Woods\_Tension+Step+Kinetics\_Analysis.R

Phil

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## Masters Thesis: Stretch activation and fatigue   
## Tension + Step + Kinetics Analysis  
## Philip C. Woods  
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library(tidyverse)  
library(readxl)  
library(tcltk)  
library(ggpubr)  
library(plotly)  
library(grid)  
theme\_set(theme\_classic())  
  
  
### Original loading in of data --------------------------------------------------  
setwd("C:/Users/Phil/Dropbox/Thesis- Stretch Activation/Data/Woods - Master's Thesis/Project/Tension + AaBbCc")  
  
my\_data <- read\_excel("SA-Fatigue\_Tension+Step+Kinetics\_PW\_10-5-22.xlsx",   
 sheet = "Trimmed",  
 skip = 5,  
 na="")  
phil\_awesome\_data <-  
 my\_data %>%   
 dplyr::filter(Exp\_Con\_Num %in% c(2:7)) %>%  
 dplyr::filter(fiber\_type\_num %in% c(1:7)) %>%   
 dplyr::group\_by(fiber\_type\_num, Exp\_Con) %>%   
 dplyr::summarize(n = n(),  
 p0\_pre\_step\_avg = mean(Po\_Pre\_Step, na.rm=T),  
 p0\_pre\_step\_sd = sd(Po\_Pre\_Step, na.rm=T),  
 p0\_pre\_step\_se = sd(Po\_Pre\_Step, na.rm=T)/sqrt(n()),  
 fsa\_avg = mean(Fsa, na.rm = T),  
 fsa\_sd = sd(Fsa, na.rm = T),  
 fsa\_se = sd(Fsa, na.rm = T)/sqrt(n()),  
 fsaf0\_avg = mean(FsaF0, na.rm = T),  
 fsaf0\_sd = sd(FsaF0, na.rm = T),  
 fsaf0\_se = sd(FsaF0, na.rm = T)/sqrt(n()),  
 fsatotal\_avg = mean(Fsa\_total, na.rm = T),  
 fsatotal\_sd = sd(Fsa\_total, na.rm = T),  
 fsatotal\_se = sd(Fsa\_total, na.rm = T)/sqrt(n()),  
 a2\_avg = mean(a2, na.rm=T),  
 a2\_sd = sd(a2, na.rm = T),  
 a2\_se = sd(a2, na.rm = T)/sqrt(n()),  
 r2\_avg = mean(r2, na.rm = T),  
 r2\_sd = sd(r2, na.rm = T),  
 r2\_se = sd(r2, na.rm = T)/sqrt(n()),  
 a3\_avg = mean(a3, na.rm=T),  
 a3\_sd = sd(a3, na.rm = T),  
 a3\_se = sd(a3, na.rm = T)/sqrt(n()),  
 r3\_avg = mean(r3, na.rm = T),  
 r3\_sd = sd(r3, na.rm = T),  
 r3\_se = sd(r3, na.rm = T)/sqrt(n()),  
 a4\_avg = mean(a4, na.rm=T),  
 a4\_sd = sd(a4, na.rm = T),  
 a4\_se = sd(a4, na.rm = T)/sqrt(n()),  
 r4\_avg = mean(r4, na.rm = T),  
 r4\_sd = sd(r4, na.rm = T),  
 r4\_se = sd(r4, na.rm = T)/sqrt(n()),  
 )  
  
  
## Graphs - Averages ---------------------------------------------------------------  
  
  
# Brent example of copy and paste ggplots  
# gg1 <-  
# ggplot(phil\_awesome\_data,   
# aes(Exp\_Con, fsa\_avg))+  
# geom\_point()+  
# geom\_errorbar(aes(ymin=fsa\_avg -fsa\_se,   
# ymax=fsa\_avg+fsa\_se),   
# width=0.25)+  
# facet\_wrap(~Muscle)  
#   
#   
# ggplotly(gg1)  
  
  
(f0\_gg <- ggplot(data = phil\_awesome\_data,  
 aes(x = factor(Exp\_Con,   
 levels = c("Fat\_5.2",   
 "Fat\_5.1",  
 "Fat\_5.0",  
 "Fat\_4.5",   
 "Active",  
 "Active\_2")),  
 y = p0\_pre\_step\_avg,  
 color = Muscle)) +  
 geom\_point() +  
   
 geom\_line(aes(group = Muscle)) +  
   
 scale\_color\_manual(breaks = c("Soleus", "EDL"),  
 values = c("red", "blue")) +  
 geom\_errorbar(aes(ymin = p0\_pre\_step\_avg - p0\_pre\_step\_se,  
 ymax = p0\_pre\_step\_avg + p0\_pre\_step\_se,  
 width = 0.1)) +  
 ylab("F0") +  
 xlab("Experimental Conditions")  
   
)  
  
(fsa\_gg <- ggplot(data = phil\_awesome\_data,  
 aes(x = factor(Exp\_Con,   
 levels = c("Fat\_5.2",   
 "Fat\_5.1",  
 "Fat\_5.0",  
 "Fat\_4.5",   
 "Active",  
 "Active\_2")),  
 y = fsa\_avg,  
 color = Muscle)) +  
 geom\_point() +  
   
 geom\_line(aes(group = Muscle)) +  
   
 scale\_color\_manual(breaks = c("Soleus", "EDL"),  
 values = c("red", "blue")) +  
 geom\_errorbar(aes(ymin = fsa\_avg - fsa\_se,  
 ymax = fsa\_avg + fsa\_se,  
 width = 0.1)) +  
 ylab("Fsa") +  
 xlab("Experimental Conditions")  
   
)  
  
(fsaf0\_gg <- ggplot(data = phil\_awesome\_data,  
 aes(x = factor(Exp\_Con,   
 levels = c("Fat\_5.2",   
 "Fat\_5.1",  
 "Fat\_5.0",  
 "Fat\_4.5",   
 "Active",  
 "Active\_2")),  
 y = fsaf0\_avg,  
 color = Muscle)) +  
 geom\_point() +  
   
 geom\_line(aes(group = Muscle)) +  
   
 scale\_color\_manual(breaks = c("Soleus", "EDL"),  
 values = c("red", "blue")) +  
 geom\_errorbar(aes(ymin = fsaf0\_avg - fsaf0\_se,  
 ymax = fsaf0\_avg + fsaf0\_se,  
 width = 0.1)) +  
 ylab("Fsa/F0") +  
 xlab("Experimental Conditions")  
   
)  
  
(fsatotal\_gg <- ggplot(data = phil\_awesome\_data,  
 aes(x = factor(Exp\_Con,   
 levels = c("Fat\_5.2",   
 "Fat\_5.1",  
 "Fat\_5.0",  
 "Fat\_4.5",   
 "Active",  
 "Active\_2")),  
 y = fsatotal\_avg,  
 color = Muscle)) +  
 geom\_point() +  
   
 geom\_line(aes(group = Muscle)) +  
   
 scale\_color\_manual(breaks = c("Soleus", "EDL"),  
 values = c("red", "blue")) +  
 geom\_errorbar(aes(ymin = fsatotal\_avg - fsatotal\_se,  
 ymax = fsatotal\_avg + fsatotal\_se,  
 width = 0.1)) +  
 ylab("Fsa/(Fsa + F0)") +  
 xlab("Experimental Conditions")  
   
)  
(a2\_gg <- ggplot(data = phil\_awesome\_data,  
 aes(x = factor(Exp\_Con,   
 levels = c("Fat\_5.2",   
 "Fat\_5.1",  
 "Fat\_5.0",  
 "Fat\_4.5",   
 "Active",  
 "Active\_2")),  
 y = a2\_avg,  
 color = Muscle)) +  
 geom\_point() +  
   
 geom\_line(aes(group = Muscle)) +  
   
 scale\_color\_manual(breaks = c("Soleus", "EDL"),  
 values = c("red", "blue")) +  
 geom\_errorbar(aes(ymin = a2\_avg - a2\_se,  
 ymax = a2\_avg + a2\_se,  
 width = 0.1)) +  
 ylab("a2") +  
 xlab("Experimental Conditions")  
   
)  
  
(a3\_gg <- ggplot(data = phil\_awesome\_data,  
 aes(x = factor(Exp\_Con,   
 levels = c("Fat\_5.2",   
 "Fat\_5.1",  
 "Fat\_5.0",  
 "Fat\_4.5",   
 "Active",  
 "Active\_2")),  
 y = a3\_avg,  
 color = Muscle)) +  
 geom\_point() +  
   
 geom\_line(aes(group = Muscle)) +  
   
 scale\_color\_manual(breaks = c("Soleus", "EDL"),  
 values = c("red", "blue")) +  
 geom\_errorbar(aes(ymin = a3\_avg - a3\_se,  
 ymax = a3\_avg + a3\_se,  
 width = 0.1)) +  
 ylab("a3") +  
 xlab("Experimental Conditions")  
   
)  
  
(a4\_gg <- ggplot(data = phil\_awesome\_data,  
 aes(x = factor(Exp\_Con,   
 levels = c("Fat\_5.2",   
 "Fat\_5.1",  
 "Fat\_5.0",  
 "Fat\_4.5",   
 "Active",  
 "Active\_2")),  
 y = a4\_avg,  
 color = Muscle)) +  
 geom\_point() +  
   
 geom\_line(aes(group = Muscle)) +  
   
 scale\_color\_manual(breaks = c("Soleus", "EDL"),  
 values = c("red", "blue")) +  
 geom\_errorbar(aes(ymin = a4\_avg - a4\_se,  
 ymax = a4\_avg + a4\_se,  
 width = 0.1)) +  
 ylab("a4") +  
 xlab("Experimental Conditions")  
   
)  
  
(r2\_gg <- ggplot(data = phil\_awesome\_data,  
 aes(x = factor(Exp\_Con,   
 levels = c("Fat\_5.2",   
 "Fat\_5.1",  
 "Fat\_5.0",  
 "Fat\_4.5",   
 "Active",  
 "Active\_2")),  
 y = r2\_avg,  
 color = Muscle)) +  
 geom\_point() +  
   
 geom\_line(aes(group = Muscle)) +  
   
 scale\_color\_manual(breaks = c("Soleus", "EDL"),  
 values = c("red", "blue")) +  
 geom\_errorbar(aes(ymin = r2\_avg - r2\_se,  
 ymax = r2\_avg + r2\_se,  
 width = 0.1)) +  
 ylab("r2") +  
 xlab("Experimental Conditions")  
   
)  
  
