

## SUPPLEMENTARY INFORMATION

**Table S1: Morphological dimensions of a subset of female buff-footed antechinus used in this study ( $n = 12$ ).**

Length	M $\pm$ SE (mm)
Head	30.25 $\pm$ 0.15
Body	64.09 $\pm$ 1.02
Tail	83.80 $\pm$ 1.17
Left forelimb	20.69 $\pm$ 0.13
Left hind limb	25.06 $\pm$ 0.12
Left forefoot	10.57 $\pm$ 0.19
Left hind foot	16.21 $\pm$ 0.14

Measurements were head length (nuchal crest to tip of snout), body length (nuchal crest to base of tail), tail length (base to tip of tail), left forelimb length (radius-ulna), left hind limb length (tibia-fibula), and left forefoot and hind foot lengths (heel to claw base).

**Table S2. Ranking of *ln* turning radius LMMs based on the likelihood of being the best model.**

Response: <i>ln</i> turning radius	<i>df</i>	<i>logLik</i>	<i>AIC<sub>C</sub></i>	$\Delta AIC_C$	<i>w</i>
<i>Model</i>					
1. <i>ln</i> pre-turn speed + friction + shelter orientation + ( <i>ln</i> pre-turn speed · friction) + ( <i>ln</i> pre-turn speed · shelter orientation)	8	-173.726	364.5	0	0.344
2. <i>ln</i> pre-turn speed + friction + shelter orientation + <i>ln</i> mass + ( <i>ln</i> pre-turn speed · friction) + ( <i>ln</i> pre-turn speed · shelter orientation)	9	-172.606	364.5	0.024	0.340
3. <i>ln</i> pre-turn speed + friction + shelter orientation + ( <i>ln</i> pre-turn speed · shelter orientation)	7	-176.303	367.4	2.925	0.080
4. <i>ln</i> pre-turn speed + friction + shelter orientation + <i>ln</i> mass + ( <i>ln</i> pre-turn speed · shelter orientation)	8	-175.300	367.6	3.148	0.071
5. <i>ln</i> pre-turn speed + friction + shelter orientation	6	-177.900	368.4	3.919	0.049
6. <i>ln</i> pre-turn speed + friction + shelter orientation + <i>ln</i> mass	7	-176.976	368.7	4.271	0.041
7. <i>ln</i> pre-turn speed + friction + shelter orientation + ( <i>ln</i> pre-turn speed · friction)	7	-177.402	369.6	5.123	0.027
8. <i>ln</i> pre-turn speed + friction + shelter orientation + <i>ln</i> mass + ( <i>ln</i> pre-turn speed · friction)	8	-176.465	370.0	5.480	0.022
<b>Full model (ranked 22<sup>nd</sup>).</b> <i>ln</i> pre-turn speed + friction + shelter orientation + <i>ln</i> mass + trial + ( <i>ln</i> pre-turn speed · friction) + ( <i>ln</i> pre-turn speed · shelter orientation) + (friction · trial)	11	-177.557	379.0	14.549	2E-4
<b>Null model (ranked 59<sup>th</sup>).</b> intercept only	3	-211.192	428.6	64.081	4E-15

*w* is the Akaike weight, which equals the probability that the model describes the data better than the other models. Only models with an Akaike weight of at least 1% are listed, in addition to the full model and the null model. In addition to their fixed effects, all models contain individual as a random effect. Continuous variables were *ln* transformed to satisfy the assumption of linearity.

**Table S3. Ranking of  $\ln$  turning speed LMMs based on the likelihood of being the best model.**

Response: $\ln$ turning speed	<i>df</i>	<i>logLik</i>	<i>AIC<sub>C</sub></i>	$\Delta AIC_C$	<i>w</i>
<i>Model</i>					
1. $\ln$ turning radius + $\ln$ pre-turn speed + friction	6	83.832	-155.1	0	0.713
2. $\ln$ turning radius + $\ln$ pre-turn speed + friction + $\ln$ mass	7	82.630	-150.5	4.605	0.071
3. $\ln$ turning radius + $\ln$ pre-turn speed + friction + ( $\ln$ pre-turn speed $\cdot$ friction)	7	82.540	-150.3	4.784	0.065
4. $\ln$ turning radius + $\ln$ pre-turn speed + friction + ( $\ln$ turning radius $\cdot$ $\ln$ pre-turn speed)	7	82.222	-149.7	5.421	0.047
5. $\ln$ turning radius + $\ln$ pre-turn speed	5	79.402	-148.4	6.692	0.025
6. $\ln$ turning radius + $\ln$ pre-turn speed + friction + shelter orientation	7	81.377	-148.0	7.110	0.020
7. $\ln$ turning radius + $\ln$ pre-turn speed + friction + shelter orientation + ( $\ln$ turning radius $\cdot$ shelter orientation)	8	82.089	-147.2	7.918	0.014
<b>Full model (ranked 160<sup>th</sup>)</b> . $\ln$ turning radius + $\ln$ pre-turn speed + friction + shelter orientation + $\ln$ mass + trial + ( $\ln$ turning radius $\cdot$ $\ln$ pre-turn speed) + ( $\ln$ turning radius $\cdot$ shelter orientation) + ( $\ln$ pre-turn speed $\cdot$ friction) + ( $\ln$ pre-turn speed $\cdot$ shelter orientation) + (friction $\cdot$ trial)	14	68.571	-106.1	49.028	2E-11
<b>Null model (ranked 252<sup>nd</sup>)</b> . intercept only	3	-52.964	112.1	267.123	7E-59

