

## Supplementary Material

```
#load library
library(rmcorr)
library(tidyverse)
library(devtools)
library(pacman)
library(readxl)
library(ggplot2)
library(lme4)
library(cocor)
library(performance)
library(sjstats)
library(car)

#import basketball & weightlifting data
bb_data <- read_excel("~/Desktop/PhD ECU [ACU]/IJSSP Spurious Correl
Editorial/WLBBSpuriousCorrel.xlsx", sheet = "BB")
wl_data <- read_excel("~/Desktop/PhD ECU [ACU]/IJSSP Spurious Correl
Editorial/WLBBSpuriousCorrel.xlsx", sheet = "WL")
View(bb_data)
View(wl_data)

#### CORRELATIONS
#get rm correlations between variables in bb_data
bb_el_coupledRA_r <- rmcorr(participant = athlete, measure1 = el_acuteRA,
measure2 = el_chronicC_RA, dataset=bb_data)
bb_el_uncoupledRA_r <- rmcorr(athlete, el_acuteRA, el_chronicUNC_RA, bb_data)
bb_el_ACWRRRA_r <- rmcorr(athlete, el_acwrC_RA, el_acwrUNC_RA, bb_data)
bb_el_coupledEWMA_r <- rmcorr(athlete, el_acuteEWMA, el_chronicC_EWMA,
bb_data)
bb_el_uncoupledEWMA_r <- rmcorr(athlete, el_acuteEWMA,
el_chronicUNC_EWMA, bb_data)
bb_el_ACWREWMA_r <- rmcorr(athlete, el_acwrC_EWMA, el_acwrUNC_EWMA,
bb_data)

bb_il_coupledRA_r <- rmcorr(athlete, il_acuteRA, il_chronicC_RA, bb_data)
bb_il_uncoupledRA_r <- rmcorr(athlete, il_acuteRA, il_chronicUNC_RA, bb_data)
bb_il_ACWRRRA_r <- rmcorr(athlete, il_acwrC_RA, il_acwrUNC_RA, bb_data)
bb_il_coupledEWMA_r <- rmcorr(athlete, il_acuteEWMA, il_chronicC_EWMA,
bb_data)
bb_il_uncoupledEWMA_r <- rmcorr(athlete, il_acuteEWMA, il_chronicUNC_EWMA,
bb_data)
bb_il_ACWREWMA_r <- rmcorr(athlete, il_acwrC_EWMA, il_acwrUNC_EWMA,
bb_data)

#call results
bb_el_coupledRA_r
```

bb\_el\_uncoupledRA\_r

bb\_el\_ACWRRRA\_r

bb\_el\_coupledEWMA\_r

bb\_el\_uncoupledEWMA\_r

bb\_el\_ACWREWMA\_r

bb\_il\_coupledRA\_r

bb\_il\_uncoupledRA\_r

bb\_il\_ACWRRRA\_r

bb\_il\_coupledEWMA\_r

bb\_il\_uncoupledEWMA\_r

bb\_il\_ACWREWMA\_r

#get correlations between variables in wl\_data

wl\_il\_coupledRA\_r <- rmcrr(ATHLETE, il\_acuteRA, il\_chronicC\_RA, wl\_data)

wl\_il\_uncoupledRA\_r <- rmcrr(ATHLETE, il\_acuteRA, il\_chronicUNC\_RA, wl\_data)

wl\_il\_ACWRRRA\_r <- rmcrr(ATHLETE, il\_acwrC\_RA, il\_acwrUNC\_RA, wl\_data)

wl\_il\_coupledEWMA\_r <- rmcrr(ATHLETE, il\_acuteEWMA, il\_chronicC\_EWMA,  
wl\_data)

wl\_il\_uncoupledEWMA\_r <- rmcrr(ATHLETE, il\_acuteEWMA,  
il\_chronicUNC\_EWMA, wl\_data)

wl\_il\_ACWREWMA\_r <- rmcrr(ATHLETE, il\_acwrC\_EWMA, il\_acwrUNC\_EWMA,  
wl\_data)

