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Galápagos Sea Lion (*Zalophus wollekaeki*) Play Behaviors on San Cristóbal Island, Ecuador

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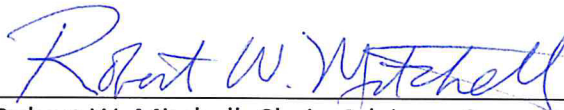
Galápagos Sea Lion (*Zalophus wollekaeki*) Play Behaviors

on San Cristóbal Island, Ecuador

By

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on San Cristóbal Island, Ecuador

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Bachelors of Arts
University of Kentucky
Lexington, Kentucky
2016

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in partial fulfillment of the requirements
for the degree of
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ABSTRACT

My thesis concerns observations of play activities from videotapes of Galápagos sea lions on San Cristóbal Island from mid-summer of 2008. I begin with a discussion of the significance of play and ideas about play and types of play, elaborate the conceptual system of projects and routines in play, and provide a brief description of sea lion taxonomy and forms of play specific to Galápagos sea lions. Observing approximately 713 minutes of videotapes, I coded approximately 161.5 minutes of play projects and routines. Of the 713 minutes, 241 minutes were used in training, and 472 were coded independently by two coders for reliability. The two coders observed approximately 141 minutes of play. For the presence of particular projects and routines at approximately the same time, reliability was 100%; for agreement about the temporal extent of projects and routines, reliability was 96% (though some infrequent projects and routines had low agreement); overall, Cohen's kappa was .97. I observed five solitary play projects (lolling, twirling, object play, jumping, and surfing), and four social play routines (playfighting, playchasing, playwrestling, and king of the hill—a form of playful boundary defense). Of these, lolling and twirling had not been previously coded as play in the scientific literature. The most common play activities were lolling and playfighting. Social object play, sexual play, and boundary defense seem likely to be present in all sea lion species, but I observed no evidence of the first two, and only one variant of boundary defense (king of the hill), in the videotaped Galápagos sea lions.

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Chapter I.

INTRODUCTION

In the summer of 2008, three Eastern Kentucky University (EKU) faculty members (Drs. Rosanne Lorden, Robert W. Mitchell, and Richard Sambrook) took several EKU students to the Galápagos Islands in Ecuador for two weeks in order to teach study abroad courses and observe sea lion behavior. Faculty and students stayed in Puerto Baquerizo Moreno, the main city on San Cristóbal Island. One of the courses, teaching observational methods in studying human and animal behavior, involved collecting videotaped observations of sea lions (*Zalophus wollekaeki*) engaging in play (as well as other activities). Sea lions congregate in two locations within easy walking distance in Puerto Baquerizo Moreno, and appear in other relatively nearby locations. Students and faculty used focal sampling methods, videotaping one sea lion as it interacted with other sea lions for an extended period, usually until it went to sleep or swam away, to capture sea lion play and other activities. The experience resulted in 713 minutes of videotaped observations of sea lions, some of which contain sea lion play behavior. I examined the play behavior of Galápagos sea lions from 48 videotapes, describing the play activities they engaged in, and obtaining reliability for these observations. Prior to presenting my findings, I discuss the significance of play, definitions of play, types of play, the projects/routines model of play, the relations among sea lion species, and evidence of play in sea lion species from other studies.

Chapter II.

LITERATURE REVIEW

The significance of play

Why study play? In children, play is commonly studied in relation to cognitive development. Play involving extensive movement is expected to benefit children in their physical development as well, but it is pretend play and its relation to representation that is focused on. Pretend play is viewed as practice for adult activities, which the child comes to understand by engaging in pretend versions of these activities. Similar reasons to study play are present for animal play: the physicality of movement in play is expected to benefit animals' bodily development, and their play that looks like adult activities is expected to be practice for adult activities (Burghardt, 2005; Fagen, 1981; Mitchell, 1990). Examining whether or these ideas are true is one goal of play research (e.g., Pellis, Pellis, & Bell, 2010), but it requires determining first what play activities animals engage in. That is the purpose of the current research: to determine which play activities Galápagos sea lions engage in.

Definitions of play

There are myriad definitions of play. The most recent formulation is detailed by Burghardt (2005): "Play is repeated, incompletely functional behavior differing from more serious versions structurally, contextually, or ontogenetically, and initiated voluntarily when the animal is in a relaxed or low-stress setting" (p. 82, italics removed). A less restrictive but similar definition is offered by Mitchell (1990): "people perceive an

activity as play when they perceive an organism engaging in intentional activity which either appears to be done for its own sake or for amusement, or appears intentionally to simulate another end-directed activity for benign ends” (p. 198, italics removed). I plan to examine these definitions because both were based on a thorough examination of the literature on animal play. I will discuss areas of agreement and corresponding areas of disagreement before discussing requirements found in one that are not in another.

