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Supplementary Materials: Play in Elephants: Wellbeing, Welfare or Distraction?

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Table S1. Final General Linear Mixed Model for total-play. Var (ID) = 24.98, p = 0.003. Dependent variable was total Play; independent variables were age (categorical, reference category: 1–6 mo), context (reference category: wild Asian), and the interactions between them. Main effects for independent factors presented as F with degrees of freedom for significant factors only, interaction effects between factors (bold) and pairwise comparisons (not bold) are shown as Coefficient (β) with 95 % confidence Interval. Where overall main effects or interactions were not significant (NS), but interactions were significant within categories or contexts, these were retained. All multiple comparisons and post-hoc pairwise tests used least significant difference to adjust for repeated tests; significance (p) associated with pairwise comparisons represents those adjusted for N of comparisons.

Total Play	Main Effect F and p Value	Coefficient β (95% CI)	P Value
Overall model fit	$F_{19, 385} = 10.135$, $p < 0.001$		
Age	$F_{4, 492} = 11.614$, $p < 0.001$		
1–6mo–7–12mo		6.532 (3.735 to 9.330)	<0.001
1–6mo–13–18mo		7.878 (5.140 to 10.616)	<0.001
1–6mo–19–24mo		7.957 (4.103 to 10.338)	<0.001
1–6mo–3.5yr		7.221 (4.103 to 10.338)	<0.001
Context	$F_{3, 58}$=26.0337, $p < 0.001$		
Asian captive		24.770 (18.192 to 31.348)	<0.001
Asian wild–African wild		4.659 (1.869 to 7.448)	0.001
Asian wild–Asian captive		−14.020 (−18.622 to −9.419)	<0.001
Asian wild–African captive		−5.695 (−10.721 to −0.668)	0.027
African wild–Asian captive		−18.679 (−23.195 to −14.162)	<0.001
African wild–African captive		−10.353 (−15.302 to −5.405)	<0.001
Asian captive–African captive		8.326 (2.150 to 14.501)	0.010
Age × context	$F_{12, 540} = 3.696$, $p < 0.001$		
1–6mo Asian wild vs all others		12.308 (6.039 to 18.577)	<0.001
13–18mo Asian captive vs all others		−11.243 (−19.563 to −2.923)	0.008
1–6mo–7–12mo × Asian wild		16.494 (10.432 to 22.556)	<0.001
1–6mo–13–18mo × Asian wild		16.233 (11.254 to 21.213)	<0.001

1–6mo–19–24mo × Asian wild	17.440 (11.013 to 23.867)	<0.001
1–6mo–3–5yrs × Asian wild	16.309 (11.747 to 20.871)	<0.001
1–6mo–13–18mo × Asian captive	5.299 (0.209 to 10.389)	0.041
13–18mo–3–5yrs × Asian captive	−7.955 (−14.766 to −1.144)	0.022
1–6mo–13–18mo × African captive	9.267 (2.806 to 15.727)	0.005
1–6mo–19–24mo × African captive	9.318 (2.492 to 16.144)	0.008
1–6mo–3–5yrs × African captive	11.229 (2.501 to 19.956)	0.012
7–12mo–13–18mo × African captive	7.588 (0.950 to 14.226)	0.025
7–12mo–19–24mo × African captive	7.639 (0.619 to 14.660)	0.033
7–12mo–3–5yrs × African captive	9.550 (0.824 to 18.276)	0.032

Table S2. Final General Linear Mixed Model for Social Play. Var (ID) = 2.86, $p = 0.132$. Dependent variable was social play; significant independent variables were age (categorical, reference category: 1–6 mo), context (reference category: wild Asian), sex and the interactions between them. Main effects for independent factors presented as F with degrees of freedom for significant factors only, interaction effects between factors (bold) and pairwise comparisons (not bold) are shown as Coefficient (β) with 95 % confidence Interval. Where overall main effects or interactions were not significant (NS), but interactions were significant within categories or contexts, these were retained. All multiple comparisons and post-hoc pairwise tests used least significant difference to adjust for repeated tests; significance (p) associated with pairwise comparisons represents those adjusted for N of comparisons.

