

Figure S1. A snapshot of hourly temperature data depicting differences in thermal variability over one week during the active season for *Onthophagus taurus*. Adult microhabitats include air, within dung pat, and soil surface temperatures. Pupal microhabitats include temperatures at 10 and 20 cm below the soil surface where brood balls are typically located.

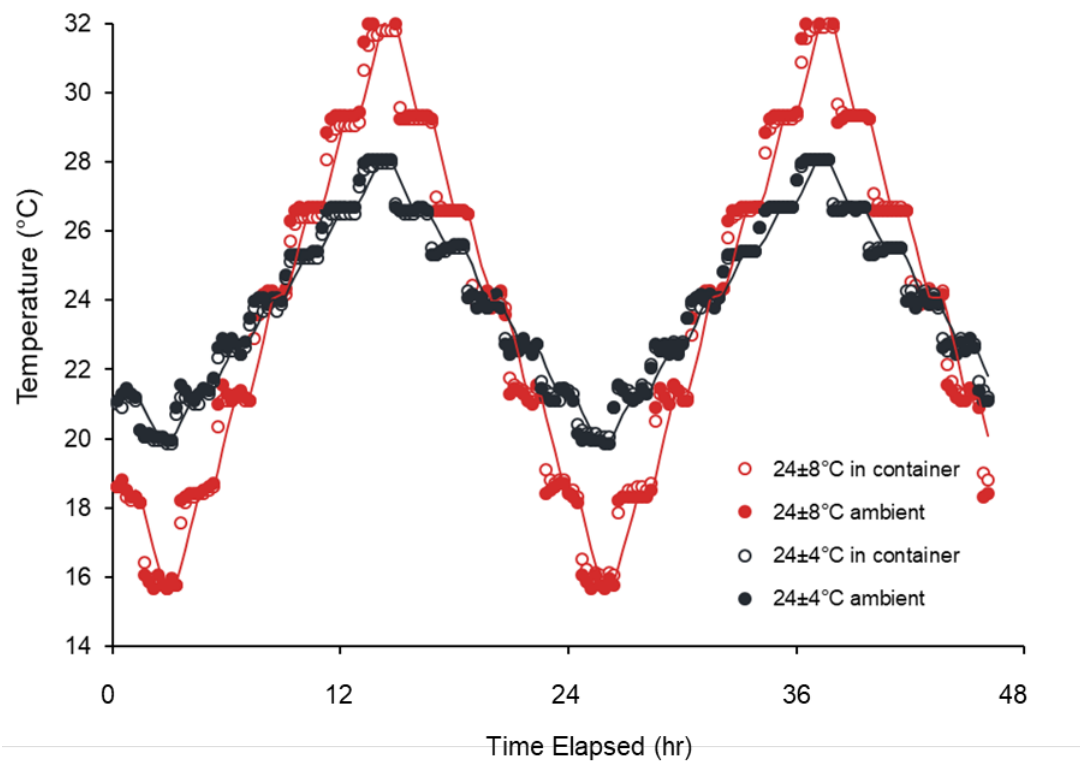


Figure S2. Ambient temperatures within the incubators (ambient, filled circles) do not differ from temperatures within the 2-ounce containers filled with moist soil (in container, open circles), which were used to house individual brood balls or adults, in either treatment. This demonstrates that realized temperatures of experimental individuals align with treatment temperatures.

