

Autocorrelation experiment - 10 days - Surface area

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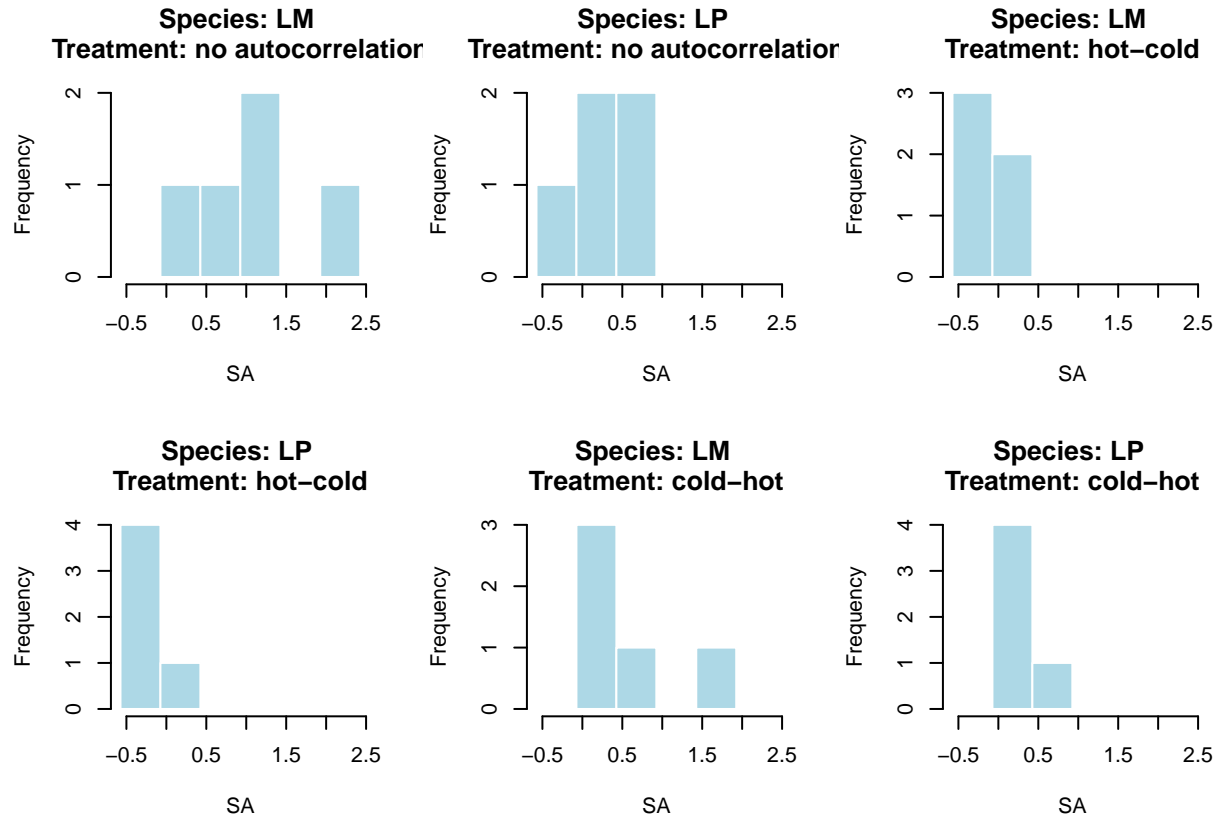
Load and Preprocess Datasets

```
# Load dataset  
original_dataset <- read.csv("https://raw.githubusercontent.com/Cuddington-Lab/thermal-experiments/main,
```

View dataset and response variable (SA = change in surface area)

Exp_run	Mean_temperature	Treatment	Species	Initial_area	Final_area	SA
1	37	no autocorrelation	LM	0.648	1.678	1.030
1	37	no autocorrelation	LP	0.456	0.782	0.326
1	37	hot-cold	LM	0.574	0.000	-0.574
1	37	hot-cold	LP	0.399	0.000	-0.399
1	37	cold-hot	LM	0.644	0.994	0.350
1	37	cold-hot	LP	0.409	0.464	0.055

