated with fear and perceived danger. If an animal loses control in play and has too much difficulty regaining it, or the situation becomes dangerous, the animal should withdraw and reassess the situation through further exploration.

HAVING FUN—THE UNDERLYING EMOTION IN PLAY

According to our hypothesis, play enables animals to develop emotional flexibility by rehearsing the emotional aspect of being surprised or temporarily disoriented or disabled. Although unexpected events that occur in a dangerous situation would likely magnify fear in inexperienced animals, we suggest that fear is modulated in play by the relatively safe context in which play occurs and the improbability that losing control will have serious consequences. In addition, regaining control following an unexpected challenge is likely to be rewarding, and the positive nature of this experience may be intensified by the rapid repetition of in-control and out-of-control elements that occur in play. Thus, we hypothesize that play is emotionally exciting (perhaps even thrilling, though not intensely frightening) and rewarding, maybe even pleasurable, while at the same time being relaxed. We suggest that this combination of affective attributes is unique to play, producing the complex emotional state that is referred to as “having fun” in human folk psychology. We propose that the three phenomenological aspects of this “having fun” feeling are directly reflected in the kinematic, structural, and motivational character of play behavior. The excitement is revealed in the vigor and speed of play movements and sequences, the pleasurable aspect in the fact that animals actively seek out and work for opportunities to play, and the relaxation by the willingness of animals to self-handicap in play and play only when they are relatively safe or unstressed. It may also be that play behavior is supported by a unique pattern of neurobiological response in the brain centers associated with complex somatosensation, motor pattern control, emotionality, and reward.