*w* is the Akaike weight, which equals the probability that the model describes the data better than the other models. Only models with an Akaike weight of at least 1% are listed, in addition to the full model and the null model. In addition to their fixed effects, all models contain individual as a random effect. Continuous variables were  $\ln$  transformed to satisfy the assumption of linearity.

**Table S4. Ranking of presence of a slip GLMMs based on the likelihood of being the best model.**

Response: presence of a slip	<i>df</i>	<i>logLik</i>	<i>AIC<sub>C</sub></i>	$\Delta AIC_C$	<i>w</i>
<i>Model</i>					
<b>1.</b> turning speed + pre-turn speed + friction + shelter orientation + trial + (friction · trial)	8	-56.315	129.6	0.00	0.014
<b>Full model (ranked 6367<sup>th</sup>).</b> turning angle + turning speed + turning radius + pre-turn speed + friction + shelter orientation + trial + mass + (turning angle · shelter orientation) + (turning speed · turning radius) + (turning speed · pre-turn speed) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation) + (friction · trial)	20	-51.412	149.3	19.64	8E-7
<b>Null model (ranked 7834<sup>th</sup>).</b> intercept only	2	-103.488	211.1	81.41	3E-20

*w* is the Akaike weight, which equals the probability that the model describes the data better than the other models. Only models with an Akaike weight of at least 1% are listed, in addition to the full model and the null model. In addition to their fixed effects, all models contain individual as a random effect.

**Table S5. Ranking of arcsine square root proportion of turning strides with a slip LMMs based on the likelihood of being the best model.**

Response: arcsine square root proportion of turning strides with a slip	<i>df</i>	<i>logLik</i>	<i>AIC<sub>C</sub></i>	$\Delta AIC_C$	<i>weight</i>
<i>Model</i>					
1. turning radius + friction	5	-35.793	82.6	0.00	0.251
2. turning radius + friction + (turning radius · friction)	6	-35.170	83.7	1.17	0.140
3. turning radius + pre-turn speed + friction	6	-36.316	86.0	3.46	0.044
4. turning speed + turning radius + friction	6	-36.336	86.1	3.50	0.044
5. turning speed + turning radius + friction + (turning speed · turning radius)	7	-35.201	86.3	3.730	0.039
6. turning radius + pre-turn speed + friction + (pre-turn speed · turning radius)	7	-35.443	86.8	4.214	0.031
7. turning speed + turning radius + friction + (turning radius · friction)	7	-35.680	87.3	4.689	0.024
8. turning radius + pre-turn speed + friction + (turning radius · friction)	7	-35.717	87.3	4.762	0.023
9. turning radius + friction + shelter orientation	6	-36.970	87.3	4.770	0.023
10. turning speed + turning radius + friction + (turning speed · turning radius) + (turning radius · friction)	8	-34.563	87.6	5.039	0.020
11. turning radius + friction + trial	6	-37.252	87.9	5.334	0.017
12. turning radius + pre-turn speed + friction + (pre-turn speed · turning radius) + (turning radius · friction)	8	-34.846	88.2	5.605	0.015
13. turning speed + turning radius + friction + (turning speed · friction) + (turning radius · friction)	8	-34.849	88.2	5.610	0.015
14. turning radius + friction + shelter orientation + (turning radius · shelter orientation)	7	-36.157	88.2	5.643	0.015
15. turning radius + pre-turn speed + friction + (pre-turn speed · friction)	7	-36.194	88.3	5.716	0.014
16. turning radius + friction + shelter orientation + (turning radius · friction)	7	-36.330	88.6	5.988	0.013
17. turning speed + turning radius + friction + (turning speed · turning radius) + (turning speed · friction) + (turning radius · friction)	9	-33.806	88.8	6.201	0.011

<b>Full model (ranked 7889<sup>th</sup>)</b> . turning angle + turning speed + turning radius + pre-turn speed + friction + shelter orientation + mass + trial + (turning angle · shelter orientation) + (turning speed · turning radius) + (turning speed · pre-turn speed) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation) + (friction · trial)	21	-46.494	155.5	72.951	4E-17
<b>Null model (ranked 100<sup>th</sup>)</b> . intercept only	3	-43.841	94.1	11.494	8E-4

$w$  is the Akaike weight, which equals the probability that the model describes the data better than the other models. Only models with an Akaike weight of at least 1% are listed, in addition to the full model and the null model. In addition to their fixed effects, all models contain individual as a random effect. The proportional response variable was *arcsine square root* transformed to approximate a normal distribution.