#call results

wl\_il\_coupledRA\_r

wl\_il\_uncoupledRA\_r

wl\_il\_ACWRRRA\_r

wl\_il\_coupledEWMA\_r

wl\_il\_uncoupledEWMA\_r

wl\_il\_ACWREWMA\_r

#compare correlations in data (refer back to correlation data)

colSums(!is.na(bb\_data))

bb\_el\_chronicRA\_rcorr <- cocor.indep.groups(0.51, 0.02, 1312, 1312, alternative =  
"two sided")

```
bb_el_chronicEWMA_rcorr <- cocor.indep.groups(0.56, -0.05, 1612,1612, alternative = "two sided")
bb_il_chronicRA_rcorr <- cocor.indep.groups(0.52, 0.10, 1312,1312, alternative = "two sided")
bb_il_chronicEWMA_rcorr <- cocor.indep.groups(0.66, 0.13, 1612,1612, alternative = "two sided")
colSums(!is.na(wl_data))
wl_il_chronicRA_rcorr <- cocor.indep.groups(0.70, -0.14, 496,496, alternative = "two sided")
wl_il_chronicEWMA_rcorr <- cocor.indep.groups(0.62, 0.00, 976,976, alternative = "two sided")
```

```
#call results
```

```
bb_el_chronicRA_rcorr
```

```
bb_el_chronicEWMA_rcorr
```

```
bb_il_chronicRA_rcorr
```

```
bb_il_chronicEWMA_rcorr
```

```
wl_il_chronicRA_rcorr
```

```
wl_il_chronicEWMA_rcorr
```

```
##### MIXED MODELS #####
```

```
#mixed models for bball
```

```
#create long data for bball chronic load comparisons
```

```
bb_chronic_eIRA <- bb_data %>% select(athlete, day, el_chronicC_RA, el_chronicUNC_RA) %>% rename(coupled = el_chronicC_RA, uncoupled = el_chronicUNC_RA)
```

```
bb_chronic_eIEWMA <- bb_data %>% select(athlete, day, el_chronicC_EWMA, el_chronicUNC_EWMA) %>% rename(coupled = el_chronicC_EWMA, uncoupled = el_chronicUNC_EWMA)
```

```
bb_chronic_ilRA <- bb_data %>% select(athlete, day, il_chronicC_RA, il_chronicUNC_RA) %>% rename(coupled = il_chronicC_RA, uncoupled = il_chronicUNC_RA)
```

```
bb_chronic_ilIEWMA <- bb_data %>% select(athlete, day, il_chronicC_EWMA, il_chronicUNC_EWMA) %>% rename(coupled = il_chronicC_EWMA, uncoupled = il_chronicUNC_EWMA)
```

```
bb_chronic_eIRA_long <- gather(bb_chronic_eIRA, condition, score, coupled, uncoupled, factor_key=TRUE) %>% drop_na()
```

```
bb_chronic_eIEWMA_long <- gather(bb_chronic_eIEWMA, condition, score, coupled, uncoupled, factor_key=TRUE) %>% drop_na()
```

```
bb_chronic_ilRA_long <- gather(bb_chronic_ilRA, condition, score, coupled, uncoupled, factor_key=TRUE) %>% drop_na()
```

```
bb_chronic_ilIEWMA_long <- gather(bb_chronic_ilIEWMA, condition, score, coupled, uncoupled, factor_key=TRUE) %>% drop_na()
```

```
#create long data for bball acwr comparisons
bb_acwr_eIRA <- bb_data %>% select(athlete, day, el_acwrC_RA,
el_acwrUNC_RA) %>% rename(coupled = el_acwrC_RA, uncoupled =
el_acwrUNC_RA)
bb_acwr_eEWMA <- bb_data %>% select(athlete, day, el_acwrC_EWMA,
el_acwrUNC_EWMA) %>% rename(coupled = el_acwrC_EWMA, uncoupled =
el_acwrUNC_EWMA)
bb_acwr_iIRA <- bb_data %>% select(athlete, day, il_acwrC_RA, il_acwrUNC_RA)
%>% rename(coupled = il_acwrC_RA, uncoupled = il_acwrUNC_RA)
bb_acwr_iEWMA <- bb_data %>% select(athlete, day, il_acwrC_EWMA,
il_acwrUNC_EWMA) %>% rename(coupled = il_acwrC_EWMA, uncoupled =
il_acwrUNC_EWMA)

bb_acwr_eIRA_long <- gather(bb_acwr_eIRA, condition, score, coupled, uncoupled,
factor_key=TRUE) %>% drop_na()
bb_acwr_eEWMA_long <- gather(bb_acwr_eEWMA, condition, score, coupled,
uncoupled, factor_key=TRUE) %>% drop_na()
bb_acwr_iIRA_long <- gather(bb_acwr_iIRA, condition, score, coupled, uncoupled,
factor_key=TRUE) %>% drop_na()
bb_acwr_iEWMA_long <- gather(bb_acwr_iEWMA, condition, score, coupled,
uncoupled, factor_key=TRUE) %>% drop_na()

#create mixed models for bball chronic coupled v uncoupled external load
#RA chronic model external load
bb_chronic_eIRA_model <- lmer(score ~ condition + (1|day) + (1|athlete),
bb_chronic_eIRA_long)
summary(bb_chronic_eIRA_model)
performance::r2(bb_chronic_eIRA_model)
std_beta(bb_chronic_eIRA_model)

#model assumptions
