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Object Play in Wild Striated Caracaras (Falconidae)

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ABSTRACT.—Animal play behavior has received increasing attention for its relationship to cognition as a possible precursor to physical problem-solving abilities across taxa. In birds, captive studies reveal that exploring and combining novel objects correlates with advanced problem solving. However, we lack systematic investigations in the wild, thus limiting our understanding of play structure, context, and demographics in a natural context. The Striated Caracara (*Phalcoboenus australis*) population endemic to the Falkland Islands (Malvinas) shows striking behavioral similarities to cognitively well-studied parrots and corvids, as opportunistic generalists and extractive foragers with a prolonged adolescence and complex social structure. We present observations of spontaneous play behavior and results of a field experiment investigating the effect of object complexity on play and exploratory behaviors. Eighteen juvenile and adult Striated Caracaras participated across eight sessions (duration mean ± SD: 401 ± 317 sec, range: 44–1134 sec), manipulating geometric objects for 84 ± 120 sec, signaling play behaviors, and directing greater attention toward a cone and triangular pyramid than a square pyramid. Further research into object properties that elicit play and exploratory behavior can shed light on the context and degree to which Striated Caracaras might disturb novel objects in their environment, such as those used in pest management, to inform effective mitigation measures. More broadly, comparative research into curiosity, exploration and play, as well as cognitive capabilities, across all caracara species would expand our empirically driven knowledge of the socio-ecological contexts that give rise to these behaviors and traits in birds.

KEY WORDS: *avian cognition*; *exploration*; *island species*; *pulsed resources*.

JUEGO CON OBJETOS EN INDIVIDUOS SILVESTRES DE *PHALCOBOENUS AUSTRALIS* (FALCONIDAE)

RESUMEN.—El comportamiento de juego animal ha recibido cada vez más atención por su relación con la cognición como un posible precursor de habilidades físicas para resolver problemas a través de diversos taxones. En las aves, estudios en cautiverio revelan que explorar y combinar objetos novedosos se correlaciona con habilidades avanzadas para resolver problemas. Sin embargo, carecemos de investigaciones sistemáticas en la naturaleza, limitando así nuestra comprensión de la estructura del juego, el contexto y la demografía en un entorno natural. La población endémica de *Phalcoboenus australis* de las Islas Falkland (Malvinas) muestra notables similitudes de comportamiento con loros y córvidos que han sido bien estudiados cognitivamente, como generalistas oportunistas y forrajeadores extractivos con una adolescencia prolongada y una estructura social compleja. Presentamos observaciones de comportamiento de juego espontáneo y resultados de un experimento de campo que investiga el efecto de la complejidad del objeto en el juego y de los comportamientos exploratorios. Dieciocho juveniles y adultos de *P. australis* participaron en ocho sesiones (duración media ± DE: 401 ± 317 segundos, rango: 44–1134 segundos), manipulando objetos geométricos durante 84 ± 120 segundos, mostrando comportamientos de juego y dirigiendo mayor atención hacia un cono y una pirámide triangular que hacia una pirámide cuadrada. Investigaciones adicionales sobre las propiedades de los objetos que provocan el juego y el

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comportamiento exploratorio pueden arrojar luz sobre el contexto y el grado en que los individuos de *P. australis* podrían alterar objetos novedosos en su ambiente, como los utilizados en el control de plagas, para informar medidas de mitigación efectivas. Más ampliamente, la investigación comparativa sobre la curiosidad, la exploración y el juego, así como las capacidades cognitivas en todas las especies de *Phalcoboenus*, expandiría nuestro conocimiento empíricamente fundamentado de los contextos socio-ecológicos que dan origen a estos comportamientos y rasgos en las aves.

[Traducción del equipo editorial]

INTRODUCTION

Play behavior has been observed across many taxa and is increasingly suggested as an adaptive precursor for how animals acquire and apply information about their physical world (Zeiträg et al. 2023). There is growing interest in investigating play behavior to build empirically driven knowledge of the socio-ecological contexts that give rise to the behavior and physical problem-solving abilities (O'Hara and Auersperg 2017). To be considered play, a behavior must meet five criteria: (1) be intrinsically rewarding (i.e., "fun," see Emery and Clayton 2015), (2) seemingly lack purpose, (3) be novelty generating, (4) be voluntary and repeatedly performed, and (5) occur in relaxed conditions (Burghardt 2005, Bateson and Martin 2013). All of these criteria can be met in the context of locomotor, social, or object play.