Both definitions focus on similarities between play behaviors and other functional activities. Thus, it is not surprising that one finds animals engaging in sexual play (e.g., play mounting) and aggressive play (e.g., play fighting). Whereas Burghardt (p. 82) calls these similarities evidence of “incompletely functional behavior,” Mitchell (p. 198) calls these instances of “simulative play,” or “simulations of other end-directed activity for benign ends.” The problem for Burghardt’s definition is that play can be completely functional while simulating other forms of activity. Burghardt (p. 71) recognizes this, and further clarifies what he means by “not fully functional”: “it includes elements, or is directed toward stimuli, that do not contribute to current survival.” But many activities of animals include elements that do not contribute to their current survival, yet we would not call these “not fully functional”; for example, heterosexual behavior of animals includes elements that do not contribute to current survival—individual animals can survive well without engaging in heterosexual behaviors and reproduction—but we still consider these “fully functional” behaviors. To say that an

activity has a function is to claim that the activity leads to some end for which it was designed by some process such as evolution via natural selection, training, intention, or planning (see Thompson, 1981, 1995, for discussion of “design”). Most of the activities animals engage in, including play, are likely functional in the sense of being designed through evolution by natural selection. And some animals engage in pretend play, which is itself a designing process that entrains the animal to gain understanding about the consequences of its actions (Mitchell, 2002).

In addition to simulative play, Mitchell’s (p. 198) definition also includes “autotelic play,” which incorporates activities that are unrelated to other functional activities in offering “intentional activity which ... appears to be done for its own sake or for amusement” as a type of play that do not necessarily bear similarity to other functional behaviors. (Both Burghardt’s and Mitchell’s definitions acknowledge that play is voluntary or intentional.) Burghardt’s definition acknowledges that play can be enacted for fun (see discussion, pp. 72-73), but this requirement must be combined with similarities between “serious” functional activities and play activities (p. 79) for play to be detected. Though indeed both fun and simulation can occur together in play, they can also occur independently.

Burghardt requires that play be repeated behavior, specifically, “the behavior is performed in a similar, but not rigidly stereotyped, form during at least part of the animal’s ontogeny” (p. 75). Burghardt focuses on repeated behavior because it is a salient property of play activities. Unfortunately, it is a salient property of almost any

animal behavior. Almost any activities at the same status as “play” (e.g., sexual behavior, aggressive behavior, feeding behavior, submissive behavior) must be performed in a “similar, but not rigidly stereotyped, form during at least part of the animal’s ontogeny.” Take aggressive behavior: animals probably use the same behaviors repeatedly to harm conspecifics in a fight, but these behaviors must also not be stereotyped in that they must be sensitive to what the opponent is doing and must also not provide that opponent with too much regularity, to avoid giving the opponent ways to predict subsequent actions. Although everyone agrees that varied repetition in behaviors is part of play behaviors (and I will use the fact of varied repetition in play in elucidating the projects/routines model of play below), it cannot be a feature that distinguishes play from other activities precisely because it is a common feature of most activities. Oftentimes an animal’s activity in which the goal is repetitively attained and lost (e.g., a dog catching a ball, dropping it, chasing it, getting it, dropping it, chasing it, etc.) or repeating a benign activity (e.g., a dog offering a ball to entice a person to try to get the ball) is evidence of the animal intending to engage in that activity. Finally, play activities do not have to be repeated to be detected as play. Thus, to reiterate, repetition is often a common feature of play, but it is not a distinguishing feature of play, and thus cannot be used to define play.

Burghardt also requires that play occur “in a relaxed or low-stress setting.” Unfortunately, play can occur in high-stress settings. Many of these occur in humans. The most disturbing evidence of play in high-stress settings comes from children in

concentration camps or in hiding during World War II (see <http://www.ushmm.org/wlc/en/article.php?ModuleId=10006128>). There are many other examples of humans playing in unrelaxed or stressful settings detailed in Sutton-Smith and Kelly-Byrne (1984). For nonhuman examples, one can look to Breuggeman's (1978) descriptions of play interactions with infant rhesus monkeys used by caregivers to distract the infants from their desire to suckle. Both when the caregiver was the mother, and especially when she was not, such play activities were enacted under stress. In other cases, play can diminish stress, rather than the reverse: common marmosets tend to play more in stressful situations than in less stressful ones surrounding feeding (see Norscia & Palagi, 2011, who provide a nice summary of work on play in relation to stress-reduction). This is not to deny that social play usually exists in the midst of friendliness and cooperation (Aldis, 1975), just that it need not and often does not.

Given that Burghardt and Mitchell both agree on all the requirements for play present in Mitchell's definition, and that the additional requirements that Burghardt adds are not essential to the definition of play, I will be assuming Mitchell's definition of play in what follows.

Types of play

Many types of play have been codified, and methods of separating these types vary across research papers. I will begin with Mitchell's distinction between autotelic and simulative play. Autotelic play is activities that are done for amusement or for their own sake. Many solo play activities can be of this type (see Mitchell, 1990). For example,

chimpanzees enjoyed tickling themselves with objects, and dolphins entertained themselves by repeatedly dunking turtles as they strove to get air (eventually killing the turtles). Such activities seem to be done because they are inherently amusing for the animals. Simulative play is activities that bear some resemblance to other goal-directed actions (such that they remind one of these actions), but have a different more benign function. Aggressive play such as playfighting reminds one of aggressive fighting, but is clearly not fighting; sexual play such as play mounting reminds one of sexual mounting, but no sexual aspect is presented, or if it is, it seems inadequate to the expected function of sexual mounting, which is sexual intercourse. Cats chase balls of yarn much as they chase mice, so predatory play is detected as there is a more benign end than is present in predation. Chase play resembles stalking (Steen & Owens, 2001) where one animal is trying to catch another who is trying to avoid being caught. This type of play is even found in reptiles and birds (Burghardt, 2005). Note that the benign end of simulative play is in comparison to the end that is expected to occur in the activities that the play behaviors simulate. Simulative play can have non-benign consequences unrelated to the end that is expected, including serious injury and death. For example, playing sea lions have been killed by killer whales (Steen & Owens, 2001) and playing seals have been killed by sea lions (Harcourt, 1991a).

