Behavioural spillover, not intra-individual repeatability, of aggression influences mating success in field crickets

**Stats Audit & R Code**

#Data:

agg=read.csv(file="Aggression.csv",header=TRUE)

aggmat=read.csv(file="AggMat.csv",header=TRUE)

inds=read.csv(file="Individuals.csv",header=TRUE)

csIC=read.csv(file="csIC.csv",header=TRUE)

csICna=read.csv(file="csICna.csv",header=TRUE)

csIR=read.csv(file="csIR.csv",header=TRUE)

csER=read.csv(file="csER.csv",header=TRUE)

csEC=read.csv(file="csEC.csv",header=TRUE)

csECna=read.csv(file="csECna.csv",header=TRUE)

figs=read.csv(file="Figs.csv",header=TRUE)

trial=read.csv(file="Trial.csv",header=TRUE)

**Aggression**

Temporal patterns of aggression:

1. Test: Sum of binary instigated aggression across trials (0-3) against random expectation  
   Model: Chi-square  
   Result: χ23  = 18.816, *N* = 124, *p* < 0.001 \*\*\*  
     
   R Script:

View(csIC)

table(csIC$Cat, csIC$Obs)

csqIC=chisq.test(table(csIC$Cat, csIC$Obs))

csqIC

subsetcsIC <- subset(csIC, select=c(Cat, Obs))

View(subsetcsIC)

csICna <- na.omit(subsetcsIC)

View(csICna)

table(csICna$Cat, csICna$Obs)

csqICna=chisq.test(table(csICna$Cat, csICna$Obs))

csqICna

write.csv(csICna, "csICna.csv")

View(csICna)

table(csICna$Cat, csICna$Obs)

csqICna=chisq.test(table(csICna$Cat, csICna$Obs))

csqICna

#X-squared = 18.816, df = 3, p-value = 0.0007712 \*\*\*

1. Test: Sum of binary expressed aggression across trials (0-3) against random expectation  
   Model: Chi-square  
   Result: χ23 = 18.518, *N* = 124, *p <* 0.001 \*\*\*  
     
   R Script:

View(csEC)

table(csEC$Cat, csEC$Obs)

csqEC=chisq.test(table(csEC$Cat, csEC$Obs))

csqEC

subsetcsEC <- subset(csEC, select=c(Cat, Obs))

View(subsetcsEC)

csECna <- na.omit(subsetcsEC)

View(csECna)

table(csECna$Cat, csECna$Obs)

csqECna=chisq.test(table(csECna$Cat, csECna$Obs))

csqECna

write.csv(csECna, "csECna.csv")

View(csECna)

table(csECna$Cat, csECna$Obs)

csqECna=chisq.test(table(csECna$Cat, csECna$Obs))

csqECna

#X-squared = 18.581, df = 3, p-value = 0.0003338 \*\*\*

1. Test: Temporal behavioural pattern (000-111) of instigated aggression against random expectation  
   Model: Chi-square  
   Result: χ27 = 14.685, *N* = 124, *p* = 0.040 \*  
     
   R Script:

View(csIR)

table(csIR$Cat, csIR$Obs)

csIR=chisq.test(table(csIR$Cat, csIR$Obs))

csIR

#X-squared = 14.685, df = 7, p-value = 0.04026 \*\*\*

1. Test: Temporal behavioural pattern (000-111) of experienced aggression against random expectation  
   Model: Chi-square  
   Result: χ27 = 19.302, *N* = 124, *p* =0.007 \*\*  
     
   R Script:

csER=chisq.test(table(csER$Cat, csER$Obs))

csER

#X-squared = 19.302, df = 7, p-value = 0.007292 \*\*\*

Repeatability of aggression:

1. Test: Focal partner identity against total number of aggressive instigations  
   Model: Linear mixed-effect model (LMM) with log-likelihood ratio test (LRT)  
   Result: χ25 = 1.726, *N* = 124, *p*= 0.092  
     
   R Script:  
   library(lme4)

colnames(inds)[1]<-"Focal"

ma3a1=lmer(X.I~Trial+(1|Focal)+(1|Interacting),data=inds)

print(ma3a1)  
anova(ma3a1)

summary(ma3a1)  
Reducedma3a1i=lmer(X.I~Trial+(1|Focal),data=inds)

summary(Reducedma3a1i)  
anova(Reducedma3a1i,ma3a1)  
#Reducedma3a1i: X.I ~ Trial + (1 | Focal)