Findings from captive large-brained parrot and corvid species suggest that play propensity may closely associate with feeding ecologies. For example, opportunists who rely on inconsistent resources show increased object play behavior, perhaps to test novel items for potential uses (for a review see O'Hara and Auersperg 2017, Lambert et al. 2019). Moreover, exploring and combining novel objects, possibly to learn their affordances, correlates with innovative problem-solving abilities (Auersperg et al. 2015, Lambert et al. 2019), which may be of adaptive value for generalists coping with variability (O'Hara and Auersperg 2017). Across taxa, captive studies also reveal object attributes affect exploratory and play behavior (e.g., the more complex an object, the more information there may be to gain, which can elicit increased interaction and manipulation; Switzky et al. 1974, Mettke-Hofmann et al. 2006, Heyser and Chemero 2012, Biondi et al. 2015, O'Hara and Auersperg 2017). However, we lack systematic investigations into play in the wild, which limits our understanding of how play is structured, when it occurs, and which individuals are likely to engage in the behavior in a natural context.

Striated Caracaras (*Phalcoboenus australis*) are classified by the International Union for Conservation of Nature as near-threatened, and are endemic to coastal areas of southernmost South America and the Falkland Islands (Islas Malvinas). They have a long adolescence and lifespan, and across their range, cope with seasonally pulsed and variable resources. Although they are opportunistic generalists, they preferentially associate with seabird colonies, breeding in relatively dense proximity to scavenge vulnerable resources such as eggs, young, and dying or dead adults (Strange 1996, Catry et al. 2008, Harrington et al. 2018, Balza et al. 2020). Although Striated Caracaras are recognized as monotypic, genetic and phenotypic evidence support consideration of possibly distinct populations on Isla de los Estados (Argentina) and the Falkland Islands (Malvinas) (BirdLife International 2016, U. Balza and K. Harrington, unpubl. data). The Falklands (Malvinas) Striated Caracara population is geographically restricted to the Falkland Islands (Malvinas) archipelago, a harsh environment isolated in the South Atlantic. Within this range, caracaras mainly inhabit the outer islands where there are dense colonies of seabirds and refuge from historical persecution (Strange 1996, Reeves et al. 2018). In winter when most seabirds migrate offshore, Falklands (Malvinas) Striated Caracaras face a reduction in their primary food source and must rely on variable resources that remain within the confines of the archipelago or that unpredictably wash ashore (Strange 1996, Rexer-Huber and Bildstein 2013).

The Falklands (Malvinas) Striated Caracara population (the population of focus for this study) shows a blend of behavioral traits found in the cognitively well-studied—and playful—Kea parrots (*Nestor notabilis*) and Common Ravens (*Corvus corax*). For example, Striated Caracaras are gregarious, exploratory, attracted to novelty, and, like Keas, unafraid of humans (Strange 1996, Harrington et al. 2021). Given these similarities, their ecological context, and the genetic advancements that place falcons as phylogenetic neighbors (see Suh 2011) to species now colloquially termed "feathered apes" (e.g., corvids, see Emery 2004, Lambert et al. 2019), we suggest Striated Caracaras should also be a species of focus for the study of cognitive ecology and the evolution and function of play.

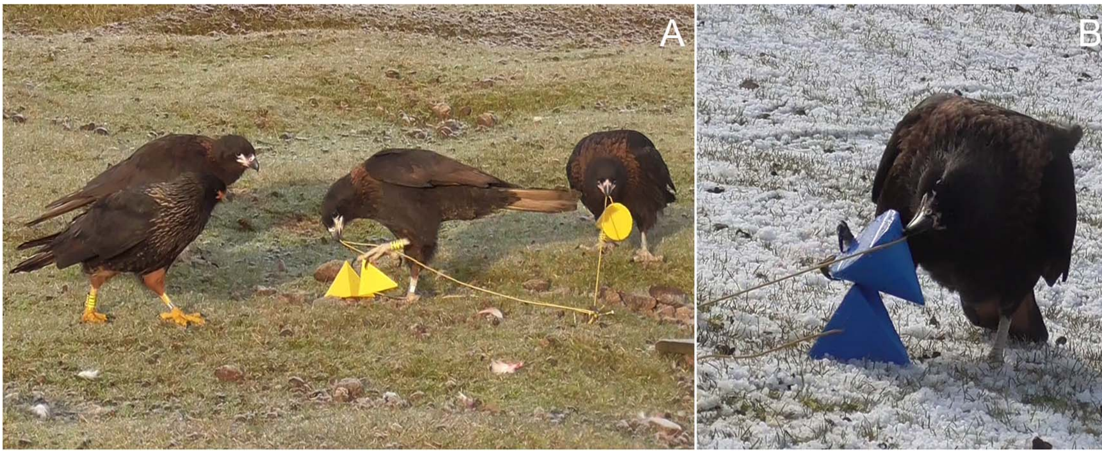

Figure 1. Social and solitary object play with the geometric object array. The full experimental setup (visible on the left) includes three objects tethered to a central stake, initially presented in an equal radial distribution. Birds carried objects throughout the tethered range, sometimes combining them (right). Still images from video by M. Lambert.