Other categorizations cut play into locomotor, object, and social (Burghardt, 2005). Locomotor play occurs when a young animal performs intense or sustained movements like running, leaping and jumping with lack of apparent purpose beyond the

pleasure experienced in running, leaping and jumping (Burghardt, 2005, p. 84)—a form of autotelic play. Object play occurs when a thing is physically manipulated apparently for amusement (rather than for exploration of the thing—see Aldis, 1975), but object play can also be simulative play: a dog attempting to capture a ball and then shaking it back and forth might remind one of predatory activities. Social play occurs when animals interact while engaging in autotelic or simulative activities for benign ends. If these animals also engage with something while engaging with each other, then they are engaging in social object play. Few mammals (aardvarks, bats, manatees, armadillos, and sloths) do not express all three types of play (Burghardt, 2005, p. 193). Note that exploration can be easily confused with object play, as the behaviors performed by the animal appear similar. Aldis (1975) explains that exploration occurs when an organism is trying to acquire new information about the object, whereas object play allows an organism to discover what can be done with an object.

Each of these types of play has subtypes, some of which (aggressive play, sexual play) have already been presented, and some of these subtypes can be further subtyped. One type of social play, playfighting, can incorporate play chasing, self-keepaway, play biting, and playwrestling. Another type of social play, king of the hill, entails several animals trying to gain and maintain a position on the top of a mound while trying to keep or displace others from getting to be on top of the mound (Aldis, 1975). Social object play can be tug o' war or object keepaway.

In all of these types of play, animals tend to enact the same set of activities over

and over again during a play bout within the play form. For example, playfighters chase, run away, bite, and wrestle over and over again. As Burghardt and others (Simpson, 1976) have noted, repetition is frequently present in play activities. It is this repetitive quality in play that led to the idea that players engage in projects.

Note that, although action repetition was denied as a defining feature of play above, it was not denied that repetition is a common feature of play. Similarly, breathing is an essential feature of play (even more essential than repetition!), but it is not a defining feature, i.e., a feature that allows one to distinguish play from nonplay. In the idea of projects discussed below, repetition with variation is used to explain the function of play as practice.

Project and routines in play

To detect types of play activities, the system described by Simpson (1976) and elaborated by Mitchell and Thompson (1990; 1991) is helpful. Simpson proposed that playing animals engage in projects, which are repetitive sequences of goal-directed actions. In Simpson's view, animals repeat these actions because repetition results in skills for engaging in these actions, and animals engage in variations in these actions so as to have a broader array of contexts in which they can enact these actions with ease. The actions within projects are repeated with variation over a short period of time, which results in a form of training and practice for animals. Essentially, players do the same thing over and over again to gain a kind of expertise over the project, which is why Simpson views engaging in projects as a form of training. Simpson elaborated his ideas

by focusing on the variations present in repetitive playful jumping by monkeys. Monkeys jump from branches of diverse bounciness and foliage to other branches and to the ground and back again. Such experiences allow monkeys to calibrate their actions in diverse circumstances, providing a repertoire of skills in relation to these actions. Simpson's idea can be applied broadly to numerous activities and numerous species. In playchase, for example, the animal will run after another player in order to reach the goal of catching that player, but in doing so will encounter a variety of varied terrains and obstacles that it must circumvent. By playing, animals learn to produce a given goal-directed activity in a variety of circumstances and from a variety of positions. Simpson's idea fits nicely into the idea that play can be explained as practice, elucidated by numerous authors (Aldis, 1975; Burghardt, 2005; Fagen, 1981), and allows researchers to look for common functions of similar projects across animal species. Play as practice also fits nicely into views of play as training for the unexpected (Pellis, Pellis, & Bell, 2010; Spinka, Newberry & Bekoff, 2001).

Mitchell and Thompson (1990; 1991) applied Simpson's notion of projects to social play between dogs and people, looking for goal-directed action sequences in play to see if they are repetitive. In this application, actions of dogs (e.g., run toward ball, pick up ball; or move an object toward and away from the partner) were combined into projects (respectively, chase the ball; object-keepaway). Projects were viewed as what the player was doing, its aim, while performing the actions, such that "project" is a category that subsumes simple actions. Not surprisingly, it was the repetitiveness of

animals' aims in play that allowed for the detection of projects in the first place, such that repetitiveness of projects was not only an empirical fact (i.e., projects were repeated in play bouts), but was also generally the reason projects could be detected as such, as the animal did the same thing over and over again. (Once projects are detected in a species, single unrepeated instances of a project in species members can be discerned.)