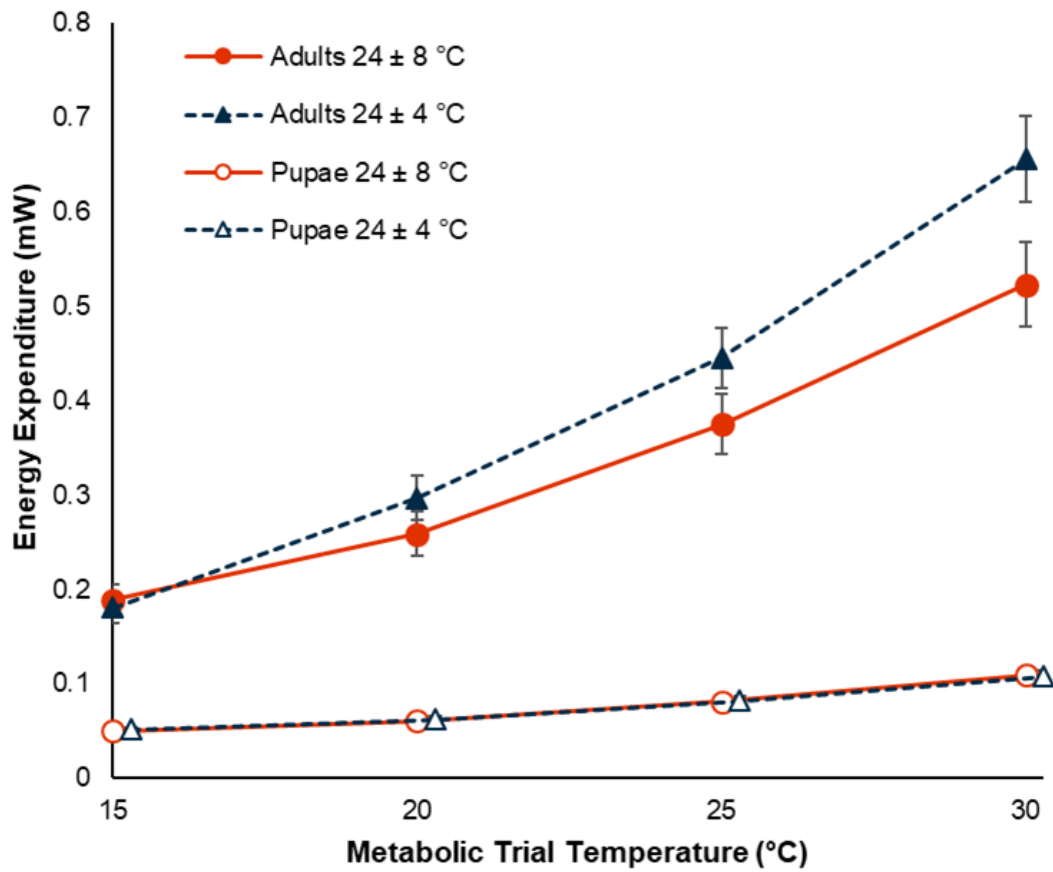


Figure S3. Using CO₂ production data and energy equivalents from Walsberg and Hoffman (2005), we calculated energy expenditure in milliwatts. Individual points are group means \pm 1 standard error and calculations were made on untransformed data. Adults are represented with filled circles and pupae are represented with open circles. Individuals from the high temperature fluctuation treatment are depicted in red and those from the low temperature fluctuation treatment are depicted in navy.

Table S1. Solution for fixed effects: Do life stages differ in thermal plasticity to increased temperature fluctuation?

<i>Effect</i>	<i>Treatment</i>	<i>Stage</i>	<i>Sex</i>	<i>Estimate</i>	<i>Standard Error</i>	<i>df</i>	<i>t-value</i>	<i>p-value</i>
Intercept				-0.00015	0.000077	115	-1.94	0.0553
Metabolic Trial Temperature				3.01E-06	2.33E-06	74.9	1.29	0.2
Treatment	<i>High Fluctuation</i>			-0.00001	0.000056	70.2	-0.23	0.8175
Treatment	<i>Low Fluctuation</i>			0	.	.	.	.
Treatment X Metabolic Trial Temperature	<i>High Fluctuation</i>			2.19E-07	3.14E-06	74	0.07	0.9448
Treatment X Metabolic Trial Temperature	<i>Low Fluctuation</i>			0	.	.	.	.
Life Stage		<i>Adult</i>		-0.00025	0.000058	78.2	-4.34	<.0001
Life Stage		<i>Pupa</i>		0	.	.	.	.
Life Stage X Metabolic Trial Temperature		<i>Adult</i>		0.000031	3.12E-06	74.9	10.07	<.0001
Life Stage X Metabolic Trial Temperature		<i>Pupa</i>		0	.	.	.	.
Treatment X Life Stage	<i>High Fluctuation</i>	<i>Adult</i>		0.000185	0.000078	70.5	2.39	0.0198
Treatment X Life Stage	<i>High Fluctuation</i>	<i>Pupa</i>		0	.	.	.	.
Treatment X Life Stage	<i>Low Fluctuation</i>	<i>Adult</i>		0	.	.	.	.
Treatment X Life Stage	<i>Low Fluctuation</i>	<i>Pupa</i>		0	.	.	.	.
Treatment X Life Stage X Metabolic Trial Temperature	<i>High Fluctuation</i>	<i>Adult</i>		-0.00001	4.33E-06	74.2	-2.4	0.0189
Treatment X Life Stage X Metabolic Trial Temperature	<i>High Fluctuation</i>	<i>Pupa</i>		0	.	.	.	.
Treatment X Life Stage X Metabolic Trial Temperature	<i>Low Fluctuation</i>	<i>Adult</i>		0	.	.	.	.
Treatment X Life Stage X Metabolic Trial Temperature	<i>Low Fluctuation</i>	<i>Pupa</i>		0	.	.	.	.
Sex			<i>Female</i>	-0.00002	0.00006	73.2	-0.42	0.6779
Sex			<i>Major Male</i>	-0.00006	0.000061	73.6	-0.99	0.326
Sex			<i>Minor Male</i>	0	.	.	.	.
Mass				0.001398	0.000352	73.7	3.98	0.0002

Note: The pupal life stage, the low fluctuation treatment, and minor males serve as the reference effects, so any higher order effects that include these effects are also zero.

