

# Synchrony in Psychotherapy, example with F1044 patient data

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```

MeanMomentumByTime <- function(subject, indexOfvideos=1:NumberOfvideos, interval, data){
  x <- c()
  for (file in indexlist[indexOfvideos]){
    dataVector <- data[which(data$file==file), subject]
    ## with ceiling : superior limit of the round
    IntervalNumbersVideo <- ceiling(length(dataVector)/interval)
    for (i in 1:IntervalNumbersVideo){
      borneinf<- 1+(i-1)*interval
      bornesup <- i*interval
      dataVectorInterval <- dataVector[borneinf:bornesup]
      mean <- mean(dataVectorInterval, na.rm=TRUE)
      x <- c(x, mean)
    }
  }
  return (x)
}

SlidingInterval <- function(subject, indexOfvideos=1:NumberOfvideos, interval, data){
  x <- c()
  for (file in indexlist[indexOfvideos]){
    dataVector <- data[which(data$file==file), subject]
    NBofAnalysedframes <- length(dataVector)-interval+1
    for (i in 1:NBofAnalysedframes){
      borneinf<- (i)
      bornesup <- (interval-1+i)
      dataVectorInterval <- dataVector[borneinf:bornesup]
      mean <- mean(dataVectorInterval, na.rm=TRUE)
      x <- c(x, mean)
    }
  }
  return (x)
}

```

## File lists

```

indexlist <- c("F1044C.VOB", "F1044D1.VOB", "F1044D2.VOB", "F1044E.VOB", "F1044F.VOB",
            "F1044G.VOB", "F1044H.VOB", "F1044I.VOB", "F1044L.VOB", "F1044M1.VOB",
            "F1044M2.VOB", "F1044N.VOB", "F1044O.VOB", "F1044P.VOB", "F1044Q.VOB",
            "F1044R1.VOB", "F1044R2.VOB")

labelvideolist<- c("C", "D1", "D2", "E", "F", "G", "H", "I", "L", "M1", "M2", "N", "O", "P", "Q",
                    "R1", "R2")

NumberOfvideos <- length(indexlist)

colOrderList <- c("blue", "red", "green", "orange")

```

## Participants list

```

## [1] "father"     "mother"      "patient"     "therapist"

```

## Presentation of the data

The timeMin is corresponding to a frame rate 25/sec.

```
str(data)
```

```
## 'data.frame': 477258 obs. of 7 variables:  
## $ frame : int 1 2 3 4 5 6 7 8 9 10 ...  
## $ father : num 0.01996 0.00915 0.01355 0.01787 0.01758 ...  
## $ mother : num 1.82e-05 1.82e-05 3.64e-05 1.82e-05 9.09e-05 ...  
## $ patient : num NA ...  
## $ therapist: num 0.00162 0.00506 0.00349 0.00223 0.00249 ...  
## $ file : Factor w/ 17 levels "F1044C.VOB","F1044D1.VOB",...: 1 1 1 1 1 1 1 1 1 1 ...  
## $ timeMin : num 0.000667 0.001333 0.002 0.002667 0.003333 ...
```

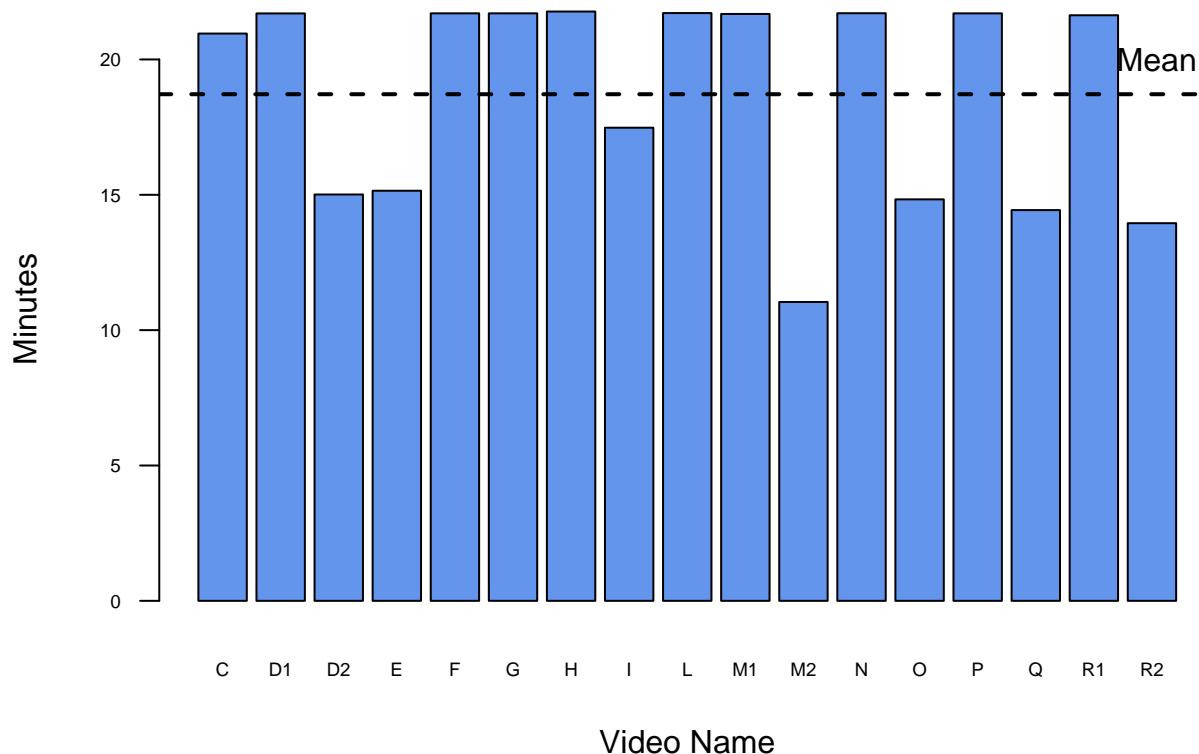
```
summary(data)
```