Projects in social play, to be successful, require enactment of compatible projects by the play partner. For example, if a dog has the project of playing object-keepaway, its human play partner must chase the object if the aim of object-keepaway is to be satisfied; and if the person's goal of chase the object is to be satisfied, the dog must offer opportunities for the person to try to obtain the object. These would be compatible projects. By contrast, if the person and dog both played object-keepaway, these would be incompatible projects, as neither project can be satisfied by enactment of the other project. The simultaneous occurrence of projects by players is called a routine. These simultaneous projects are not always compatible, but one would expect that they would be the majority of the times they are enacted. To assess whether routines during dog-humans play were largely based on compatible projects, Mitchell and Thompson (1990; 1991) examined the simultaneous occurrence of different projects of familiar and unfamiliar dogs and people playing from categorical and temporal perspectives. For both familiar and unfamiliar dogs and people playing, the frequency with which a project in a routine was compatible with the other project was

73%, and the time spent engaging in compatible projects was 81% of the time spent in routines.

In the current research, the repetitiveness of actions in play allows for the detection of particular play projects of sea lions. This research is part of a larger study to provide a taxonomy or ethogram of the projects and routines of Galápagos sea lions, which will allow for elaborate comparison across sea lion species. Although in the discussion of sea lion play below I do not always use the terms “project” or “routines,” it should be clear that the different forms of play noted—object play (rock play, kelp toss and chase), playfighting, playwrestling, playchasing, and wave surfing—all involve projects and, when social, routines as well. In addition, the point of this research is not to test the idea that play is practice, but rather to develop a taxonomy of the play behaviors of Galápagos sea lions.

Sea Lions

Sea lions are part of the group of sea mammals known as pinnipeds, which includes seals, sea lions, and walruses (Riedman, 1990). Sea lions are the subfamily Otariidae of the superfamily Otarioidea. Typically five species of sea lion are described—California (*Zalophus californianus*), Stellar’s or Stellar (*Eumetopias jubatus*), Southern (*Otaria flavescens*), Australian (*Neophoca cinerea*), and Hooker’s or New Zealand (*Phocarctos hookeri*)—with Galápagos and Japanese sea lions presented as subspecies of California sea lions (Bonner, 1994; Riedman, 1990). More recent assessments through genetic analysis (Wolf, Tautz & Trillmich, 2007) and other means (see Trites et al., 2006)

indicate that the Galápagos sea lion (*Zalophus wollekaeki*) as well as the extinct Japanese sea lion (*Zalophus japonicus*) are distinct species.

Systematic studies of play have focused on Steller sea lions (Farentinos, 1971; Gentry, 1974), with less formal studies of other sea lions, including and Galápagos sea lions (Eibl-Eibesfeldt, 1955; Riedman, 1990). See Table 1. Eibl-Eibesfeldt noted locomotor play (surfing on waves and sliding on water), social play (playfighting), object play (pulling rope attached to boats) and predatory object play (carrying and tossing items like wood and stones). California sea lions engage in predatory object play with fish in a similar way (Riedman, 1990). Apparently, sometimes the play with rocks became social, suggesting object-keepaway games (Eibl-Eibesfeldt, 1955). Sea lions also chase and capture their own bubbles (Riedman, 1990). Riedman noted that sea lions universally like surfing and rough-and-tumble play (i.e., playfighting and playwrestling), and observed Galápagos sea lions playchasing each other and human divers underwater, and engaging in tug o' war with humans over objects like swim fins.

Among Stellar sea lions (Farentinos, 1971), pups congregate and play when their mothers leave to forage, largely engaging in playfighting, which pups initiate and maintain by biting or attempting to bite other sea lions on the neck, head, and flippers; they sometimes hold on to loose skin and shake their head in a manner comparable to that of adult males fighting. Similar playfighting (apparently without head-shaking) is enacted by pups toward their mothers, who remain passive or respond gently in kind; in playfighting, pups sometimes climb over their mother's neck, biting nearby.

Playwrestling among pups entails pushing another sea lion with the chest or intertwining necks in attempts to push each other over. Both playfighting and playwrestling were sometimes preceded by or interspersed with playchasing. (Mother-infant pairs of California sea lions in captivity appear to engage in similar play interactions, with pups initiating and mothers ending the play [Soriano, González, & Maté, 2009].) Pups also played with their own bodies, repeatedly attempting to catch and bite their front and back flippers. Solitary object play entailed repetitive sequences of picking up and biting a small rock, and dropping it while sharply turning (“rearing back”) the head away while staring at the rock, as well as repetitive sequences of holding sea kelp, tossing it in the air, and catching it when it returned or otherwise retrieving it to toss again. Subadults and adults also engage in play activities similar to those of pups, though more skillfully, with subadults (and presumably adults) showing feinting and head jabbing. (Rock play appeared to be exclusive to pups.) Adults may continue playchases into the water, leaping out of the water and flipping over.

Gentry (1974) noted play forms in Stellar sea lion similar to those discerned by Farentinos (1971): playfighting (biting) and playwrestling (neck rubbing), with limited playchasing and fleeing, and solitary object play. Gentry also noted playmounting, as well as playful boundary defense: pups engaged in playfighting unless they were near small ridges, which seemed to initiate playful boundary defense. Gentry focused on the components (or actions) that made up the play forms. He detected 98 components, including lunging at an opponent, retracting one’s flipper, biting the neck or chest of an

opponent, interlocking mouths, maintaining an orientation toward an opponent, showing a non-prone orientation (lying on one's side), mounting, fleeing, chasing, running in circles, approaching, head tossing, boundary display posturing, submitting with open mouth, hard biting and shaking, pushing chest to chest, neck-fencing, lunging at front flippers, walking parallel to a border, and vocalizing while head nodding. Which play behaviors were displayed was influenced by four factors: the age of the pup, the play partner, its sex, and the terrain of the encounter.