Here, we expand upon play research to examine spontaneous and experimentally induced play behavior in a falcon species in a natural setting. We present a sample of opportunistic behavioral observations that meet the criteria for play, involving both natural (e.g., plants, rocks, desiccated penguin skins) and human-made objects (e.g., debris that has washed ashore). We follow that with results from a theory-driven pilot study in which we presented an object array to Striated Caracaras to systematically investigate individuals' attraction to and manipulation of geometric objects that vary in complexity. Because Striated Caracaras are opportunistic generalists, we expected them to be interested in the novel object array in their environment, and based on previous research, we expected their engagement with the objects to correlate positively with object complexity.

METHODS

During austral summers (February–March 2017, December–Jan 2018) and winters (July–August 2019), we opportunistically recorded behavioral observations that met criteria defined by Burghardt (2005) and Bateson and Martin (2013) for identification of play behavior. Observations occurred during regular monitoring and research of Striated Caracaras on Saunders Island, a privately owned farm island with six human inhabitants in the northwest of the Falkland Islands (Malvinas; 51.37°S 60.09°W). As Striated Caracaras are locally abundant and conspicuous with small daily ranges (Harrington et al. 2020), we accumulated >700 hr of direct observation of the species. For each observation, we recorded individual identity (i.e., alphanumeric band, when possible), age (i.e., hatch-year, juvenile, subadult, and adult; as indicated by plumage, Strange 1996), degree of crop visibility (i.e., not visible, partial, or fully visible, as a proxy for hunger-driven motivation), group size, object type (when applicable), and notes on body movements and manipulation.

From 18–31 August 2022 (i.e., late austral winter), we conducted repeated field experiments into play behavior using a temporarily available object array (Fig. 1). The array comprised three 8-cm-tall hollow plastic geometric shapes (i.e., cone, triangular pyramid, and square pyramid; TimeTEX, Germany). We chose these objects to vary in the number of surfaces as others have used number of surfaces as a key measure of complexity, which can affect exploratory and play behavior (Attneave 1957, Demery 2013, Biondi et al. 2013, 2015). We considered the cone to be least complex with a single surface, followed by the more complex triangular pyramid and most complex square pyramid. Each shape was uniformly covered with tape to add grip (tesa, Hamburg, Germany), and shapes were individually tethered to a single central stake using 50 cm of Dyneema line (2 mm diameter). Sessions occurred opportunistically during daylight hours, and the array was removed and unavailable to birds between sessions. Sessions began when any individual voluntarily entered a 3-m radial approach threshold (measured from the central stake) and ended after 3 min lapsed with no individual contacting the array. Participation was open and limited only by the birds' interest. We videotaped sessions and later analyzed them with BORIS video coding software (Friard and Gamba 2016). For each bird, we coded their session duration and how they contacted each object (i.e., beak or foot, frequency, and duration).

From the coded videos, for each individual within a session, we recorded participation duration (i.e., time from entering the approach threshold until departing the threshold or 3 min had lapsed without contacting an object), latency to contact the array (i.e., time from entering the approach threshold until first contacting an object), and frequency and duration of contact per object (i.e., as a proxy for interest in an object). We used R v. 4.2.2 (R Core Team 2022) for statistical analyses, using an ANOVA to test differences in object interest and Tukey's honest significant differences (HSD; package *stats* v. 4.2.2) for post-hoc tests. Eighteen birds participated across eight sessions; however, as five birds participated in more than one session (two hatch-year birds and three juveniles), to avoid pseudoreplication, we restricted our statistical analysis to the individuals' first session and we report qualitatively on individuals' additional trials.

RESULTS

Striated Caracaras across age classes and seasons on Saunders Island engaged in spontaneous behavior that met the criteria for play. Play bouts were social and solitary, occurred within and among age classes, with and without natural or human-made objects, lasted multiple minutes, and involved birds with crops ranging from not visible to highly visible.

Instances of social play without objects involved two to three individuals rolling onto their backs in close contact, clasping talons, and looking at each other. These events occurred (but were not limited to) moments when Striated Caracaras were milling amid Gentoo Penguins (*Pygoscelis papua*), extractive foraging in kelp wrack (giant kelp, *Macrocystis pyrifera*; *Lessonia* sp.; *Durvillea* sp.), or dust-bathing. Events ended with no apparent aggression among participants (i.e., no agonistic gestures, such as pinning or kicking and grabbing the other), and no apparent external threat or pressure from peers or predators.