```
##      frame           father          mother          patient  
## Min.   :    1   Min.   :0.00   Min.   :0.00   Min.   :0.00  
## 1st Qu.: 7019  1st Qu.:0.00  1st Qu.:0.00  1st Qu.:0.00  
## Median :14038  Median :0.00  Median :0.00  Median :0.00  
## Mean   :14576  Mean   :0.00  Mean   :0.00  Mean   :0.01  
## 3rd Qu.:21364 3rd Qu.:0.00  3rd Qu.:0.00  3rd Qu.:0.01  
## Max.   :32656  Max.   :0.19  Max.   :0.49  Max.   :0.54  
##             NA's   :265686  NA's   :91545  NA's   :189317  
##      therapist        file       timeMin  
## Min.   :0.0   F1044H.VOB: 32656  Min.   : 0.000667  
## 1st Qu.:0.0   F1044L.VOB: 32570  1st Qu.: 4.679333  
## Median :0.0   F1044N.VOB: 32562  Median : 9.358333  
## Mean   :0.0   F1044G.VOB: 32556  Mean   : 9.717052  
## 3rd Qu.:0.0   F1044F.VOB: 32555  3rd Qu.:14.242667  
## Max.   :0.8   F1044P.VOB: 32554  Max.   :21.770667  
## NA's   :77972  (Other)   :281805
```

## Length of the videos in minutes

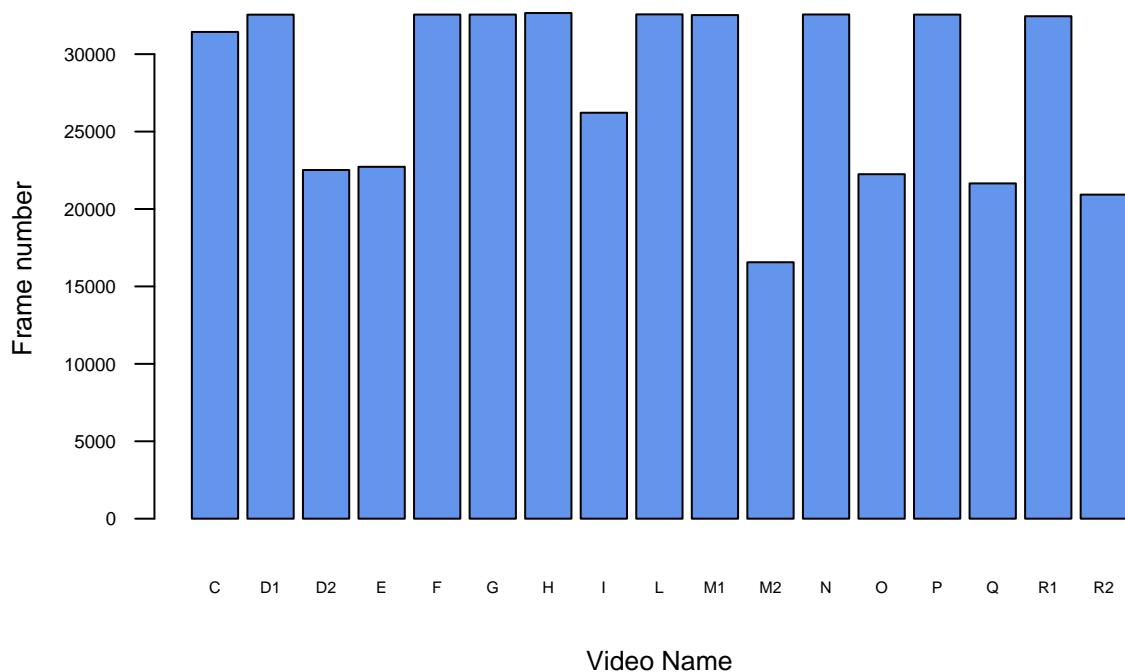
```
## [1] 20.95667 21.70067 15.01133 15.15067 21.70333 21.70400 21.77067  
## [8] 17.47800 21.71333 21.68133 11.04000 21.70800 14.83133 21.70267  
## [15] 14.43533 21.63267 13.95200
```

### Length in each F1044 video (min)

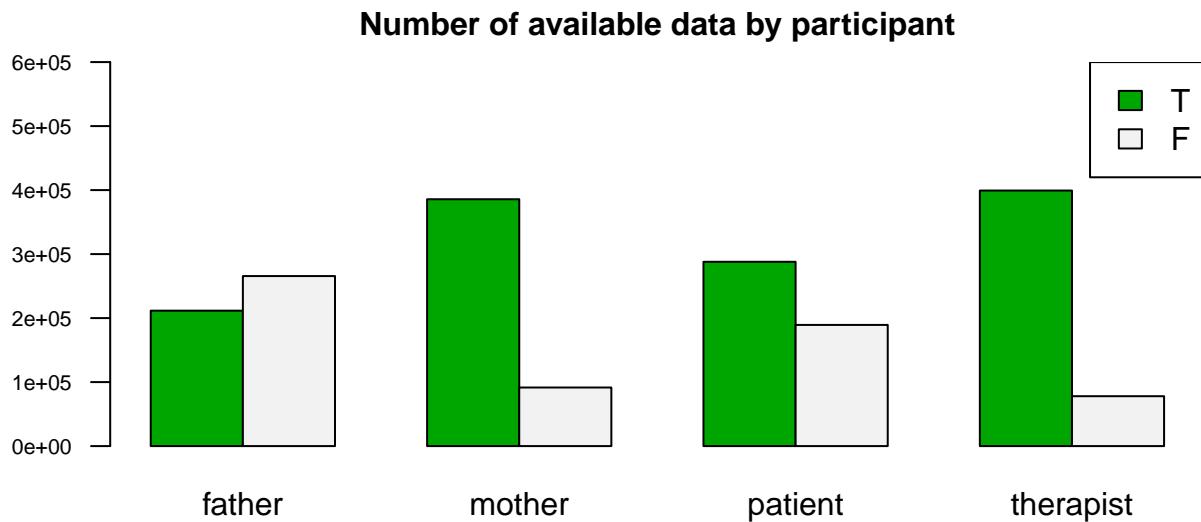


### Length of the videos in number of frames

#### Number of frames in each F1044 video



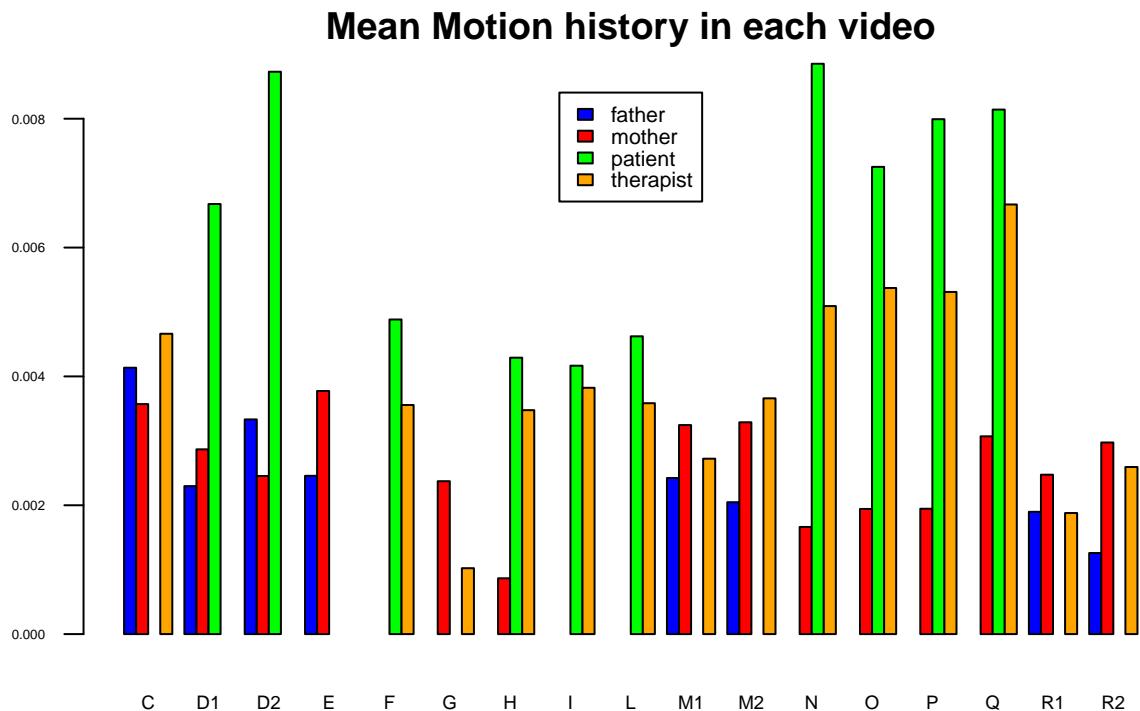
Number of Available (True) and Not Available (False) data for each participant



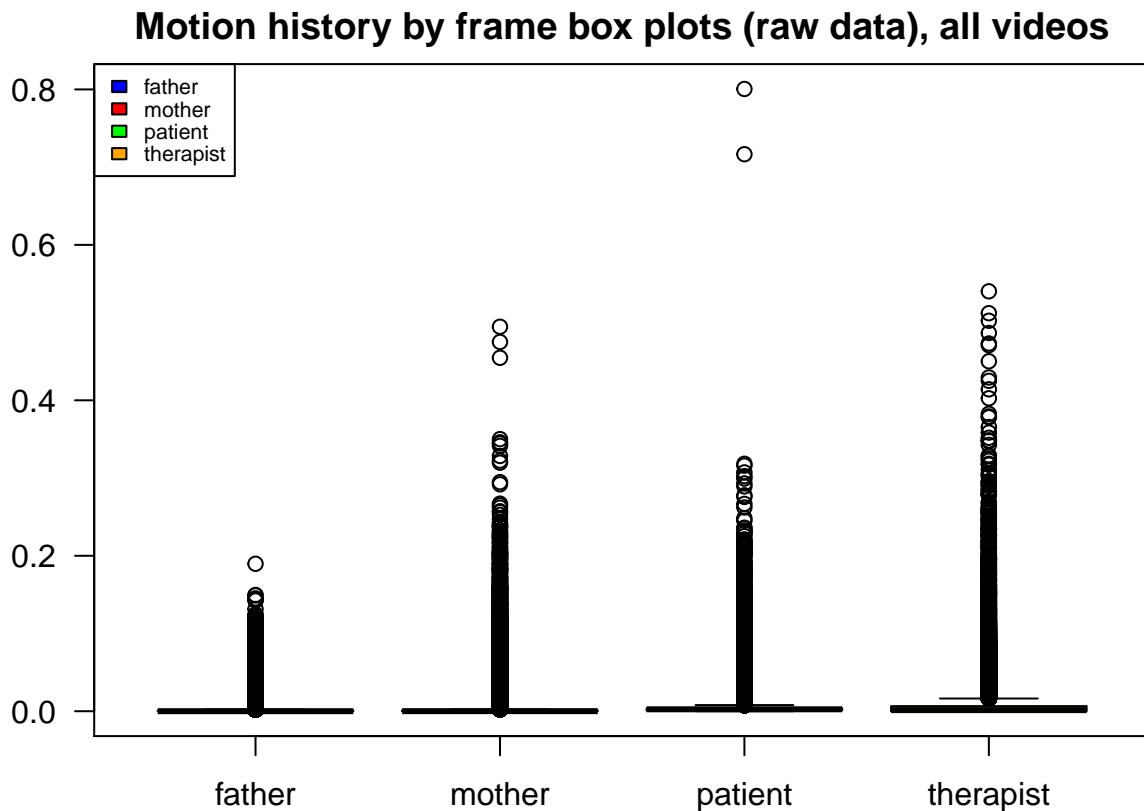
Mother and therapist are the more often present participants.

## Global Motion history

Mean Motion history by video by participant



## Motion history box plots by frame (raw data), all videos



## Raw data and mean of Motion History on sliding and non overlapping intervals on F1044C video

### F1044C video

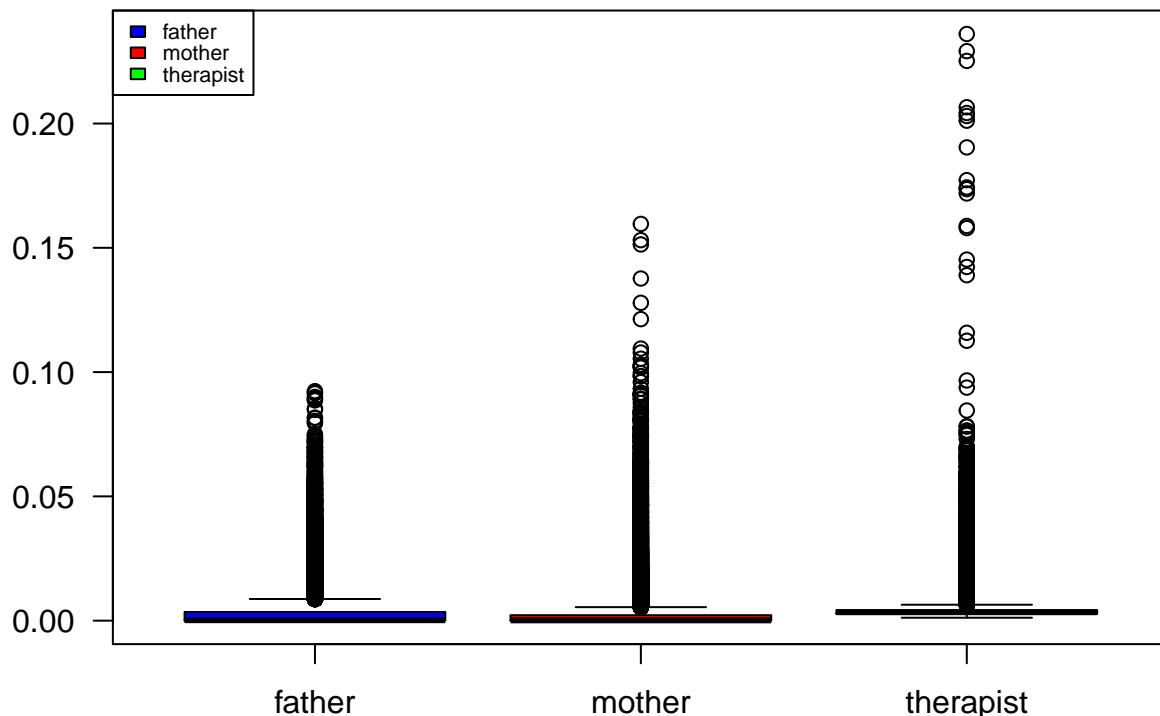
It is the first video of F10044C. The father, mother and therapist are present. The patient is absent.

### Raw data

```
rawdatafather <- data[which(data$file=="F1044C.VOB"),]$father
rawdataMother <- data[which(data$file=="F1044C.VOB"),]$mother
rawdataTherapist <- data[which(data$file=="F1044C.VOB"),]$therapist

par(mar=c(3,3,3,2))
boxplot(rawdatafather, rawdataMother, rawdataTherapist,
        col=colOrderList[c(1,2,4)],
        names=ParticipantsList[c(1,2,4)],
        main= "Box plots of motion history mean
on 11 frames rawdata on F1044C video", las=1)
par(mar=c(1,0.5,0.5,1))
legend("topleft", ParticipantsList[c(1,2,4)], fill=colOrderList, cex=0.7)
```

## Box plots of motion history mean on 11 frames rawdata on F1044C video