(r3\_gg <- ggplot(data = phil\_awesome\_data,  
 aes(x = factor(Exp\_Con,   
 levels = c("Fat\_5.2",   
 "Fat\_5.1",  
 "Fat\_5.0",  
 "Fat\_4.5",   
 "Active",  
 "Active\_2")),  
 y = r3\_avg,  
 color = Muscle)) +  
 geom\_point() +  
   
 geom\_line(aes(group = Muscle)) +  
   
 scale\_color\_manual(breaks = c("Soleus", "EDL"),  
 values = c("red", "blue")) +  
 geom\_errorbar(aes(ymin = r3\_avg - r3\_se,  
 ymax = r3\_avg + r3\_se,  
 width = 0.1)) +  
 ylab("r3") +  
 xlab("Experimental Conditions")  
   
)  
  
(r4\_gg <- ggplot(data = phil\_awesome\_data,  
 aes(x = factor(Exp\_Con,   
 levels = c("Fat\_5.2",   
 "Fat\_5.1",  
 "Fat\_5.0",  
 "Fat\_4.5",   
 "Active",  
 "Active\_2")),  
 y = r4\_avg,  
 color = Muscle)) +  
 geom\_point() +  
   
 geom\_line(aes(group = Muscle)) +  
   
 scale\_color\_manual(breaks = c("Soleus", "EDL"),  
 values = c("red", "blue")) +  
 geom\_errorbar(aes(ymin = r4\_avg - r4\_se,  
 ymax = r4\_avg + r4\_se,  
 width = 0.1)) +  
 ylab("r4") +  
 xlab("Experimental Conditions")  
   
)  
  
plot\_all\_sa <- ggarrange(f0\_gg,   
 fsa\_gg,   
 fsaf0\_gg,   
 fsatotal\_gg,  
 ncol = 2,  
 nrow = 2)  
  
plot\_all\_amps <- ggarrange(a2\_gg,  
 a3\_gg,  
 a4\_gg,  
 ncol = 1,  
 nrow = 3)  
  
plot\_all\_rates <- ggarrange(r2\_gg,  
 r3\_gg,  
 r4\_gg,  
 ncol = 1,  
 nrow = 3)  
ggexport(list(plot\_all\_sa,plot\_all\_amps,plot\_all\_rates), filename = "Woods\_Thesis\_Graphs\_Averages.pdf")  
  
  
## Graphs - Individual Fibers -------------------------------------------------  
  
my\_data2 <- my\_data %>%   
 filter(Exp\_Con\_Num %in% c(2:7))  
  
(f0\_plot\_fibers <- ggplot(data = my\_data2,   
 aes(x = factor(Exp\_Con,  
 levels = unique(Exp\_Con)),  
 y = Po\_Pre\_Step,  
 color = factor(Mouse))) + #w/out character, fiber\_num is considered num  
 geom\_point() +  
 geom\_line(aes(group = Filename)) +  
 xlab("Experiment Conditions") +  
 ylab("F0") +  
 facet\_wrap( ~ Muscle)   
)  
  
(fsa\_plot\_fibers <- ggplot(data = my\_data2,   
 aes(x = factor(Exp\_Con,  
 levels = unique(Exp\_Con)),  
 y = Fsa,  
 color = factor(Mouse))) + #w/out character, fiber\_num is considered num  
 geom\_point() +  
 geom\_line(aes(group = Filename)) +  
 xlab("Experiment Conditions") +  
 ylab("Fsa") +  
 facet\_wrap( ~ Muscle)  
)  
  
(fsaf0\_plot\_fibers <- ggplot(data = my\_data2,   
 aes(x = factor(Exp\_Con,  
 levels = unique(Exp\_Con)),  
 y = FsaF0,  
 color = factor(Mouse))) + #w/out character, fiber\_num is considered num  
 geom\_point() +  
 geom\_line(aes(group = Filename)) +  
 xlab("Experiment Conditions") +  
 ylab("Fsa/F0") +  
 facet\_wrap( ~ Muscle)  
)  
  
  
(fsatotal\_plot\_fibers <- ggplot(data = my\_data2,   
 aes(x = factor(Exp\_Con,  
 levels = unique(Exp\_Con)),  
 y = Fsa\_total,  
 color = factor(Mouse))) + #w/out character, fiber\_num is considered num  
 geom\_point() +  
 geom\_line(aes(group = Filename)) +  
 xlab("Experiment Conditions") +  
 ylab("Fsa/(Fsa + F0)") +  
 facet\_wrap( ~ Muscle)  
)  
  
(a2\_plot\_fibers <- ggplot(data = my\_data2,   
 aes(x = factor(Exp\_Con,  
 levels = unique(Exp\_Con)),  
 y = a2,  
 color = factor(Mouse))) + #w/out character, fiber\_num is considered num  
 geom\_point() +  
 geom\_line(aes(group = Filename)) +  
 xlab("Experiment Conditions") +  
 ylab("a2") +  
 facet\_wrap( ~ Muscle)  
)  
  
(a3\_plot\_fibers <- ggplot(data = my\_data2,   
 aes(x = factor(Exp\_Con,  
 levels = unique(Exp\_Con)),  
 y = a3,  
 color = factor(Mouse))) + #w/out character, fiber\_num is considered num  
 geom\_point() +  
 geom\_line(aes(group = Filename)) +  
 xlab("Experiment Conditions") +  
 ylab("a3") +  
 facet\_wrap( ~ Muscle)  
)  
  
(a4\_plot\_fibers <- ggplot(data = my\_data2,   
 aes(x = factor(Exp\_Con,  
 levels = unique(Exp\_Con)),  
 y = a4,  
 color = factor(Mouse))) + #w/out character, fiber\_num is considered num  
 geom\_point() +  
 geom\_line(aes(group = Filename)) +  
 xlab("Experiment Conditions") +  
 ylab("a4") +  
 facet\_wrap( ~ Muscle)  
)  
  
(r2\_plot\_fibers <- ggplot(data = my\_data2,   
 aes(x = factor(Exp\_Con,  
 levels = unique(Exp\_Con)),  
 y = r2,  
 color = factor(Mouse))) + #w/out character, fiber\_num is considered num  
 geom\_point() +  
 geom\_line(aes(group = Filename)) +  
 xlab("Experiment Conditions") +  
 ylab("r2") +  
 facet\_wrap( ~ Muscle)  
)  
  
(r3\_plot\_fibers <- ggplot(data = my\_data2,   
 aes(x = factor(Exp\_Con,  
 levels = unique(Exp\_Con)),  
 y = r3,  
 color = factor(Mouse))) + #w/out character, fiber\_num is considered num  
 geom\_point() +  
 geom\_line(aes(group = Filename)) +  
 xlab("Experiment Conditions") +  
 ylab("r3") +  
 facet\_wrap( ~ Muscle)  
)  
  
(r4\_plot\_fibers <- ggplot(data = my\_data2,   
 aes(x = factor(Exp\_Con,  
 levels = unique(Exp\_Con)),  
 y = r4,  
 color = factor(Mouse))) + #w/out character, fiber\_num is considered num  
 geom\_point() +  
 geom\_line(aes(group = Filename)) +  
 xlab("Experiment Conditions") +  
 ylab("r4") +  
 facet\_wrap( ~ Muscle)  
)  
  
plot\_fibers\_sa <- ggarrange(f0\_plot\_fibers,   
 fsa\_plot\_fibers,   
 fsaf0\_plot\_fibers,  
 fsatotal\_plot\_fibers,  
   
 ncol = 1,  
 nrow = 4)  
  
plot\_fibers\_amps <- ggarrange(a2\_plot\_fibers,  
 a3\_plot\_fibers,  
 a4\_plot\_fibers,  
 ncol = 1,  
 nrow = 3)  
  
plot\_fibers\_rates <- ggarrange(r2\_plot\_fibers,  
 r3\_plot\_fibers,  
 r4\_plot\_fibers,  
 ncol = 1,  
 nrow = 3)  
  
ggexport(list(plot\_fibers\_sa, plot\_fibers\_amps, plot\_fibers\_rates),   
 filename = "Woods\_Thesis\_Graphs\_IndividualFibers.pdf")  
### Positive Phase 3 Graphs-------------------------------------------------------------------------  
  
my\_data2 <- read\_excel("SA-Fatigue\_Tension+Step+Kinetics\_PW\_10-2-22.xlsx",   
 sheet = "Included",  
 skip = 5,  
 na="")  
df2 <- my\_data2 %>%   
 filter(Exp\_Con\_Num %in% c(2:6)) %>%   
 filter(fiber\_type\_num %in% c(1:4,6,7)) %>%   
 group\_by(fiber\_type, Exp\_Con) %>%   
 summarize(phase3 = plyr::count(P3, vars = 1))  
  
(df2\_gg <- df2 %>%   
 group\_by(fiber\_type) %>%   
 filter(phase3$x == "Yes") %>%   
 ggplot(aes(x = Exp\_Con, y = phase3$freq, fill = fiber\_type)) +  
 geom\_bar(stat = 'identity',  
 position = position\_dodge()) +  
 geom\_text(aes(label = phase3$freq),   
 position = position\_dodge(width = 0.9))   
)  
  
ggsave("Woods\_Positive\_Phase3.jpeg", df2\_gg, width = 12, height = 10, units = "in", dpi = 300)  
  
  
### NEACSM: F0, Fsa, Ratio scatter plots ----------------------------------------------------------------------  
  
  
setwd("C:/Users/Phil/Dropbox/Thesis- Stretch Activation/Data/Woods - Master's Thesis/Project/Tension + AaBbCc")  
  
my\_data <- read\_excel("SA-Fatigue\_Tension+Step+Kinetics\_PW\_10-5-22.xlsx",   
 sheet = "NEACSM",  
 skip = 5,  
 na="")  
  
  
acsm\_data <- my\_data %>%  
 filter(Exp\_Con\_Num %in% c(3,5,6)) %>%  
 filter(fiber\_type\_num %in% (1:4)) %>%  
 group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%  
 summarize(n = n(),  
 f0\_avg = mean(Po\_Pre\_Step, na.rm=T),  
 f0\_sd = sd(Po\_Pre\_Step, na.rm=T),  
 f0\_se = sd(Po\_Pre\_Step, na.rm=T)/sqrt(n()),  
 fsa\_avg = mean(Fsa, na.rm = T),  
 fsa\_sd = sd(Fsa, na.rm = T),  
 fsa\_se = sd(Fsa, na.rm = T)/sqrt(n()),  
 fsaf0\_avg = mean(FsaF0, na.rm = T),  
 fsaf0\_sd = sd(FsaF0, na.rm = T),  
 fsaf0\_se = sd(FsaF0, na.rm = T)/sqrt(n()),  
 fsatotal\_avg = mean(Fsa\_total, na.rm = T),  
 fsatotal\_sd = sd(Fsa\_total, na.rm = T),  
 fsatotal\_se = sd(Fsa\_total, na.rm = T)/sqrt(n())  
 )  
  
