Mazurka paper figures

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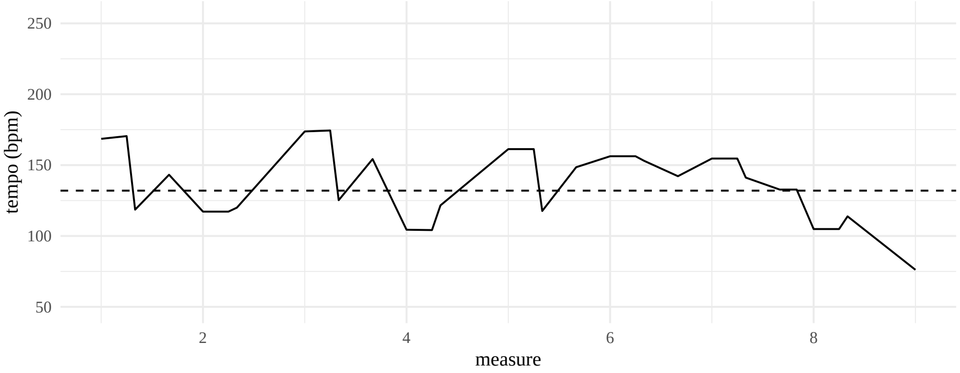
8/20/2018

Suggested order

1. Parameter interpretation in Fliere
2. Using parameters to examine two different performances
3. Clustering performances (compare the clusters)
    a. what can we say about the parameters of each cluster? what is different about them?
4. Similar performances (Rubinstein)
5. Model issues

Short tempo

```
ggplot(tempos, aes(x=note_onset, y=Rubinstein_1961)) +
  geom_line() + ylab('tempo (bpm)') + xlab('measure') +
  scale_x_continuous(breaks=1:4*2, limits = c(1,9)) +
  # coord_cartesian(xlim=c(1,9-1e-6)) +
  geom_hline(yintercept = 132, linetype='dashed')
```

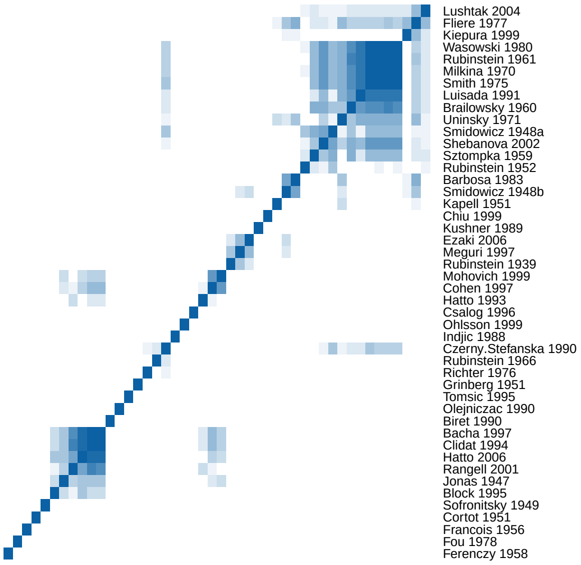


Comparing clusters

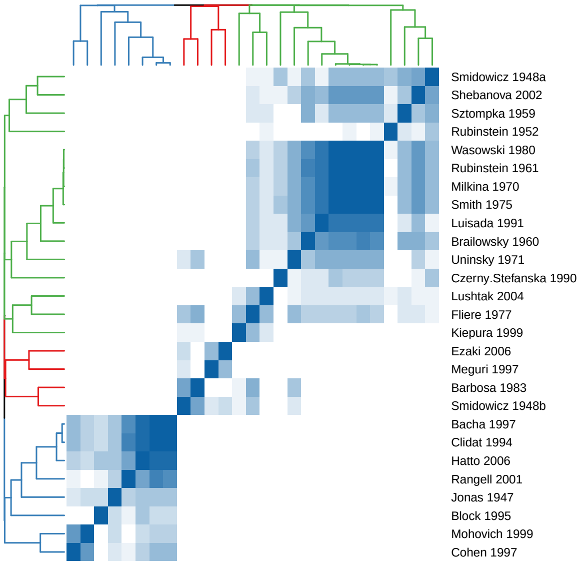
```
perfs = tempos[,-c(1:3)] %>% as.matrix %>% t
row.names(pvec_ml) = sub('_',' ',row.names(pvec_ml))
hc_parm = pvec_ml %>% Dist
row.names(hc_parm) = row.names(pvec_ml)
hc_perf = perfs %>% dist %>% percentize %>% hclust

dend_parm = hc_parm %>% as.dist %>% hclust %>% as.dendrogram
dend_perf = hc_perf %>% as.dendrogram
```

```
subs = rowMeans(hc_parm) <.961
sDmat = hc_parm[subs,subs]
```

```
nclusts = 3
colorthem = TRUE
heatmap.2(hc_parm,
          Rowv = dend_parm, Colv = dend_parm,
          symm=TRUE,
          dendrogram = 'none',
          density.info = 'none', trace='none',
          #labRow = TRUE,
          labCol = NA,
          key.title = NA,
          col=colorRampPalette(c('#0b61a4','white')),
          key.xlab = NA,
          margins = c(1,6),
          cexRow = .6,
          cexCol = .6,
          lhei=c(1,15),
          lwid=c(1,15),
          offsetCol = 0, offsetRow = 0,
          key=FALSE
)
```

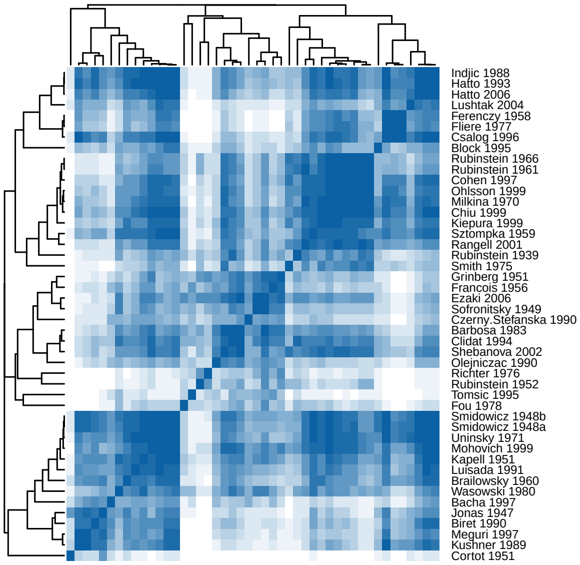


```
sdends = sDmat %>% as.dist %>% hclust %>% as.dendrogram
if(colorthem) sdends = sdends %>% set('labels_col', value=fivecolors[1:nclusts], k=nclusts) %>%
  set('branches_lty', 1) %>%
  set('branches_k_color', value=fivecolors[1:nclusts], k=nclusts)
heatmap.2(sDmat,
          Rowv = sdends, Colv = sdends,
          symm=TRUE,
          density.info = 'none', trace='none',
          #labRow = TRUE,
          labCol = NA,
          key.title = NA,
          col=colorRampPalette(c('#0b61a4','white')),
          key.xlab = NA,
          margins = c(1,6),
          cexRow = .6,
          cexCol = .6,
          lhei=c(1,8),
          lwid=c(1,8),
          offsetCol = 0, offsetRow = 0,
          key=FALSE
)
```