```
summary(rawdatafather)
```

```
##      Min. 1st Qu. Median     Mean 3rd Qu.     Max.    NA's
## 0.000000 0.000000 0.000196 0.004135 0.003488 0.092340      10
```

```
summary(rawdatamother)
```

```
##      Min. 1st Qu. Median     Mean 3rd Qu.     Max.    NA's
## 0.000000 0.000036 0.000127 0.003570 0.002200 0.159600      10
```

```
summary(rawdatatherapist)
```

```
##      Min. 1st Qu. Median     Mean 3rd Qu.     Max.    NA's
## 0.001179 0.002750 0.003405 0.004662 0.004234 0.236000      10
```

### Sliding interval

```
slidedfather <- SlidingInterval("father", 1, 11, data)
slidemother <- SlidingInterval("mother", 1, 11, data)
slidedtherapist <- SlidingInterval("therapist", 1, 11, data)
slidedpatient <- SlidingInterval("patient", 1, 11, data)

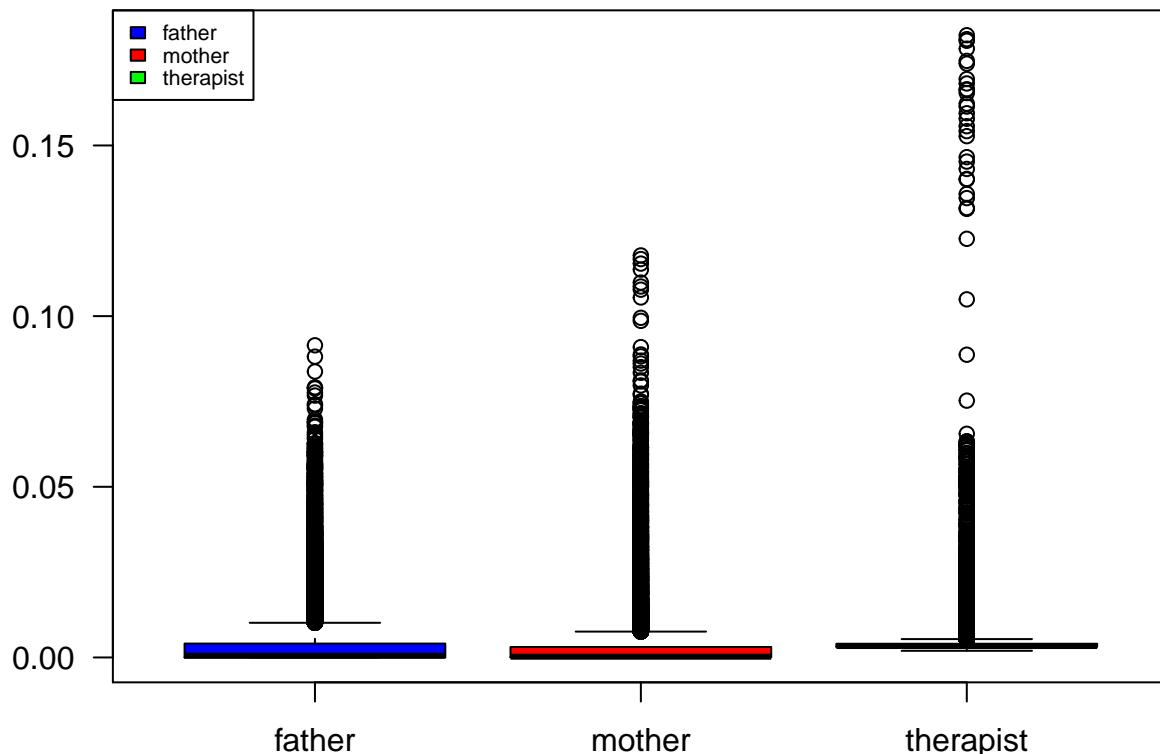
par(mar=c(3,3,2,2))
```

```

boxplot(slidedfather, slidedmother, slidedtherapist,
        col=colOrderList[c(1,2,4)],
        names=ParticipantsList[c(1,2,4)],
        main= "Box plot of motion history sliding interval on F1044C video", las=1)
par(mar=c(1,0.5,0.5,1))
legend("topleft", ParticipantsList[c(1,2,4)], fill=colOrderList, cex=0.7)

```

## Box plot of motion history sliding interval on F1044C video



```
summary(slidedfather)
```

```

##      Min.    1st Qu.     Median      Mean    3rd Qu.      Max.
## 0.000e+00 5.560e-06 4.862e-04 4.145e-03 4.066e-03 9.145e-02

```

```
summary(slidedmother)
```

```

##      Min.    1st Qu.     Median      Mean    3rd Qu.      Max.
## 0.000e+00 4.298e-05 2.132e-04 3.581e-03 3.056e-03 1.178e-01

```

```
summary(slidedtherapist)
```

```

##      Min.    1st Qu.     Median      Mean    3rd Qu.      Max.
## 0.001948 0.003099 0.003345 0.004688 0.004012 0.182300

```

Non overlapping interval

```

fatherEleven<- MeanMomentumByTime("father", indexOfvideos=1, interval=11, data)

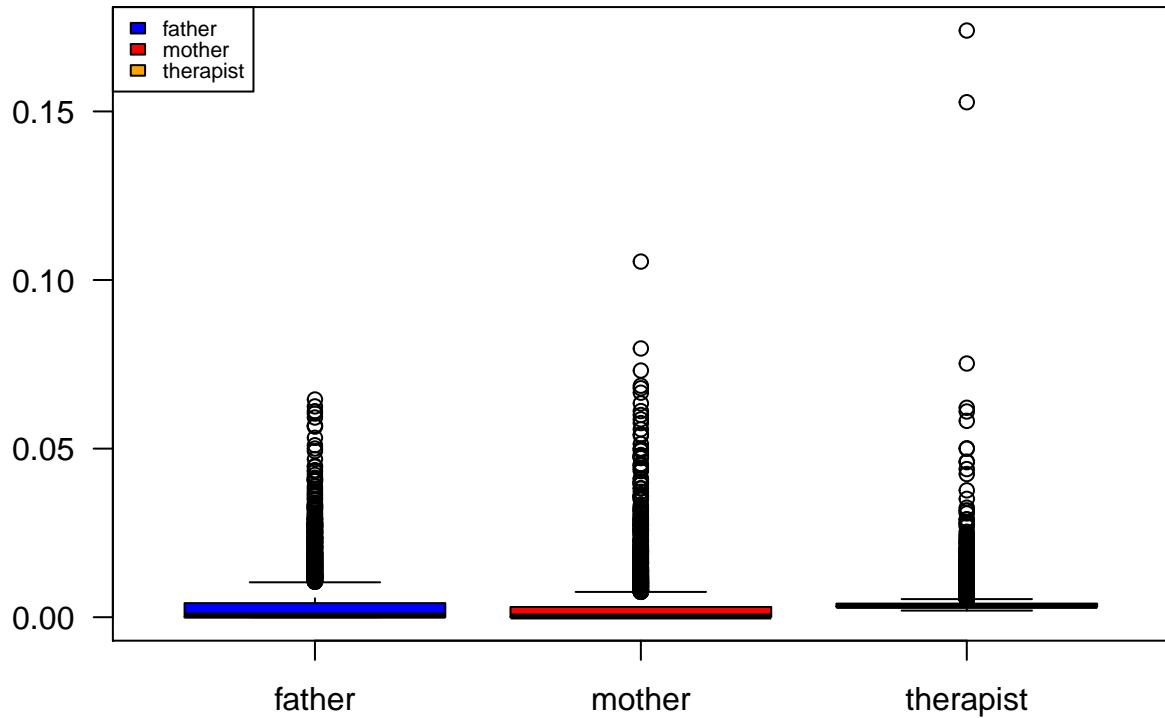
motherEleven <- MeanMomentumByTime("mother", indexOfvideos=1, interval=11, data)

therapistEleven <- MeanMomentumByTime("therapist", indexOfvideos=1, interval=11, data)

par(mar=c(3,3,3,2))
boxplot(fatherEleven, motherEleven, therapistEleven,
        col=colOrderList[c(1,2,4)],
        names=ParticipantsList[c(1,2,4)],
        main= "Box plots of motion history mean
on 11 frames non overlapping interval for F1044C video", las=1)
par(mar=c(1,0.5,0.5,1))
legend("topleft", ParticipantsList[c(1,2,4)], fill=colOrderList[c(1,2,4)], cex=0.7)

```

**Box plots of motion history mean  
on 11 frames non overlapping interval for F1044C video**



```
summary(fatherEleven)
```

```

##      Min.    1st Qu.     Median      Mean    3rd Qu.      Max.    NA's
## 0.0000000 0.0000056 0.0004807 0.0041380 0.0041740 0.0645600      1

```

```
summary(motherEleven)
```

```

##      Min.    1st Qu.     Median      Mean    3rd Qu.      Max.    NA's
## 0.0000033 0.0000430 0.0002248 0.0035770 0.0030270 0.1055000      1

```