## MHC IIX only  
(gg1 <- acsm\_data %>%   
 filter(fiber\_type == "IIX") %>%   
 ggplot(aes(Exp\_Con, f0\_avg)) +  
 geom\_point(aes(col = fiber\_type),  
 size = 2.5) +  
 geom\_errorbar(aes(ymin=f0\_avg-f0\_se,  
 ymax=f0\_avg+f0\_se,  
 col = fiber\_type),  
 width=0.1,  
 size = 1) +  
 scale\_y\_continuous(limits = c(0,200)) +  
 ylab("Calcium-activated Specific Tension (mN/mm^2)") +  
 guides(color=guide\_legend(title = "Fiber Types")) +  
 theme(axis.title.y = element\_text(size = 18),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 15),  
 legend.text = element\_text(size = 13),  
 legend.key.size = unit(1,"cm")) +  
 scale\_color\_manual(breaks = c("IIX"),  
 values = c("Purple"))  
)  
  
  
(gg1.2 <- acsm\_data %>%   
 filter(fiber\_type == "IIX") %>%   
 ggplot(aes(Exp\_Con, fsa\_avg)) +  
 geom\_point(aes(col = fiber\_type),  
 size = 2.5) +  
 geom\_errorbar(aes(ymin=fsa\_avg-fsa\_se,  
 ymax=fsa\_avg+fsa\_se,  
 col = fiber\_type),  
 width=0.1,  
 size=1) +  
 ylab("Stretch-activated Specific Tension (mN/mm^2)") +  
 xlab("Experimental Condtions") +  
 guides(color=guide\_legend(title = "Fiber Types")) +  
 theme(axis.title.x = element\_blank(),  
 axis.title.y = element\_text(size = 18),  
 axis.text.y = element\_text(size = 15),  
 axis.text.x = element\_blank(),  
 legend.title = element\_text(size = 15),  
 legend.text = element\_text(size = 13),  
 legend.key.size = unit(1,"cm")) +  
 scale\_color\_manual(breaks = c("IIX"),  
 values = c("Purple"))  
)  
  
(gg1.3 <- acsm\_data %>%   
 filter(fiber\_type == "IIX") %>%   
 ggplot(aes(Exp\_Con, fsatotal\_avg)) +  
 geom\_point(aes(col = fiber\_type),  
 size = 2.5) +  
 geom\_errorbar(aes(ymin=fsatotal\_avg-fsatotal\_sd,  
 ymax=fsatotal\_avg+fsatotal\_sd,  
 col = fiber\_type),  
 width=0.1,  
 size = 1) +  
 ylab("Stretch- to Calcium-activated Specific Tension (%)") +  
 xlab("Experimental Condtions") +  
 guides(color=guide\_legend(title = "Fiber Types")) +  
 theme(axis.title = element\_text(size = 18),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 15),  
 legend.text = element\_text(size = 13),  
 legend.key.size = unit(1,"cm")) +  
 scale\_color\_manual(breaks = c("IIX"),  
 values = c("Purple"))  
)  
  
## MHC IIX & IIB   
(gg2 <- acsm\_data %>%   
 filter(fiber\_type == "IIX" | fiber\_type == "IIB") %>%   
 ggplot(aes(Exp\_Con, f0\_avg)) +  
 geom\_point(aes(col = fiber\_type),  
 size = 2.5) +  
 geom\_errorbar(aes(ymin=f0\_avg-f0\_se,  
 ymax=f0\_avg+f0\_se,  
 col = fiber\_type),  
 width=0.1,  
 size = 1) +  
 scale\_y\_continuous(breaks = seq(0,200, by = 50)) +  
 ylab("Calcium-activated Specific Tension (mN/mm^2)") +  
 xlab("Experimental Conditions") +  
 guides(color=guide\_legend(title = "Fiber Types")) +  
 theme(axis.title = element\_text(size = 18),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 15),  
 legend.text = element\_text(size = 13),  
 legend.key.size = unit(1,"cm")) +  
 scale\_color\_manual(breaks = c("IIX", "IIB"),  
 values = c("Purple", "Red"))  
)  
  
(gg2.2 <- acsm\_data %>%   
 filter(fiber\_type == "IIX" | fiber\_type == "IIB") %>%   
 ggplot(aes(Exp\_Con, fsa\_avg)) +  
 geom\_point(aes(col = fiber\_type),  
 size=2.5) +  
 geom\_errorbar(aes(ymin=fsa\_avg-fsa\_se,  
 ymax=fsa\_avg+fsa\_se,  
 col = fiber\_type),  
 width=0.1,  
 size = 1) +  
 ylab("Stretch-activated Specific Tension (mN/mm^2)") +  
 xlab("Experimental Condtions") +  
 guides(color=guide\_legend(title = "Fiber Types")) +  
 theme(axis.title.x = element\_blank(),  
 axis.title.y = element\_text(size = 18),  
 axis.text.y = element\_text(size = 15),  
 axis.text.x = element\_blank(),  
 legend.title = element\_text(size = 15),  
 legend.text = element\_text(size = 13),  
 legend.key.size = unit(1,"cm")) +  
 scale\_color\_manual(breaks = c("IIX", "IIB"),  
 values = c("Purple", "Red"))  
)  
  
(gg2.3 <- acsm\_data %>%   
 filter(fiber\_type == "IIX" | fiber\_type == "IIB") %>%   
 ggplot(aes(Exp\_Con, fsatotal\_avg)) +  
 geom\_point(aes(col = fiber\_type),  
 size = 2.5) +  
 geom\_errorbar(aes(ymin=fsatotal\_avg-fsatotal\_sd,  
 ymax=fsatotal\_avg+fsatotal\_sd,  
 col = fiber\_type),  
 width=0.1,  
 size = 1) +  
 ylab("Stretch- to Calcium-actived Specific Tension (%)") +  
 xlab("Experimental Condtions") +  
 guides(color=guide\_legend(title = "Fiber Types")) +  
 theme(axis.title = element\_text(size = 18),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 15),  
 legend.text = element\_text(size = 13),  
 legend.key.size = unit(1,"cm")) +  
 scale\_color\_manual(breaks = c("IIX", "IIB"),  
 values = c("Purple", "Red"))  
)  
  
## MHC IIA  
(gg3 <- acsm\_data %>%   
 filter(fiber\_type == "IIX" | fiber\_type == "IIB" | fiber\_type == "IIA") %>%  
 ggplot(aes(Exp\_Con, f0\_avg)) +  
 geom\_point(aes(col = fiber\_type),  
 size = 2.5) +  
 geom\_errorbar(aes(ymin=f0\_avg-f0\_se,  
 ymax=f0\_avg+f0\_se,  
 col = fiber\_type),  
 width=0.1,  
 size=1) +  
 scale\_y\_continuous(breaks = seq(0,200, by = 50)) +  
 ylab("Calcium-activated Specific Tension (mN/mm^2)") +  
 xlab("Experimental Conditions") +  
 guides(color=guide\_legend(title = "Fiber Types")) +  
 theme(axis.title = element\_text(size = 18),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 15),  
 legend.text = element\_text(size = 13),  
 legend.key.size = unit(1,"cm")) +  
 scale\_color\_manual(breaks = c("IIA", "IIX", "IIB"),  
 values = c("Green", "Purple", "Red"))  
)  
  
(gg3.2 <- acsm\_data %>%   
 filter(fiber\_type == "IIX" | fiber\_type == "IIB" | fiber\_type == "IIA") %>%   
 ggplot(aes(Exp\_Con, fsa\_avg)) +  
 geom\_point(aes(col = fiber\_type),  
 size=2.5) +  
 geom\_errorbar(aes(ymin=fsa\_avg-fsa\_se,  
 ymax=fsa\_avg+fsa\_se,  
 col = fiber\_type),  
 width=0.1,  
 size=1) +  
 ylab("Stretch-activated Specific Tension (mN/mm^2)") +  
 xlab("Experimental Condtions") +  
 guides(color=guide\_legend(title = "Fiber Types")) +  
 theme(axis.title.x = element\_blank(),  
 axis.title.y = element\_text(size = 18),  
 axis.text.y = element\_text(size = 15),  
 axis.text.x = element\_blank(),  
 legend.title = element\_text(size = 15),  
 legend.text = element\_text(size = 13),  
 legend.key.size = unit(1,"cm")) +  
 scale\_color\_manual(breaks = c("IIA", "IIX", "IIB"),  
 values = c("Green", "Purple", "Red"))  
)  
  
(gg3.3 <- acsm\_data %>%   
 filter(fiber\_type == "IIX" | fiber\_type == "IIB" | fiber\_type == "IIA") %>%   
 ggplot(aes(Exp\_Con, fsatotal\_avg)) +  
 geom\_point(aes(col = fiber\_type),  
 size=2.5) +  
 geom\_errorbar(aes(ymin=fsatotal\_avg-fsatotal\_sd,  
 ymax=fsatotal\_avg+fsatotal\_sd,  
 col = fiber\_type),  
 width=0.1,  
 size=1) +  
 ylab("Stretch- to Calcium-activated Specific Tension (%)") +  
 xlab("Experimental Condtions") +  
 guides(color=guide\_legend(title = "Fiber Types")) +  
 theme(axis.title = element\_text(size = 18),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 15),  
 legend.text = element\_text(size = 13),  
 legend.key.size = unit(1,"cm")) +  
 scale\_color\_manual(breaks = c("IIA", "IIX", "IIB"),  
 values = c("Green", "Purple", "Red"))  
)  
  
## All MHC   
  
(gg4 <- acsm\_data %>%   
 ggplot(aes(Exp\_Con, f0\_avg)) +  
 geom\_point(aes(col = fiber\_type),  
 size=2.5) +  
 geom\_errorbar(aes(ymin=f0\_avg-f0\_se,  
 ymax=f0\_avg+f0\_se,  
 col = fiber\_type),  
 width=0.1,  
 size=1) +  
 scale\_y\_continuous(breaks = seq(0,200, by = 50)) +  
 ylab("Calcium-activated Specific Tension (mN/mm^2)") +  
 xlab("Experimental Conditions") +  
 guides(color=guide\_legend(title = "Fiber Types")) +  
 theme(axis.title = element\_text(size = 18),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 15),  
 legend.text = element\_text(size = 13),  
 legend.key.size = unit(1,"cm")) +  
 scale\_color\_manual(breaks = c("I", "IIA", "IIX", "IIB"),  
 values = c("Orange", "Green", "Purple", "Red"))  
)  
  