#ma3a1: X.I ~ Trial + (1 | Focal) + (1 | Interacting)

# Df AIC BIC logLik deviance Chisq Chi Df Pr(>Chisq)

#Reducedma3a1i 4 870.30 885.98 -431.15 862.30

#ma3a1 5 870.58 890.17 -430.29 860.58 1.7263 1 0.1889

#Interacting removed loglik:  
pchisq(2\*(logLik(ma3a1)-logLik(Reducedma3a1i)),df=1,lower.tail=FALSE)/2

#'log Lik.' 0.0917278 (df=5)

1. Test: Interacting partner identity against total number of aggressive instigations  
   Model: Linear mixed-effect model (LMM) with log-likelihood ratio test (LRT)  
   Result: χ25 = 0.513, *N* = 124, *p* = 0.233  
     
   R Script:   
   library(lme4)

colnames(inds)[1]<-"Focal"

ma3a1=lmer(X.I~Trial+(1|Focal)+(1|Interacting),data=inds)

print(ma3a1)

anova(ma3a1)

summary(ma3a1)  
Reducedma3a1f=lmer(X.I~Trial+(1|Interacting),data=inds)

summary(Reducedma3a1f)  
anova(Reducedma3a1f,ma3a1)  
#Reducedma3a1f: X.I ~ Trial + (1 | Interacting)

#ma3a1: X.I ~ Trial + (1 | Focal) + (1 | Interacting)

# Df AIC BIC logLik deviance Chisq Chi Df Pr(>Chisq)

#Reducedma3a1f 4 869.09 884.77 -430.55 861.09

#ma3a1 5 870.58 890.17 -430.29 860.58 0.5129 1 0.4739  
#Focal removed loglik:  
pchisq(2\*(logLik(ma3a1)-logLik(Reducedma3a1f)),df=1,lower.tail=FALSE)/2

#'log Lik.' 0.2330142 (df=5)

1. Test: Focal partner identity against average aggressive duration  
   Model: Linear mixed-effect model (LMM) with log-likelihood ratio test (LRT)  
   Result: χ25 <0.001, *N* = 124, *p*= 0.500  
     
   R Script:   
   colnames(agg\_removed)[1]<-"Focal"

duration=lmer(Dur~Trial+(1|Focal)+(1|Interacting),data=agg\_removed)

summary(duration)

#Random effects:

#Groups Name Variance Std.Dev.

#Interacting (Intercept) 3.705e+01 6.08697

#Focal (Intercept) 1.688e-04 0.01299

#Residual 1.773e+02 13.31615

#Number of obs: 135, groups: Interacting, 90; Focal, 88

reduceddurationf=lmer(Dur~Trial+(1|Interacting),data=agg\_removed)

reduceddurationf2=glmer(Dur~Trial+(1|Interacting),data=agg\_removed)

summary(reduceddurationf2)

#REML criterion at convergence: 1099.1

#Scaled residuals:

# Min 1Q Median 3Q Max

#-1.3246 -0.7214 -0.1832 0.4542 2.8586

#Random effects:

#Groups Name Variance Std.Dev.

#Interacting (Intercept) 37.05 6.087

#Residual 177.32 13.316

#Number of obs: 135, groups: Interacting, 90

#Fixed effects:

# Estimate Std. Error t value

#(Intercept) 16.698 3.495 4.777

#Trial 1.126 1.530 0.736

#Correlation of Fixed Effects:

#(Intr)

#Trial -0.924

anova(reduceddurationf,duration)

#refitting model(s) with ML (instead of REML)

# reduceddurationf: Dur ~ Trial + (1 | Interacting)

#duration: Dur ~ Trial + (1 | Focal) + (1 | Interacting)

# Df AIC BIC logLik deviance Chisq Chi Df Pr(>Chisq)

#reduceddurationf 4 1112.2 1123.8 -552.1 1104.2

#duration 5 1114.2 1128.7 -552.1 1104.2 0 1 1

#Focal removed loglik:

pchisq(2\*(logLik(duration)-logLik(reduceddurationf)),df=1,lower.tail=FALSE)/2

#'log Lik.' 0.5 (df=5)