```
summary(therapistEleven)
```

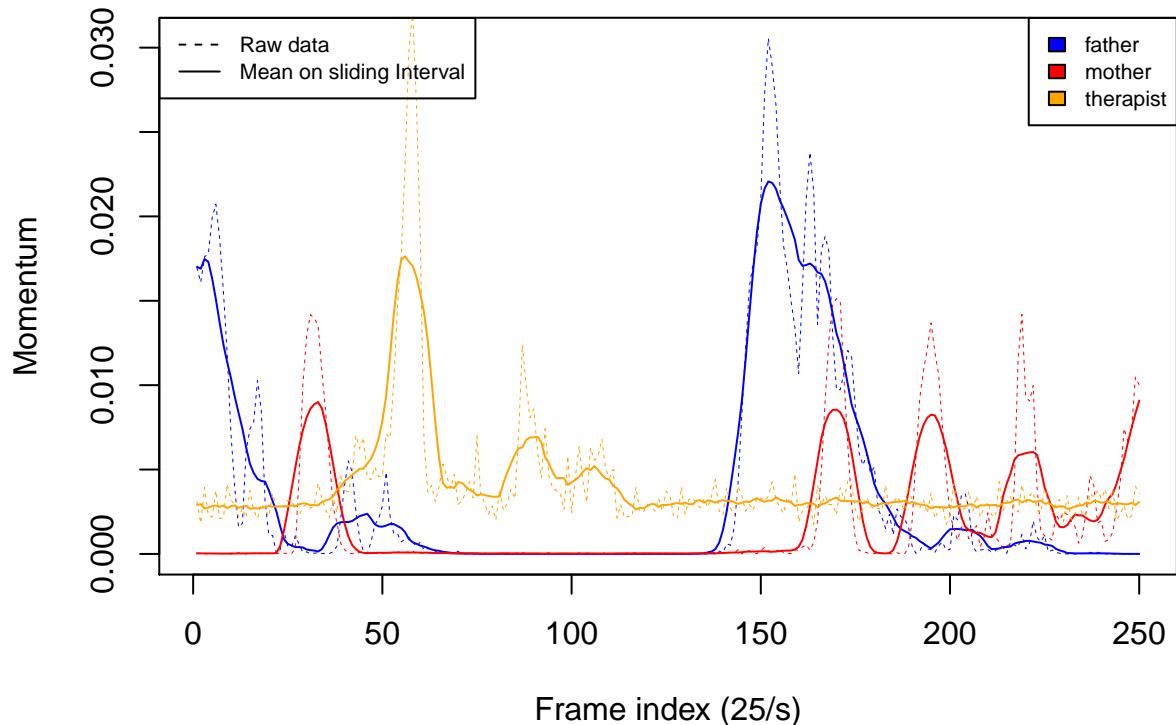
```
##      Min. 1st Qu. Median     Mean 3rd Qu.    Max. NA's
## 0.001964 0.003099 0.003349 0.004673 0.004016 0.174000      1
```

**Focus on the motion history of the first 20 seconds of the first video(C)**

Sliding interval function on a 11 frames interval

```
par(mar=c(4,4,4,2))
plot(1:250, data$father[6:255], main="Mean motion history (Sliding 11 frames interval)
for father on F1044C video, 10 seconds ", xlab="Frame index (25/s)", ylab="Momentum",
col="blue", type="l", lty=2, lwd=0.5)
lines(slidedfather[1:250], col="blue", lty=1)
lines(data$mother[6:255], col="red", lty=2, lwd=0.5)
lines(slidemother[1:250], col="red", lty=1)
lines(data$therapist[6:255], col="orange", lty=2, lwd=0.5)
lines(slidetherapist[1:250], col="orange", lty=1)
legend("topleft", c("Raw data", "Mean on sliding Interval"), lty=c(2, 1), cex=0.7)
legend("topright", ParticipantsList[c(1,2,4)], fill=colOrderList[c(1,2,4)], cex=0.7)
```

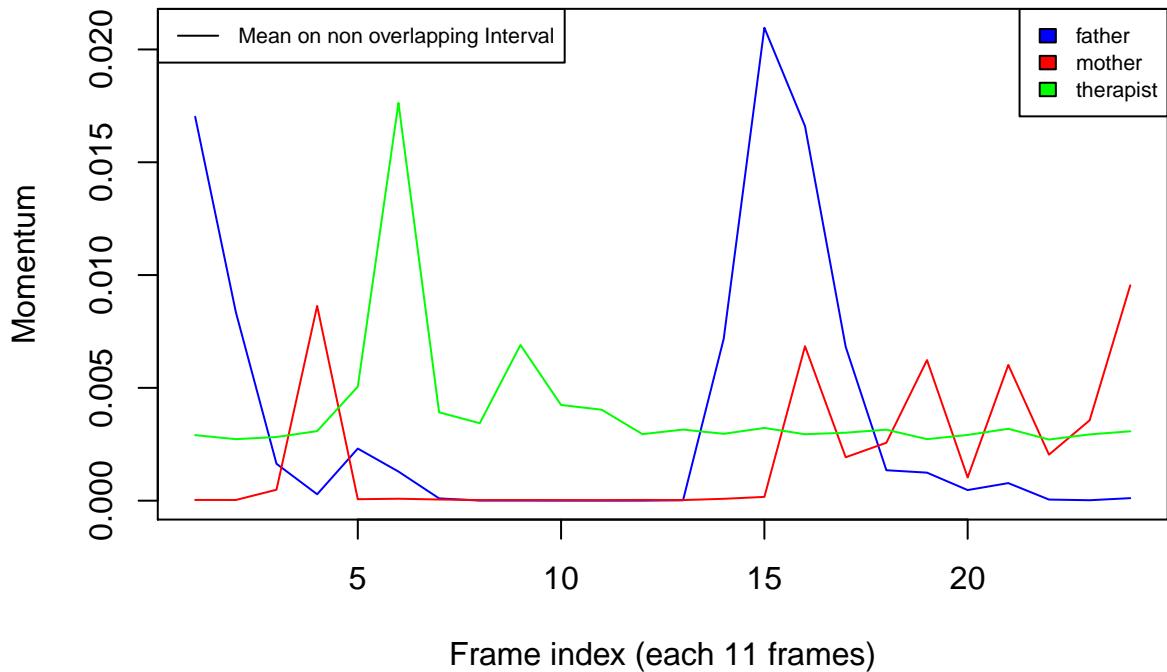
**Mean motion history (Sliding 11 frames interval)  
for father on F1044C video, 10 seconds**



Non overlapping interval function on a 11 frames interval

```
plot (1:24, fatherEleven[1:24], type="l", col="blue", main="Mean Momentum (non overlapping 11 frames intervals) for father on F1044C video, first 10 seconds", ylab="Momentum", xlab="Frame index (each 11 frames)", lty=1)
lines(motherEleven[1:24], col="red", lty=1)
lines(therapistEleven[1:24], col="green", lty=1)
legend("topleft", "Mean on non overlapping Interval" , lty=1, cex=0.7)
legend("topright", ParticipantsList[c(1,2,4)], fill=colOrderList, cex=0.7)
```

### Mean Momentum (non overlapping 11 frames intervals) for father on F1044C video, first 10 seconds

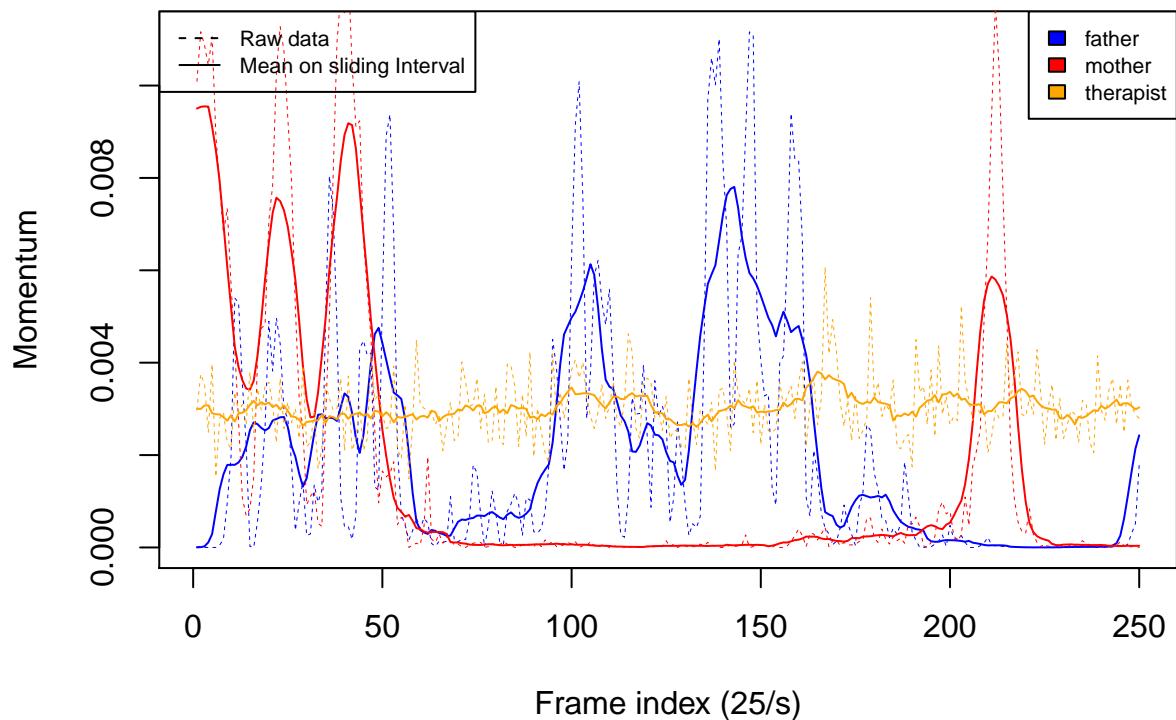


Motion history of the father during 10-20 seconds of the first video(C)

Non overlapping interval function on a 11 frames interval

```
par(mar=c(4,4,4,2))
plot(1:250, data$father[256:505], main="Mean motion history (Sliding 11 frames interval) for father on F1044C video, 10-20 seconds", xlab="Frame index (25/s)", ylab="Momentum", lty=1)
lines(slidedfather[251:500], col="blue", lty=1)
lines(data$mother[256:505], col="red", lty=2, lwd=0.5)
lines(slidemother[251:500], col="red", lty=1)
lines(data$therapist[256:505], col="orange", lty=2, lwd=0.5)
lines(slidedtherapist[251:500], col="orange", lty=1)
legend("topleft", c("Raw data", "Mean on sliding Interval") , lty=c(2, 1), cex=0.7)
legend("topright", ParticipantsList[c(1,2,4)], fill=colOrderList[c(1,2,4)], cex=0.7)
```

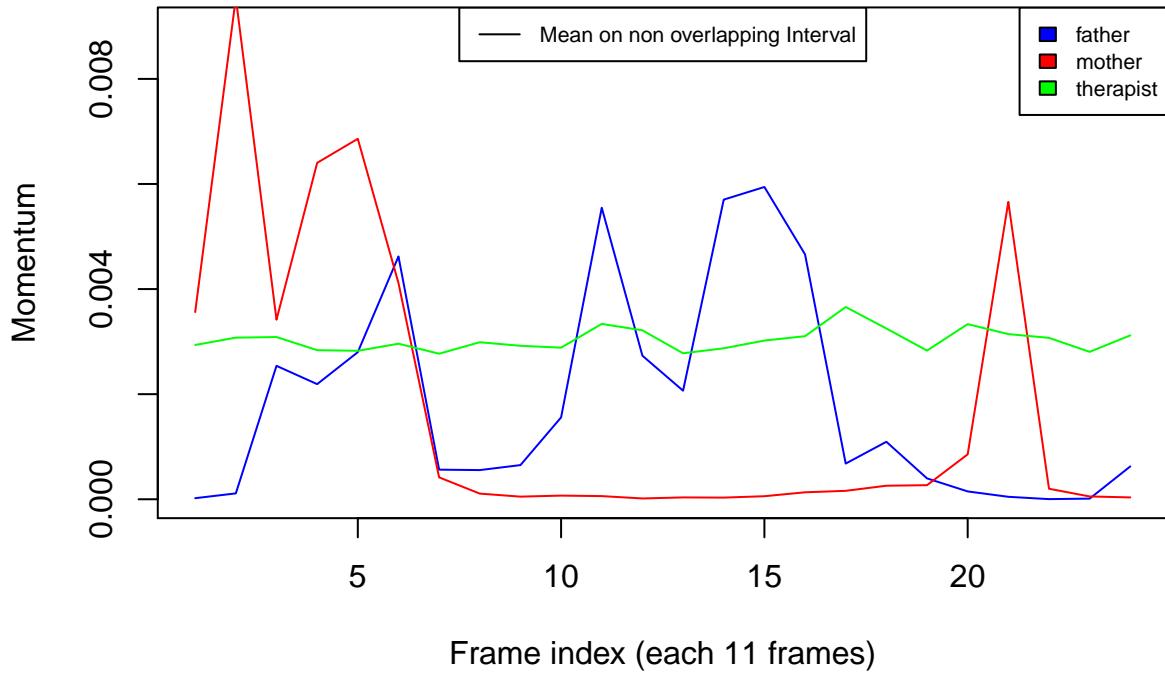
## Mean motion history (Sliding 11 frames interval) for father on F1044C video, 10–20 seconds



Non overlapping interval function on a 11 frames interval