Table S2. Solution for fixed effects: Do temperature fluctuations during early life stages carry-over to affect adult plasticity and phenotype?

<i>Effect</i>	<i>Temperature Treatment</i>	<i>Metabolic Trial Temperature</i>	<i>Estimate</i>	<i>Standard Error</i>	<i>df</i>	<i>t-value</i>	<i>p-value</i>
Intercept			0.000688	0.00006	119	11.5	<.0001
Metabolic Trial Temperature		15	-0.00063	0.000042	61.5	-14.88	<.0001
Metabolic Trial Temperature		20	-0.00059	0.00004	59.3	-14.95	<.0001
Metabolic Trial Temperature		25	-0.00029	0.000031	67	-9.13	<.0001
Metabolic Trial Temperature		30	0	.	.	.	.
Adult Treatment	<i>High Fluctuation</i>		-0.00004	0.000049	63.4	-0.82	0.4179
Adult Treatment	<i>Low Fluctuation</i>		0	.	.	.	.
Developmental Treatment	<i>High Fluctuation</i>		-0.00005	0.000049	65.2	-1.03	0.3087
Developmental Treatment	<i>Low Fluctuation</i>		0	.	.	.	.
Adult Treatment X Metabolic Trial Temperature	<i>High Fluctuation</i>	15	-3.51E-06	0.00005	63	-0.07	0.9436
Adult Treatment X Metabolic Trial Temperature	<i>High Fluctuation</i>	20	0.000027	0.000046	60.8	0.59	0.5601
Adult Treatment X Metabolic Trial Temperature	<i>High Fluctuation</i>	25	-0.00006	0.000037	68.1	-1.64	0.1066
Adult Treatment X Metabolic Trial Temperature	<i>High Fluctuation</i>	30	0	.	.	.	.
Adult Treatment X Metabolic Trial Temperature	<i>Low Fluctuation</i>	15	0	.	.	.	.
Adult Treatment X Metabolic Trial Temperature	<i>Low Fluctuation</i>	20	0	.	.	.	.
Adult Treatment X Metabolic Trial Temperature	<i>Low Fluctuation</i>	25	0	.	.	.	.
Adult Treatment X Metabolic Trial Temperature	<i>Low Fluctuation</i>	30	0	.	.	.	.
Developmental Treatment X Metabolic Trial Temperature	<i>High Fluctuation</i>	15	0.00004	0.000049	63.3	0.8	0.4261
Developmental Treatment X Metabolic Trial Temperature	<i>High Fluctuation</i>	20	0.000062	0.000046	61.1	1.34	0.1852
Developmental Treatment X Metabolic Trial Temperature	<i>High Fluctuation</i>	25	3.79E-06	0.000037	68.3	0.1	0.9179
Developmental Treatment X Metabolic Trial Temperature	<i>High Fluctuation</i>	30	0	.	.	.	.
Developmental Treatment X Metabolic Trial Temperature	<i>Low Fluctuation</i>	15	0	.	.	.	.
Developmental Treatment X Metabolic Trial Temperature	<i>Low Fluctuation</i>	20	0	.	.	.	.
Developmental Treatment X Metabolic Trial Temperature	<i>Low Fluctuation</i>	25	0	.	.	.	.
Developmental Treatment X Metabolic Trial Temperature	<i>Low Fluctuation</i>	30	0	.	.	.	.
Mass			0.002334	0.00046	70	5.08	<.0001

Notes: The 30 °C and the low fluctuation treatments serve as the reference effects, so any higher order effects that include these effects are also zero.

This table corresponds to the model where metabolic trial temperature is characterized as a fixed (categorical) effect.

Table S3. Solution for fixed effects: Do temperature fluctuations during early life stages carry-over to affect adult plasticity and phenotype?

<i>Effect</i>	<i>Temperature Treatment</i>	<i>Estimate</i>	<i>Standard Error</i>	<i>df</i>	<i>t-value</i>	<i>p-value</i>
Intercept		-0.00046	0.000052	110	-8.86	<.0001
Metabolic Trial						
Temperature		0.00003	1.47E-06	68.1	20.48	<.0001
Developmental Treatment	<i>High Fluctuation</i>	7.83E-06	0.000018	70.1	0.44	0.6581
Developmental Treatment	<i>Low Fluctuation</i>	0	.	.	.	.
Adult Treatment	<i>High Fluctuation</i>	-0.00003	0.000017	70	-1.61	0.1125
Adult Treatment	<i>Low Fluctuation</i>	0	.	.	.	.
Mass		0.002309	0.000458	70	5.04	<.0001

Notes: The low fluctuation treatment serves as the reference effect.

This table corresponds to the model where metabolic trial temperature is characterized as a continuous effect (covariate).