1. Test: Interacting partner identity against average aggressive duration  
   Model: Linear mixed-effect model (LMM) with log-likelihood ratio test (LRT)  
   Result: χ25 = 0.980, *N* = 124, *p* = 0.155  
     
   R Script:   
   duration=lmer(Dur~Trial+(1|Focal)+(1|Interacting),data=agg\_removed)

reduceddurationi=lmer(Dur~Trial+(1|Focal),data=agg\_removed)

reduceddurationi2=glmer(Dur~Trial+(1|Focal),data=agg\_removed)

summary(reduceddurationi2)

#REML criterion at convergence: 1100.1

#Scaled residuals:

# Min 1Q Median 3Q Max

#-1.2739 -0.7975 -0.1997 0.5437 2.8769

#Random effects:

# Groups Name Variance Std.Dev.

#Focal (Intercept) 8.625 2.937

#Residual 205.008 14.318

#Number of obs: 135, groups: Focal, 88

#Fixed effects:

# Estimate Std. Error t value

#(Intercept) 17.2681 3.5189 4.907

#Trial 0.9038 1.5572 0.580

#Correlation of Fixed Effects:

#(Intr)

#Trial -0.932

anova(reduceddurationi,duration)

#refitting model(s) with ML (instead of REML)

# reduceddurationi: Dur ~ Trial + (1 | Focal)

#duration: Dur ~ Trial + (1 | Focal) + (1 | Interacting)

# Df AIC BIC logLik deviance Chisq Chi Df Pr(>Chisq)

#reduceddurationi 4 1113.2 1124.8 -552.59 1105.2

#duration 5 1114.2 1128.7 -552.10 1104.2 0.9795 1 0.3223

#Interacting removed loglik:

pchisq(2\*(logLik(duration)-logLik(reduceddurationi)),df=1,lower.tail=FALSE)/2

#'log Lik.' 0.1551176 (df=5)

The influence of previous interactions on aggression:

1. Test: Number of aggressive instigations against trial number (1-3)  
   Model: Likelihood ratio test  
   Result: χ22 = 7.463, p = 0.024 \*  
     
   R Script:   
   glm9<-glm(X.I~Trial,data=xidat,family="poisson")

glm9.null<-glm(X.I~1,data=xidat,family="poisson")

anova(glm9,glm9.null,test="Chisq")

#Results:

# Model 1: X.I ~ Trial

#Model 2: X.I ~ 1

# Resid. Df Resid. Dev Df Deviance Pr(>Chi)

#1 369 403.55

#2 371 411.01 -2 -7.4631 0.02396 \*

1. Test: Instigated / experienced aggression in trials 2 and 3 against instigated / experienced aggression in trials 1 and 2 where appropriate, with focal ID included as a random effect  
   Model: Generalised linear mixed-effects models (GLMM) with single-term deletions  
   Result: All p > 0.08; full statistical results in Supplementary Table S2  
     
   R Script:   
   ma2b4=glmer(E3~I1\*I2\*E1\*E2+(1|ID),family=binomial,data=agg)

summary(ma2b4)

#Fixed effects:

#Estimate Std. Error z value Pr(>|z|)

#(Intercept) -0.0953 0.4371 -0.218 0.8274

#I1 0.6549 0.7691 0.852 0.3945

#I2 -1.3710 0.7915 -1.732 0.0832 .

#E1 -1.8506 1.1710 -1.580 0.1140

#E2 -0.2614 0.6596 -0.396 0.6919

#I1:I2 0.1183 1.2223 0.097 0.9229

#I1:E1 1.2910 1.9341 0.668 0.5044

#I2:E1 2.4006 1.5829 1.517 0.1294

#I1:E2 -0.7037 1.2919 -0.545 0.5859

#I2:E2 20.4608 788.7164 0.026 0.9793

#E1:E2 1.5141 1.4489 1.045 0.2960

#I1:I2:E1 -19.8971 1097.6763 -0.018 0.9855

#I1:I2:E2 0.2095 1182.5813 0.000 0.9999

#I1:E1:E2 0.1441 2.6092 0.055 0.9560

#I2:E1:E2 -21.4904 788.7164 -0.027 0.9783

#I1:I2:E1:E2 19.5694 1752.3291 0.011 0.9911

**Mating Success**

Intrasexual aggression and mating success:

*Aggression instigation and mating success*

1. Test: Temporal behavioural pattern (000-111) against mating success (1/0)  
   Model: Chi-square  
   Result: χ27 = 5.2045, *N* = 96, *p*  = 0.635  
     
   R Script:   
   table(aggmat$Mated, aggmat$I)

csM11=chisq.test(aggmat$Mated, aggmat$I)

csM11

#X-squared = 5.2045, df = 7, p-value = 0.635

1. Test: Temporal behavioural pattern (000-111) against mating efficiency  
   Model: Chi-square  
   Result: χ221 = 23.255, *N* = 96, *p* = 0.331  
     
   R Script:   
   table(aggmat$F., aggmat$I)

csM12=chisq.test(aggmat$F., aggmat$I)

csM12

#X-squared = 23.255, df = 21, p-value = 0.3306

1. Test: Experiment-level aggression (0-3) against mating success (1/0)  
   Model: Binary logistic regression  
   Result: z1,95 = -0.514, *p* = 0.607  
     
   R Script:   
   glm13=glm(Mated~IC, data = aggmat, family = "binomial")

summary(glm13)

#Results:

# Estimate Std. Error z value Pr(>|z|)

#(Intercept) 1.7853 0.4481 3.984 6.78e-05 \*\*\*

#IC -0.1564 0.3041 -0.514 0.607

1. Test: Experiment-level aggression (0-3) against mating efficiency   
   Model: Spearman rank correlation coefficient  
   Result: *r*s = 0.180, *N* = 96, *p* = 0.080  
     
   R Script:  
   cor.test(fdat$F.,fdat$IC,method='spearman')

#Results:

#S = 120935, rho = 0.179769, p-value = 0.07967

1. Test: Total instigations of aggression against mating success (1/0)  
   Model: Binary logistic regression  
   Result: z1,95 = -0.441, *p* = 0.660  
     
   R Script:

glm15=glm(Mated~X.I, data = aggmat, family = "binomial")

summary(glm15)  
#Results:

#Estimate Std. Error z value Pr(>|z|)

#(Intercept) 1.73730 0.40678 4.271 1.95e-05 \*\*\*

#X.I -0.08642 0.19614 -0.441 0.66

1. Test: Total instigations of aggression against mating efficiency  
   Model: Spearman rank correlation coefficient   
   Result *r*s = 0.144, *N* = 96, *p* = 0.163  
     
   R Script:  
   cor.test(fdat$F.,fdat$X.I,method='spearman')

#Results:

#S = 126268, rho = 0.1435974, p-value = 0.1628

1. Test: Total duration of instigated aggression against mating success (1/0)  
   Model: Binary logistic regression  
   Result: z95 = -0.079, *p* = 0.937  
     
   R Script:   
   glm17=glm(Mated~TDur, data = aggmat, family = "binomial")

summary(glm17)

#Results:

#Estimate Std. Error z value Pr(>|z|)

#(Intercept) 1.628065 0.362382 4.493 7.03e-06 \*\*\*

#TDur -0.001033 0.013058 -0.079 0.937

1. Test: Average duration of instigated aggression against mating success (1/0)  
   Model: Binary logistic regression  
   Result: z95 = 0.147, *p* = 0.883  
     
   R Script:   
   glm18=glm(Mated~AvDur, data = aggmat, family = "binomial")

summary(glm18)

#Results:

#Estimate Std. Error z value Pr(>|z|)

#(Intercept) 1.569686 0.382045 4.109 3.98e-05 \*\*\*

#AvDur 0.004421 0.030043 0.147 0.883

1. Test: Total duration of instigated aggression against mating efficiency  
   Model: Spearman rank correlation coefficient  
   Result: *r*s = 0.096, *N* = 96, *p* = 0.353  
     
   R Script:   
   cor.test(fdat$F.,fdat$TDur,method='spearman')

#Results:

#S = 133308, rho = 0.09584849, p-value = 0.3529

1. Test: Average duration of instigated aggression against mating efficiency  
   Model: Spearman rank correlation coefficient  
   Result: *r*s = 0.089, *N* = 96, *p* = 0.391  
     
   R Script:   
   cor.test(fdat$F.,fdat$AvDur,method='spearman')