```
plot (1:24, fatherEleven[23:46], type="l", col="blue", main="Mean Momentum (non overlapping 11 frames in father on F1044C video, between 10-20 seconds", ylab="Momentum", xlab="Frame index (each 11 frames)", yaxt="none")
lines(motherEleven[23:46], col="red", lty=1)
lines(therapistEleven[23:46], col="green", lty=1)
legend("top", "Mean on non overlapping Interval" , lty=1, cex=0.7)
legend("topright", ParticipantsList[c(1,2,4)], fill=colOrderList, cex=0.7)
```

## Mean Momentum (non overlapping 11 frames intervals) for father on F1044C video, between 10–20 seconds



## Mean Momentum by minute plots

```

for (i in 1:Number0fvideos){
  fatherMinute<- MeanMomentumByTime("father", index0fvideos=i, interval=1500, data)

  MotherMinute<- MeanMomentumByTime("mother", index0fvideos=i, interval=1500, data)

  TherapistMinute<- MeanMomentumByTime("therapist", index0fvideos=i, interval=1500, data)

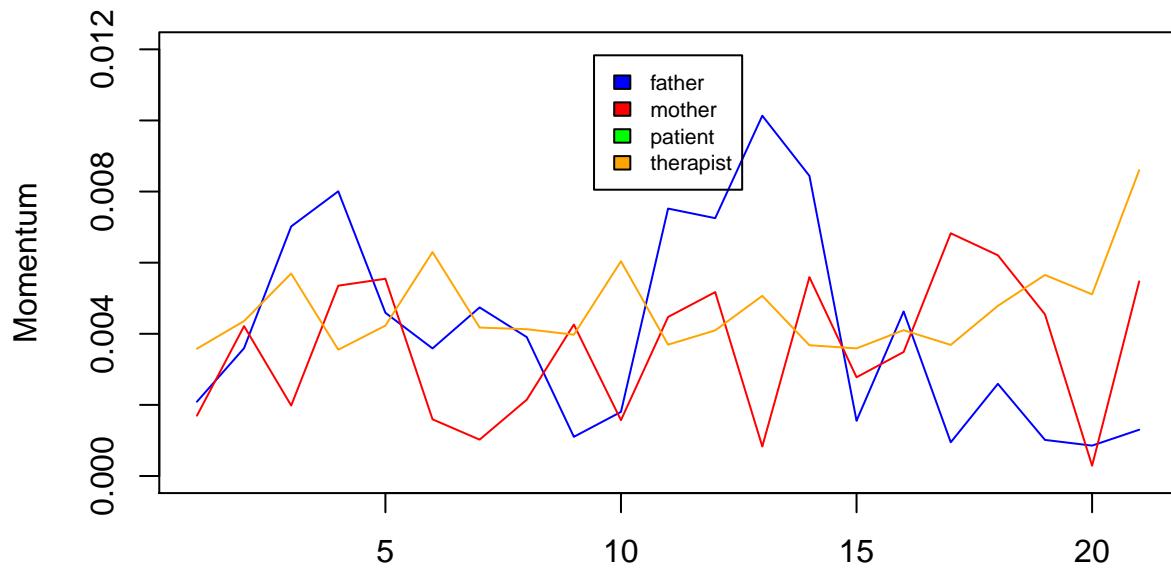
  PatientMinute<- MeanMomentumByTime("patient", index0fvideos=i, interval=1500, data)

length(fatherMinute)