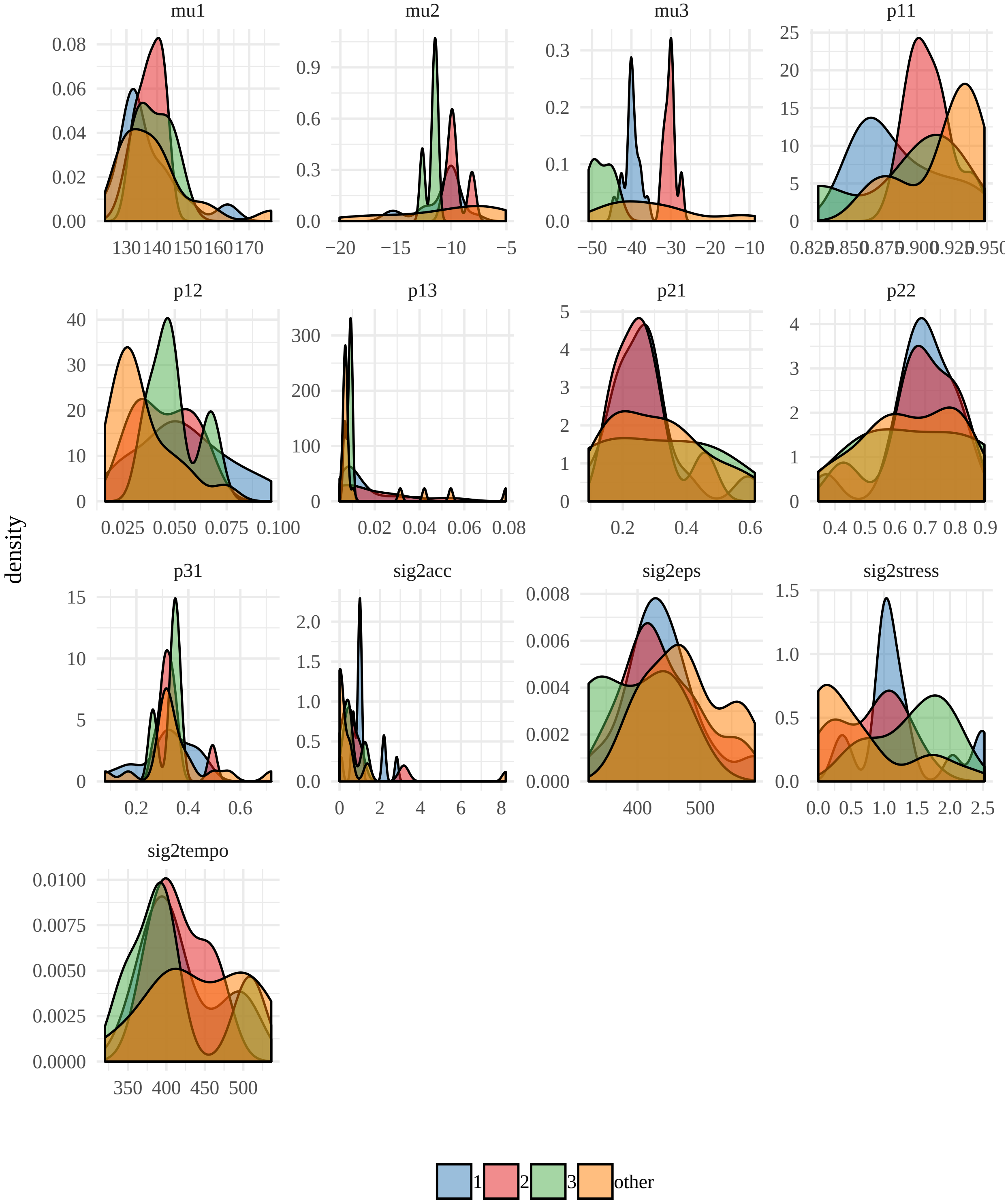
```
clustered = data.frame(clust = as.factor(cutree(as.hclust(sdends), k = nclusts)),
                 performer = row.names(sDmat))
pvec_all = pvec_ml %>% data.matrix %>% data.frame
pvec_all$performer = row.names(pvec_ml)
row.names(pvec_all) = NULL
pvec_all = full_join(pvec_all, clustered)
levels(pvec_all$clust) = c(levels(pvec_all$clust),'other')
pvec_all$clust[is.na(pvec_all$clust)] = 'other'
```

```
heatmap.2(as.matrix(percentize(dist(perfs))),
          Rowv = dend_perf, Colv = dend_perf,
          symm=TRUE,
          density.info = 'none', trace='none',
          labRow = sub('_',' ',row.names(pvec_ml)),
          labCol = NA,
          key.title = NA,
          col=colorRampPalette(c('#0b61a4','white')),
          key.xlab = NA,
          margins = c(1,6),
          cexRow = .6,
          cexCol = .6,
          lhei=c(1,8),
          lwid=c(1,8),
          offsetCol = 0, offsetRow = 0,
          key=FALSE
)
```



Cluster densities

```
pvec_all %>% gather(key='parameter',value='value',-clust,-performer) %>%
  ggplot(aes(x=value, fill=clust)) + geom_density(alpha=.5) +
  facet_wrap(~parameter,scales='free') +
  scale_fill_manual(values=fivecolors[1:(nclusts+1)]) + xlab('') +
  theme(legend.title = element_blank(), legend.position = 'bottom')
```