#Results:

#S = 134377, rho = 0.08860156, p-value = 0.3907

*Experience of aggression and mating success*

1. Test: Temporal behavioural pattern (000-111) against mating success (1/0)  
   Model: Spearman rank correlation coefficient  
   Result: χ221 = 12.652, *N* = 96, *p* = 0.179  
     
   R Script:   
   table(fdat$F., fdat$EC)

csM21=chisq.test(fdat$F., fdat$EC)

csM21

#X-squared = 12.652, df = 9, p-value = 0.179

1. Test: Temporal behavioural pattern (000-111) against mating efficiency  
   Model: Chi-square  
   Result: χ221 = 21.186, *N* = 96, *p* = 0.448  
     
   R Script:   
   table(aggmat$F., aggmat$E)

csM20=chisq.test(aggmat$F., aggmat$E)

csM20

#X-squared = 21.186, df = 21, p-value = 0.4476

1. Test: Experiment-level aggression (0-3) against mating success (1/0)  
   Model: Binary logistic regression  
   Result: z95 = -1.979, *p* = 0.048 \*  
     
   R Script:   
   glm23=glm(Mated~EC, data = aggmat, family = "binomial")

summary(glm23)

#Results:

#Estimate Std. Error z value Pr(>|z|)

#(Intercept) 2.3492 0.5044 4.658 3.2e-06 \*\*\*

#EC -0.5958 0.3010 -1.979 0.0478 \*

1. Test: Experiment-level aggression (0-3) against mating efficiency  
   Model: Spearman’s rank correlation coefficient   
   Result: t95 = *r*s = 0.223, *N* = 96, *p* = 0.261  
     
   R Script:   
   cor.test(aggmat$F.,aggmat$EC,method='spearman')

#S = 180324, rho = -0.2230326, p-value = 0.02895

#Bonferroni adjust signif. P-value for cor.test(F.,Agg)

9\*cor.test(aggmat$F.,aggmat$EC,method='spearman')$p.value

#Results:

#[1] 0.2605081

1. Test: Total experiences of aggression against mating success (1/0)  
   Model: Binary logistic regression  
   Result: z95 = -1.914, *p* = 0.056 .  
     
   R Script:   
   glm25=glm(Mated~X.E, data = aggmat, family = "binomial")

summary(glm25)

#Results:

#Estimate Std. Error z value Pr(>|z|)

#(Intercept) 2.1763 0.4341 5.013 5.35e-07 \*\*\*

#X.E -0.3447 0.1801 -1.914 0.0556 .

1. Test: Total experiences of aggression against mating efficiency  
   Model: Spearman rank correlation coefficient  
   Result: *r*s = 0.047, *N* = 96, *p* = 0.648  
     
   R Script:   
   cor.test(fdat$F.,fdat$X.E,method='spearman')

#Results:

#S = 140473, rho = 0.04725304, p-value = 0.6475

1. Test: Total duration of experienced aggression against mating success (1/0)  
   Model: Binary logistic regression  
   Result: z95 = -0.569, *p* = 0.569  
     
   R Script:   
   glm27=glm(Mated~TDurE, data = aggmat, family = "binomial")

summary(glm27)

#Results:

# Estimate Std. Error z value Pr(>|z|)

#(Intercept) 1.745447 0.372464 4.686 2.78e-06 \*\*\*

#TDurE -0.007194 0.012634 -0.569 0.569

1. Test: Average duration of experienced aggression against mating success (1/0)  
   Model: Binary logistic regression  
   Result: z95 = -0.596, *p* = 0.551

R Script:   
glm28=glm(Mated~AvDurE, data = aggmat, family = "binomial")

summary(glm28)

#Results:

# Estimate Std. Error z value Pr(>|z|)

#(Intercept) 1.75155 0.37248 4.702 2.57e-06 \*\*\*

#AvDurE -0.02257 0.03785 -0.596 0.551

1. Test: Total duration of experienced aggression against mating efficiency  
   Model: Spearman rank correlation coefficient  
   Result: *r*s = -0.056, *N* = 96, *p* = 0.587  
     
   R Script:   
   cor.test(fdat$F.,fdat$TDurE,method='spearman')

#Results:

#S = 155720, rho = -0.05616011, p-value = 0.5868

1. Test: Average duration of experienced aggression against mating efficiency  
   Model: Spearman rank correlation coefficient  
   Result: *r*s = 0.046, *N* = 96, *p* = 0.654  
     
   R Script:   
   cor.test(fdat$F.,fdat$AvDurE,method='spearman')

#Results:

#S = 154266, rho = -0.04629751, p-value = 0.6542

Male-instigated intersexual aggression and mating success:

1. Test: Behavioural consistency of instigating aggression against intersexual aggression (1/0)  
   Model: Binary logistic regression  
   Result: t95 = 0.597, *p* = 0.551  
     
   R Script:   
   glm31=glm(Aggb~IC, data = aggmat, family = "binomial")

summary(glm31)

#Results:

# Estimate Std. Error z value Pr(>|z|)

#(Intercept) -1.9847 0.4784 -4.149 3.34e-05 \*\*\*

#IC 0.1909 0.3198 0.597 0.551

1. Test: Behavioural consistency of experiencing aggression against intersexual aggression (1/0)  
   Model: Binary logistic regression  
   Result: t95 = 1.832, *p* = 0.067  
     
   R Script:   
   glm32=glm(Aggb~EC, data = aggmat, family = "binomial")

summary(glm32)

#Results:

# Estimate Std. Error t value Pr(>|t|)

#(Intercept) -2.4880 0.5327 -4.671 3e-06 \*\*\*

#EC 0.5770 0.3149 1.832 0.0669 .

1. Test: Total duration of aggression against intersexual aggression (1/0)  
   Model: Binary logistic regression  
   Result: t95 = -0.777, *p* = 0.437  
     
   R Script:   
   glm33=glm(Aggb~TDur, data = aggmat, family = "binomial")

summary(glm33)

#Results:

#Estimate Std. Error t value Pr(>|t|)

#(Intercept) -1.56598 0.37155 -4.215 2.5e-05 \*\*\*

#TDur -0.01256 0.01615 -0.777 0.437

1. Test: Average duration of aggression against intersexual aggression (1/0)  
   Model: Binary logistic regression  
   Result: t95 = -1.018, *p* = 0.309  
     
   R Script:   
   glm34=glm(Aggb~AvDur, data = aggmat, family = "binomial")

summary(glm34)

#Results:

# Estimate Std. Error t value Pr(>|t|)

#(Intercept) -1.46731 0.38953 -3.767 0.000165 \*\*\*

#AvDur -0.03728 0.03661 -1.018 0.308514

1. Test: Intersexual aggression (1/0) against mating success (1/0)  
   Model: Chi-square  
   Result: χ21 = 40.156, *N* = 96, *p* < 0.001 \*\*\*  
     
   R Script:   
   table(aggmat$Mated, aggmat$Aggb)

csM4f=chisq.test(aggmat$Mated, aggmat$Aggb)

csM4f

#X-squared = 40.156, df = 1, p-value = 2.345e-10 \*\*\*

1. Test: Intersexual aggression (1/0) against mating efficiency  
   Model: Wilcoxon rank-sum test  
   Result: t95 = -5.561, *p* < 0.001 \*\*\*  
     
   R Script:   
   wilcox.test(fdat$F.~fdat$Aggb)

#Results:

#W = 147, p-value = 2.294e-07 \*\*\*

1. Test: Intersexual aggression behavioural consistency (0-3) against mating success (1/0)  
   Model: Binary logistic regression  
   Result: W = 147, *p* < 0.001 \*\*\*  
     
   R Script:   
   glm37=glm(Mated~Agg, data = aggmat, family = "binomial")

summary(glm37)

#Results:

# Estimate Std. Error z value Pr(>|z|)

#(Intercept) 2.7394 0.4613 5.938 2.89e-09 \*\*\*

#Agg -3.6091 0.8144 -4.432 9.35e-06 \*\*\*

1. Test: Intersexual aggression behavioural consistency (0-3) against mating efficiency  
   Model: Spearman rank correlation coefficient with Bonferroni adjustment  
   Result: *r*s = 0.537, *N* = 96, *p* < 0.001 \*\*\*  
     
   R Script:   
   cor.test(fdat$F.,fdat$Agg,method='spearman')