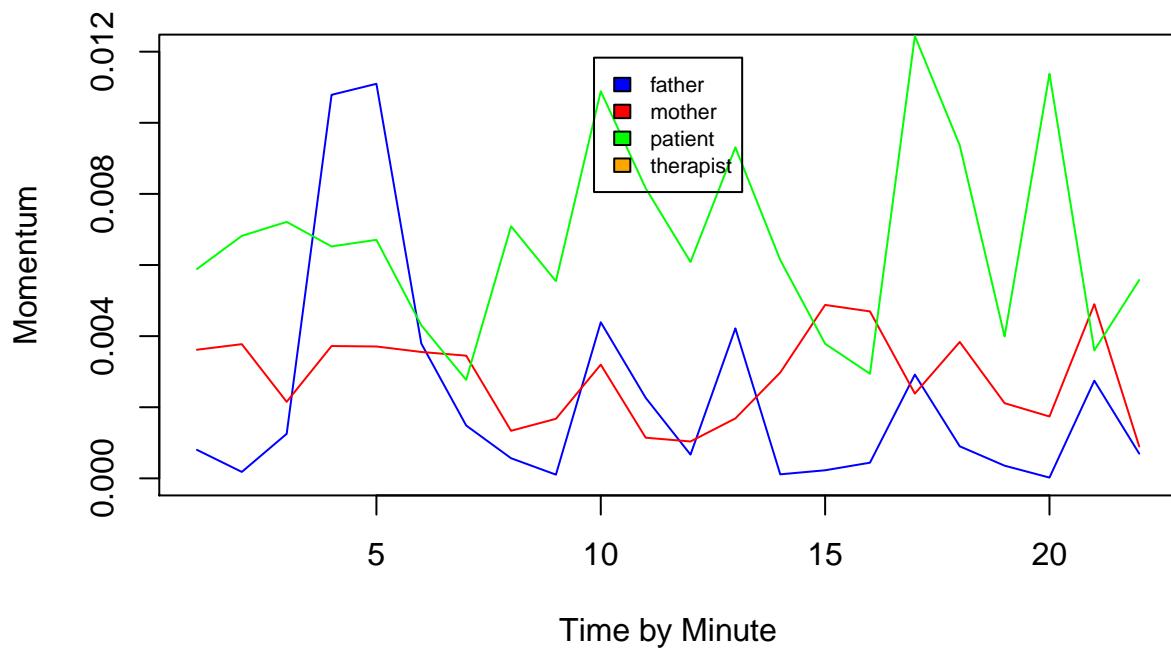
  par(mar=c(4,4,4,2))
  plot (1:length(fatherMinute), fatherMinute, type="l", col="blue",
  main=paste("Mean Momentum (non overlaping minute intervals)
on F1044", labelvideolist[i], " video" , sep=""),
  ylab="Momentum", xlab="Time by Minute", ylim=c(0, 12E-03) )
  lines(MotherMinute, col="red")
  lines(TherapistMinute, col="orange")
  lines(PatientMinute, col="green")
  legend("top", inset=.05, ParticipantsList,
         fill=colOrderList, cex=0.7)
}

```

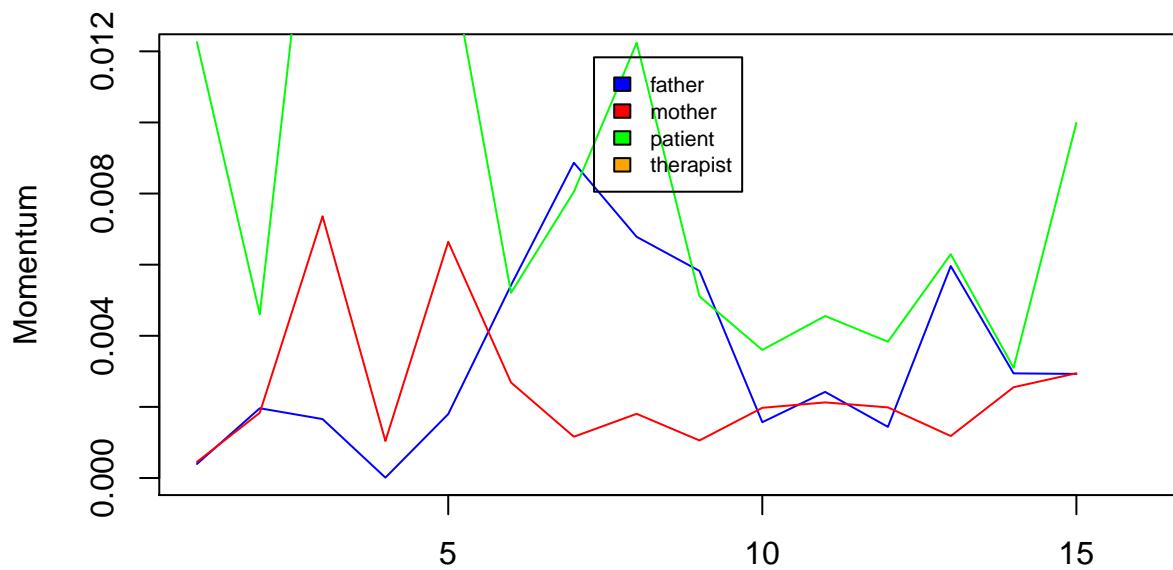
**Mean Momentum (non overlapping minute intervals)  
on F1044C video**



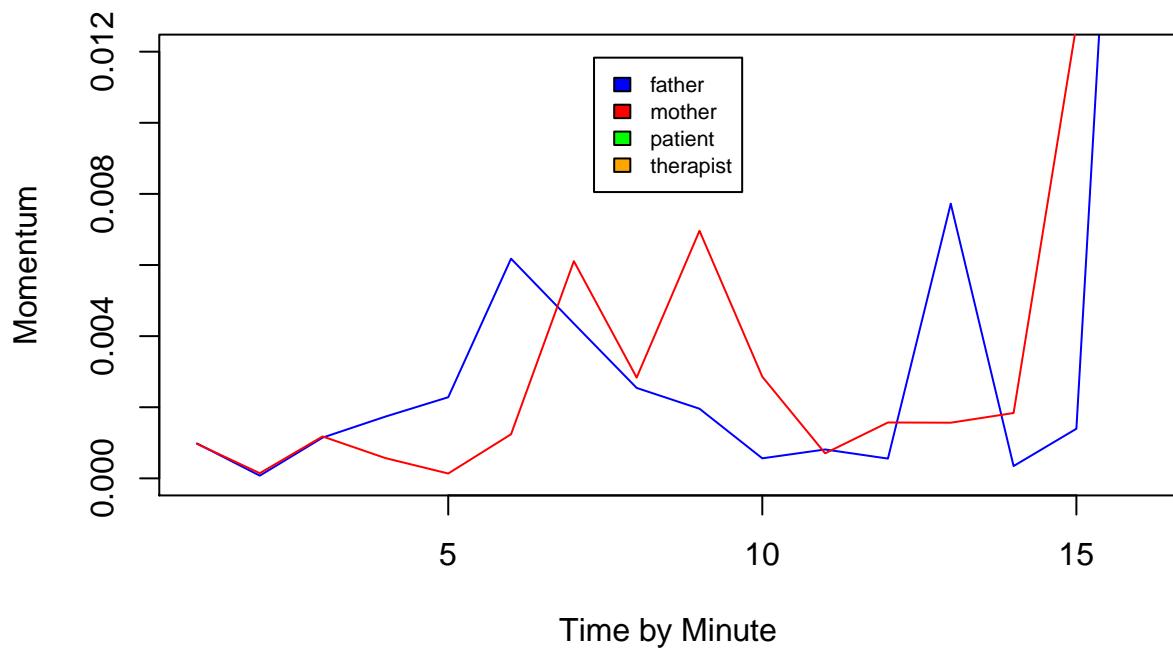
**Time by Minute  
Mean Momentum (non overlapping minute intervals)  
on F1044D1 video**



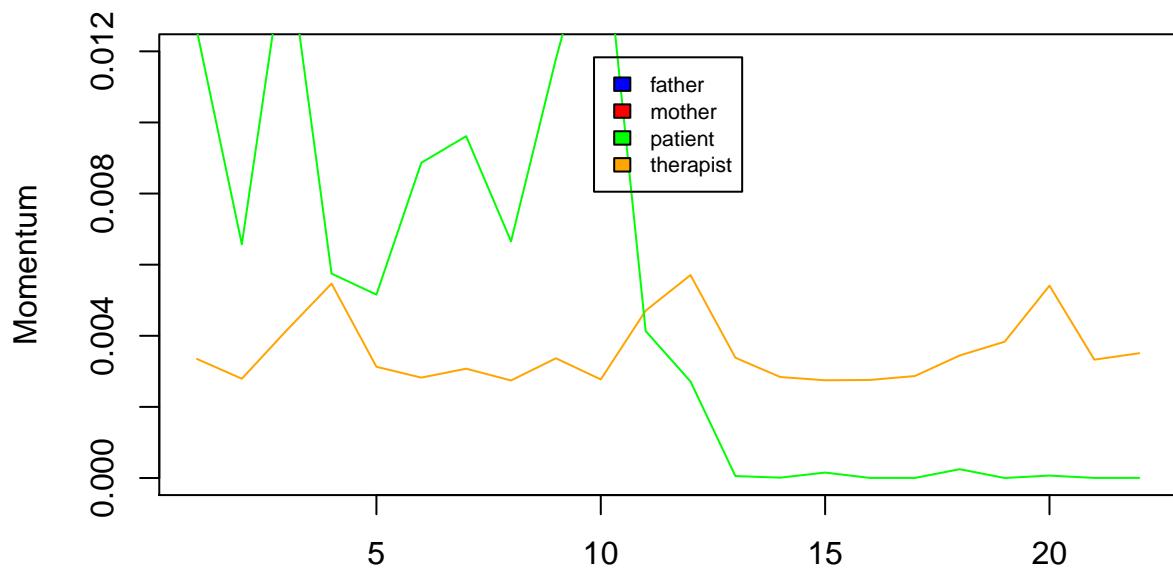