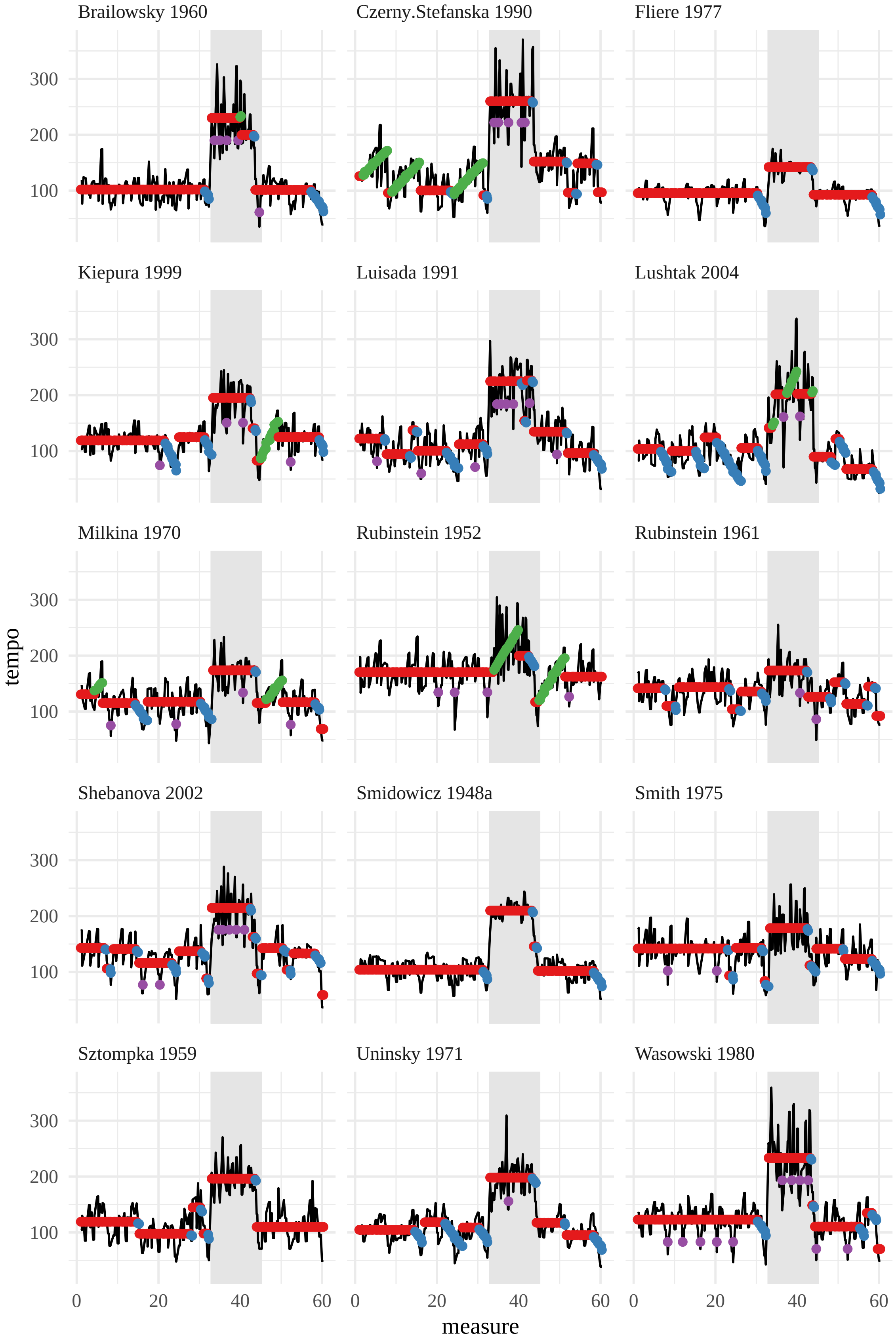


Plotting performances

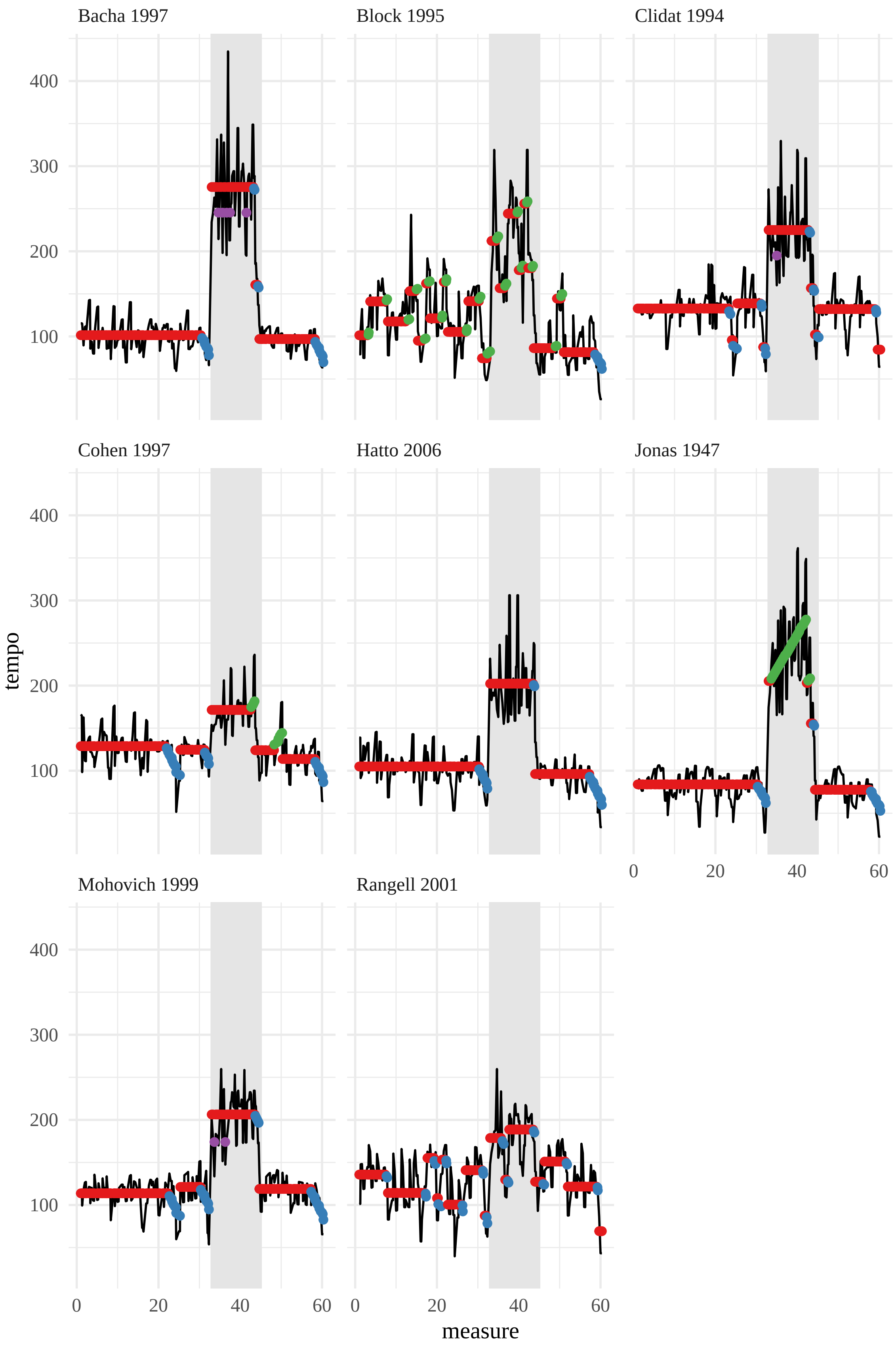
```
plots = vector("list", 4)
lt = diff(c(tempos$note_onset, 61))
```

```r
for(i in 1:nrow(pvec_ml)){
  params = unlist(pvec_ml[i,])
  y = matrix(tempos[,i+3], nrow = 1)
  pmats = yupengMats(lt, params[1], params[2:4], params[5:7], params[8:13],
                     c(132,0), c(400,10))
  beam = beamSearch(pmats$a0, pmats$P0, c(1,0,0,0,0,0,0,0,0,0),
                    pmats$dt, pmats$ct, pmats$Tt, pmats$Zt,
                    pmats$HHt, pmats$GGt, y, pmats$transMat, 200)
  bestpath = beam$paths[which.max(beam$weights),]
  kal = kalman(pmats, bestpath, y)
  plots[[i]] = data.frame(measure = tempos$note_onset, tempo = c(y),
                  inferred = c(kal$ests), state = convert10to4(bestpath))
}
plots = bind_rows(plots)
plots$performer = rep(pvec_all$performer, each=length(y))
plots$clust = rep(pvec_all$clust, each=length(y))
plots$state = as.factor(plots$state)
# plots$pointx = 10
# plots$pointy = 400
# deunderscore = function(x) gsub('_',' ',x)
```