(gg4.2 <- acsm\_data %>%   
 ggplot(aes(Exp\_Con, fsa\_avg)) +  
 geom\_point(aes(col = fiber\_type),  
 size=2.5) +  
 geom\_errorbar(aes(ymin=fsa\_avg-fsa\_se,  
 ymax=fsa\_avg+fsa\_se,  
 col = fiber\_type),  
 width=0.1,  
 size=1) +  
 ylab("Stretch-activated Specific Tension (mN/mm^2)") +  
 xlab("Experimental Condtions") +  
 guides(color=guide\_legend(title = "Fiber Types")) +  
 theme(axis.title.x = element\_blank(),  
 axis.title.y = element\_text(size = 18),  
 axis.text.y = element\_text(size = 15),  
 axis.text.x = element\_blank(),  
 legend.title = element\_text(size = 15),  
 legend.text = element\_text(size = 13),  
 legend.key.size = unit(1,"cm")) +  
 scale\_color\_manual(breaks = c("I", "IIA", "IIX", "IIB"),  
 values = c("Orange", "Green", "Purple", "Red"))  
)  
  
(gg4.3 <- acsm\_data %>%  
 ggplot(aes(Exp\_Con, fsatotal\_avg)) +  
 geom\_point(aes(col = fiber\_type),  
 size=2.5) +  
 geom\_errorbar(aes(ymin=fsatotal\_avg-fsatotal\_sd,  
 ymax=fsatotal\_avg+fsatotal\_sd,  
 col = fiber\_type),  
 width=0.1,  
 size=1) +  
 ylab(expression(atop("Stretch- to Calcium-Activated",  
 paste("Specific Tension (%)"))))+  
 guides(color=guide\_legend(title = "Fiber Types")) +  
 scale\_y\_continuous(limits = c(0,33.5)) +  
 theme(axis.title = element\_text(size = 30),  
 axis.text = element\_text(size = 25),  
 axis.title.x = element\_blank(),  
 legend.title = element\_text(size = 25),  
 legend.text = element\_text(size = 20),  
 legend.key.size = unit(1,"cm")) +  
 scale\_color\_manual(breaks = c("I",  
 "IIA",  
 "IIX",  
 "IIB"),  
 values = c("#E69F00",  
 "#56B4E9",  
 "#CC79A7",  
 "#009E73"))+  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 "High Calcium Fatigue",  
 "Low Calcium Fatigue"))  
)  
  
  
  
## Bar Plots  
  
  
  
# grid.newpage()  
# p1<- grid.draw(rbind(ggplotGrob(gg1.2),   
# ggplotGrob(gg1),   
# size = "last"))  
# p2 <- grid.draw(rbind(ggplotGrob(gg2.2),  
# ggplotGrob(gg2),   
# size = "last"))  
# p3 <- grid.draw(rbind(ggplotGrob(gg3.2),  
# ggplotGrob(gg3),   
# size = "last"))  
# p4 <- grid.draw(rbind(ggplotGrob(gg4.2),  
# ggplotGrob(gg4),   
# size = "last"))  
  
ggexport(gg1.1111, filename = "Woods\_ACSM\_F0\_MHCIIX.png",  
 width = 100,height = 100, units = "in", dpi = 300)  
ggexport(gg1.2, filename = "Woods\_ACSM\_Fsa\_MHCIIX.png")  
ggexport(gg1.3, filename = "Woods\_ACSM\_Ratio\_MHCIIX.png")  
  
ggexport(gg2, filename = "Woods\_ACSM\_F0\_MHCIIX+B.png")  
ggexport(gg2.2, filename = "Woods\_ACSM\_Fsa\_MHCIIX+B.png")  
ggexport(gg2.3, filename = "Woods\_ACSM\_Ratio\_MHCIIX+B.png")  
  
ggexport(gg3, filename = "Woods\_ACSM\_F0\_MHCIIXBA.png")  
ggexport(gg3.2, filename = "Woods\_ACSM\_Fsa\_MHCIIXBA.png")  
ggexport(gg3.3, filename = "Woods\_ACSM\_Ratio\_MHCIIXBA.png")  
  
ggexport(gg4, filename = "Woods\_ACSM\_F0\_All.png")  
ggexport(gg4.2, filename = "Woods\_ACSM\_Fsa\_All.png")  
ggexport(gg4.3, filename = "Woods\_ACSM\_Ratio\_All.png")  
  
  
### NEACSM: F0, Fsa, Ratio bar plots ----------------------------------------------  
  
setwd("C:/Users/Phil/Dropbox/Thesis- Stretch Activation/Data/Woods - Master's Thesis/Project/Tension + AaBbCc")  
  
my\_data <- read\_excel("SA-Fatigue\_Tension+Step+Kinetics\_PW\_10-28-22.xlsx",   
 sheet = "NEACSM",  
 skip = 5,  
 na="")  
  
  
acsm\_data <- my\_data %>%  
 filter(Exp\_Con\_Num %in% c(3,5,6)) %>%  
 filter(fiber\_type\_num %in% (1:4)) %>%  
 group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%  
 summarize(n = n(),  
 f0\_avg = mean(Po\_Pre\_Step, na.rm=T),  
 f0\_sd = sd(Po\_Pre\_Step, na.rm=T),  
 f0\_se = sd(Po\_Pre\_Step, na.rm=T)/sqrt(n()),  
 fsa\_avg = mean(Fsa, na.rm = T),  
 fsa\_sd = sd(Fsa, na.rm = T),  
 fsa\_se = sd(Fsa, na.rm = T)/sqrt(n()),  
 fsaf0\_avg = mean(FsaF0, na.rm = T),  
 fsaf0\_sd = sd(FsaF0, na.rm = T),  
 fsaf0\_se = sd(FsaF0, na.rm = T)/sqrt(n()),  
 fsatotal\_avg = mean(Fsa\_total, na.rm = T),  
 fsatotal\_sd = sd(Fsa\_total, na.rm = T),  
 fsatotal\_se = sd(Fsa\_total, na.rm = T)/sqrt(n())  
 )  
  
  
acsm\_data2 <- my\_data %>%   
 filter(Exp\_Con\_Num %in% c(3,5,6)) %>%   
 filter(fiber\_type\_num %in% c(1:4)) %>%   
 group\_by(Exp\_Con, fiber\_type)  
  
  
## MHC IIX only  
x <- acsm\_data2 %>%   
 filter(fiber\_type == "IIX")  
  
(gg1 <- acsm\_data %>%   
 filter(fiber\_type == "IIX") %>%   
 ggplot(aes(Exp\_Con, f0\_avg)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity") +  
 geom\_point(data = x,  
 aes(x = Exp\_Con,  
 y = Po\_Pre\_Step))+  
 geom\_errorbar(aes(ymin=f0\_avg-f0\_se,  
 ymax=f0\_avg+f0\_se),  
 width=0.1,  
 size = 1) +  
 scale\_y\_continuous(limits = c(0,275)) +  
 ylab(expression(atop("Calcium-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 30),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 25),  
 legend.title = element\_text(size = 25),  
 legend.text = element\_text(size = 20),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIX"),  
 values = c("#CC79A7")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(gg1.2 <- acsm\_data %>%   
 filter(fiber\_type == "IIX") %>%   
 ggplot(aes(Exp\_Con, fsa\_avg)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity") +  
 geom\_point(data = x,  
 aes(x = Exp\_Con,  
 y = Fsa))+  
 geom\_errorbar(aes(ymin=fsa\_avg-fsa\_se,  
 ymax=fsa\_avg+fsa\_se),  
 width=0.1,  
 size = 1) +  
 scale\_y\_continuous(limits = c(0,70)) +  
 ylab(expression(atop("Stretch-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 30),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 25),  
 legend.title = element\_text(size = 25),  
 legend.text = element\_text(size = 20),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIX"),  
 values = c("#CC79A7")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
(gg1.3 <- acsm\_data %>%   
 filter(fiber\_type == "IIX") %>%  
 ggplot(aes(Exp\_Con,   
 fsatotal\_avg)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity")+  
 geom\_point(data = x,  
 aes(x = Exp\_Con,  
 y = Fsa\_total)) +  
 geom\_errorbar(aes(ymin=fsatotal\_avg-fsatotal\_se,  
 ymax=fsatotal\_avg+fsatotal\_se),  
 position = position\_dodge(width = 0.9),  
 width=0.15,  
 size = 1.25) +  
 scale\_y\_continuous(limits = c(0,37)) +  
 ylab(expression(atop("Stretch-to-Calcium-activated",  
 paste("Specific Tension (%)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 30),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 25),  
 legend.title = element\_text(size = 25),  
 legend.text = element\_text(size = 20),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("I",  
 "IIA",  
 "IIX",  
 "IIB"),  
 values = c("#E69F00",  
 "#56B4E9",  
 "#CC79A7",  
 "#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
## MHC IIX,IIB  
y <- acsm\_data2 %>%   
 filter(fiber\_type == "IIX" | fiber\_type == "IIB")   
  