plot(bb_chronic_eIRA_model)
qqp(resid(bb_chronic_eIRA_model), "norm")

#create model without coupling effect and R2 calculation of effect size
bb_chronic_eIRA_model1 <- lmer(score ~ (1|day) + (1|athlete),
bb_chronic_eIRA_long)
summary(bb_chronic_eIRA_model1)
performance::r2(bb_chronic_eIRA_model1)

#refer to results of r2
bb_chronic_eIRA_F2marg <- (0.001-0.00)/(1-0.001)
bb_chronic_eIRA_F2marg

#EWMA chronic model external load
bb_chronic_eIEWMA_model <- lmer(score ~ condition + (1|day) + (1|athlete),
bb_chronic_eIEWMA_long)
summary(bb_chronic_eIEWMA_model)
performance::r2(bb_chronic_eIEWMA_model)
std_beta(bb_chronic_eIEWMA_model)
```

```
#model assumptions
plot(bb_chronic_eIEWMA_model)
qqp(resid(bb_chronic_eIEWMA_model), "norm")

#create model without coupling effect and R2 calculation of effect size
bb_chronic_eIEWMA_model1 <- lmer(score ~ (1|day) + (1|athlete),
bb_chronic_eIEWMA_long)
summary(bb_chronic_eIEWMA_model1)
performance::r2(bb_chronic_eIEWMA_model1)

#refer to results of r2
bb_chronic_eIEWMA_F2marg <- (0.000-0.000)/(1-0.000)
bb_chronic_eIEWMA_F2marg

#create mixed models for bball chronic coupled v uncoupled internal load
#RA chronic model internal load
bb_chronic_ilRA_model <- lmer(score ~ condition + (1|day) + (1|athlete),
bb_chronic_ilRA_long)
summary(bb_chronic_ilRA_model)
performance::r2(bb_chronic_ilRA_model)

#model assumptions
plot(bb_chronic_ilRA_model)
qqp(resid(bb_chronic_ilRA_model), "norm")

#create model without coupling effect and R2 calculation of effect size
bb_chronic_ilRA_model1 <- lmer(score ~ (1|day) + (1|athlete),
bb_chronic_ilRA_long)
summary(bb_chronic_ilRA_model1)
performance::r2(bb_chronic_ilRA_model1)
#refer to resultys of r2
bb_chronic_ilRA_F2marg <- (0.000-0.000)/(1-0.000)
bb_chronic_ilRA_F2marg

#EWMA chronic model internal load
bb_chronic_iIEWMA_model <- lmer(score ~ condition + (1|day) + (1|athlete),
bb_chronic_iIEWMA_long)
summary(bb_chronic_iIEWMA_model)
performance::r2(bb_chronic_iIEWMA_model)

#model assumptions
plot(bb_chronic_iIEWMA_model)
qqp(resid(bb_chronic_ilRA_model), "norm")

#create model without coupling effect and R2 calculation of effect size
bb_chronic_iIEWMA_model1 <- lmer(score ~ (1|day) + (1|athlete),
bb_chronic_iIEWMA_long)
summary(bb_chronic_iIEWMA_model1)
performance::r2(bb_chronic_iIEWMA_model1)
```

```
#refer to resultys of r2
bb_chronic_iIEWMA_F2marg <- (0.000-0.000)/(1-0.000)
bb_chronic_iIEWMA_F2marg

#create mixed models for bball acwr coupled v uncoupled external load
#RA acwr model external load
bb_acwr_eIRA_model <- lmer(score ~ condition + (1|day) + (1|athlete),
bb_acwr_eIRA_long)
summary(bb_acwr_eIRA_model)
performance::r2(bb_acwr_eIRA_model)

#model assumptions
plot(bb_acwr_eIRA_model)
qqp(resid(bb_acwr_eIRA_model), "norm")

#create model without coupling effect and R2 calculation of effect size
bb_acwr_eIRA_model1 <- lmer(score ~ (1|day) + (1|athlete), bb_acwr_eIRA_long)
summary(bb_acwr_eIRA_model1)
performance::r2(bb_acwr_eIRA_model1)
#refer to resultys of r2
bb_acwr_eIRA_F2marg <- (0.001-0.000)/(1-0.001)
bb_acwr_eIRA_F2marg

#EWMA acwr model external load
bb_acwr_eIEWMA_model <- lmer(score ~ condition + (1|day) + (1|athlete),
bb_acwr_eIEWMA_long)
summary(bb_acwr_eIEWMA_model)
performance::r2(bb_acwr_eIEWMA_model)

#model assumptions
plot(bb_acwr_eIEWMA_model)
qqp(resid(bb_acwr_eIEWMA_model), "norm")

#create model without coupling effect and R2 calculation of effect size
bb_acwr_eIEWMA_model1 <- lmer(score ~ (1|day) + (1|athlete),
bb_acwr_eIEWMA_long)
summary(bb_acwr_eIEWMA_model1)
performance::r2(bb_acwr_eIEWMA_model1)
#refer to resultys of r2
bb_acwr_eIEWMA_F2marg <- (0.004-0.000)/(1-0.004)
bb_acwr_eIEWMA_F2marg

#create mixed models for bball acwr coupled v uncoupled internal load
#RA acwr model internal load