#S = 68274, rho = 0.5369355, p-value = 1.705e-08 \*\*\*

#Bonferroni adjust signif. P-value for cor.test(F.,Agg)

9\*cor.test(fdat$F.,fdat$Agg,method='spearman')$p.value

#Results:

#[1] 1.534501e-07 \*\*\*

**Figures**

library(tidyverse)

View(figs)

## Graph colours

colours <- c("#FFFFFF", "#D3D3D3", "#747474", "#000000")

######################### Figure\_1 ##########################

# Cricket line drawing figure (no associated code)

######################### Figure\_2 ##########################

## set AggPattern as character

is.character(figs$AggPattern)

figs$AggPattern <- as.character(figs$AggPattern)

figs$AggFBin <- as.character(figs$AggFBin)

# select the columns from dataset and remove NAs

ex <- subset(figs,select = c("AggPattern", "IPatternFreq", "EPatternFreq"))

ex <- na.omit(ex)

ex$Inst\_Prop <- ex$IPatternFreq

ex$Inst\_Prop <- with(ex, Inst\_Prop /124)

ex$Exp\_Prop <- ex$EPatternFreq

ex$Exp\_Prop <- with(ex, Exp\_Prop /124)

## Rename columns for plot legend later

ex <- rename(ex, Instigated = Inst\_Prop, Experienced = Exp\_Prop)

## convert data into long format (requires tidyverse)

ex\_long <- gather(ex,PatternFreq,Frequency,Instigated:Experienced)

## GGplot

fig\_2 <- ggplot(data = ex\_long, aes(x = AggPattern, y = Frequency, fill = PatternFreq))+

geom\_col(position = position\_dodge2 (reverse = TRUE), width = 0.5, col = "#000000")+

theme\_classic()+

scale\_fill\_manual(values = (colours))+

ylab("Proportion of males")+

xlab("Temporal behavioural pattern category")+

theme(legend.title = element\_blank())+

theme(legend.position = c(0.9, 0.9))+

scale\_y\_continuous(limits = c(0,0.3), breaks = c(0,0.05,0.1,0.15,0.2,0.25,0.3))+

scale\_x\_discrete(labels = c("000", "001","010","100","101","011", "110","111"))

######################### Figure\_3 ##########################

# select the columns in the dataset and remove NAs

f3 <- subset(figs,select = c("TrialsE", "AvMatSucE", "AvMatSucESEProp"))

f3 <- na.omit(f3)

fig\_3 <- ggplot(data = f3, aes(x = TrialsE, y = AvMatSucE))+

geom\_col(col = "#000000", fill = "#FFFFFF")+

geom\_errorbar(aes(ymin = AvMatSucE-AvMatSucESEProp, ymax = AvMatSucE+AvMatSucESEProp), width = 0.2)+

theme\_classic()+

ylab("Proportion of males that mated")+

xlab("Number of trials in which males experienced aggression")+

scale\_y\_continuous(limits = c(0,1))

######################### Figure\_4 ##########################

f4 <- subset(figs,select = c("AggE","MatEfE1Prop","MatEfE2Prop", "MatEfE3Prop", "NMEProp"))

f4 <- na.omit(f4)

f4 <- rename(f4, `High Efficiency` = MatEfE1Prop, `Medium Efficiency` = MatEfE2Prop, `Low Efficiency` = MatEfE3Prop, `Never Mated` = NMEProp)

f4\_long <- gather(f4, Number\_Males,Frequency,`High Efficiency`:`Never Mated`)

f4\_long$Number\_Males <- factor(f4\_long$Number\_Males, levels=c('High Efficiency', 'Medium Efficiency', 'Low Efficiency', 'Never Mated'))

fig\_4 <- ggplot(f4\_long,aes(AggE,Frequency,fill = Number\_Males))+

geom\_col(col = "#000000")+

theme\_classic()+

scale\_fill\_manual(values = (colours))+

xlab("Number of aggressive encounters experienced")+

ylab("Proportion of males")+

theme(legend.title = element\_blank())+

theme(legend.position = c(0.7, 0.7))+

scale\_y\_continuous(limits = c(0,0.4))+

scale\_x\_continuous(limits = c(-1,8), breaks = c(0,1,2,3,4,5,6,7))

fig\_4

######################### Figure\_5a ##########################

f5 <- subset(figs, select = c("AggFBin", "AvMatSucFBin", "AvMatSucFBinSEProp"))

f5 <- na.omit(f5)

fig\_5a <- ggplot(f5,aes(AggFBin,AvMatSucFBin))+

geom\_col(col = "#000000", fill = "#FFFFFF", width = 0.5)+

geom\_errorbar(aes(ymin = AvMatSucFBin-AvMatSucFBinSEProp, ymax = AvMatSucFBin+AvMatSucFBinSEProp), width = 0.1)+

theme\_classic()+

scale\_fill\_manual(values = (colours))+

ylab("Proportion of males that mated")+

xlab("Male-instigated intersexual aggression")