(gg2 <- acsm\_data %>%   
 filter(fiber\_type == "IIX" | fiber\_type == "IIB") %>%   
 ggplot(aes(Exp\_Con,   
 f0\_avg,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 geom\_point(data = y,  
 aes(x = Exp\_Con,  
 y = Po\_Pre\_Step),  
 position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=f0\_avg-f0\_se,  
 ymax=f0\_avg+f0\_se),  
 width=0.1,  
 size = 1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(limits = c(0,275)) +  
 ylab(expression(atop("Calcium-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 30),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 25),  
 legend.title = element\_text(size = 25),  
 legend.text = element\_text(size = 20),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIX","IIB"),  
 values = c("#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(gg2.2 <- acsm\_data %>%   
 filter(fiber\_type == "IIX" | fiber\_type == "IIB") %>%   
 ggplot(aes(Exp\_Con,   
 fsa\_avg,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 geom\_point(data = y,  
 aes(x = Exp\_Con,  
 y = Fsa),  
 position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=fsa\_avg-fsa\_se,  
 ymax=fsa\_avg+fsa\_se),  
 width=0.1,  
 size = 1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(limits = c(0,70)) +  
 ylab(expression(atop("Stretch-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 30),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 25),  
 legend.title = element\_text(size = 25),  
 legend.text = element\_text(size = 20),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIX","IIB"),  
 values = c("#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(gg2.3 <- acsm\_data %>%   
 filter(fiber\_type == "IIX" | fiber\_type == "IIB") %>%   
 ggplot(aes(Exp\_Con,   
 fsatotal\_avg,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 geom\_point(data = y,  
 aes(x = Exp\_Con,  
 y = Fsa\_total),  
 position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=fsatotal\_avg-fsatotal\_se,  
 ymax=fsatotal\_avg+fsatotal\_se),  
 width=0.1,  
 size = 1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(limits = c(0,37)) +  
 ylab(expression(atop("Stretch-to-Calcium-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 30),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 25),  
 legend.title = element\_text(size = 25),  
 legend.text = element\_text(size = 20),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIX","IIB"),  
 values = c("#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
## MHC IIA,IIX,IIB  
z <- acsm\_data2 %>%   
 filter(fiber\_type == "IIX" | fiber\_type == "IIB" | fiber\_type == "IIA")   
  
(gg3 <- acsm\_data %>%   
 filter(fiber\_type == "IIX" | fiber\_type == "IIB" | fiber\_type == "IIA") %>%   
 ggplot(aes(Exp\_Con,   
 f0\_avg,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 geom\_point(data = z,  
 aes(x = Exp\_Con,  
 y = Po\_Pre\_Step),  
 position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=f0\_avg-f0\_se,  
 ymax=f0\_avg+f0\_se),  
 width=0.1,  
 size = 1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(limits = c(0,350)) +  
 ylab(expression(atop("Calcium-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 30),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 25),  
 legend.title = element\_text(size = 25),  
 legend.text = element\_text(size = 20),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIA","IIX","IIB"),  
 values = c("#56B4E9", "#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
(gg3.2 <- acsm\_data %>%   
 filter(fiber\_type == "IIX" | fiber\_type == "IIB" | fiber\_type == "IIA") %>%   
 ggplot(aes(Exp\_Con,   
 fsa\_avg,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 geom\_point(data = z,  
 aes(x = Exp\_Con,  
 y = Fsa),  
 position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=fsa\_avg-fsa\_se,  
 ymax=fsa\_avg+fsa\_se),  
 width=0.1,  
 size = 1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(limits = c(0,75)) +  
 ylab(expression(atop("Stretch-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 30),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 25),  
 legend.title = element\_text(size = 25),  
 legend.text = element\_text(size = 20),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIA","IIX","IIB"),  
 values = c("#56B4E9", "#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(gg3.3 <- acsm\_data %>%   
 filter(fiber\_type == "IIX" | fiber\_type == "IIB" | fiber\_type == "IIA") %>%   
 ggplot(aes(Exp\_Con,   
 fsatotal\_avg,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 geom\_point(data = z,  
 aes(x = Exp\_Con,  
 y = Fsa\_total),  
 position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=fsatotal\_avg-fsatotal\_se,  
 ymax=fsatotal\_avg+fsatotal\_se),  
 width=0.1,  
 size = 1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(limits = c(0,40)) +  
 ylab(expression(atop("Stretch-to-Calcium-activated",  
 paste("Specific Tension (%)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 30),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 25),  
 legend.title = element\_text(size = 25),  
 legend.text = element\_text(size = 20),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIA","IIX","IIB"),  
 values = c("#56B4E9", "#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
  
## All isoforms  
(gg4 <- acsm\_data %>%   
 ggplot(aes(Exp\_Con,   
 f0\_avg,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge())+  
 geom\_point(data = acsm\_data2,  
 aes(x = Exp\_Con,  
 y = Po\_Pre\_Step),  
 position = position\_dodge(width = 0.9)) +  
 geom\_errorbar(aes(ymin=f0\_avg-f0\_se,  
 ymax=f0\_avg+f0\_se),  
 position = position\_dodge(width = 0.9),  
 width=0.15,  
 size = 1.25) +  
 scale\_y\_continuous(limits = c(0,350)) +  
 ylab(expression(atop("Calcium-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 30),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 25),  
 legend.title = element\_text(size = 25),  
 legend.text = element\_text(size = 20),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("I",  
 "IIA",  
 "IIX",  
 "IIB"),  
 values = c("#E69F00",  
 "#56B4E9",  
 "#CC79A7",  
 "#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(gg4.2 <- acsm\_data %>%   
 ggplot(aes(Exp\_Con,   
 fsa\_avg,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge())+  
 geom\_point(data = acsm\_data2,  
 aes(x = Exp\_Con,  
 y = Fsa),  
 position = position\_dodge(width = 0.9)) +  
 geom\_errorbar(aes(ymin=fsa\_avg-fsa\_se,  
 ymax=fsa\_avg+fsa\_se),  
 position = position\_dodge(width = 0.9),  
 width=0.15,  
 size = 1.25) +  
 scale\_y\_continuous(limits = c(0,75)) +  
 ylab(expression(atop("Stretch-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 30),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 25),  
 legend.title = element\_text(size = 25),  
 legend.text = element\_text(size = 20),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("I",  
 "IIA",  
 "IIX",  
 "IIB"),  
 values = c("#E69F00",  
 "#56B4E9",  
 "#CC79A7",  
 "#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(gg4.3 <- acsm\_data %>%   
 ggplot(aes(Exp\_Con,   
 fsatotal\_avg,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge())+  
 geom\_point(data = acsm\_data2,  
 aes(x = Exp\_Con,  
 y = Fsa\_total),  
 position = position\_dodge(width = 0.9)) +  
 geom\_errorbar(aes(ymin=fsatotal\_avg-fsatotal\_se,  
 ymax=fsatotal\_avg+fsatotal\_se),  
 position = position\_dodge(width = 0.9),  
 width=0.15,  
 size = 1.25) +  
 scale\_y\_continuous(limits = c(0,35)) +  
 ylab(expression(atop("Stretch-to-Calcium-activated",  
 paste("Specific Tension (%)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 30),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 25),  
 legend.title = element\_text(size = 25),  
 legend.text = element\_text(size = 20),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("I",  
 "IIA",  
 "IIX",  
 "IIB"),  
 values = c("#E69F00",  
 "#56B4E9",  
 "#CC79A7",  
 "#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
# ggexport(gg1, filename = "Woods\_ACSM\_F0\_MHCIIX.jpeg")  
# ggexport(gg1.2, filename = "Woods\_ACSM\_Fsa\_MHCIIX.jpeg")  
# ggexport(gg1.3, filename = "Woods\_ACSM\_Ratio\_MHCIIX.jpeg")  
#   
# ggexport(gg2, filename = "Woods\_ACSM\_F0\_MHCIIX+B.jpeg")  
# ggexport(gg2.2, filename = "Woods\_ACSM\_Fsa\_MHCIIX+B.jpeg")  
# ggexport(gg2.3, filename = "Woods\_ACSM\_Ratio\_MHCIIX+B.jpeg")  
#   
# ggexport(gg3, filename = "Woods\_ACSM\_F0\_MHCIIXBA.jpeg")  
# ggexport(gg3.2, filename = "Woods\_ACSM\_Fsa\_MHCIIXBA.jpeg")  
# ggexport(gg3.3, filename = "Woods\_ACSM\_Ratio\_MHCIIXBA.jpeg")  
#   
# ggexport(gg4, filename = "Woods\_ACSM\_F0\_All.jpeg")  
# ggexport(gg4.2, filename = "Woods\_ACSM\_Fsa\_All.jpeg")  
# ggexport(gg4.3, filename = "Woods\_ACSM\_Ratio\_All.jpeg")  
  
ggsave("Woods\_NEACSM\_F0\_IIX.jpeg", gg1, width = 12, height = 10, units = "in", dpi = 300)  
ggsave("Woods\_NEACSM\_Fsa\_IIX.jpeg", gg1.2, width = 12, height = 10, units = "in", dpi = 300)  
ggsave("Woods\_NEACSM\_ratio\_IIX.jpeg", gg1.3, width = 12, height = 10, units = "in", dpi = 300)  
  
ggsave("Woods\_NEACSM\_F0\_IIXB.jpeg", gg2, width = 13, height = 10, units = "in", dpi = 300)  
ggsave("Woods\_NEACSM\_Fsa\_IIXB.jpeg", gg2.2, width = 13, height = 10, units = "in", dpi = 300)  
ggsave("Woods\_NEACSM\_ratio\_IIXB.jpeg", gg2.3, width = 13, height = 10, units = "in", dpi = 300)  
  
ggsave("Woods\_NEACSM\_F0\_3.jpeg", gg3, width = 14, height = 10, units = "in", dpi = 300)  
ggsave("Woods\_NEACSM\_Fsa\_3.jpeg", gg3.2, width = 14, height = 10, units = "in", dpi = 300)  
ggsave("Woods\_NEACSM\_ratio\_3.jpeg", gg3.3, width = 14, height = 10, units = "in", dpi = 300)  
  
ggsave("Woods\_NEACSM\_F0\_all\_.jpeg", gg4, width = 15, height = 10, units = "in", dpi = 300)  
ggsave("Woods\_NEACSM\_Fsa\_all\_.jpeg", gg4.2, width = 15, height = 10, units = "in", dpi = 300)  
ggsave("Woods\_NEACSM\_ratio\_all\_.jpeg", gg4.3, width = 15, height = 10, units = "in", dpi = 300)  
### NEACSM: M7F10 (IIX) Rate Fits ------------------------  
  
setwd("C:/Users/Phil/Dropbox/Thesis- Stretch Activation/Data/Woods - Master's Thesis/Project/")  
  
df3 <- read\_excel("Woods\_M7F10\_all-fits.xlsx")  
  
(gg5 <- df3 %>%   
 ggplot(aes(x = Time,   
 col = "#CC79A7")) +  
 geom\_line(aes(y = Active),  
 linetype = "solid",  
 size = 2) +  
 geom\_line(aes(y = Fat\_high),  
 linetype = "longdash",  
 size = 2) +  
 geom\_line(aes(y = Fat\_low),  
 linetype = "dotted",  
 size = 2) +  
 ylab("Specific Tension (mN/mm^2)") +  
 theme(axis.title = element\_text(size = 30),  
 axis.text = element\_text(size = 25),  
 legend.position = "none")  
)  
  
ggexport(gg5, filename = "Woods\_NEACSM\_3fits.jpeg")  
  