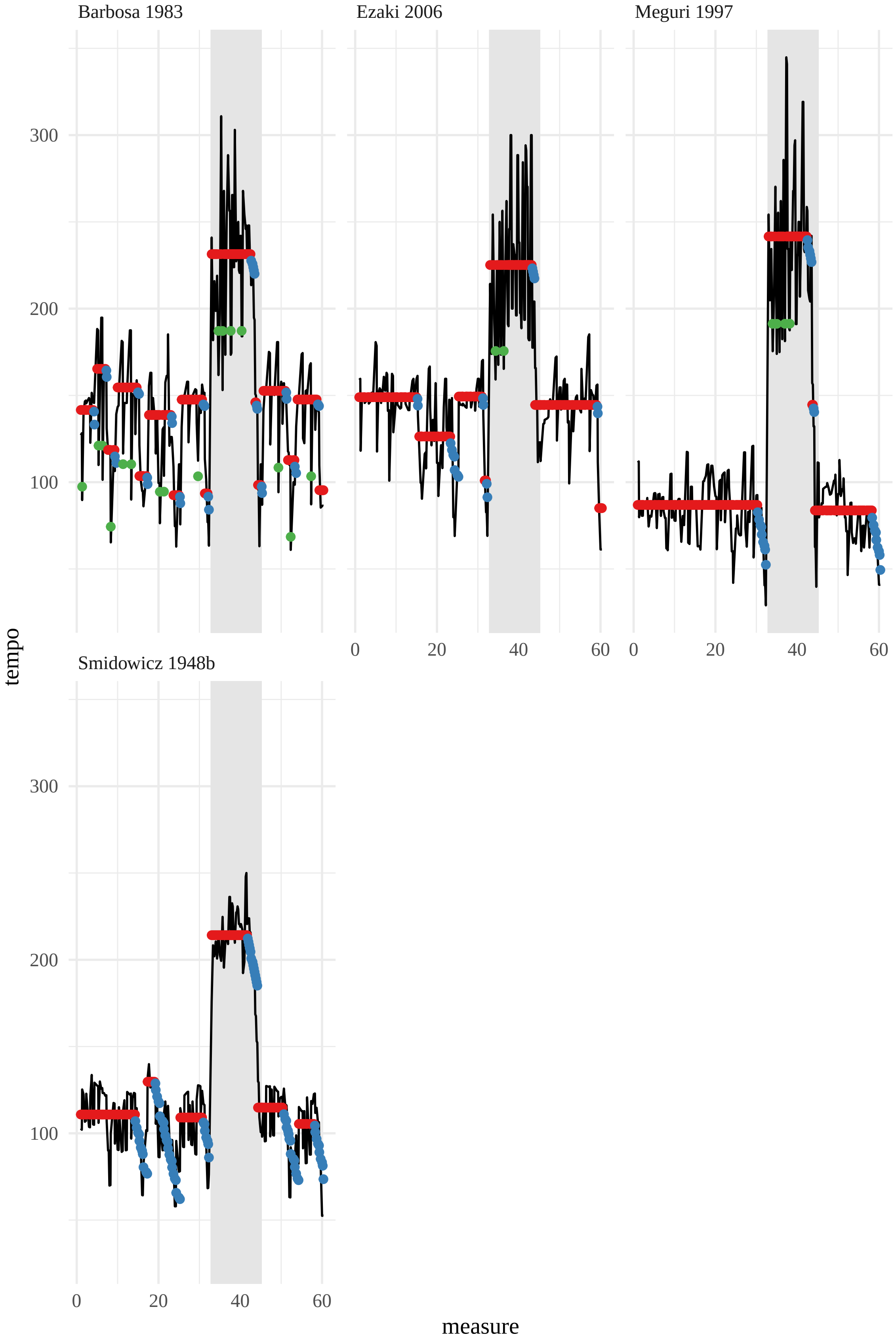
```r
ggplot(filter(plots, clust=='1')) +
  geom_rect(data=data.frame(xmin = 33, xmax = 45, ymin = -Inf, ymax = Inf),
            aes(xmin=xmin,xmax=xmax,ymin=ymin,ymax=ymax),
            fill = 'gray90', color = 'gray90') +
  geom_line(aes(x=measure, y=tempo), color='black') +
  geom_point(aes(x=measure, y=inferred, color=state)) +
  scale_color_brewer(palette='Set1') +
  theme(legend.position = 'none', legend.title = element_blank(),
        strip.text = element_text(hjust = 0)) +
  facet_wrap(~performer,ncol=3) #+
```


Brailowsky 1960
Czerny.Stefanska 1990
Fliere 1977
Kiepura 1999
Luisada 1991
Lushtak 2004
Milkina 1970
Rubinstein 1952
Rubinstein 1961
Shebanova 2002
Smidowicz 1948a
Smith 1975
Sztompka 1959
Uninsky 1971
Wasowski 1980
tempo
300
200
100
measure
0
20
40
60