Observations of social object play with natural and human-made objects occurred while individuals loafed midday. In one observation, a banded juvenile female kicked and clasped a basket kelp (i.e., the dried root system of giant kelp) then took flight holding the basket kelp in her talons, pursued by two juvenile Striated Caracaras (Fig. 2). The three proceeded to drop and catch the basket kelp in an acrobatic manner (i.e., not unidirectional) before abandoning the object and departing. In a second observation, a banded subadult female and an unbanded hatch-year bird simultaneously grasped a desiccated Gentoo Penguin skin from opposing sides and rolled onto their sides and backs while tugging, with no apparent interest in eating the skin. In a third observation, a hatch-year bird with a full crop alternated between standing and laying on its side kicking a sheet of clear plastic roughly the size of its body (Fig. 3); the individual was joined by a banded adult male who took a corner of the plastic in his beak and kicked at it.

We also observed Striated Caracaras engage in solitary play. In one observation, a hatch-year female spent >5 min lying alone with a basket kelp, holding and tumbling over it, before releasing and running to kick a nearby object. In another observation, a juvenile female held and hopped with a smooth, flat, round rock in her talons, stopping to kick and flip it along the way. In a third observation, a subadult female ran up a sandy incline kicking the bloom of a sea cabbage (*Senecio candidans*). She kicked various parts of the plant, clutching the blooms, and extending her wings upward. In a fourth example, a solitary juvenile picked up a single sheep dropping (one among many) with its beak and released it, whereupon the sheep dropping rolled approximately 10 cm downhill in the wind. The bird followed its movement visually (i.e., tracked the trajectory of the dropping with its head), stepped to retrieve it with its beak, and then brought the dropping back to a starting position to release it again. This occurred six times before the wind blew it farther away. The bird did not continue this behavior with the scattered droppings that remained nearby.

Within our experimental context, Striated Caracaras voluntarily showed prolonged interest in manipulating the geometric object array (Fig. 1). Eighteen banded birds (seven hatch-year birds, nine juveniles, and two adults) participated across eight sessions, five of which were social with up to six participants, and three of which were solitary (by a hatch-year bird, and twice by a juvenile; Table 1). Adults only participated in social sessions when no other adult was involved. During social trials we observed multiple instances of conspecific displacement and monopolization. Five of the 18 individuals participated in a second session. First session participation lasted 419 ± 317 sec (mean ± SD, range: 44–114 sec), and second session participations lasted a similar duration (413 ± 324 sec, range: 132–883 sec).

At the onset of a session, the first caracara to contact an object did so in 9 ± 6 sec (range: 3–20 sec). At