In my thesis research, I plan to use the framework of projects and routines in play to describe the play behavior of Galápagos sea lions. I will elaborate the types of play routines and solitary projects discovered in Galápagos sea lions, and compare these play projects with those of other sea lions. This research is part of a larger program to articulate the actions, projects, and routines of Galápagos sea lions.

Chapter III.

METHODS

Subjects

Subjects are the Galápagos sea lions videotaped by seven students and two faculty members from Eastern Kentucky University who visited the Galápagos Islands from June 27 to July 13 of 2008 to record sea lions in their natural habitat. There were three main areas of San Cristóbal Island where the videotapes were recorded in the Puerto Baquerizo Moreno area: a rookery in Shipwreck Bay, closed off to some degree from humans, by a short overlook; an attached tidal pool and rocky area, with a higher overlook; and a boat docking station. Animals were unmarked, as San Cristóbal Island is a tourist destination.

Videotaping procedures

Videotapers filmed focal observations of individual sea lions that were, or seemed likely to start, engaging in play or teasing (i.e., behaviors that appear intended to irritate other sea lions). Filming was to remain on the focal animal and its partners, if any, until the animal slept or disappeared from view. If neither play nor teasing seemed likely, videotapers filmed mother-infant interaction or (usually when filming near the dock) human-sea lion interaction. Each videotaper attempted to film about an hour a day of observations, though this was not always achieved due to scheduled excursions, weather conditions, lack of activity by sea lions, or other countervailing issues. When sea lions stayed in view, it was possible to recognize individuals, though often the sex of

the animals was unknown. (Sea lions are, until adulthood, largely sexually monomorphic.) Often a videotaper's filming would include several different observations, as no observations of the focal animal lasted an hour. Each videotaper's filming for the day was downloaded at the end of the day; I call each of these a videotape. A total of just over 48 hours of filmed material was created from 85 videotapes.

Materials

The videotapes were uploaded onto an IBM computer and analyzed via the Noldus System. Noldus is a video analysis system that documents the number of seconds that elapse as the videos proceed so that the beginning and end of play activities can be noted and the time enacted can be discerned.

Procedure

The evaluation of the videos proceeded in two phases. In Phase 1, three coders marked, using the Noldus System, the times when play was occurring on the videos. The purpose was to specify the periods during the videos in which play occurred, using as wide a net as possible, and to develop a list of the types of play activities enacted by sea lions. Phase 1 occurred prior to my assessment of the data. After reading about and discussing the definition of play (Mitchell, 1990; Mitchell & Thompson, 1991) and the types of play likely to be observed based on the literature about play in sea lions with Drs. Robert W. Mitchell and Rosanne Lorden, three ECU graduate student coders, none of whom had previous training in observational methods, were paid to observe the

videotapes, and coded when they believed the sea lions were playing. Reliability was poor, so the decision was made to include all the times on the videos in which at least one of the coders observed play, and then to use these segments of the videos to code for specific play behaviors. A total of 13.28 hours of potential sea lion play was coded from all 85 videotapes.

In addition, these coders described types of play behaviors they observed. (Note, however, that neither mother-infant interactions nor human-sea lion interactions were examined for play during this coding, as these are to be examined separately.) Specific play behaviors they (and I) expected to see were, of course, those from the previously described literature, but other behaviors that satisfied the definition of play (e.g., lolling, twirling) were also noted. The types of solitary play projects and social play routines were elaborated and their definition clarified based on these observations. The expected types of projects and routines, based on previous research and observation of the videotapes, are presented in Table 1, where the criteria for each are provided.

There are some points to clarify about the solitary projects and the routines. Solitary projects are solitary in the sense that the activities themselves did not require another sea lion. However, one sea lion jumping, lolling, surfing, or twirling sometimes occurred simultaneously with other sea lions nearby doing the same thing. It is unclear if the sea lions are acting because others are doing the same thing, or just happen to be doing the same thing. By contrast, in the case of object play, it is obvious whether it is solitary or social: when social, other sea lions attempted to obtain the object or chase

the sea lion with the object.

Table 1. Names and definitions of solitary play projects and play routines of Galápagos and other sea lions

<u>Solitary Projects</u>	<u>Definitions</u>
<i>Lolling</i> ^K	A sea lion rolls back and forth along the shoreline, resting on or near land but still in the water.
<i>Twirling</i> ^K	A sea lion spins in circles in water, either itself making a circle or spinning on its central axis.
<i>Surfing</i> ^{eRKP}	A sea lion catches a wave in deeper water and rides it to shore.
<i>Jumping</i> ^{KP}	One or more sea lions leap out of the water, sometimes twisting in the air. Also called “porpoising.”
<i>Object play</i> ^{efgRKPAM}	A sea lion picks up, carries, tosses, and/or chases an item in the water or on land.
<i>Body play</i> ^{•f}	A sea lion pup lies on its back and attempts to bite its flipper, alternately biting and releasing.
<u>Routines</u>	
<i>Playchasing</i> ^{fgRKPAM}	A sea lion runs or swims away from another sea lion, while the latter pursues the former. Once contact is made, the chaser may become the chasee. Some chase birds ^M .
<i>Playfighting</i> ^{efgRKPAM}	Sea lions bite or attempt to bite each other while avoiding being bitten; resembles low intensity fighting. Can occur with playwrestling.