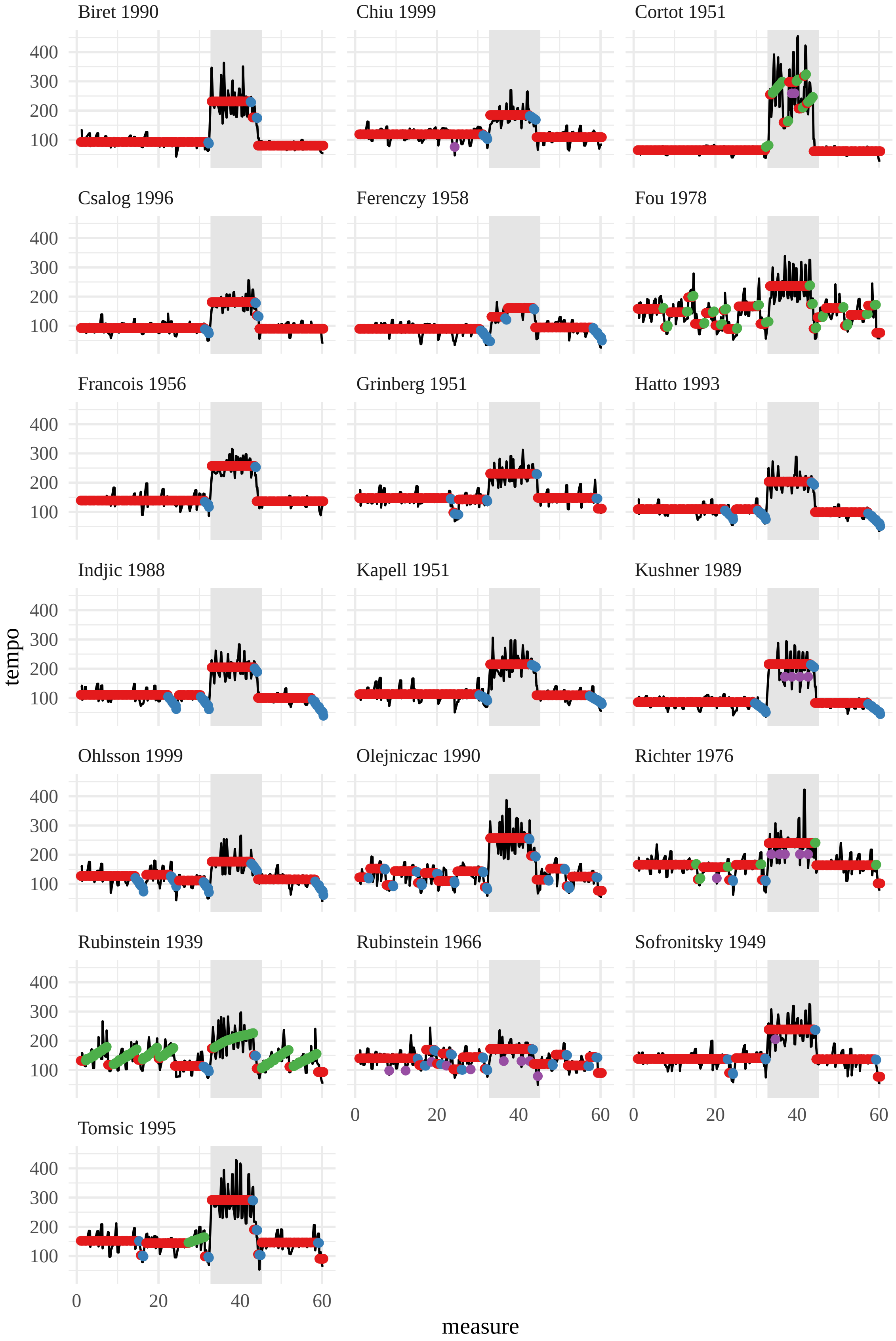
```r
ggplot(filter(plots, clust=='2')) +
  geom_rect(data=data.frame(xmin = 33, xmax = 45, ymin = -Inf, ymax = Inf),
              aes(xmin=xmin,xmax=xmax,ymin=ymin,ymax=ymax),
              fill = 'gray90', color = 'gray90') +
  geom_line(aes(x=measure, y=tempo), color='black') +
  geom_point(aes(x=measure, y=inferred, color=state)) +
  scale_color_brewer(palette='Set1') +
  theme(legend.position = 'none', legend.title = element_blank(),
        strip.text = element_text(hjust = 0)) +
  facet_wrap(~performer,ncol = 3) #+
```


Bacha 1997
Block 1995
Clidat 1994
Cohen 1997
Hatto 2006
Jonas 1947
Mohovich 1999
Rangell 2001
tempo
400
300
200
100
0
20
40
60
measure

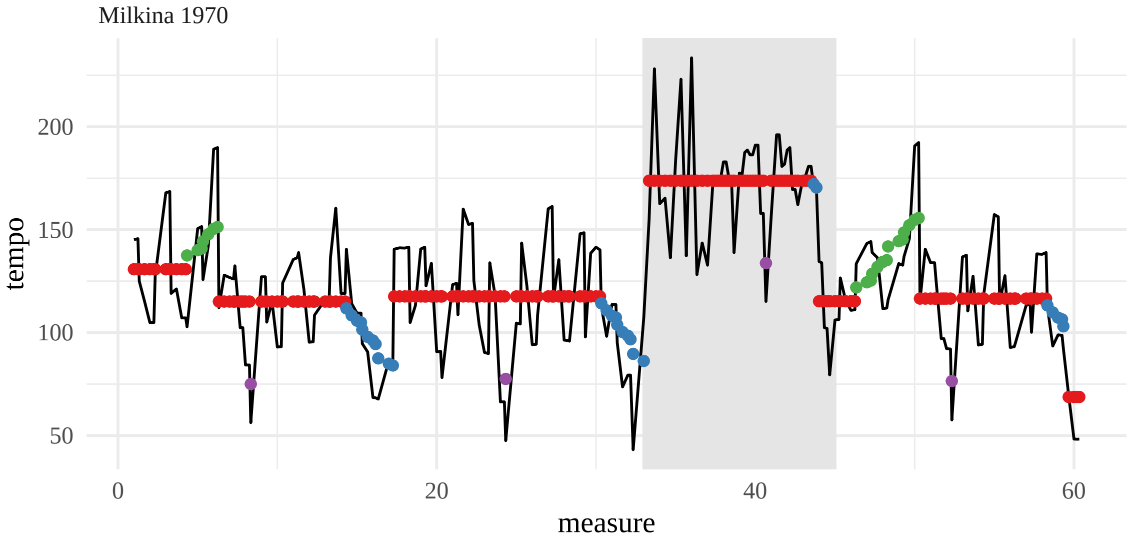
```r
ggplot(filter(plots, clust=='3')) +
  geom_rect(data=data.frame(xmin = 33, xmax = 45, ymin = -Inf, ymax = Inf),
              aes(xmin=xmin,xmax=xmax,ymin=ymin,ymax=ymax),
              fill = 'gray90', color = 'gray90') +
  geom_line(aes(x=measure, y=tempo), color='black') +
  geom_point(aes(x=measure, y=inferred, color=state)) +
  scale_color_brewer(palette='Set1') +
  theme(legend.position = 'none', legend.title = element_blank(),
        strip.text = element_text(hjust = 0)) +
  facet_wrap(~performer,ncol=3) #+
```


Barbosa 1983
Ezaki 2006
Meguri 1997
Smidowicz 1948b
tempo
300
200
100
0
20
40
60
measure

```
ggplot(filter(plots, clust=='other')) +
  geom_rect(data=data.frame(xmin = 33, xmax = 45, ymin = -Inf, ymax = Inf),
              aes(xmin=xmin,xmax=xmax,ymin=ymin,ymax=ymax),
              fill = 'gray90', color = 'gray90') +
  geom_line(aes(x=measure, y=tempo), color='black') +
  geom_point(aes(x=measure, y=inferred, color=state)) +
  scale_color_brewer(palette='Set1') +
  theme(legend.position = 'none', legend.title = element_blank(),
        strip.text = element_text(hjust = 0)) +
  facet_wrap(~performer,ncol=3) #+
```