bb_acwr_iIRA_model <- lmer(score ~ condition + (1|day) + (1|athlete),
bb_acwr_iIRA_long)
summary(bb_acwr_iIRA_model)
```

```
performance::r2(bb_acwr_ilRA_model)

#model assumptions
plot(bb_acwr_ilRA_model)
qqp(resid(bb_acwr_ilRA_model), "norm")

#create model without coupling effect and R2 calculation of effect size
bb_acwr_ilRA_model1 <- lmer(score ~ (1|day) + (1|athlete), bb_acwr_ilRA_long)
summary(bb_acwr_ilRA_model1)
performance::r2(bb_acwr_ilRA_model1)
#refer to resultys of r2
bb_acwr_ilRA_F2marg <- (0.005-0.000)/(1-0.005)
bb_acwr_ilRA_F2marg

#EWMA acwr model internal load
bb_acwr_iIEWMA_model <- lmer(score ~ condition + (1|day) + (1|athlete),
bb_acwr_iIEWMA_long)
summary(bb_acwr_iIEWMA_model)
performance::r2(bb_acwr_iIEWMA_model)

#model assumptions
plot(bb_acwr_iIEWMA_model)
qqp(resid(bb_acwr_iIEWMA_model), "norm")

#create model without coupling effect and R2 calculation of effect size
bb_acwr_iIEWMA_model1 <- lmer(score ~ (1|day) + (1|athlete),
bb_acwr_iIEWMA_long)
summary(bb_acwr_iIEWMA_model1)
performance::r2(bb_acwr_iIEWMA_model1)
#refer to results of r2
bb_acwr_iIEWMA_F2marg <- (0.009-0.000)/(1-0.009)
bb_acwr_iIEWMA_F2marg

#mixed models for weightlifting
#create long data for weightlifting chronic load comparisons
wl_chronic_ilRA <- wl_data %>% select(ATHLETE, day, il_chronicC_RA,
il_chronicUNC_RA) %>% rename(coupled = il_chronicC_RA, uncoupled =
il_chronicUNC_RA)
wl_chronic_iIEWMA <- wl_data %>% select(ATHLETE, day, il_chronicC_EWMA,
il_chronicUNC_EWMA) %>% rename(coupled = il_chronicC_EWMA, uncoupled =
il_chronicUNC_EWMA)

wl_chronic_ilRA_long <- gather(wl_chronic_ilRA, condition, score, coupled,
uncoupled, factor_key=TRUE) %>% drop_na()
wl_chronic_iIEWMA_long <- gather(wl_chronic_iIEWMA, condition, score, coupled,
uncoupled, factor_key=TRUE) %>% drop_na()

#create long data for weightlifting acwr comparisons
```

```
wl_acwr_iIRA <- wl_data %>% select(ATHLETE, day, il_acwrC_RA,  
il_acwrUNC_RA) %>% rename(coupled = il_acwrC_RA, uncoupled =  
il_acwrUNC_RA)  
wl_acwr_iEWMA <- wl_data %>% select(ATHLETE, day, il_acwrC_EWMA,  
il_acwrUNC_EWMA) %>% rename(coupled = il_acwrC_EWMA, uncoupled =  
il_acwrUNC_EWMA)  
  
wl_acwr_iIRA_long <- gather(wl_acwr_iIRA, condition, score, coupled, uncoupled,  
factor_key=TRUE) %>% drop_na()  
wl_acwr_iEWMA_long <- gather(wl_acwr_iEWMA, condition, score, coupled,  
uncoupled, factor_key=TRUE) %>% drop_na()  
  
#create mixed models for weightlifting chronic coupled v uncoupled internal load  
#RA chronic internal load  
wl_chronic_iIRA_model <- lmer(score ~ condition + (1|day) + (1|ATHLETE),  
wl_chronic_iIRA_long)  
summary(wl_chronic_iIRA_model)  
performance::r2(wl_chronic_iIRA_model)  
  
#model assumptions  
plot(wl_chronic_iIRA_model)  
qqp(resid(wl_chronic_iIRA_model), "norm")  
  
#create model without coupling effect and R2 calculation of effect size  
wl_chronic_iIRA_model1 <- lmer(score ~ (1|day) + (1|ATHLETE),  
wl_chronic_iIRA_long)  
summary(wl_chronic_iIRA_model1)  
performance::r2(wl_chronic_iIRA_model1)  
#refer to results of r2  
wl_chronic_iIRA_F2marg <- (0.005-0.000)/(1-0.005)  
wl_chronic_iIRA_F2marg  
  
#EWMA model internal load  
wl_chronic_iEWMA_model <- lmer(score ~ condition + (1|day) + (1|ATHLETE),  
wl_chronic_iEWMA_long)  
summary(wl_chronic_iEWMA_model)  
performance::r2(wl_chronic_iEWMA_model)  
  
#model assumptions  
plot(wl_chronic_iEWMA_model)  
qqp(resid(wl_chronic_iEWMA_model), "norm")  
  
#create model without coupling effect and R2 calculation of effect size  
wl_chronic_iEWMA_model1 <- lmer(score ~ (1|day) + (1|ATHLETE),  
wl_chronic_iEWMA_long)  
summary(wl_chronic_iEWMA_model1)  
performance::r2(wl_chronic_iEWMA_model1)  
#refer to results of r2  
wl_chronic_iEWMA_F2marg <- (0.000-0.000)/(1-0.000)
```