Table 1 (continued).

<u>Routines</u>	<u>Definitions</u>
<i>Playwrestling</i> ^{efgRKM}	Sea lions rub and push their necks against each other, trying to push each other's head down.
<i>Boundary defense</i> ^{•gP}	Pups may threaten each other as if daring each other to cross a line, where each is on opposite sides of a mound. This playful boundary defense may turn into playfighting.
<i>King of the hill</i> ^{KP}	Two or more animals threaten, push, or shove one another when one is on a higher location than the other(s), and the one on top of this location resists incursions of others. King of the hill is a form of playful <i>boundary defense</i> .
<i>Sexual play</i> ^{•gPM}	A sea lion mounts, or attempts to mount, another sea lion.
<i>Social object play</i> ^{eRPA}	One or more sea lions chases a sea lion who has an item in the sea or on land, or mutually pull on the item (tug o' war ^R —observed only between sea lions and humans). A sea lion may use the item to entice others to chase it to get the item.

Notes: Galápagos sea lions: ^e Eibl-Eibesfeldt (1955), ^r Riedman (1990), ^k the current study; Stellar sea lions: ^f Farentinos (1971), ^g Gentry (1974); California sea lions: ^A Aldis (1975), ^P Peterson & Bartholomew (1967); ^M Australian and New Zealand sea lions: Marlow (1975); sea lions generally: ^R Riedman (1990); • not (yet) observed in Galápagos sea lions.

My participation in the project began in Phase 2. In Phase 2, the goal was to specify the times when the Galápagos sea lions engaged in particular play routines and solitary play projects, most likely during segments of the videos in which play was potentially present in Phase 1, and to obtain reliability in detection of these play activities with another coder.

Coding in Phase 2 required marking, via the Noldus system, the start and stop times of specific play behaviors that occurred during the potential play coded in Phase 1. During coding, if a behavior stopped for 10 seconds or more, coders would then note the time the behavior stopped prior to those 10 seconds of no play. If the behavior paused anywhere from 1-9 seconds, but then the animals reengaged, the time for the routine was continuous and included the pause.

Training. In order to obtain reliability, one coder must train a second coder to observe and distinguish the behaviors that the first coder believes to be present. Thus, the first coder must categorize the behaviors first, and then interactively engage the second coder in detecting the same behaviors by pointing out when they start and stop. As the first coder, I examined 241 minutes (14,460 seconds) on 6 videotapes containing 27.4 minutes (1,645 seconds) of potential play (as coded in Phase 1), and coded these according to the descriptions of particular play activities described in Table 1. I then used these coded observations to train another graduate student on the play behaviors from Table 1. We observed these videotapes together. I explained how to determine where a Phase 1 coder had indicated that play may be present, but we both watched

the 6 videotapes in their entirety. Amidst the observations of play, I pointed out when the particular play behaviors from those in Table 1 occurred, explaining how the sea lions' activities fit the definition of the play behavior, and answering any questions the other coder had. We agreed that play behaviors occurred in about 26.8 minutes (1,607 seconds) of the videotapes, almost all of it during the precoded potential play. We observed all of the behaviors described as occurring in Galápagos sea lions in Table 1, except social object play.

Reliability coding. The second coder and I independently coded the particular play behaviors that occurred in 472 minutes (28,320 seconds) from 28 videotapes containing 150.6 minutes (9,036 seconds) of potential play (as coded in Phase 1), though again we watched all the videotapes in their entirety. Reliability was examined in three ways. First, reliability was examined categorically: did the coders agree that particular play behaviors occurred at approximately the same time on the videotapes? This reliability was determined by the number of times there was overlap for each behavior in coding the same behavior by both coders, divided by the number of times there was overlap and the number of times there was no overlap. Second, reliability was examined for the number of seconds of agreement for each behavior, or the percent agreement. This reliability was examined by the number of seconds the coders agreed that a given behavior occurred, divided by the number of seconds the coders agreed and the number of second they disagreed that a behavior occurred. Third, reliability was examined overall, using Cohen's kappa. In this reliability, kappa compares the seconds

of agreements and disagreements between coders, but, unlike percent agreement, kappa includes agreements as to the presence and absence of play behaviors during the potential play times, separates disagreements for each coder, and controls for chance agreement. Although typically reliability in relation to seconds discounts a few seconds of error on either side of a code, thereby diminishing the rate of disagreement and increasing the percent agreement and kappa, the current coding uses the exact number of seconds of disagreement.

Determining the extent of play observed. Following attainment of reliability, I combined the observations from training and reliability sessions to give an overall account of the observations of play. From the reliability coding, I used the number of seconds agreed on by both coders for the times for play projects and routines. Overall I coded approximately 161.4 minutes (9,688 seconds) of distinct solitary play projects and social play routines.

Chapter IV.

RESULTS

Reliability

Reliability scores are presented in Table 2. Note that the data provided in Table 2 may include multiple sea lions.