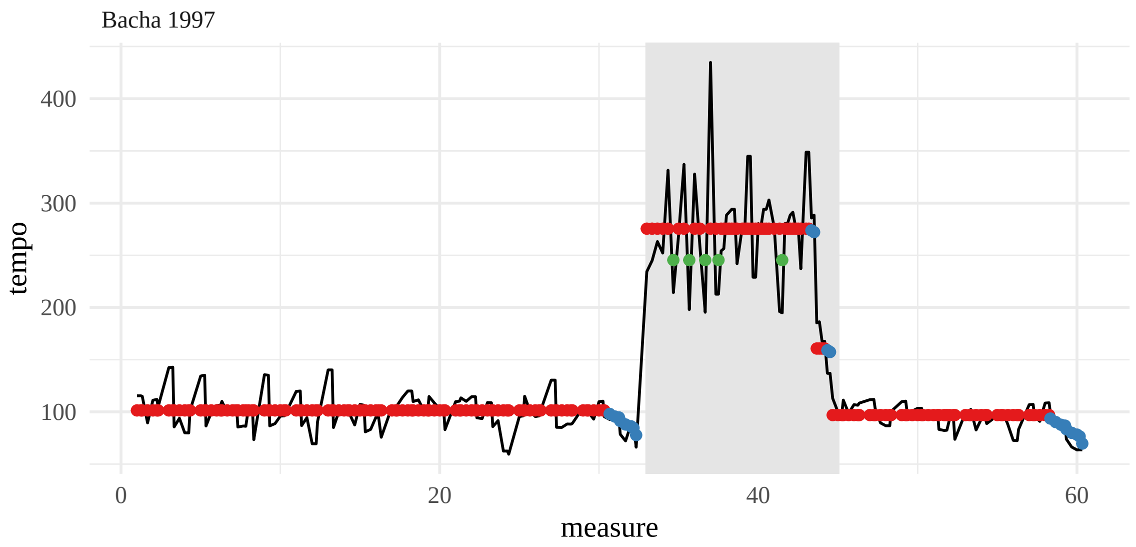

Biret 1990
Chiu 1999
Cortot 1951
Csalog 1996
Ferenczy 1958
Fou 1978
Francois 1956
Grinberg 1951
Hatto 1993
Indjic 1988
Kapell 1951
Kushner 1989
Ohlsson 1999
Olejniczac 1990
Richter 1976
Rubinstein 1939
Rubinstein 1966
Sofronitsky 1949
Tomsic 1995
tempo
100
200
300
400
measure
0
20
40
60

```
ggplot(filter(plots, performer == 'Milkina 1970')) +
  geom_rect(data=data.frame(xmin = 33, xmax = 45, ymin = -Inf, ymax = Inf),
            aes(xmin=xmin,xmax=xmax,ymin=ymin,ymax=ymax),
            fill = 'gray90', color = 'gray90') +
  geom_line(aes(x=measure, y=tempo), color='black') +
  geom_point(aes(x=measure, y=inferred, color=state)) +
  scale_color_brewer(palette='Set1') +
  theme(legend.position = 'none', legend.title = element_blank(),
        strip.text = element_text(hjust = 0)) +
  facet_wrap(~performer) #+
```



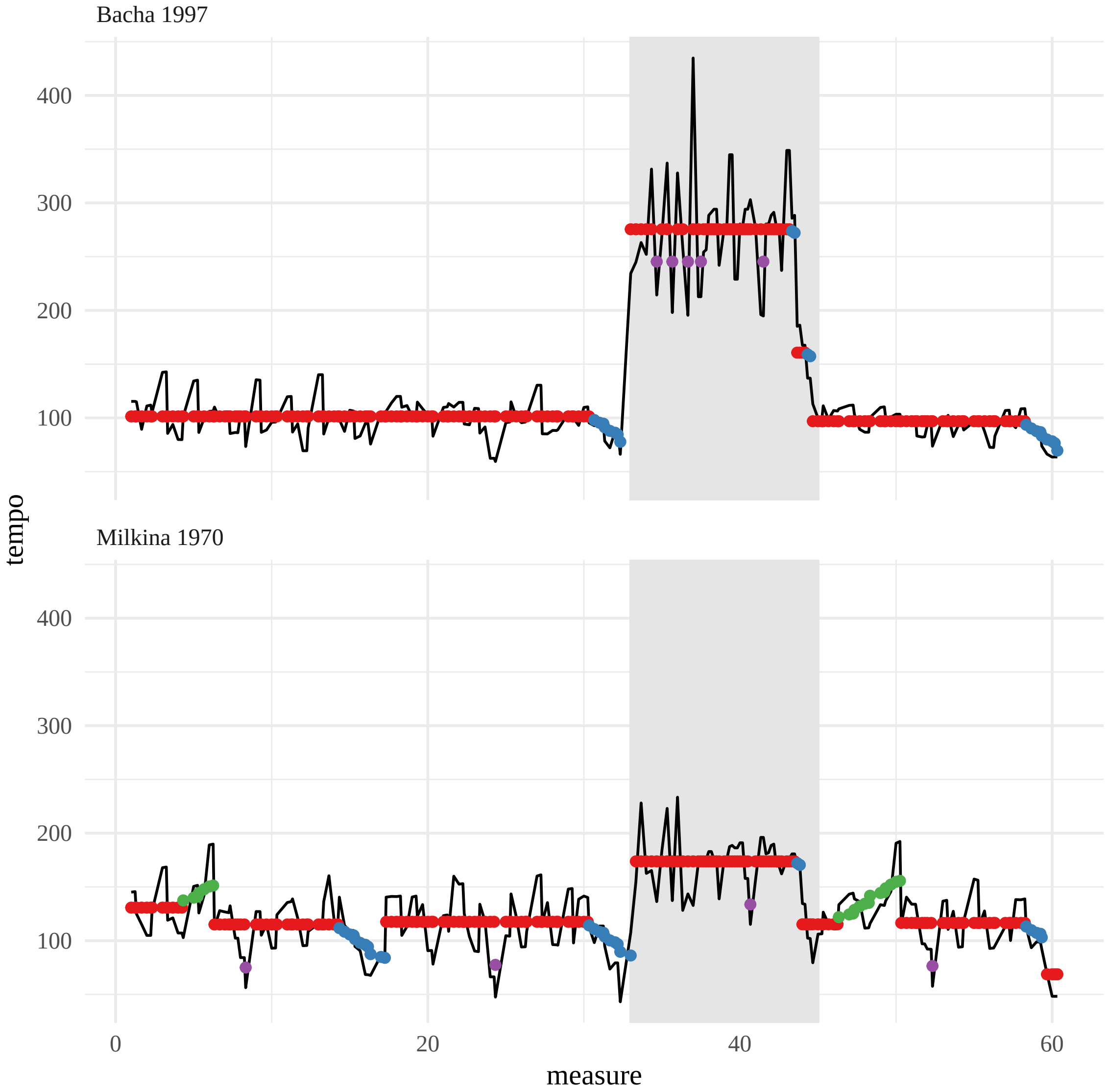
```
  # geom_point(aes(x=pointx,y=pointy,color=clust),alpha=.5, size=5, shape=15) +
  # scale_color_manual(values = fivecolors)
```

```
ggplot(filter(plots, performer == 'Bacha 1997')) +
  geom_rect(data=data.frame(xmin = 33, xmax = 45, ymin = -Inf, ymax = Inf),
            aes(xmin=xmin,xmax=xmax,ymin=ymin,ymax=ymax),
            fill = 'gray90', color = 'gray90') +
  geom_line(aes(x=measure, y=tempo), color='black') +
  geom_point(aes(x=measure, y=inferred, color=state)) +
  scale_color_brewer(palette='Set1') +
  theme(legend.position = 'none', legend.title = element_blank(),
        strip.text = element_text(hjust = 0)) +
  facet_wrap(~performer) #+
```



```r
  # geom_point(aes(x=pointx,y=pointy,color=clust),alpha=.5, size=5, shape=15) +
  # scale_color_manual(values = fivecolors)
```

```r
ggplot(filter(plots, performer %in% c('Milkina 1970','Bacha 1997'))) +
  geom_rect(data=data.frame(xmin = 33, xmax = 45, ymin = -Inf, ymax = Inf),
            aes(xmin=xmin,xmax=xmax,ymin=ymin,ymax=ymax),
            fill = 'gray90', color = 'gray90') +
  geom_line(aes(x=measure, y=tempo), color='black') +
  geom_point(aes(x=measure, y=inferred, color=state)) +
  scale_color_brewer(palette='Set1') +
  theme(legend.position = 'none', legend.title = element_blank(),
        strip.text = element_text(hjust = 0)) +
  facet_wrap(~performer,nrow = 2) #+
```