### NEACSM: Mouse 7: MHC I, IIA, IIX, IIB Fits on one graph -----------  
  
setwd("C:/Users/Phil/Dropbox/Thesis- Stretch Activation/Data/Woods - Master's Thesis/Project/")  
  
df4 <- read\_excel("Woods\_NEACSM\_high\_Fat\_fits.xlsx")  
  
df4.1 <- df4 %>%   
 mutate(I\_mod = I/0.002710547, .after = I) %>%   
 mutate(IIA\_mod = IIA/0.000780136, .after = IIA) %>%   
 mutate(IIX\_mod = IIX/0.001272394, .after = IIX) %>%   
 mutate(IIB\_mod = IIB/0.001450591, .after = IIB)  
  
  
(gg6 <- df4.1 %>%   
 ggplot(aes(x = Time)) +  
 geom\_line(aes(y = I\_mod),  
 col = "#E69F00",  
 size = 1.25) +  
 geom\_line(aes(y = IIA\_mod),  
 col = "#56B4E9",  
 size = 1.25) +  
 geom\_line(aes(y = IIX\_mod),  
 col = "#CC79A7",  
 size = 1.25) +  
 geom\_line(aes(y = IIB\_mod),  
 col = "#009E73",  
 size = 1.25) +  
 labs(y = "Specific Tension (mN/mm^2)") +  
 theme(axis.title = element\_text(size = 30),  
 axis.text = element\_text(size = 25))  
)  
  
# ggexport(gg6, filename = "Woods\_NEACSM\_High\_Fat\_Fits.png")  
  
ggsave("Woods\_NEACSM\_Fits\_allisoforms.jpeg",  
 gg6,   
 width = 10,   
 height = 10,   
 units = "in",   
 dpi = 300)  
  
  
### Defense: Positive Phase 3 in MHC I,IIA,IIX,IIB --------  
setwd("C:/Users/Phil/Dropbox/Thesis- Stretch Activation/Data/Woods - Master's Thesis/Project/Tension + AaBbCc")  
  
  
# M4F6  
data\_I <- read\_excel("Woods\_EMM\_10-29-22.xlsx",  
 sheet = "I",  
 na = "") %>%   
 select(Time, Low\_Fat, Fiber\_type,High\_Fat,Active)  
  
#M8F6  
data\_IIA <- read\_excel("Woods\_EMM\_10-29-22.xlsx",  
 sheet = "IIA",  
 na = "") %>%   
 select(Time, Low\_Fat,Fiber\_type,High\_Fat,Active)   
# filter(Time < 0.25)  
  
#M3F18  
data\_IIX <- read\_excel("Woods\_EMM\_10-29-22.xlsx",  
 sheet = "IIX",  
 na = "") %>%   
 select(Time, Low\_Fat,Fiber\_type,High\_Fat,Active)   
 # filter(Time < 0.05)  
  
#M6F13  
data\_IIB <- read\_excel("Woods\_EMM\_10-29-22.xlsx",  
 sheet = "IIB",  
 na = "") %>%   
 select(Time, Low\_Fat,Fiber\_type,High\_Fat,Active)   
 # filter(Time < 0.03)  
  
  
  
(I\_gg <- ggplot(data\_I,  
 aes(x = Time,  
 col = Fiber\_type)) +  
 geom\_line(aes(y = Low\_Fat),  
 size = 1.25,  
 linetype = "dotted") +  
 geom\_line(aes(y = High\_Fat),  
 size = 1.25,  
 linetype = "longdash") +  
 geom\_line(aes(y = Active),  
 size = 1.25,  
 linetype = "solid")+  
 ylab("Force (mN)") +  
 xlab("Time (s)")+  
 theme(axis.title = element\_blank(),  
 axis.text = element\_text(size = 18),  
 legend.title = element\_blank(),  
 legend.text = element\_blank(),  
 legend.key.size = unit(0,"cm")) +  
 guides(col=guide\_legend(title = "Fiber Type")) +   
 scale\_color\_manual(breaks = c("I"),  
 values = c("#E69F00"))  
)  
  
(IIA\_gg <- ggplot(data\_IIA,  
 aes(x = Time,  
 col = Fiber\_type)) +  
 geom\_line(aes(y = Low\_Fat),  
 size = 1.25,  
 linetype = "dotted") +  
 # geom\_line(aes(y = Low\_Fat\_No),  
 # size = 1.25,  
 # linetype = "dotdash") +  
 geom\_line(aes(y = High\_Fat),  
 size = 1.25,  
 linetype = "longdash") +  
 geom\_line(aes(y = Active),  
 size = 1.25,  
 linetype = "solid")+  
 ylab("Force (mN)") +  
 theme(axis.title = element\_blank(),  
 axis.text = element\_text(size = 18),  
 legend.title = element\_blank(),  
 legend.text = element\_blank(),  
 legend.key.size = unit(0,"cm")) +  
 scale\_color\_manual(breaks = c("IIA"),  
 values = c("#56B4E9"))  
)  
  
(IIX\_gg <- ggplot(data\_IIX,  
 aes(x = Time,  
 col = Fiber\_type)) +  
 geom\_line(aes(y = Low\_Fat),  
 size = 1.25,  
 linetype = "dotted") +  
 geom\_line(aes(y = High\_Fat),  
 size = 1.25,  
 linetype = "longdash") +  
 geom\_line(aes(y = Active),  
 size = 1.25,  
 linetype = "solid")+  
 ylab("Force (mN)") +  
 theme(axis.title = element\_blank(),  
 axis.text = element\_text(size = 18),  
 legend.title = element\_blank(),  
 legend.text = element\_blank(),  
 legend.key.size = unit(0,"cm")) +  
 guides(col=guide\_legend(title = "Fiber Type"))+  
 scale\_color\_manual(breaks = c("IIX"),  
 values = c("#CC79A7"))  
)  
  
(IIB\_gg <- ggplot(data\_IIB,  
 aes(x = Time,  
 col = Fiber\_type)) +  
 geom\_line(aes(y = Low\_Fat),  
 size = 1.25,  
 linetype = "dotted") +  
 geom\_line(aes(y = High\_Fat),  
 size = 1.25,  
 linetype = "longdash") +  
 geom\_line(aes(y = Active),  
 size = 1.25,  
 linetype = "solid")+  
 ylab("Force (mN)") +  
 theme(axis.title = element\_blank(),  
 axis.text = element\_text(size = 18),  
 legend.title = element\_blank(),  
 legend.text = element\_blank(),  
 legend.key.size = unit(0,"cm")) +  
 guides(col=guide\_legend(title = "Fiber Type"))+  
 scale\_color\_manual(breaks = c("IIB"),  
 values = c("#009E73"))  
)  
  
  
## starting from zero  
(I\_gg <- ggplot(data\_I,  
 aes(x = Time,  
 col = Fiber\_type)) +  
 geom\_line(aes(y = Low\_Fat),  
 size = 1.25,  
 linetype = "dotted") +  
 geom\_line(aes(y = High\_Fat),  
 size = 1.25,  
 linetype = "longdash") +  
 geom\_line(aes(y = Active),  
 size = 1.25,  
 linetype = "solid")+  
 ylab("Force (mN)") +  
 xlab("Time (s)")+  
 scale\_y\_continuous(limits = c(0,0.12)) +  
 theme(axis.title = element\_blank(),  
 axis.text = element\_text(size = 18),  
 legend.title = element\_blank(),  
 legend.text = element\_blank(),  
 legend.key.size = unit(0,"cm")) +  
 guides(col=guide\_legend(title = "Fiber Type")) +   
 scale\_color\_manual(breaks = c("I"),  
 values = c("#E69F00"))  
)  
  
(IIA\_gg <- ggplot(data\_IIA,  
 aes(x = Time,  
 col = Fiber\_type)) +  
 geom\_line(aes(y = Low\_Fat),  
 size = 1.25,  
 linetype = "dotted") +  
 # geom\_line(aes(y = Low\_Fat\_No),  
 # size = 1.25,  
 # linetype = "dotdash") +  
 geom\_line(aes(y = High\_Fat),  
 size = 1.25,  
 linetype = "longdash") +  
 geom\_line(aes(y = Active),  
 size = 1.25,  
 linetype = "solid")+  
 scale\_y\_continuous(limits = c(0,0.05)) +  
 ylab("Force (mN)") +  
 theme(axis.title = element\_blank(),  
 axis.text = element\_text(size = 18),  
 legend.title = element\_blank(),  
 legend.text = element\_blank(),  
 legend.key.size = unit(0,"cm")) +  
 scale\_color\_manual(breaks = c("IIA"),  
 values = c("#56B4E9"))  
)  
  
(IIX\_gg <- ggplot(data\_IIX,  
 aes(x = Time,  
 col = Fiber\_type)) +  
 geom\_line(aes(y = Low\_Fat),  
 size = 1.25,  
 linetype = "dotted") +  
 geom\_line(aes(y = High\_Fat),  
 size = 1.25,  
 linetype = "longdash") +  
 geom\_line(aes(y = Active),  
 size = 1.25,  
 linetype = "solid")+  
 ylab("Force (mN)") +  
 scale\_y\_continuous(limits = c(0,0.038)) +  
 theme(axis.title = element\_blank(),  
 axis.text = element\_text(size = 18),  
 legend.title = element\_blank(),  
 legend.text = element\_blank(),  
 legend.key.size = unit(0,"cm")) +  
 guides(col=guide\_legend(title = "Fiber Type"))+  
 scale\_color\_manual(breaks = c("IIX"),  
 values = c("#CC79A7"))  
)  
  
(IIB\_gg <- ggplot(data\_IIB,  
 aes(x = Time,  
 col = Fiber\_type)) +  
 geom\_line(aes(y = Low\_Fat),  
 size = 1.25,  
 linetype = "dotted") +  
 geom\_line(aes(y = High\_Fat),  
 size = 1.25,  
 linetype = "longdash") +  
 geom\_line(aes(y = Active),  
 size = 1.25,  
 linetype = "solid")+  
 ylab("Force (mN)") +   
 scale\_y\_continuous(limits = c(0,0.06)) +  
 theme(axis.title = element\_blank(),  
 axis.text = element\_text(size = 18),  
 legend.title = element\_blank(),  
 legend.text = element\_blank(),  
 legend.key.size = unit(0,"cm")) +  
 guides(col=guide\_legend(title = "Fiber Type"))+  
 scale\_color\_manual(breaks = c("IIB"),  
 values = c("#009E73"))  
)  
  
ggsave("Woods\_Defense\_Traces\_MHCI.jpeg",  
 I\_gg, width = 6, height = 4, units = "in", dpi = 300)  
ggsave("Woods\_Defense\_Traces\_MHCIIA.jpeg",  
 IIA\_gg, width = 6, height = 4, units = "in", dpi = 300)  
ggsave("Woods\_Defense\_Traces\_MHCIIX.jpeg",  
 IIX\_gg, width = 6, height = 4, units = "in", dpi = 300)  
ggsave("Woods\_Defense\_Traces\_MHCIIB.jpeg",  
 IIB\_gg, width = 6, height = 4, units = "in", dpi = 300)  
  