**Table S6. Ranking of turning angle LMMs based on the likelihood of being the best model.**

Response: turning angle	<i>df</i>	<i>logLik</i>	<i>AIC<sub>C</sub></i>	$\Delta AIC_C$	<i>w</i>
<i>Model</i>					
1. turning speed + turning radius + pre-turn speed + friction + shelter orientation + (turning speed · turning radius) + (turning speed · pre-turn speed) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation)	16	-590.222	1216.5	0	0.198
2. turning speed + turning radius + pre-turn speed + friction + shelter orientation + trial + (turning speed · turning radius) + (turning speed · pre-turn speed) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation)	17	-589.604	1217.8	1.307	0.103
3. turning speed + turning radius + pre-turn speed + friction + shelter orientation + mass + (turning speed · turning radius) + (turning speed · pre-turn speed) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation)	17	-589.873	1218.4	1.844	0.079
4. turning speed + turning radius + pre-turn speed + friction + shelter orientation + trial + (turning speed · turning radius) + (turning speed · pre-turn speed) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation) + (friction · trial)	18	-588.619	1218.4	1.917	0.076
5. turning speed + turning radius + pre-turn speed + friction + shelter orientation + mass + trial + (turning speed · turning radius) + (turning speed · pre-turn speed) + (turning speed · friction) + (turning radius · pre-turn speed) +	18	-589.267	1219.7	3.213	0.040

	(turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation)					
<b>6. Full model.</b>	turning speed + turning radius + pre-turn speed + friction + shelter orientation + mass + trial + (turning speed · turning radius) + (turning speed · pre-turn speed) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation) + (friction · trial)	19	-588.292	1220.4	3.883	0.028
<b>7.</b>	turning speed + turning radius + pre-turn speed + friction + shelter orientation + (turning speed · turning radius) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation)	15	-593.540	1220.6	4.133	0.025
<b>8.</b>	turning speed + turning radius + pre-turn speed + friction + shelter orientation + (turning speed · turning radius) + (turning speed · pre-turn speed) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · shelter orientation)	15	-593.692	1221.0	4.446	0.021
<b>9.</b>	turning speed + turning radius + pre-turn speed + friction + shelter orientation + (turning speed · pre-turn speed) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation)	15	-593.891	1221.3	4.835	0.018
<b>10.</b>	turning speed + turning radius + pre-turn speed + friction + shelter orientation + (turning speed · turning radius) + (turning speed · pre-turn speed) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction)	15	-594.041	1221.6	5.135	0.015
<b>11.</b>	turning speed + turning radius + pre-turn speed + friction + shelter orientation + (turning speed · turning radius) + (turning speed · pre-turn speed) +	15	-594.107	1221.8	5.266	0.014



				(turning speed · friction) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation)					
<b>12.</b>	turning speed + turning radius + pre-turn speed + friction + shelter orientation + (turning speed · turning radius) + (turning speed · pre-turn speed) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation)	15	-594.147	1221.9	5.346	0.014			
<b>13.</b>	turning speed + turning radius + pre-turn speed + friction + shelter orientation + (turning speed · turning radius) + (turning speed · pre-turn speed) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation)	15	-594.167	1221.9	5.386	0.013			
<b>14.</b>	turning speed + turning radius + pre-turn speed + friction + shelter orientation + trial + (turning speed · turning radius) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation)	16	-592.951	1222.0	5.460	0.013			
<b>15.</b>	turning speed + turning radius + pre-turn speed + friction + shelter orientation + trial + (turning speed · turning radius) + (turning speed · pre-turn speed) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · shelter orientation)	16	-593.019	1222.1	5.595	0.012			
<b>16.</b>	turning speed + turning radius + pre-turn speed + friction + shelter orientation + mass + (turning speed · turning radius) + (turning speed · friction) + (turning radius · pre-turn speed) + (turning radius · friction) + (turning radius · shelter orientation) + (pre-turn speed · friction) + (pre-turn speed · shelter orientation)	16	-593.176	1222.4	5.909	0.010			
<b>17.</b>	turning speed + turning radius + pre-turn speed + friction + shelter orientation + trial + (turning speed · pre-turn speed) + (turning speed · friction) + (turning radius · pre-turn speed) +	16	-593.185	1222.4	5.927	0.010			

(turning radius · friction) +  
(turning radius · shelter orientation) +  
(pre-turn speed · friction) +  
(pre-turn speed · shelter orientation)

**Null model (ranked 2841<sup>st</sup>).** intercept only                      3           -663.310           1332.8           116.280           1E-26

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$w$  is the Akaike weight, which equals the probability that the model describes the data better than the other models. Only models with an Akaike weight of at least 1% are listed, in addition to the full model and the null model. In addition to their fixed effects, all models contain individual as a random effect.