Social Play	**Main Effect *F* and *p* Value**	**Coefficient β (95% CI)**	***p* Value**
Overall model fit	$F_{38, 194} = 3.554$, $p < 0.001$		
Context	$F_{3, 37} = 20.282$ $p < 0.001$		
Asian captive vs all others		11.304 (5.080 to 16.988)	<0.001
Asian wild–Asian captive		−7.459 (−9.776 to −5.141)	<0.001
Asian wild–African captive		−2.722 (−5.267 to −0.177)	0.037
African wild–Asian captive		−8.002 (−10.209 to −5.796)	<0.001
African wild–African captive		−3.266 (−5.711 to −0.821)	0.010
Asian captive–African captive		4.737 (1.819 to 7.655)	0.003
Age × sex	$F_{4, 513} = 1.015$ $p = 0.399$ (NS)		
1–6mo × male		15.432 (2.340 to 28.523)	0.021
7–12mo × male		17.668 (4.251 to 31.085)	0.010
13–18mo × male		16.534 (3.106 to 29.962)	0.016
19–24mo × male		15.363	0.001

		(6.125 to 24.601)	
Age × context	$F_{12, 384}$=2.191 p=0.012		
1–6mo × Asian wild		8.128 (1.134 to 15.123)	0.023
Sex × context	$F_{3, 39}$ = 1.515 p = 0.226 (NS)		
Male × Asian wild		14.583 (1.715 to 27.450)	0.026
Sex × age (within context)	$F_{11, 607}$ = 1.360 p = 0.187 (NS)		
Male × 1–6mo (within Asian wild)		−22.313 (−36.892 to −7.733)	0.003
Male × 7–12mo (within Asian wild)		−24.955 (−40.546 to −9.364)	0.002
Male × 13–18mo (within Asian wild)		−19.655 (−34.484 to −4.824)	0.009
Male × 19–24mo (within Asian wild)		−18.429 (−31.036 to −5.821)	0.004
Male × 1–6mo (within African wild)		−15.970 (−30.125 to −1.816)	0.027
Male × 7–12mo (within African wild)		−17.117 (−31.694 to −2.541)	0.021
Male × 13–18mo (within African wild)		−14.826 (−29.598 to −0.054)	0.049
Male × 19–24mo (within African wild)		−15.882 (−27.459 to −4.304)	0.007
Male × 1–6mo (within Asian captive)		−12.666 (−25.046 to −0.287)	0.045

Table S3. Final General Linear Mixed Model for Non-social Play. Var (ID) = 12.35, p > 0.001. Dependent variable was non-social play; independent variables were age (categorical: 1–6mo as reference category), context (wild Asian as reference category), and the interactions between them. Main effects for independent factors presented as F with degrees of freedom for significant factors only, interaction effects between factors (bold) and pairwise comparisons (not bold) are shown as Coefficient (*ß*) with 95 % confidence Interval. Where overall main effects or interactions were not significant (NS), but interactions were significant within categories or contexts, these were retained. All multiple comparisons and post-hoc pairwise tests used least significant difference to adjust for repeated tests; significance (p) associated with pairwise comparisons represents those adjusted for N of comparisons.

Non-Social Play	**Main Effect *F* and *p* value**	**Coefficient *β* (95% CI)**	***p* value**
Overall model fit	$F_{19, 445}$ = 9.918, p < 0.001		
Age	$F_{4, 528}$ = 18.537, p < 0.001		
1–6mo–7–12mo		6.007 (4.166 to 7.847)	<0.001
1–6mo–13–18mo		6.697 (4.896 to 8.498)	<0.001
1–6mo–19–24mo		5.872 (3.786 to 7.958)	<0.001
1–6mo–3–5yr		5.752 (3.672 to 7.831)	<0.001
Context	$F_{3, 66}$ = 18.146, p < 0.001		
African wild		13.852 (9.420 to 18.284)	<0.001
Asian wild–frican wild		3.504 (1.639 to 5.369)	<0.001
Asian wild–Asian captive		−6.356 (−9.508 to −3.205)	<0.001
Asian wild–African captive		−3.897	0.027

		(−7.334 to −0.461)	
African wild–Asian captive		−9.860 (−12.957 to −6.764)	<0.001
African wild–African captive		−7.401 (−10.787 to −4.015)	<0.001
Age × context	$F_{12, 555} = 3.302$, $p < 0.001$		
1–6mo Asian wild		8.626 (4.466 to 12.789)	<0.001
1–6mo African captive		9.311 (2.799 to 15.824)	0.005
7–12mo Asian captive		−6.723 (−12.080 to −1.366)	0.014
13–18mo Asian captive		−7.735 (−13.233 to −2.236)	0.006
1–6mo–7–12mo Asian wild		10.448 (6.440 to 14.456)	<0.001
1–6mo–13–18mo Asian wild		9.007 (5.719 to 12.296)	<0.001
1–6mo–19–24mo Asian wild		8.501 (4.251 to 12.752)	<0.001
1–6mo–3–5yrs Asian wild		10.172 (7.147 to 13.198)	<0.001
1–6mo–7–12mo Asian captive		7.269 (4.166 to 10.371)	<0.001
1–6mo–13–18mo Asian captive		7.519 (4.182 to 10.856)	<0.001
1–6mo–19–24mo Asian captive		4.975 (0.972 to 8.979)	0.015
7–12mo–3–5yrs Asian captive		−6.839 (−11.287 to −2.391)	0.003
13–18mo–3–5yrs Asian captive		−7.090 (−11.590 to −2.590)	0.002
19–24mo–3–5yrs Asian captive		−4.546 (−9.080 to −0.012)	0.049
1–6mo–7–12mo African captive		4.648 (0.393 to 8.903)	0.032
1–6mo–13–18mo African captive		9.359 (5.119 to 13.598)	<0.001
1–6mo–19–24mo African captive		8.303 (3.824 to 12.782)	<0.001
1–6mo–3–5yrs African captive		10.858 (5.003 to 16.713)	<0.001
7–12mo–13–18mo African captive		4.711 (0.362 to 9.060)	0.034
7–12mo–3–5yrs African captive		6.210 (0.373 to 12.047)	0.037