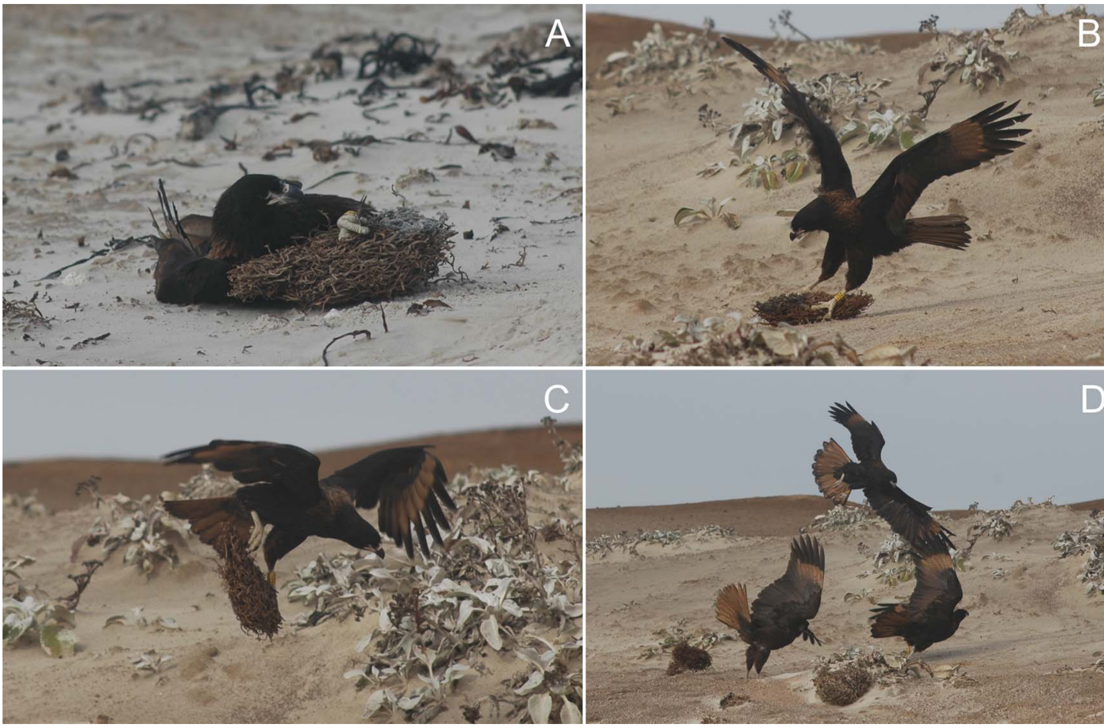

Figure 2. Social object play sequence in which a juvenile kicking and grabbing a dried basket kelp (i.e., root system of giant kelp) took flight with it and was joined by conspecifics, chasing each other acrobatically (i.e., not unidirectionally) and exchanging possession before departing the area. No individual was seen to ingest any material from the basket. Photo by K. Harrington.

the individual level, latency to first contact was 47 ± 78 sec (range: 3–283 sec). Eight birds first contacted the cone, while four first contacted the triangular pyramid, and six the square pyramid. Seven birds proceeded to contact all three objects throughout their session, while seven others contacted only two objects, and four contacted just one object.

The objects were of varying apparent interest to Striated Caracaras ($F_{2,51} = 4.146$, $P = 0.02$, $n = 18$ birds), with individuals contacting the cone significantly more than the square pyramid (proportion of contact; TukeyHSD cone vs. square pyramid $P = 0.03$; cone vs. triangular pyramid $P = 0.059$; triangular pyramid vs. square pyramid $P = 0.95$; Fig. 4). Striated Caracaras moved among the objects and repeatedly returned to previously visited objects. On average, individuals spent 14% of their participation time contacting the array (84 ± 120 sec), which increased to 37% for those returning for a second session. One particularly motivated individual, a juvenile (assumed female based on weight during banding), contacted objects for 60% of her second session.

Motor diversity varied, with individuals on average using their beak for 55% of contacts (35% pecking and 20% biting), and their foot for 45% of contacts (31% kicking, and 14% grabbing; $n = 829$ total number of contacts). Birds frequently used their beak and feet concurrently (e.g., holding an object's tether while kicking the object, transferring an object between beak and talons repeatedly, or holding two objects at once [sometimes in contact with each other]). Striated Caracaras also held objects while hopping, rolling onto their sides and backs, or kicking with wings spread. Rapid contact typically occurred in bouts, interspersed with periods of holding the object and preening or observing elsewhere (e.g., watching an approaching conspecific).

DISCUSSION

We experimentally investigated the propensity of Striated Caracaras to engage in spontaneous play behavior by presenting free ranging individuals with an unbaited (i.e., no supplemental food) geometric

Figure 3. Solitary-turned-social object play in which a juvenile laid and kicked at a sheet of plastic before being joined by an adult who picked up a corner of the plastic and began kicking at it. Neither bird was observed ingesting the plastic. Photo by K. Harrington.

object array to measure how, and for how long, Striated Caracaras expressed their interest and in what context. Our results suggest the responses to the geometric array meet criteria for object play (Burghardt 2005, Bateson and Martin 2013). The behaviors were voluntary and repeated, seemingly intrinsically rewarding (i.e., no external resource was provided for their effort), nonfunctional (i.e., directed toward extraneous stimuli), generating novel situations (e.g., novel objects in combinations), and occurred in relaxed conditions (e.g., subsequent to loafing). Furthermore, the behaviors occurred in social contexts, and some individuals exhibited play signaling behavior by rolling onto their sides and backs while holding objects (i.e., self-handicapping, Bekoff and Allen 1998, Ham et al. 2023), providing a context from which the nonvisible intrinsically rewarding criteria can more readily be inferred (Bateson and Martin 2013) and in line with typical social play behaviors described for Keas and ravens (Bond and Diamond 2003, Osvath et al. 2014).

It is possible the Striated Caracaras were searching for food within the objects; however, we consider this unlikely as their actions toward the arrays were similar to interactions with familiar inorganic objects in their environment (e.g., rocks). Moreover, to our knowledge, the objects' shape and size did not resemble any food sources available in their environment. The nearest similarity may be that of the cone

Table 1. Individuals' participation grouped by age (HY = hatch-year bird, JUV = juvenile, AD = adult).