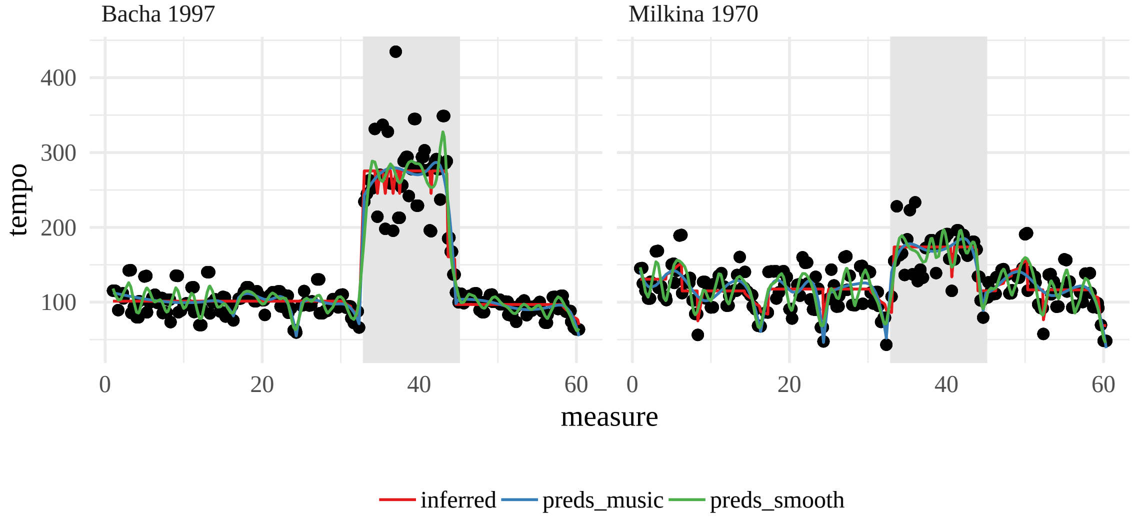
```
  # geom_point(aes(x=pointx,y=pointy,color=clust),alpha=.5, size=5, shape=15) +
  # scale_color_manual(values = fivecolors)
```

Different smoothing

Try splines, replicating knots, l1tf?

```
nsplines = 64 # 1 knot per bar plus boundary
B = bs(tempos$note_onset, df=nsplines, intercept = TRUE)
single.knots = match(seq(4,56,by=4)+1,tempos$meas_num)
double.knots = match(c(16,24,32,44)+1, tempos$meas_num)
triple.knots = match(c(16,24,32,44)+1, tempos$meas_num)
quad.knots = match(c(16,24,32,44)+1, tempos$meas_num)
all.knots = tempos$note_onset[
  sort(c(single.knots,double.knots,triple.knots,quad.knots))]
B1 = bs(tempos$note_onset, knots = all.knots, intercept = TRUE,Boundary.knots = c(1,61))
```