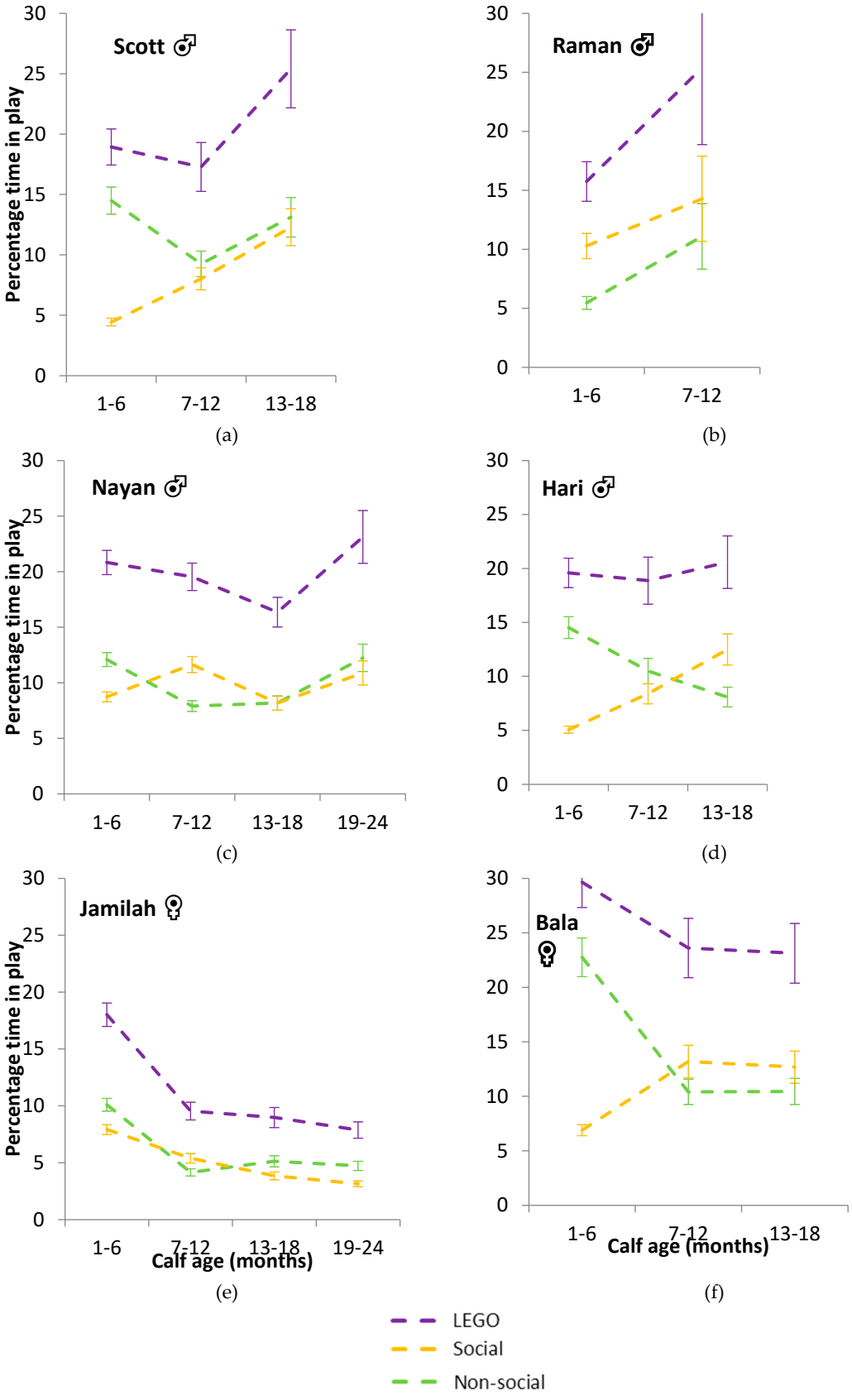


Figure S1. Play categories for individual captive Asian calves followed from birth to 18+ months of age (or death); (a) Scott, (b) Raman, (c) Nayan, (d) Hari, (e) Jamilah, (f) Bala. Social, non-social and LEGO (TOTAL) play types. Data from scans at 5min intervals from 10min focal observations. Binomial 95%CI.