### Defense: EMM Graphs-------------------  
setwd("C:/Users/Phil/Dropbox/Thesis- Stretch Activation/Data/Woods - Master's Thesis/Project/Tension + AaBbCc")  
  
df1 <- read\_excel("Woods\_EMM\_10-29-22.xlsx",  
 na = "",  
 sheet = "EMM") %>%   
 filter(Include == 1)  
  
df2 <- read\_excel("SA-Fatigue\_Tension+Step+Kinetics\_PW\_10-28-22.xlsx",  
 sheet = "Included",  
 skip = 5,  
 na="") %>%   
 filter(Exp\_Con\_Num %in% c(3,5,6)) %>%   
 filter(Ran\_Num ==1)   
  
df3 <- read\_excel("SA-Fatigue\_Tension+Step+Kinetics\_PW\_10-28-22.xlsx",  
 sheet = "Included",  
 skip = 5,  
 na="") %>%   
 filter(Exp\_Con\_Num %in% c(3,5,6)) %>%   
 filter(fiber\_type\_num %in% c(1:4)) %>%   
 filter(Ran\_Num ==1) %>%   
 filter(P3\_num ==1) %>%   
 group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%  
 summarize(n=n())  
  
### MHC IIX .............................  
x <- df2 %>%   
 filter(fiber\_type == "IIX")  
  
(f0\_X\_gg <- df1 %>%   
 filter(Fiber\_Type == "IIX") %>%   
 filter(Value == "F0") %>%   
 ggplot(aes(Exp\_Con, EMM)) +  
 geom\_bar(aes(fill = Fiber\_Type),  
 stat = "identity") +  
 geom\_point(data = x,  
 aes(x = Exp\_Con,  
 y = Po\_Pre\_Step))+  
 geom\_errorbar(aes(ymin=EMM-SE,  
 ymax=EMM+SE),  
 width=0.25,  
 size = 1.1) +  
 scale\_y\_continuous(limits = c(0,200)) +  
 ylab(expression(atop("Calcium-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 23),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 20),  
 legend.text = element\_text(size = 18),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIX"),  
 values = c("#CC79A7")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(fsa\_X\_gg <- df1 %>%   
 filter(Fiber\_Type == "IIX") %>%   
 filter(Value == "Fsa") %>%   
 ggplot(aes(Exp\_Con, EMM)) +  
 geom\_bar(aes(fill = Fiber\_Type),  
 stat = "identity") +  
 geom\_point(data = x,  
 aes(x = Exp\_Con,  
 y = Fsa))+  
 geom\_errorbar(aes(ymin=EMM-SE,  
 ymax=EMM+SE),  
 width=0.25,  
 size = 1.1) +  
 scale\_y\_continuous(limits = c(0,70)) +  
 ylab(expression(atop("Stretch-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 23),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 20),  
 legend.text = element\_text(size = 18),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIX"),  
 values = c("#CC79A7")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
   
(ratio\_X\_gg <- df1 %>%   
 filter(Fiber\_Type == "IIX") %>%   
 filter(Value == "Ratio") %>%   
 ggplot(aes(Exp\_Con, EMM)) +  
 geom\_bar(aes(fill = Fiber\_Type),  
 stat = "identity") +  
 geom\_point(data = x,  
 aes(x = Exp\_Con,  
 y = FsaF0))+  
 geom\_errorbar(aes(ymin=EMM-SE,  
 ymax=EMM+SE),  
 width=0.25,  
 size = 1.1) +  
 scale\_y\_continuous(limits = c(0,58)) +  
 ylab(expression(atop("Stretch-to-Calcium-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 23),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 20),  
 legend.text = element\_text(size = 18),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIX"),  
 values = c("#CC79A7")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
# (p3\_time\_X\_gg <- df1 %>%   
# filter(Fiber\_Type == "IIX") %>%   
# filter(Value == "r3") %>%  
# # mutate(P3\_Time = 1/EMM) %>%   
# ggplot(aes(Exp\_Con, EMM)) +  
# geom\_bar(aes(fill = Fiber\_Type),  
# stat = "identity") +  
# geom\_point(data = x,  
# aes(x = Exp\_Con,  
# y = r3))+  
# geom\_errorbar(aes(ymin=EMM-SE,  
# ymax=EMM+SE),  
# width=0.25,  
# size = 1.1) +  
# scale\_y\_continuous(limits = c(0,150)) +  
# ylab("r3")+  
# guides(fill=guide\_legend(title = "Fiber Types")) +   
# theme(axis.title.y = element\_text(size = 23),  
# axis.title.x = element\_blank(),  
# axis.text = element\_text(size = 15),  
# legend.title = element\_text(size = 20),  
# legend.text = element\_text(size = 18),  
# legend.key.size = unit(1,"cm")) +  
# scale\_fill\_manual(breaks = c("IIX"),  
# values = c("#CC79A7")) +  
# scale\_x\_discrete(breaks = c("Active",  
# "Fat\_4.5",  
# "Fat\_5.1"),  
# labels = c("Active",  
# expression(atop("High Calcium",  
# paste("Fatigue"))),  
# expression(atop("Low Calcium",  
# paste("Fatigue")))))  
# )  
  
### MHC IIX & IIB  
  
y <- df2 %>%   
 filter(fiber\_type == "IIX"| fiber\_type == "IIB")  
  
(f0\_Xb\_gg <- df1 %>%   
 filter(fiber\_type == "IIX"| fiber\_type == "IIB") %>%   
 filter(Value == "F0") %>%   
 group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%   
 ggplot(aes(x = Exp\_Con,   
 y = EMM,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 geom\_point(data = y,  
 aes(x = Exp\_Con,  
 y = Po\_Pre\_Step),  
 position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=EMM - SE,  
 ymax=EMM + SE),  
 width=0.25,  
 size = 1.1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(limits = c(0,275)) +  
 ylab(expression(atop("Calcium-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 23),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 20),  
 legend.text = element\_text(size = 18),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIX", "IIB"),  
 values = c("#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(fsa\_Xb\_gg <- df1 %>%   
 filter(fiber\_type == "IIX"| fiber\_type == "IIB") %>%   
 filter(Value == "Fsa") %>%   
 group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%   
 ggplot(aes(x = Exp\_Con,   
 y = EMM,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 geom\_point(data = y,  
 aes(x = Exp\_Con,  
 y = Fsa),  
 position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=EMM - SE,  
 ymax=EMM + SE),  
 width=0.25,  
 size = 1.1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(limits = c(0,75)) +  
 ylab(expression(atop("Stretch-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 23),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 20),  
 legend.text = element\_text(size = 18),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIX", "IIB"),  
 values = c("#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(ratio\_Xb\_gg <- df1 %>%   
 filter(fiber\_type == "IIX"| fiber\_type == "IIB") %>%   
 filter(Value == "Ratio") %>%   
 group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%   
 ggplot(aes(x = Exp\_Con,   
 y = EMM,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 geom\_point(data = y,  
 aes(x = Exp\_Con,  
 y = FsaF0),  
 position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=EMM - SE,  
 ymax=EMM + SE),  
 width=0.25,  
 size = 1.1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(limits = c(0,60)) +  
 ylab(expression(atop("Stretch-to-Calcium-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 23),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 20),  
 legend.text = element\_text(size = 18),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIX", "IIB"),  
 values = c("#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
# (p3\_time\_Xb\_gg <- df1 %>%   
# filter(fiber\_type == "IIX"| fiber\_type == "IIB") %>%   
# filter(Value == "r3") %>%   
# group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%   
# ggplot(aes(x = Exp\_Con,   
# y = EMM,   
# group = fiber\_type\_num)) +  
# geom\_bar(aes(fill = fiber\_type),  
# stat = "identity",  
# position = position\_dodge()) +  
# geom\_point(data = y,  
# aes(x = Exp\_Con,  
# y = r3),  
# position = position\_dodge(width = 0.9))+  
# geom\_errorbar(aes(ymin=EMM - SE,  
# ymax=EMM + SE),  
# width=0.25,  
# size = 1.1,  
# position = position\_dodge(width = 0.9)) +  
# scale\_y\_continuous(limits = c(0,1000)) +  
# ylab(expression(atop("Stretch-to-Calcium-activated",  
# paste("Specific Tension (mN/mm^2)"))))+  
# guides(fill=guide\_legend(title = "Fiber Types")) +   
# theme(axis.title.y = element\_text(size = 23),  
# axis.title.x = element\_blank(),  
# axis.text = element\_text(size = 15),  
# legend.title = element\_text(size = 20),  
# legend.text = element\_text(size = 18),  
# legend.key.size = unit(1,"cm")) +  
# scale\_fill\_manual(breaks = c("IIX", "IIB"),  
# values = c("#CC79A7","#009E73")) +  
# scale\_x\_discrete(breaks = c("Active",  
# "Fat\_4.5",  
# "Fat\_5.1"),  
# labels = c("Active",  
# expression(atop("High Calcium",  
# paste("Fatigue"))),  
# expression(atop("Low Calcium",  
# paste("Fatigue")))))  
# )  
  
  
### MHC IIA,IIX,IIB  
  
z <- df2 %>%   
 filter(fiber\_type =="IIA" |fiber\_type == "IIX"| fiber\_type == "IIB")   
  
z.2 <- df2 %>%   
 filter(fiber\_type =="IIA" |fiber\_type == "IIX"| fiber\_type == "IIB") %>%   
 filter(P3\_num ==1)   
  