						Contact Frequency		
Age	ID	Session	Trial	Duration (sec)	Contact Latency (sec)	Cone	Triangular Pyramid	Square Pyramid
HY	A17	3	1	96	21	4	1	0
	G18	1	1	49	16	3	1	0
	G18	8	2	618	28	81	15	25
	S18	1	1	430	201	27	4	8
	S18	8	2	884	36	131	54	40
	S17	5	1	752	14	10	15	0
	U12	6	1	724	23	37	4	19
	V13	8	1	278	64	10	5	4
	X57	2	1	154	6	8	3	0
JUV	A15	6	1	436	43	4	0	12
	H15	5	1	661	3	116	0	22
	H15	7	2	227	4	21	28	9
	K15	1	1	778	283	1	48	9
	K15	3	2	132	76	5	0	0
	M17	8	1	1134	15	134	49	34
	P16	4	1	136	14	3	0	0
	P17	6	1	134	20	0	22	0
	R15	1	1	131	15	0	0	7
	R15	3	2	205	106	9	4	3
	V16	1	1	741	32	114	24	2
	W14	8	1	253	65	0	7	7
AD	S16	3	1	44	3	3	0	0
	V17	1	1	503	6	6	10	32

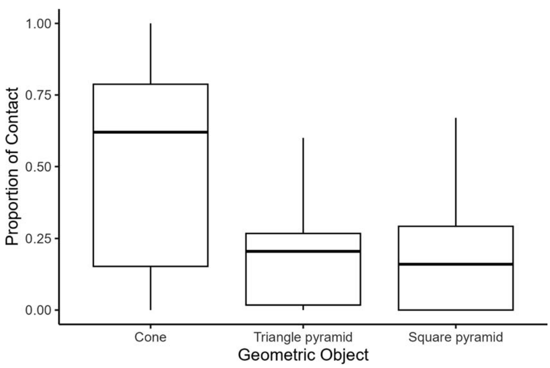

Figure 4. Proportion of individuals' total contact per object during a play session. On average, the birds played most with the cone, and less with the triangular and square pyramids. Boxplot bars show median and first and third quartiles, and whiskers extend to the largest and smallest values (at most 1.5 × interquartile range).

to limpets (*Fissurella picta* and *Patinigera* spp.), which Striated Caracaras forage on during summer within a different habitat (i.e., intertidal) at a site 16 km northwest of the study area (Harrington and Bildstein 2019). However, while limpets are conical, they are less than half the height and width of the base of the geometric object, differ in color, and unlike the geometric cone, have a malleable (and edible) muscular underside or a conspicuous concavity. It is also possible the Striated Caracaras exhibited prolonged exploration of the objects, though this does not explain the play signals nor the repeated investment, for example by the individuals who participated in more than one session.

Contrary to our expectation, Striated Caracaras did not engage most with the square pyramid, which we had identified as the most complex in our array based on number of surfaces. Rather, Striated Caracaras showed more interest in interacting with the cone. It could be that the array did not vary sufficiently enough in its complexity to elicit corresponding responses, or perhaps other properties outweighed the value of the total surfaces available. For example, the cone produced comparatively more movement feedback than the pyramids by rolling after contact, which may have induced a stronger playful circular reaction (i.e., the interaction encouraged increased interaction; Piaget 1952, Smith 1982) than the square pyramid. Future research would benefit from testing alternative measures of complexity (e.g., internal skeletal structure, which has been shown to guide attention and engagement in humans; Sun and Firestone 2021) to better understand the effect of complexity on Striated Caracaras' exploratory and play behavior.

Across participants, the proportion of time spent in contact with objects may have been modulated by social dynamics, such that group composition affected individuals' access to objects (e.g., monopolization, facilitation, or an individual's social position). This may also suggest a social hierarchy that may dictate access to resources, though this needs further investigation. From a conservation perspective, systematic studies of object properties and social dynamics that elicit play and exploratory behaviors can shed light on the context and degree to which species might disturb novel objects in their environment, such as those used in pest management (e.g., toxic baits and traps used for small mammals), and can inform effective mitigation measures (see Marzluff and Swift 2017, Bastos et al. 2022).

Play propensity within the Falkland Islands (Malvinas) Striated Caracara population may function to maintain the behavioral and cognitive flexibility needed to overcome challenges associated with variable resource availability, similar to what has been suggested for Keas (Diamond and Bond 1999). Future research would benefit from also experimentally assessing neophilia, object manipulation, and play propensities in the mainland population of Striated Caracaras (e.g., Isla de Los Estados, Argentina), to better understand observed behavioral differences between the two populations and their potential drivers (U. Balza pers. comm.).