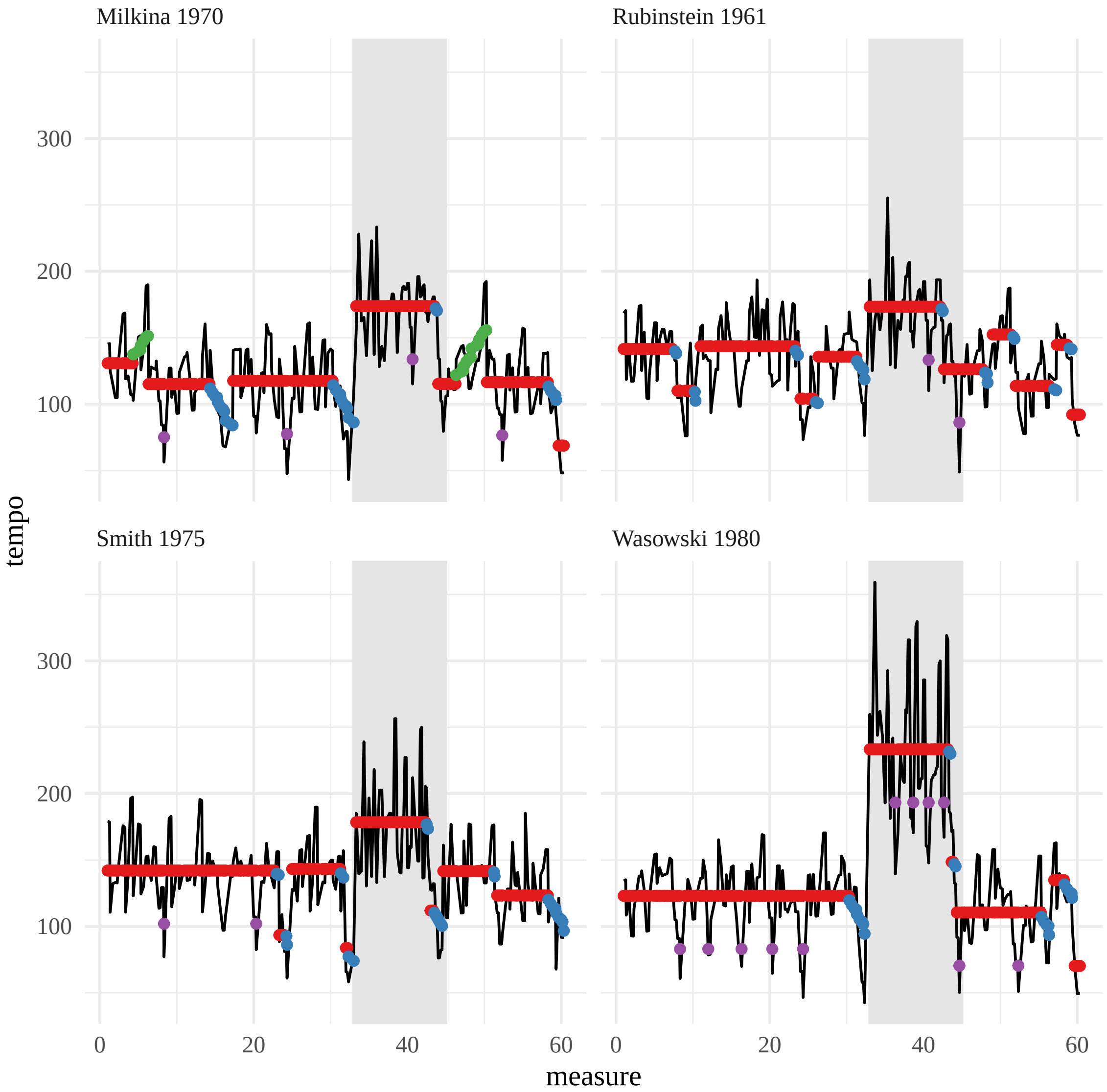
```
spline_music = plots %>% group_by(performer) %>%
  mutate(preds_smooth = fitted(lm(tempo~B-1)),
         preds_music = fitted(lm(tempo~B1-1)))
filter(spline_music , performer %in% c('Milkina 1970','Bacha 1997')) %>%
  gather(key='key',value = 'value', -tempo,
         -measure, -state, -performer, -clust) %>%
  ggplot() +
  geom_rect(data=data.frame(xmin = 33, xmax = 45, ymin = -Inf, ymax = Inf),
            aes(xmin=xmin,xmax=xmax,ymin=ymin,ymax=ymax),
            fill = 'gray90', color = 'gray90', show.legend = FALSE) +
  geom_point(aes(x=measure, y=tempo), color='black', show.legend = FALSE) +
  geom_line(aes(x=measure, y=value, color=key)) +
  scale_color_brewer(palette='Set1') +
  #scale_color_manual(values=fivecolors[3:5]) +
  theme(legend.position = 'bottom', legend.title = element_blank(),
      strip.text = element_text(hjust = 0)) +
  facet_wrap(~performer) #+
```



```
  # geom_rect(aes(xmin=pointx-2.5, xmax=pointx+2.5,
  #               ymin=pointy-2.5,ymax=pointy+2.5,fill=clust),
  #           show.legend = FALSE,
  #            alpha=.5,size=5) +
  # scale_fill_manual(values = fivecolors)
```

Similar performances

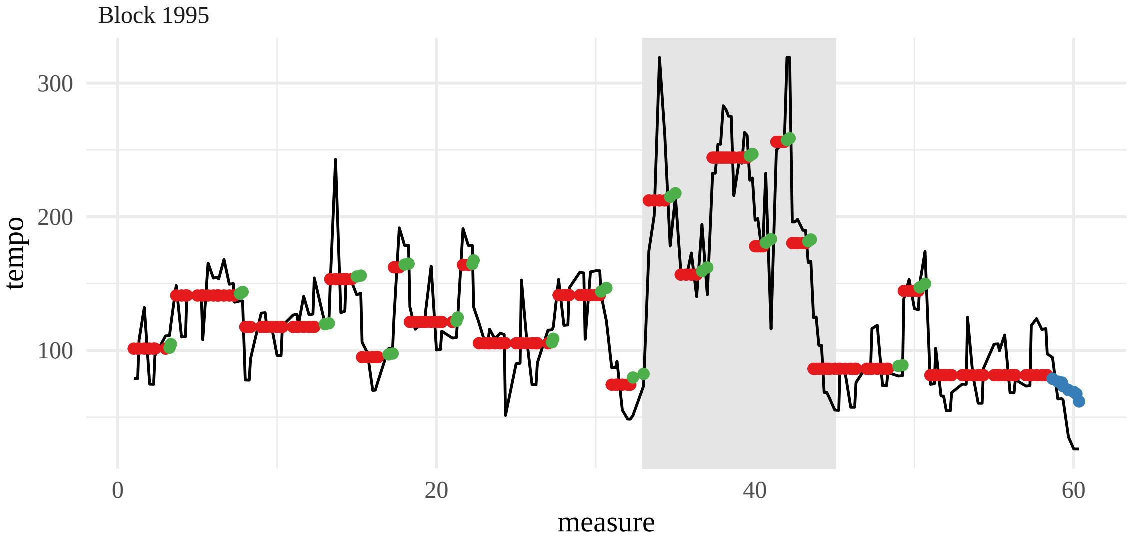
```
similar = c('Wasowski 1980','Rubinstein 1961','Milkina 1970','Smith 1975')
ggplot(filter(plots, performer %in% similar)) +
  geom_rect(data=data.frame(xmin = 33, xmax = 45, ymin = -Inf, ymax = Inf),
            aes(xmin=xmin,xmax=xmax,ymin=ymin,ymax=ymax),
            fill = 'gray90', color = 'gray90') +
  geom_line(aes(x=measure, y=tempo), color='black') +
  geom_point(aes(x=measure, y=inferred, color=state)) +
  scale_color_brewer(palette='Set1') +
  theme(legend.position = 'none', legend.title = element_blank(),
        strip.text = element_text(hjust = 0)) +
  facet_wrap(~performer,nrow=2) #+
```



```
  # geom_point(aes(x=pointx,y=pointy,color=clust),alpha=.5, size=5, shape=15) +
  # scale_color_manual(values = fivecolors)
```

Bad estimation

```
ggplot(filter(plots, performer == 'Block 1995')) +
  geom_rect(data=data.frame(xmin = 33, xmax = 45, ymin = -Inf, ymax = Inf),
            aes(xmin=xmin,xmax=xmax,ymin=ymin,ymax=ymax),
            fill = 'gray90', color = 'gray90') +
  geom_line(aes(x=measure, y=tempo), color='black') +
  geom_point(aes(x=measure, y=inferred, color=state)) +
  scale_color_brewer(palette='Set1') +
  theme(legend.position = 'none', legend.title = element_blank(),
        strip.text = element_text(hjust = 0)) +
  facet_wrap(~performer)
```



Problems with the model

- Problem with retransitioning to state 1
- states 2 and 3 aren't constrained to always decrease/increase, only in mean
- state 4 may not always emphasize a slow down
- previous 2 have to do with Gaussian assumptions
- necessity for strong priors
- but priors are on parameters, not on path (how would we want this to change?)