(f0\_axb\_gg <- df1 %>%   
 filter(fiber\_type == "IIX"| fiber\_type == "IIB"| fiber\_type =="IIA") %>%   
 filter(Value == "F0") %>%   
 group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%   
 ggplot(aes(x = Exp\_Con,   
 y = EMM,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 geom\_point(data = z,  
 aes(x = Exp\_Con,  
 y = Po\_Pre\_Step),  
 position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=EMM - SE,  
 ymax=EMM + SE),  
 width=0.25,  
 size = 1.1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(limits = c(0,275)) +  
 ylab(expression(atop("Calcium-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 23),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 20),  
 legend.text = element\_text(size = 18),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIA","IIX", "IIB"),  
 values = c("#56B4E9", "#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(fsa\_axb\_gg <- df1 %>%   
 filter(fiber\_type == "IIX"| fiber\_type == "IIB"| fiber\_type =="IIA") %>%   
 filter(Value == "Fsa") %>%   
 group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%   
 ggplot(aes(x = Exp\_Con,   
 y = EMM,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 geom\_point(data = z.2,  
 aes(x = Exp\_Con,  
 y = Fsa),  
 position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=EMM - SE,  
 ymax=EMM + SE),  
 width=0.25,  
 size = 1.1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(limits = c(0,60)) +  
 ylab(expression(atop("Stretch-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 23),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 20),  
 legend.text = element\_text(size = 18),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIA","IIX", "IIB"),  
 values = c("#56B4E9", "#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(ratio\_axb\_gg <- df1 %>%   
 filter(fiber\_type == "IIX"| fiber\_type == "IIB"| fiber\_type =="IIA") %>%   
 filter(Value == "Ratio") %>%   
 group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%   
 ggplot(aes(x = Exp\_Con,   
 y = EMM,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 geom\_point(data = z.2,  
 aes(x = Exp\_Con,  
 y = FsaF0),  
 position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=EMM - SE,  
 ymax=EMM + SE),  
 width=0.25,  
 size = 1.1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(limits = c(0,60)) +  
 ylab(expression(atop("Stretch-to-Calcium-activated",  
 paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_text(size = 23),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 15),  
 legend.title = element\_text(size = 20),  
 legend.text = element\_text(size = 18),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("IIA","IIX", "IIB"),  
 values = c("#56B4E9", "#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
# (r3\_axb\_gg <- df1 %>%   
# filter(fiber\_type == "IIX"| fiber\_type == "IIB"| fiber\_type =="IIA") %>%   
# filter(Value == "r3") %>%   
# group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%   
# ggplot(aes(x = Exp\_Con,   
# y = EMM,   
# group = fiber\_type\_num)) +  
# geom\_bar(aes(fill = fiber\_type),  
# stat = "identity",  
# position = position\_dodge()) +  
# geom\_point(data = z.2,  
# aes(x = Exp\_Con,  
# y = r3),  
# position = position\_dodge(width = 0.9))+  
# geom\_errorbar(aes(ymin=EMM - SE,  
# ymax=EMM + SE),  
# width=0.25,  
# size = 1.1,  
# position = position\_dodge(width = 0.9)) +  
# scale\_y\_continuous(limits = c(0,1000)) +  
# ylab("r3")+  
# guides(fill=guide\_legend(title = "Fiber Types")) +   
# theme(axis.title.y = element\_text(size = 23),  
# axis.title.x = element\_blank(),  
# axis.text = element\_text(size = 15),  
# legend.title = element\_text(size = 20),  
# legend.text = element\_text(size = 18),  
# legend.key.size = unit(1,"cm")) +  
# scale\_fill\_manual(breaks = c("IIA","IIX", "IIB"),  
# values = c("#56B4E9", "#CC79A7","#009E73")) +  
# scale\_x\_discrete(breaks = c("Active",  
# "Fat\_4.5",  
# "Fat\_5.1"),  
# labels = c("Active",  
# expression(atop("High Calcium",  
# paste("Fatigue"))),  
# expression(atop("Low Calcium",  
# paste("Fatigue")))))  
# )  
  
  
### ALL MHC ...........................................................  
w <- df2 %>%  
 filter(fiber\_type\_num %in% c(1,2,3,4)) %>%   
 filter(P3\_num == 1)  
  
(f0\_all\_gg <- df1 %>%   
 filter(Value == "F0") %>%   
 group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%   
 ggplot(aes(x = Exp\_Con,   
 y = EMM,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 # geom\_point(data = w,  
 # aes(x = Exp\_Con,  
 # y = Po\_Pre\_Step),  
 # position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=EMM - SE,  
 ymax=EMM + SE),  
 width=0.25,  
 size = 1.1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(expand = c(0,0),  
 limits = c(0,225)) +  
 # ylab(expression(atop("Calcium-activated",  
 # paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_blank(),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 22),  
 legend.title = element\_text(size = 20),  
 legend.text = element\_text(size = 18),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("I", "IIA","IIX", "IIB"),  
 values = c("#E69F00","#56B4E9", "#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(fsa\_all\_gg <- df1 %>%   
 filter(Value == "Fsa") %>%   
 group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%   
 ggplot(aes(x = Exp\_Con,   
 y = EMM,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 # geom\_point(data = w.w,  
 # aes(x = Exp\_Con,  
 # y = Fsa),  
 # position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=EMM - SE,  
 ymax=EMM + SE),  
 width=0.25,  
 size = 1.1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(expand = c(0,0),  
 limits = c(0,52)) +  
 # ylab(expression(atop("Stretch-activated",  
 # paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_blank(),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 22),  
 legend.title = element\_text(size = 20),  
 legend.text = element\_text(size = 18),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("I", "IIA","IIX", "IIB"),  
 values = c("#E69F00","#56B4E9", "#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(ratio\_all\_gg <- df1 %>%   
 filter(Value == "Ratio") %>%   
 group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%   
 ggplot(aes(x = Exp\_Con,   
 y = EMM,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 # geom\_point(data = w.w,  
 # aes(x = Exp\_Con,  
 # y = FsaF0),  
 # position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=EMM - SE,  
 ymax=EMM + SE),  
 width=0.25,  
 size = 1.1,  
 position = position\_dodge(width = 0.9)) +  
 scale\_y\_continuous(expand = c(0,0),  
 limits = c(0,52)) +  
 # ylab(expression(atop("Stretch-to-Calcium-activated",  
 # paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 theme(axis.title.y = element\_blank(),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 22),  
 legend.title = element\_text(size = 20),  
 legend.text = element\_text(size = 18),  
 legend.key.size = unit(1,"cm")) +  
 scale\_fill\_manual(breaks = c("I", "IIA","IIX", "IIB"),  
 values = c("#E69F00","#56B4E9", "#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(r3\_all\_gg <- df1 %>%   
 filter(Value == "r3") %>%   
 group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%   
 ggplot(aes(x = Exp\_Con,   
 y = EMM,   
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 # geom\_point(data = w.w,  
 # aes(x = Exp\_Con,  
 # y = r3),  
 # position = position\_dodge(width = 0.9))+  
 geom\_errorbar(aes(ymin=EMM - SE,  
 ymax=EMM + SE),  
 width=0.25,  
 size = 1.1,  
 position = position\_dodge(width = 0.9)) +  
 # scale\_y\_continuous(expand = c(0,0),  
 # limits = c(0,500)) +  
 # ylab(expression(atop("Stretch-to-Calcium-activated",  
 # paste("Specific Tension (mN/mm^2)"))))+  
 guides(fill=guide\_legend(title = "Fiber Types")) +   
 facet\_wrap(~factor(Muscle,  
 levels = c("Soleus", "EDL")),  
 scales = "free") +  
 theme(axis.title.y = element\_blank(),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 18),  
 legend.title = element\_text(size = 20),  
 legend.text = element\_text(size = 18),  
 legend.key.size = unit(1,"cm"),  
 strip.background = element\_blank(),  
 strip.text.x = element\_blank()) +  
 scale\_fill\_manual(breaks = c("I", "IIA","IIX", "IIB"),  
 values = c("#E69F00","#56B4E9", "#CC79A7","#009E73")) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
(t3\_all\_gg <- df1 %>%  
 filter(Value == "t3") %>%  
 group\_by(Exp\_Con, fiber\_type, fiber\_type\_num) %>%  
 ggplot(aes(x = Exp\_Con,  
 y = EMM,  
 group = fiber\_type\_num)) +  
 geom\_bar(aes(fill = fiber\_type),  
 stat = "identity",  
 position = position\_dodge()) +  
 geom\_point(data = w,  
 aes(x = Exp\_Con,  
 y = t3),  
 position = position\_dodge(width = 0.9)) +  
 geom\_errorbar(aes(ymin=(EMM) - (SE),  
 ymax=(EMM) + (SE)),  
 width=0.25,  
 size = 1.1,  
 position = position\_dodge(width = 0.9)) +  
 # facet\_wrap(~factor(Muscle,  
 # levels = c("Soleus", "EDL")),  
 # scales = "free") +  
 # scale\_y\_continuous(limits = c(0,150)) +  
 # ylab("t3 (ms)")+  
 guides(fill=guide\_legend(title = "Fiber Types")) +  
 theme(axis.title.y = element\_blank(),  
 axis.title.x = element\_blank(),  
 axis.text = element\_text(size = 18),  
 legend.title = element\_text(size = 20),  
 legend.text = element\_text(size = 18),  
 legend.key.size = unit(1,"cm"),  
 strip.background = element\_blank(),  
 strip.text.x = element\_blank()) +  
 scale\_fill\_manual(breaks = c("I", "IIA","IIX", "IIB"),  
 values = c("#E69F00","#56B4E9", "#CC79A7","#009E73")) +  
 scale\_y\_continuous(expand = c(0,0)) +  
 scale\_x\_discrete(breaks = c("Active",  
 "Fat\_4.5",  
 "Fat\_5.1"),  
 labels = c("Active",  
 expression(atop("High Calcium",  
 paste("Fatigue"))),  
 expression(atop("Low Calcium",  
 paste("Fatigue")))))  
)  
  
  
ggsave("Woods\_Defense\_F0\_All.jpeg",   
 f0\_all\_gg, width = 12, height = 10, units = "in", dpi = 300)  
ggsave("Woods\_Defense\_Fsa\_All.jpeg",   
 fsa\_all\_gg, width = 12, height = 10, units = "in", dpi = 300)  
ggsave("Woods\_Defense\_ratio\_All.jpeg",   
 ratio\_all\_gg, width = 12, height = 10, units = "in", dpi = 300)  
ggsave("Woods\_Defense\_r3\_All.jpeg",  
 r3\_all\_gg, width = 13, height = 10, units = "in", dpi = 300)  
# ggsave("Woods\_Defense\_t3\_All.jpeg",   
# t3\_all\_gg, width = 13, height = 10, units = "in", dpi = 300)