Research suggests play evolved independently in different taxa (Burghardt 2005, Osvath et al. 2014) and constitutes an important factor in developing skills involved in physical problem solving; however, we lack empirically driven studies of avian play outside of parrots and corvids (O'Hara and Auersperg 2017). Our study supports the feasibility of a broader comparative approach to include a species within a closely related family, Striated Caracaras, to expand our knowledge of the socio-ecological contexts that give rise to play behavior. As exploration and play have been linked to innovative problem solving in parrots and corvids, the two most used avian models in technical cognition (Auersperg 2015, Auersperg and von Bayern 2019, Lambert et al. 2019), we also emphasize the opportunity to explore cognitive capabilities in Striated Caracaras and more broadly across caracara species.

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LITERATURE CITED

Attneave, F. (1957). Physical determinants of the judged complexity of shapes. Journal of Experimental Psychology 53:221–227.

Auersperg, A. M. (2015). Exploration technique and technical innovations in corvids and parrots. In Animal Creativity and Innovation (J. C. Kaufman and A. B. Kaufman, Editors). Academic Press, San Diego, CA, USA. pp. 42–72.

Auersperg, A. M., J. O. Van Horik, T. Bugnyar, A. Kacelnik, N. J. Emery, and A. M. von Bayern (2015). Combinatory actions during object play in psittaciformes (*Diopsittaca nobilis, Pionites melanocephala*, *Cacatua goffini*) and corvids (*Corvus corax*, *C. monedula*, *C. moneduloides*). Journal of Comparative Psychology 129:62–71.

Auersperg, A. M., and A. M. von Bayern (2019). Who's a clever bird—now? A brief history of parrot cognition. Behaviour 156:391–407.

Balza, U., N. A. Lois, M. J. Polito, K. Pütz, A. Salom, and A. Raya Rey (2020). The dynamic trophic niche of an island bird of prey. Ecology and Evolution 10:12264–12276.

Bastos, A. P., X. J. Nelson, and A. H. Taylor (2022). From the lab to the wild: How can captive studies aid the conservation of Kea (*Nestor notabilis*)? Current Opinion in Behavioral Sciences 45:101131. doi:10.1016/j.cobeha.2022.101131.

Bateson, P. P., and P. Martin (2013). Play, Playfulness, Creativity and Innovation. Cambridge University Press, Cambridge, UK.

Bekoff, M., and C. Allen (1998). Intentional communication and social play: How and why animals negotiate and agree to play. In Animal Play: Evolutionary, Comparative, and Ecological Perspectives (M. Bekoff and J. A. Byers, Editors). Cambridge University Press, Cambridge, UK. pp. 97–114.

Biondi, L. M., J. M. Guido, M. S. Bó, R. N. Muzio, and A. I. Vassallo (2015). The role of stimulus complexity, age and experience in the expression of exploratory behaviour in the Chimango Caracara, *Milvago chimango*. Animal Cognition 18:139–150.

Biondi, L. M., J. Guido, E. Madrid, M. S. Bó, and A. I. Vassallo (2013). The effect of age and sex on object exploration and manipulative behavior in a Neotropical raptor, the Chimango Caracara, *Milvago chimango*. Ethology 119:221–232.

BirdLife International (2023). Species factsheet: *Phalcoboenus australis*. http://www.birdlife.org.

Bond, A., and J. Diamond (2003). A comparative analysis of social play in birds. Behaviour 140:1091–1115.

Burghardt, G. M. (2005). The Genesis of Animal Play: Testing the Limits. MIT Press, Cambridge, MA, USA.

Catry, P., M. Lecoq, and I. J. Strange (2008). Population growth and density, diet and breeding success of Striated Caracaras *Phalcoboenus australis* on New Island, Falkland Islands. Polar Biology 31:1167–1174.

Demery, Z. P. (2013). Comparative sensory and cognitive adaptations for exploratory learning in parrots and humans. Ph.D. dissertation, University of Birmingham, Edgbaston, Birmingham, UK. https://etheses.bham.ac.uk/id/eprint/4526/.

Diamond, J., and A. B. Bond (1999). Kea, Bird of Paradox: The Evolution and Behavior of a New Zealand Parrot. University of California Press, Berkeley, CA, USA.

Emery, N. J. (2004). Are corvids "feathered apes"? Cognitive evolution in crows, jays, rooks and jackdaws. In Comparative Analysis of Minds (S. Watanabe, Editor). Keio University Press, Tokyo, Japan. pp. 181–213.

Emery, N. J., and N. S. Clayton (2015). Do birds have the capacity for fun? Current Biology 25:R16–R20. doi:10.1016/j.cub.2014.09.020.