**Mean Momentum (non overlapping minute intervals)  
on F1044D2 video**



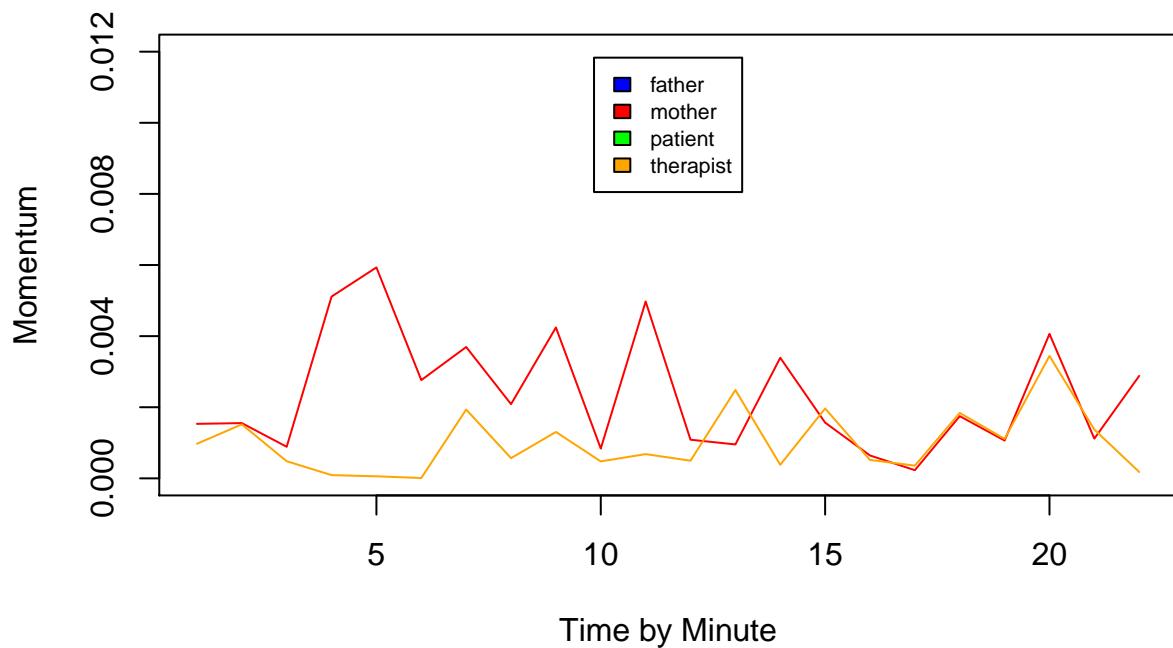
**Time by Minute  
Mean Momentum (non overlapping minute intervals)  
on F1044E video**



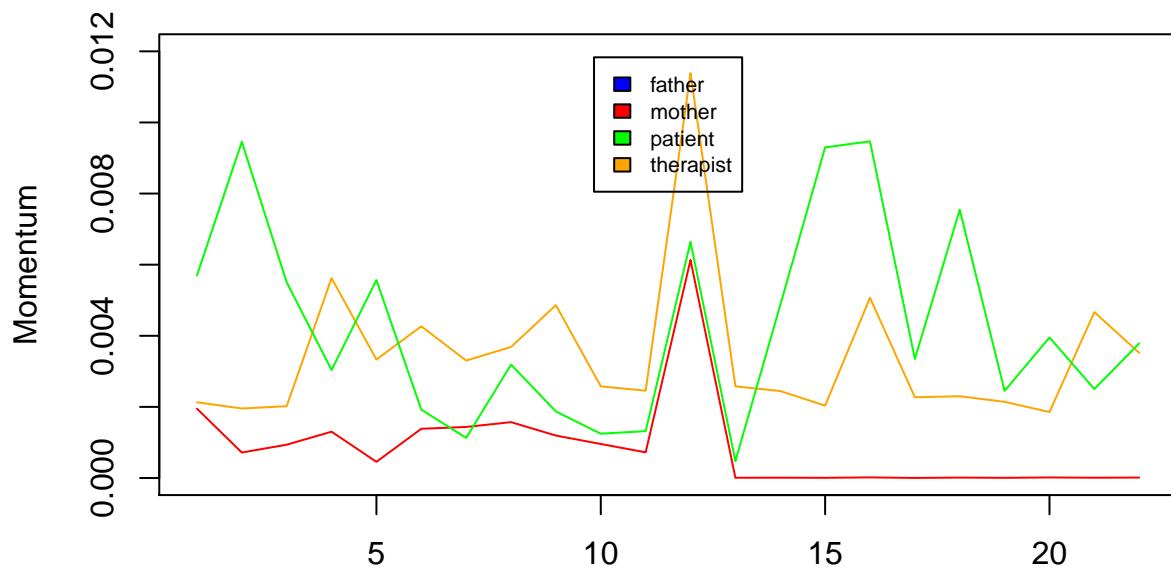
**Mean Momentum (non overlapping minute intervals)  
on F1044F video**



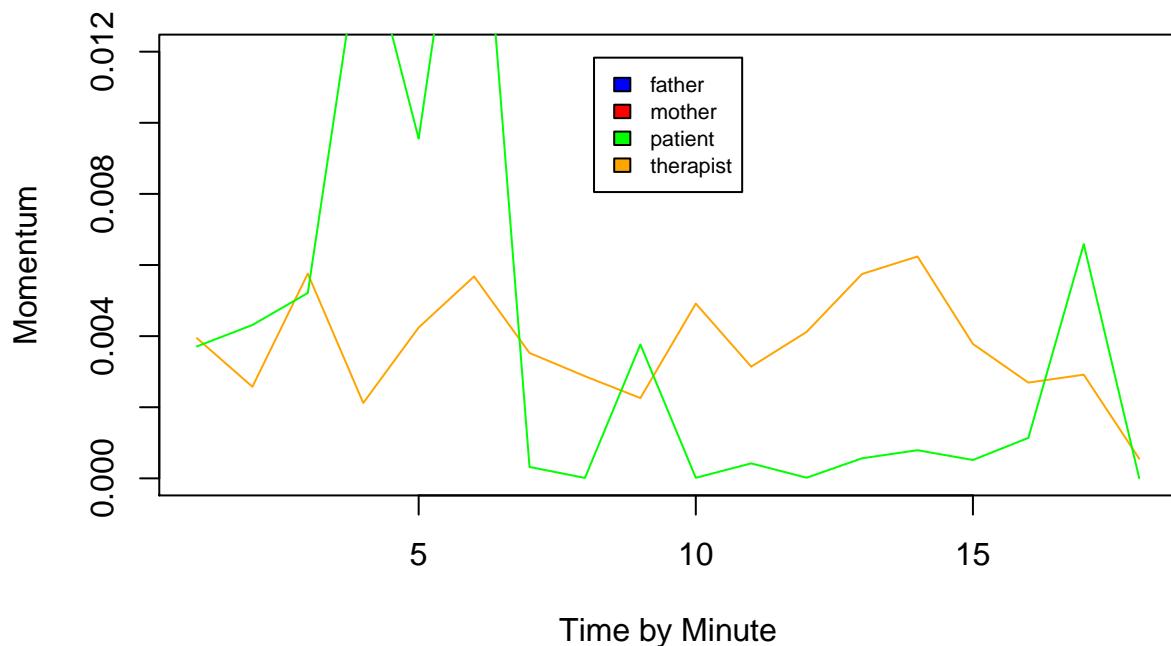
**Time by Minute  
Mean Momentum (non overlapping minute intervals)  
on F1044G video**



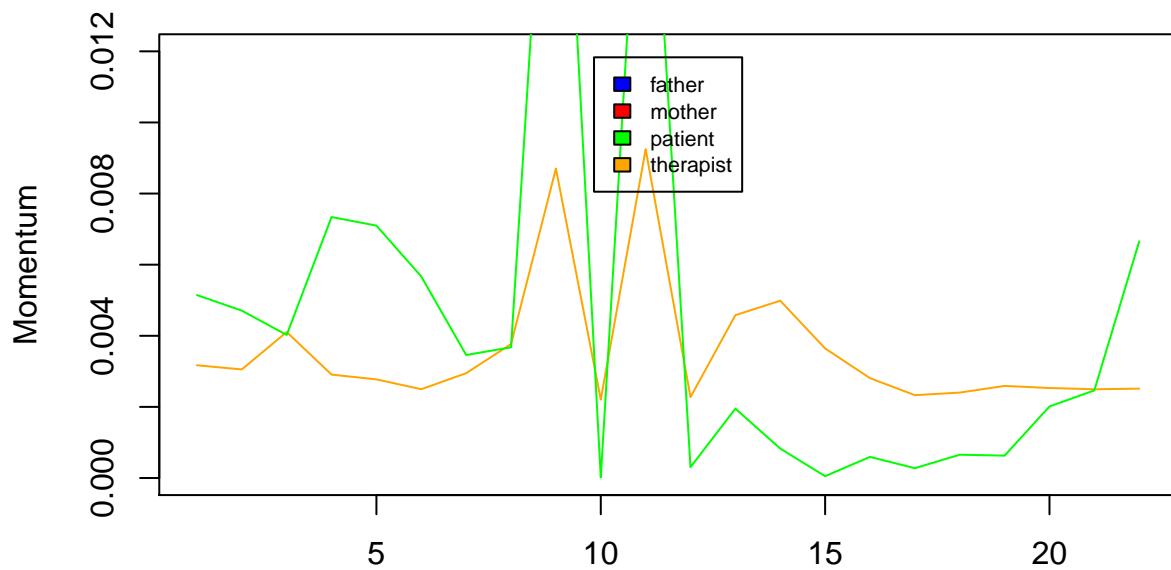
**Mean Momentum (non overlapping minute intervals)  
on F1044H video**



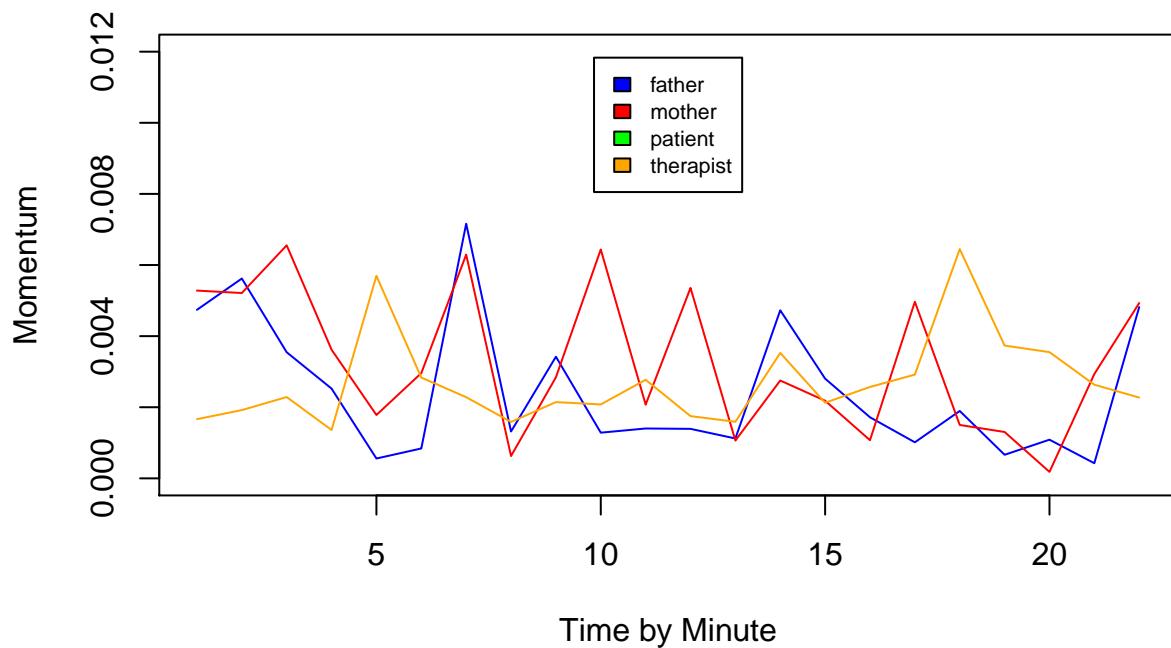
**Time by Minute  
Mean Momentum (non overlapping minute intervals)  
on F1044I video**



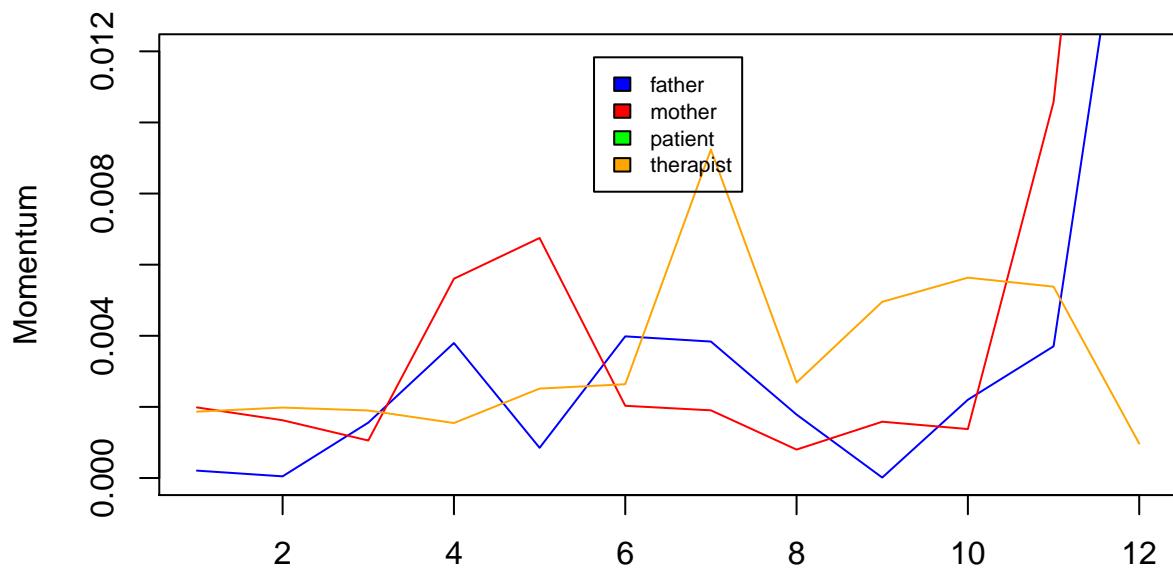
**Mean Momentum (non overlapping minute intervals)  
on F1044L video**



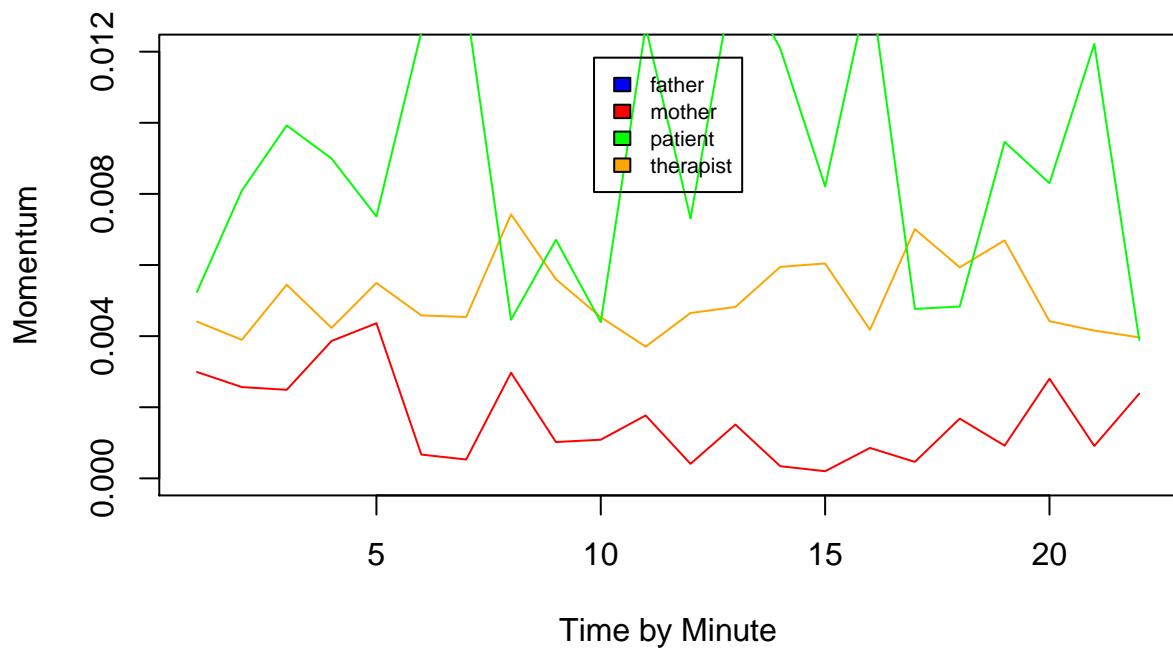