######################### Figure\_5b ##########################

f6 <- subset(figs, select = c("AggFBin", "MatEfFBin1Prop", "MatEfFBin2Prop", "MatEfFBin3Prop", "NMFBinProp"))

f6 <- na.omit(f6)

f6 <- rename(f6, `High Efficiency` = MatEfFBin1Prop, `Medium Efficiency` = MatEfFBin2Prop, `Low Efficiency` = MatEfFBin3Prop, `Never Mated` = NMFBinProp)

f6\_long <- gather(f6, Number\_Males,Frequency,`High Efficiency`:`Never Mated`)

f6\_long$Number\_Males <- factor(f6\_long$Number\_Males, levels=c('High Efficiency', 'Medium Efficiency', 'Low Efficiency', 'Never Mated'))

fig\_5b <- ggplot(f6\_long,aes(AggFBin,Frequency,fill = Number\_Males))+

geom\_col(col = "#000000", width = 0.5)+

theme\_classic()+

scale\_fill\_manual(values = (colours))+

theme(legend.title = element\_blank())+

theme(legend.position = c(0.8, 0.7))+

ylab("Proportion of males")+

xlab("Male-instigated intersexual aggression")+

scale\_y\_continuous(limits = c(0,1))

######################### Figure\_5c ##########################

f7 <- subset(figs, select = c("AggF", "AvMatSucF", "AvMatSucFSEProp"))

f7 <- na.omit(f7)

fig\_5c <- ggplot(f7,aes(AggF,AvMatSucF))+

geom\_col(col = "#000000", fill = "#FFFFFF")+

geom\_errorbar(aes(ymin = AvMatSucF-AvMatSucFSEProp, ymax = AvMatSucF+AvMatSucFSEProp), width = 0.2)+

theme\_classic()+

scale\_fill\_manual(values = (colours))+

ylab("Proportion of males that mated")+

xlab("Instances of male-instigated intersexual aggression")

######################### Figure\_5d ##########################

f8 <- subset(figs, select = c("AggF", "MatEfF1Prop", "MatEfF2Prop", "MatEfF3Prop", "NMFProp"))

f8 <- na.omit(f8)

f8 <- rename(f8, `High Efficiency` = MatEfF1Prop, `Medium Efficiency` = MatEfF2Prop, `Low Efficiency` = MatEfF3Prop, `Never Mated` = NMFProp)

f8\_long <- gather(f8, Number\_Males,Frequency,`High Efficiency`:`Never Mated`)

f8\_long$Number\_Males <- factor(f8\_long$Number\_Males, levels=c('High Efficiency', 'Medium Efficiency', 'Low Efficiency', 'Never Mated'))

fig\_5d <- ggplot(f8\_long,aes(AggF,Frequency,fill = Number\_Males), width = 0.2)+

geom\_col(col = "#000000")+

theme\_classic()+

scale\_fill\_manual(values=c("#FFFFFF", "#D3D3D3", "#747474", "#000000"))+

ylab("Proportion of males")+

xlab("Instances of male-instigated intersexual aggression")+

theme(legend.title = element\_blank())+

theme(legend.position = c(0.8, 0.7))+

scale\_y\_continuous(limits = c(0,1))

######################### Figure\_5 Composite ##########################

# Make composite figure (Fig. 5) options:

install.packages("gridExtra")

library("gridExtra")

#2x2 grid: par(mfrow = c(2, 2))

Fig\_5 = grid.arrange(fig\_5a,fig\_5b, fig\_5c, fig\_5d, ncol = 2, nrow = 2)

##############################################################################

# All Figures:

fig\_2

fig\_3

fig\_4

fig\_5