Histogram of surface areas for each species



Mixed-Effects Model Fitting

```
results_list <- list()

for (species in unique(dataset$Species)) {

  species_data <- subset(dataset, Species == species)
  library(lme4)

  simple <- lm(SA ~ Treatment,
               data = species_data)

  exp_number <- lmer(SA ~ Treatment + (1 | Exp_run),
                    data = species_data)

  L0 <- logLik(simple)
  L1 <- logLik(exp_number)
  L.ratio <- as.vector(- 2 * (L0 - L1))
  p_value <- 0.5 * (1 - pchisq(L.ratio, 1))
  options(scipen = 999)
  print(paste("Comparing simple x mixed model:"))
  cat("p_value:", p_value, "\n")
}
```

Mixed models were selected for all analyses, as likelihood-ratio tests indicated that the random effects

```
results_list[[species]] <- exp_number
}
```

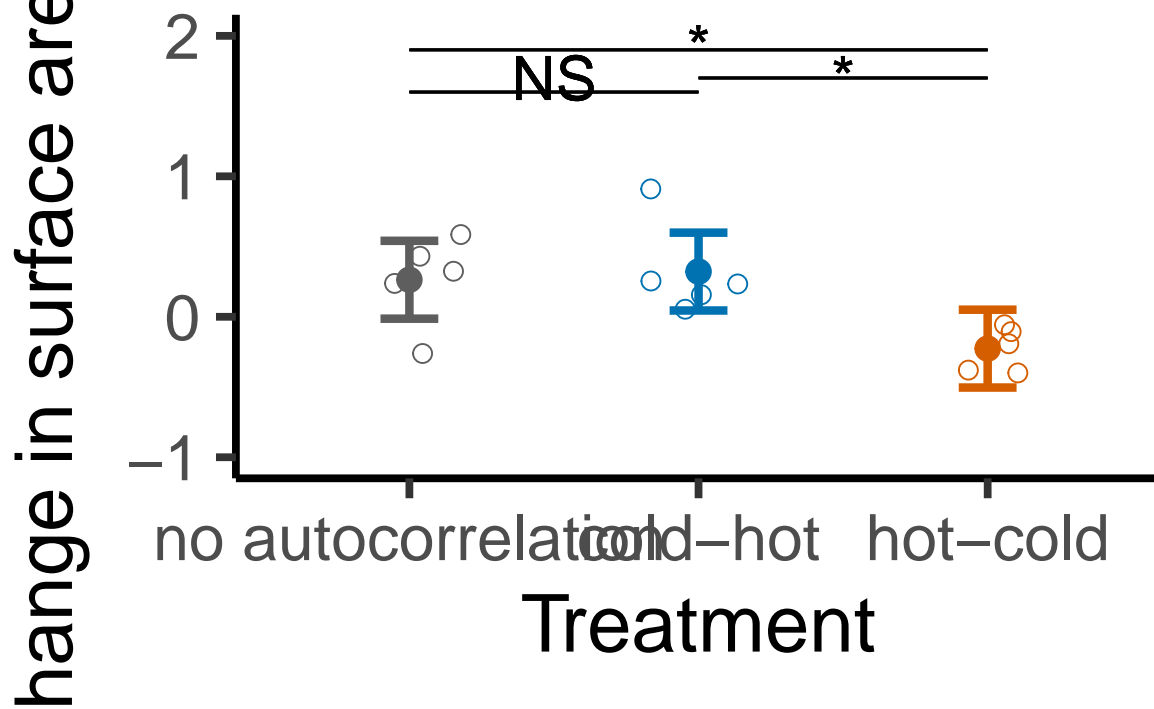
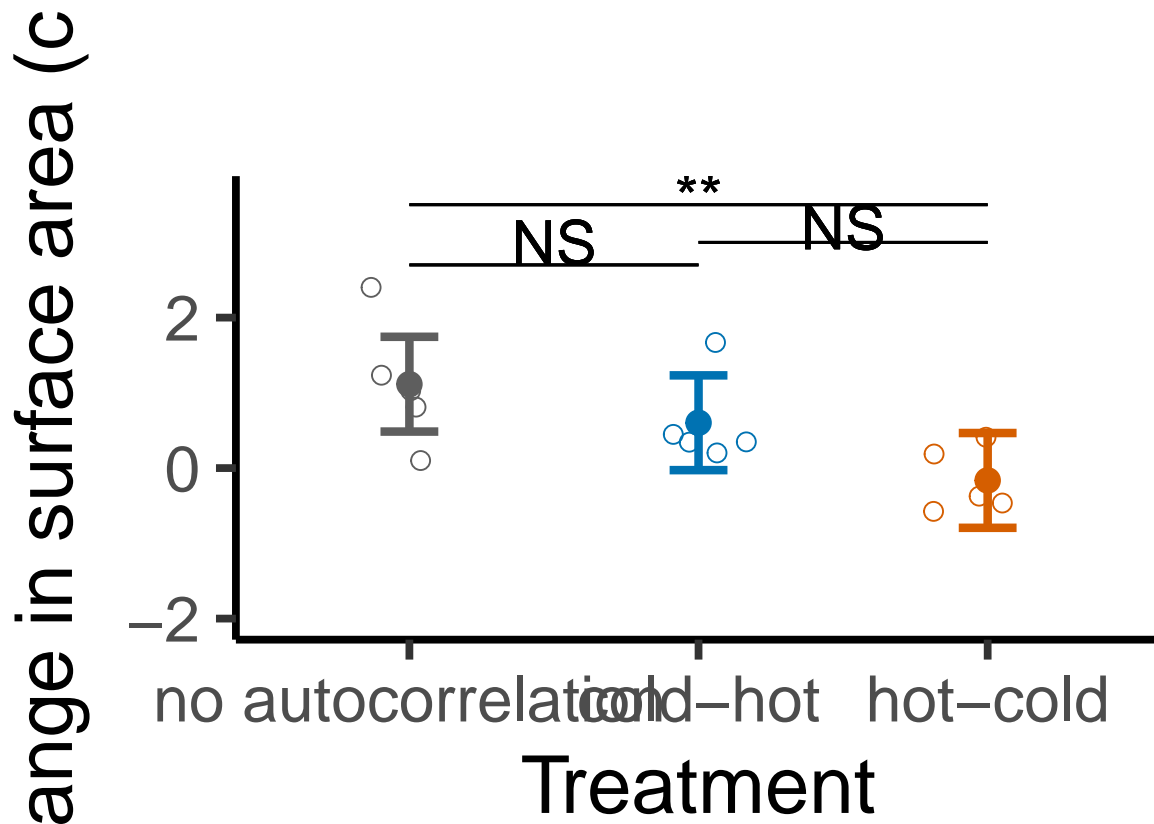
```
## [1] "Comparing simple x mixed model:"
## p_value: 0.5
## [1] "Comparing simple x mixed model:"
## p_value: 0.5
```