**Time by Minute  
Mean Momentum (non overlapping minute intervals)  
on F1044M1 video**



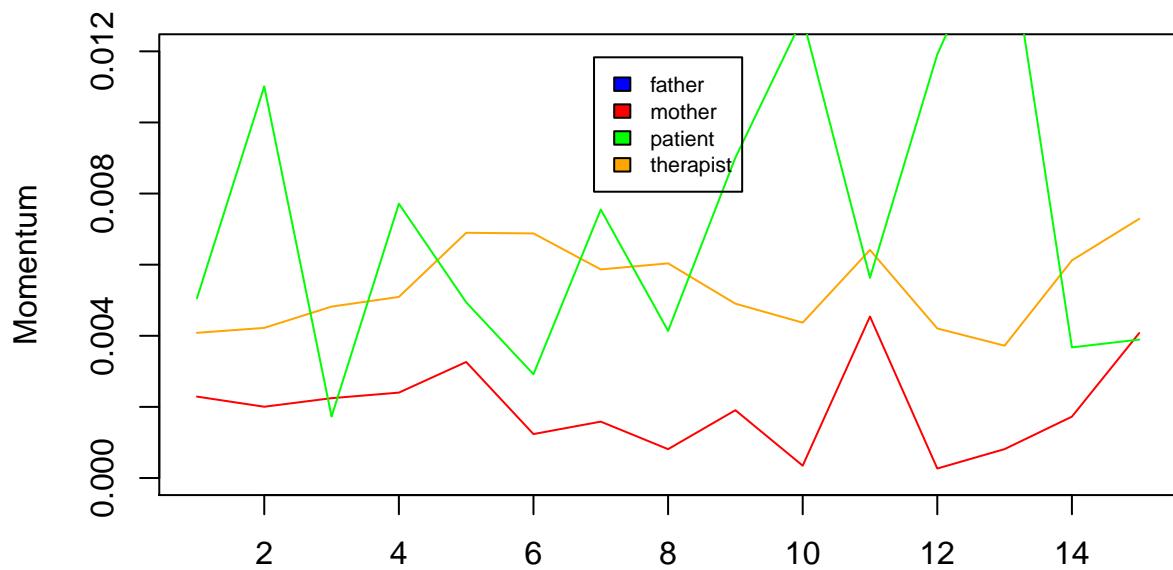
**Mean Momentum (non overlapping minute intervals)  
on F1044M2 video**



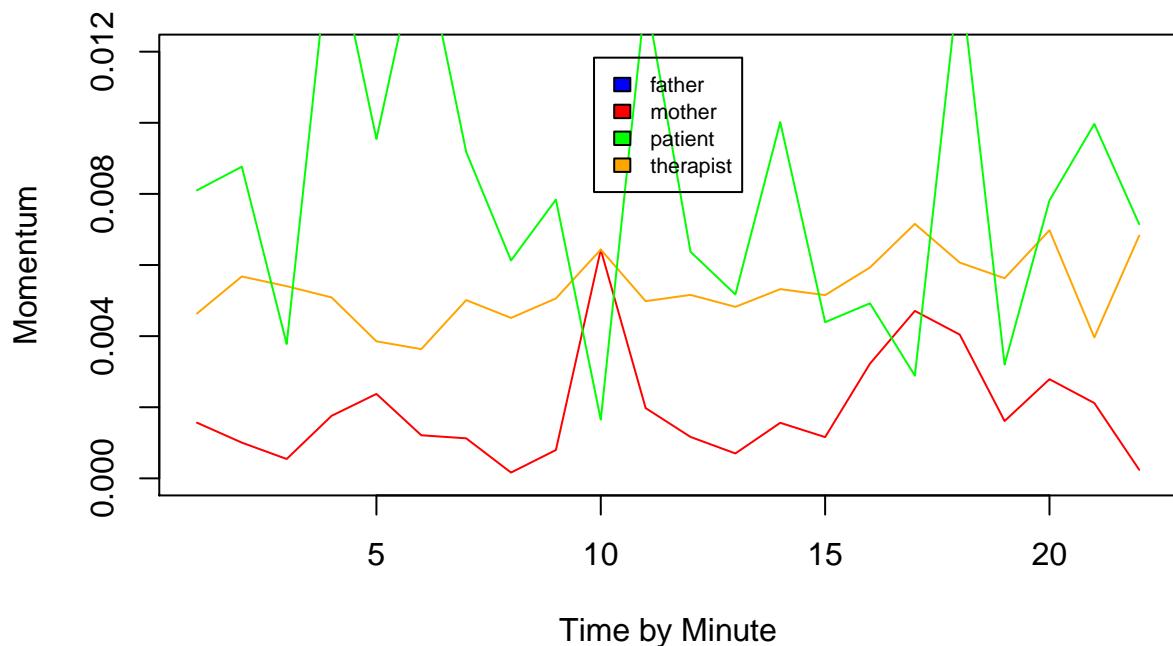
**Time by Minute  
Mean Momentum (non overlapping minute intervals)  
on F1044N video**



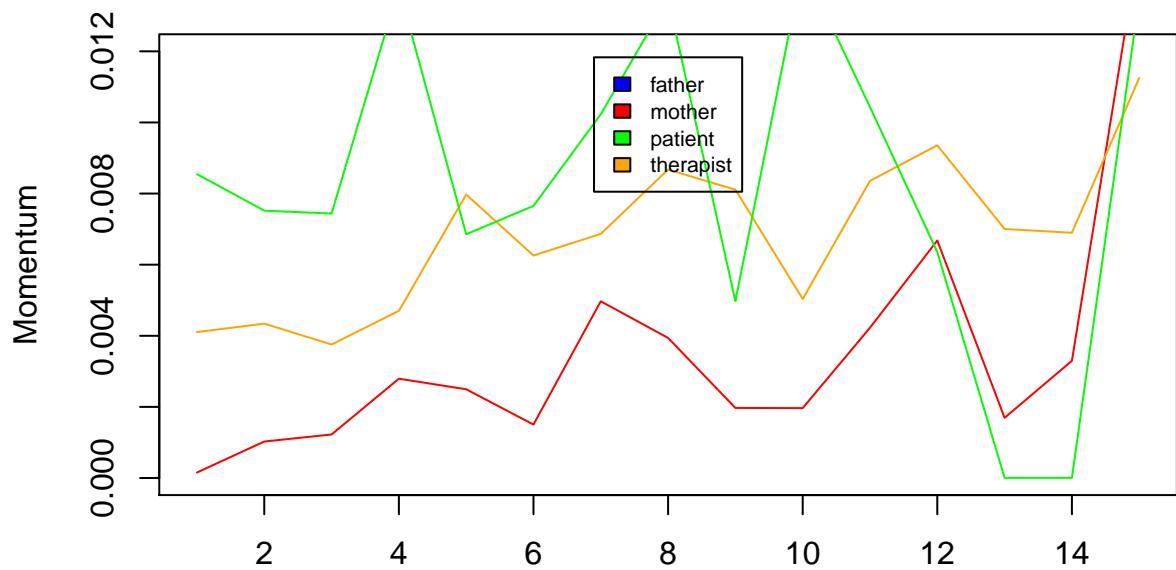
**Mean Momentum (non overlapping minute intervals)  
on F1044O video**



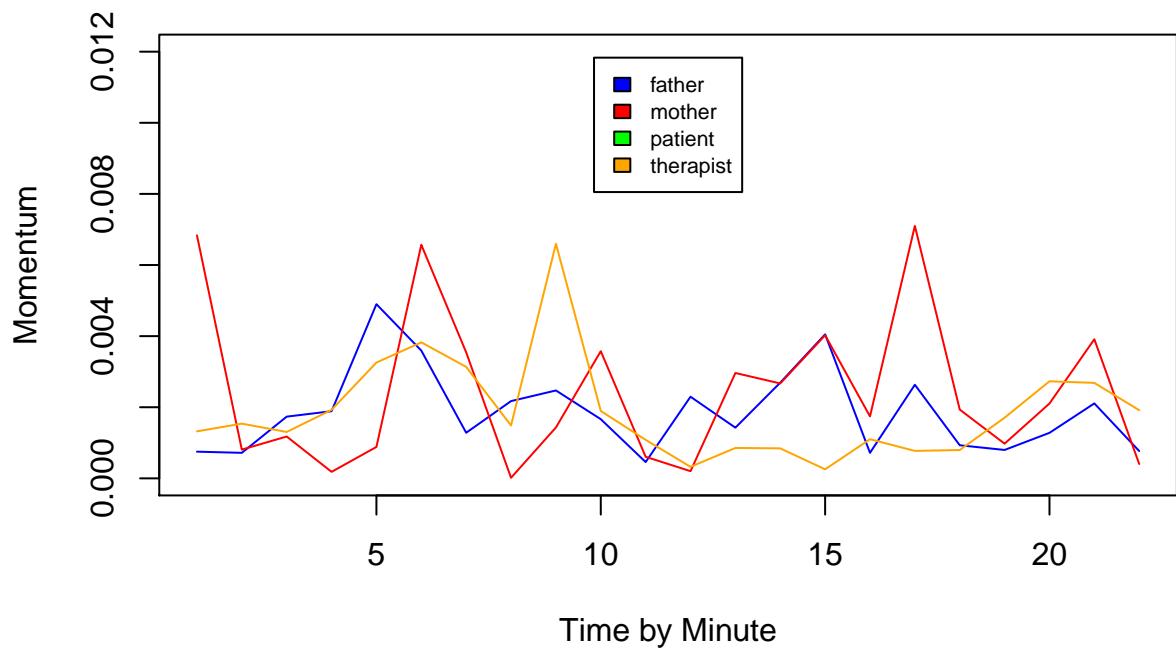
**Time by Minute  
Mean Momentum (non overlapping minute intervals)  
on F1044P video**



**Mean Momentum (non overlapping minute intervals)  
on F1044Q video**



Time by Minute  
**Mean Momentum (non overlapping minute intervals)  
on F1044R1 video**



**Mean Momentum (non overlapping minute intervals)  
on F1044R2 video**