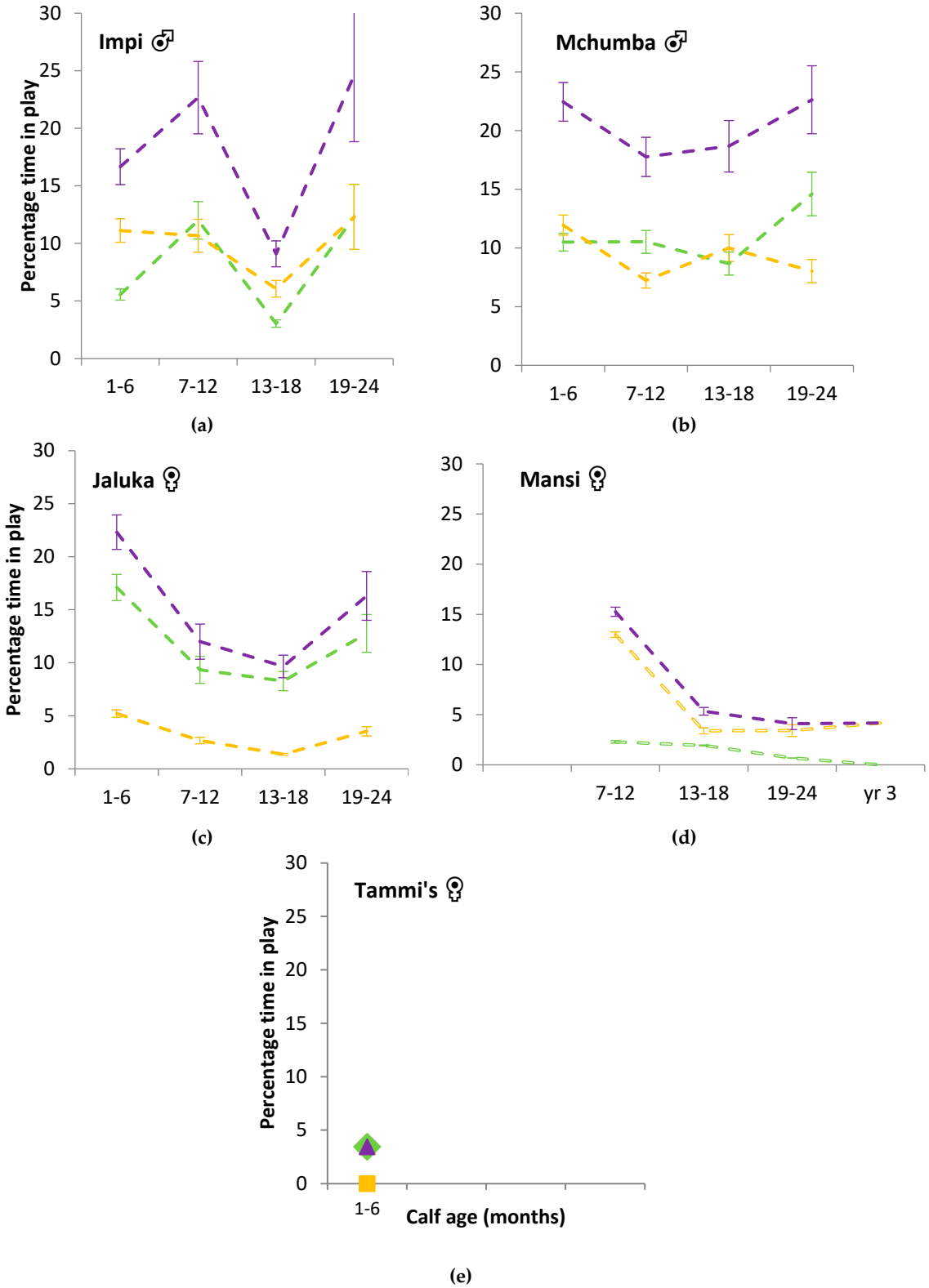


Figure S2. Play categories for individual captive African calves followed from birth to 18+ months (or death); (a) Impi, (b) Mchumba, (c) Jaluka, (d) Mansi, (e) Tammi's. Social, non-social and Total play types (legend as Supp Fig 1). Data from scans at 5min intervals from 10min focal observations. For Tammi's calf, the two incidences of play were trunk-behaviours. Binomial 95% CI.

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