Model significance testing

The best model selected in the step above is tested for significance, for each species

```
## [1] "Anova - linear mixed model - species LM :"
## Analysis of Deviance Table (Type II Wald chisquare tests)
##
## Response: SA
##           Chisq Df Pr(>Chisq)
## Treatment 10.212  2    0.00606 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Residual degrees of freedom for species LM : 10
## [1] "Anova - linear mixed model - species LP :"
## Analysis of Deviance Table (Type II Wald chisquare tests)
##
## Response: SA
##           Chisq Df Pr(>Chisq)
## Treatment 11.563  2    0.003084 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Residual degrees of freedom for species LP : 10
```

Visualization of Results



Model diagnostics

```
## Processing mixed-effects model for LM
## Shapiro-Wilk test for random effects (Intercept) for LM :
##
## Shapiro-Wilk normality test
##
## data: ranef_component[[1]][, "(Intercept)"]
## W = 0.83582, p-value = 0.1537
##
## Processing mixed-effects model for LP
## Shapiro-Wilk test for random effects (Intercept) for LP :
##
## Shapiro-Wilk normality test
##
## data: ranef_component[[1]][, "(Intercept)"]
## W = 0.95199, p-value = 0.7514
##
## Post-hoc Test Results for Species: LM
##
##
## 1
```

	estimate	SE	df	t.ratio	p.value
no autocorrelation - (cold-hot)	0.512	0.403	491.053	1.272	0.412
no autocorrelation - (hot-cold)	1.279	0.403	491.053	3.175	0.005
(cold-hot) - (hot-cold)	0.766	0.403	491.053	1.903	0.139

```
##
## Post-hoc Test Results for Species: LP
##
##
## 1
```

	estimate	SE	df	t.ratio	p.value
no autocorrelation - (cold-hot)	-0.058	0.177	8	-0.328	0.943
no autocorrelation - (hot-cold)	0.490	0.177	8	2.767	0.057
(cold-hot) - (hot-cold)	0.548	0.177	8	3.095	0.035