wl\_chronic\_iEWMA\_F2marg

```
#create mixed models for weightlifting acwr coupled v uncoupled internal load
#RA acwr model internal load
wl_acwr_iRA_model <- lmer(score ~ condition + (1|day) + (1|ATHLETE),
wl_acwr_iRA_long)
summary(wl_acwr_iRA_model)
performance::r2(wl_acwr_iRA_model)

#model assumptions
plot(wl_acwr_iRA_model)
qqp(resid(wl_acwr_iRA_model), "norm")

#create model without coupling effect and R2 calculation of effect size
wl_acwr_iRA_model1 <- lmer(score ~ (1|day) + (1|ATHLETE), wl_acwr_iRA_long)
summary(wl_acwr_iRA_model1)
performance::r2(wl_acwr_iRA_model1)
#refer to results of r2
wl_acwr_iRA_F2marg <- (0.001-0.000)/(1-0.001)
wl_acwr_iRA_F2marg

#EWMA acwr model internal load
wl_acwr_iEWMA_model <- lmer(score ~ condition + (1|day) + (1|ATHLETE),
wl_acwr_iEWMA_long)
summary(wl_acwr_iEWMA_model)
performance::r2(wl_acwr_iEWMA_model)

#model assumptions
plot(wl_acwr_iEWMA_model)
qqp(resid(wl_acwr_iEWMA_model), "norm")

#create model without coupling effect and R2 calculation of effect size
wl_acwr_iEWMA_model1 <- lmer(score ~ (1|day) + (1|ATHLETE),
wl_acwr_iEWMA_long)
summary(wl_acwr_iEWMA_model1)
performance::r2(wl_acwr_iEWMA_model1)
#refer to results of r2
wl_acwr_iEWMA_F2marg <- (0.000-0.000)/(1-0.000)
wl_acwr_iEWMA_F2marg
```