Categorical reliability was excellent: though some of the behaviors occurred only once in the coded videotapes, reliability was 100% for each of the behaviors. Thus, coders agreed on the presence of each of the play behaviors at the same approximate time (see Table 2). However, they showed some differences in the length of time the behaviors lasted, as indicated in the next two paragraphs.

Reliability based on percent correct for each behavior was also generally good. Two play behaviors, jumping and king of the hill, occurred only once each during the coded videotapes, and coders agreed for 50% and 63% of the seconds elapsed for each behavior, respectively. For all other play behaviors, coders agreed on 86% or more of the seconds they occurred. Overall reliability across codes was 96% agreement. (Note again that absolute time of agreement and disagreement was used for reliability, with no margin for error, which reduced reliability.)

Reliability between coders based on Cohen's kappa was also good. Cohen's kappa was .97, representing excellent agreement between coders. Note that all the play behaviors coded during both training and reliability occurred during the potential play periods coded in Phase 1, give or take a few seconds at the beginning or end.

Table 2. Reliability scores for Galápagos sea lion play in general, and for their particular solitary play projects and play routines.

<u>Play activities</u>	<u># of instances</u>	<u>% instances agreed on</u>	<u># seconds agreed</u>	<u># seconds disagreed</u>	<u>% seconds agreement</u>
<i>Solitary play projects</i>					
Lolling	14	100	2,065	124	94
Twirling	8	100	1,104	62	95
Object play	1	100	62	10	86
Jumping	1	100	6	6	50
Surfing	0	--	--	--	--
<i>Play routines</i>					
Social object play	0	--	--	--	--
Playfighting	14	100	2,093	92	96
Playchasing	4	100	1,575	32	98
Playwrestling	6	100	1,148	44	96
King of the hill	1	100	17	10	63
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Play (total)	49	100	8,070	380	96

Play behaviors coded and compared across species

The total number of times particular projects and routines occurred in sea lion play, and the total time spent in such play, are presented in Table 3. As with Table 2, data in Table 3 may include multiple sea lions.

Of the solitary play projects anticipated, the coders observed *lolling*, *jumping*, *twirling*, *surfing*, and *object play*. Of these play behaviors, object play is a common activity in Galápagos or other sea lions, as well as in mammals in general (Aldis, 1975), but I observed it only twice. Oddly, lolling and twirling, the first and second most frequently observed solitary play activities, have never been coded as play in sea lions, and among sea lions, jumping was described as play only in California sea lions (Peterson & Bartholomew, 1967). This apparent failure to detect these behaviors may have resulted because researchers did not consider lolling, jumping and twirling to be play behaviors. (Note that multiple sea lions may have engaged in the play behavior over the time during which a behavior was coded.)

Youtube provides some easily available videotapes of sea lions engaging in solitary play. A videotape of a Galápagos sea lion lolling is available at https://www.youtube.com/watch?v=EfsDrkg_cpE. For a videotape of a Galápagos sea lion twirling, see <https://www.youtube.com/watch?v=d-cymAVPdtQ>. The one instance of *surfing* was observed during the training videotapes. A videotape of Galápagos sea lions surfing and jumping is available at <http://www.arkive.org/galapagos-sea-lion/zalophus-wollebaeki/video-wo06a.html>. Note that the jumping and twirling

instances observed during coding occurred when other sea lions were doing the same thing.

Of the play routines anticipated, the coders observed *playfighting*, *playwrestling*, and *king of the hill* (a distinct form of playful boundary defense). Of these, the most frequent routine among the coded videotapes was playfighting, followed by playchasing and then playwrestling. King of the hill occurred once in the videotapes coded for reliability, at the docking station of Puerto Baquerizo Moreno, where a sea lion on the dock threatened others trying to get onto the dock from the water.

Coders did not observe *body play*, of the sort practiced by Stellar sea lion pups biting their own fins, as observed by Farentinos (1971). This is not surprising, as coders did not code mother-infant interactions, where such play behavior would likely occur. Coders also did not observe *sexual play*, *social object play*, nor any form of playful *boundary defense* other than king of the hill. Dr. Mitchell informed me that he observed social object play in the Galápagos sea lions, as have others (see Table 1). As noted in Table 1, there have been observations of sexual play and playful boundary defense in Stellar sea lions, sexual play in Australian sea lions, and king of the hill (a form of boundary defense) in California sea lions.

Table 3. Number of instances observed, and time spent, for particular play projects and routines in Galápagos sea lions.

<u>Play activities</u>	<u># of instances</u>	<u># seconds</u>
<i>Solitary play projects</i>		
Lolling	21	2,668
Twirling	10	1,355
Object play	3	126
Jumping	2	18
Surfing	1	8
<i>Play routines</i>		
Social object play	0	--
Playfighting	20	2,567
Playchasing	6	1,762
Playwrestling	6	1,148
King of the hill	2	36
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Play (total)	71	9,688

Chapter V.

DISCUSSION

The Galápagos sea lions studied in this research played in a variety of ways. In solitary projects, they engaged in lolling, twirling, object play, jumping and surfing. In social routines, they engaged in playfighting, playchasing, playwrestling, and king of the hill (a form of boundary defense). These play activities are reliably detectable. Although most of these activities seem to be practice for adult activities (e.g., playfighting is practice for fighting, playwrestling is practice for wrestling), the play as practice hypothesis was not being examined; rather, the research was intended to create a taxonomy of the play behaviors of Galápagos sea lions. Some play activities, such as lolling, twirling and surfing, do not appear to be practice for anything, but instead seem to be done because they are enjoyable.