Friard, O., and M. Gamba (2016). BORIS: A free, versatile open-source event-logging software for video/audio coding and live observations. Methods in Ecology and Evolution 7:1325–1330.

Ham, J. R., M. K. Lilley, M. R. Miller, J. B. Leca, S. M. Pellis, and H. M. Manitzas Hill (2023). Self-handicapping in object play: How belugas (*Delphinapterus leucas*) make play difficult. International Journal of Play 12:67–80.

Harrington, K. J., and K. L. Bildstein (2019). Predation of southern red octopus (*Enteroctopus megalocyathus*) by Striated Caracaras (*Phalcoboenus australis*) in the Falkland Islands. Journal of Raptor Research 53:220–222.

Harrington, K. J., J. A. Fahlbusch, R. Langrock, J. F. Therrien, J. L. Houtz, and B. I. McDonald (2020). Seasonal activity levels of a farm-island population of Striated Caracaras (*Phalcoboenus australis*) in the Falkland Islands. Animal Biotelemetry 8:27. doi:10.1186/s40317-020-00214-y.

Harrington, K. J., J. Meiburg, and J. L. Houtz (2021). Winter bird gets the worm: Consumption of earthworms (Lumbricidae) by Striated Caracaras (*Phalcoboenus australis*) in invasive Yorkshire fog (*Holcus lanatus*) in the Falkland Islands (Malvinas). Polar Biology 44:1009–1013.

Harrington, K. J., S. Pole-Evans, M. Reeves, M. Bechard, M. Bobowski, D. R. Barber, K. Rexer-Huber, N. Lecomte, and K. L. Bildstein (2018). Seasonal micro-migration in a farm-island population of Striated Caracaras (*Phalcoboenus australis*) in the Falkland Islands. Movement Ecology 6:4. doi:10.1186/s40462-018-0122-8.

Heyser, C. J., and A. Chemero (2012). Novel object exploration in mice: Not all objects are created equal. Behavioural Processes 89:232–238.

Lambert, M. L., I. Jacobs, M. Osvath, and A. M. von Bayern (2019). Birds of a feather? Parrot and corvid cognition compared. Behaviour 156:505–594.

Marzluff, J. M., and K. N. Swift (2017). Connecting animal and human cognition to conservation. Current Opinion in Behavioral Sciences 16:87–92.

Mettke-Hofmann, C., K. C. Rowe, T. J. Hayden, and V. Canoine (2006). Effects of experience and object complexity on exploration in Garden Warblers (*Sylvia borin*). Journal of Zoology 268:405–413.

O'Hara, M., and A. M. Auersperg (2017). Object play in parrots and corvids. Current Opinion in Behavioral Sciences 16:119–125.

Osvath, M., H. Osvath, and R. Bååth (2014). An exploration of play behaviors in raven nestlings. Animal Behavior and Cognition 1:157–165.

Piaget, J. (1952). The Origins of Intelligence in Children. International Universities Press, New York, NY, USA.

R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/.

Reeves, M., S. Crofts, and K. L. Bildstein (2018). Distribution and abundance of breeding Striated Caracaras in the Falkland Islands (Malvinas). Journal of Raptor Research 52:309–315.

Rexer-Huber, K., and K. L. Bildstein (2013). Winter diet of Striated Caracara *Phalcoboenus australis* (Aves, Polyborinae) at a farm settlement on the Falkland Islands. Polar Biology 36:437–443.

Smith, P. K. (1982). Does play matter? Functional and evolutionary aspects of animal and human play. Behavioral and Brain Sciences 5:139–155.

Strange, I. J. (1996). The Striated Caracara (*Phalcoboenus australis*) in the Falkland Islands. Philip Myers, Warrington, UK.

Suh, A., M. Paus, M. Kiefmann, G. Churakov, F. A. Franke, J. Brosius, J. O. Kriegs, and J. Schmitz (2011). Mesozoic retroposons reveal parrots as the closest living relatives of passerine birds. Nature Communications 2:443. doi:10.1038/ncomms1448.

Sun, Z., and C. Firestone (2021). Curious objects: How visual complexity guides attention and engagement. Cognitive Science 45:e12933. doi:10.1111/cogs.12933.

Switzky, H. N., H. C. Haywood, and R. Isett (1974). Exploration, curiosity, and play in young children: Effects of stimulus complexity. Developmental Psychology 10:321–329.

Zeiträg, C., T. R. Jensen, and M. Osvath (2023). Play in juvenile Greater Rheas: Different modes and their evolutionary and socio-cognitive implications. International Journal of Play 12:4–19.

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