Playfighting, playchasing, and playwrestling are present in five sea lion species—Galápagos, Australian, New Zealand, California, and Stellar—and these and other play behaviors that have been observed in one or more species (social object play, sexual play, playful boundary defense) seem likely to be present in all sea lion species. Most of the routines, especially playchasing and playfighting, are quite common among mammals (Aldis, 1975; Burghardt, 2005; Fagen, 1981). Playwrestling in sea lions, which involves pushing each other at the neck while staying in a rather sedentary position, is similar to that of other pinnipeds, and is present in antelopes, (Oguya & Eltringham, 1991), kangaroos, and wallabies (Watson, 1993). Animals such as rhesus monkeys,

macaques, cats, squirrel monkeys and squirrels use a more rough-and-tumble style of play wrestling (Biben, 1986; 1988; Fagen, 1981; Hassett, Siebert & Wallen, 2008; Pastor et al., 2001; Petit, Bertrand & Thierry, 2008; von Fersen, 2013). Rough-and-tumble style playwrestling involves climbing over each other and rolling around on the ground.

Play boundary defense (including king of the hill) and social object play are common games among mammals and some birds that focus on one animal maintaining a place or object while thwarting others from obtaining it (Aldis, 1975). These behaviors are common in Arabian babblers (Pozis-Francois, Zahavi & Zahavi, 2004), canids (Biben, 1983) and Stellar and California sea lions (see Table 1). No playful boundary defense except for king of the hill was observed in Galápagos sea lions. In adulthood, it is common for mammals to use actual (nonplayful) boundary defense during the breeding season (Gese, 2001), and this is true for Stellar and California sea lions as well (Farentinos, 1971; Gentry, 1974).

Of the solitary play projects, surfing, jumping, and object play (both social and solitary) are common among other marine mammals, particularly dolphins (Fagen, 1981; Kuczaj, Makecha, Paulos & Ramos, 2006, Paulos, Trone & Kuczaj, 2010; Renouf, 1993; von Fersen, 2013) and harbor seals (Fagen, 1981; Renouf, 1993; Saayman, Tayler & Bower, 1973; Wilson & Kleiman, 1974). Dolphins jump in two ways, leaps and high jumps, which were differentiated by the height of the angle their body made over the water (Saayman, Tayler & Bower, 1973).

Two of the solitary play projects—lolling and twirling—have not been described

as play behaviors in sea lions, although they fit the definition: the animal appears to be intentionally engaging in the activity for its own sake or amusement. Seals pirouette in play, which is another name for twirling; harbor seals do this vertically and also move in circles, chasing their tail (Renouf, 1993). Although I only observed horizontal twirling in the Galápagos sea lions, the youtube videotape mentioned earlier shows almost vertical twirling in this species.

Limitations

Coding sea lion play from videotapes has its problems. The videotapes themselves at times created ambiguity from shaky hands, darkness, and movement of the sea lions out of the scene. Videotapers sometimes stopped filming for no apparent reason. (Similar issues are mentioned by Nelson and Fijn, 2013, in assessing the usefulness of youtube videotapes of animals.) At times play started before the filming of the animals began, and sea lions engaged in some play in the water, where their activities below the surface were unobservable. Thus, how long particular play activities occurred could not always be determined, which is why average play times are not presented. In addition, a variety of play behaviors that happen underwater in marine mammals, such as blowing bubbles (harbor seals: Renouf, 1993; Wilson, 1972; beluga whales: Delfour & Aulagnier, 1997; Paulos, Trone & Kuczaj, 2010; bottlenose dolphin: McCowan et al., 2000), were unobservable. Nothing comparable to dyadic “erotic rolling” in common seals (Venables & Venables, 1955; 1957; Wilson, 1972) was observed, though similar behaviors may have occurred at other times of the year.

Because animals could not be marked, individual sea lions could not be detected unless a videotaper followed a particular animal during the filming. Nor could the sex of the sea lion be detected unless a penis was visible, as juvenile males and females are monomorphic; thus the influence of sex on play could not be examined. Thus, I could not corroborate if, as Eibl-Eibesfeldt (1995) stated, female Galápagos sea lions were the only ones who performed solitary object play. (Bulls were never observed playing.) In addition, average times spent in play could not be determined.

Overview

During 713 minutes of sea lion behavior on videotapes focusing on their play and other activities taken during the summer of 2008, I observed sea lions engaging in five solitary play activities (lolling, twirling, surfing, object play, and jumping), and four social play activities (social jumping, chasing, playfighting, king of the hill), and obtained good reliability for most of these observations. All of these play activities have been observed in other sea lion species, and in other marine mammals. Lolling and playfighting were the most commonly observed play activities, with twirling, playchasing, and playwrestling occurring about half as often. Social object play, sexual play, and perhaps body play by pups, present in other sea lions, were not observed in the videotapes, though social object play was observed in Galápagos sea lions by others. The next step in the analysis of Galápagos sea lion play is a closer examination of the actions that occur during play projects and routines, to examine their repetitiveness as anticipated in the idea of projects.

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