

```
> install.packages('nparLD');
> library(package = "lattice")
> library(package = "nparLD")
```

NB delete text columns and any after end of values

```
> data<-read.table("questionnaire-resp-20170608-for-stats.csv", sep=";", header=TRUE)
```

```
> summary(data)
```

participant		page.no		performance		enjoyed		attention	
Min.	: 1	Min.	: 1.00	Min.	:1.0	Min.	:2.000	Min.	:2.000
1st Qu.:	11	1st Qu.:	21.25	1st Qu.:	1.0	1st Qu.:	5.000	1st Qu.:	5.000
Median	:21	Median	:41.50	Median	:1.5	Median	:6.000	Median	:6.000
Mean	:21	Mean	:41.50	Mean	:1.5	Mean	:5.654	Mean	:5.532
3rd Qu.:	31	3rd Qu.:	61.75	3rd Qu.:	2.0	3rd Qu.:	6.000	3rd Qu.:	6.000
Max.	:41	Max.	:82.00	Max.	:2.0	Max.	:7.000	Max.	:7.000
						NA's	:4	NA's	:20

sound		pianist		keys		video		app	
Min.	:3.000	Min.	:2.000	Min.	:2.00	Min.	:2.000	Min.	:2.000
1st Qu.:	6.000	1st Qu.:	5.000	1st Qu.:	5.00	1st Qu.:	5.000	1st Qu.:	5.000
Median	:6.000	Median	:6.000	Median	:6.00	Median	:6.000	Median	:5.000
Mean	:5.961	Mean	:5.553	Mean	:5.74	Mean	:5.338	Mean	:5.267
3rd Qu.:	6.000	3rd Qu.:	6.000	3rd Qu.:	7.00	3rd Qu.:	6.000	3rd Qu.:	6.000
Max.	:7.000	Max.	:7.000	Max.	:7.00	Max.	:7.000	Max.	:7.000
NA's	:6	NA's	:6	NA's	:5	NA's	:8	NA's	:22

understood		control		responded		app.before	
Min.	:1.000	Min.	:2.000	Min.	:2.000	Min.	:1.000
1st Qu.:	5.000	1st Qu.:	5.000	1st Qu.:	5.000	1st Qu.:	2.000
Median	:6.000	Median	:6.000	Median	:6.000	Median	:4.000
Mean	:5.267	Mean	:5.557	Mean	:5.494	Mean	:3.845
3rd Qu.:	6.000	3rd Qu.:	6.000	3rd Qu.:	6.000	3rd Qu.:	5.000
Max.	:7.000	Max.	:7.000	Max.	:7.000	Max.	:7.000
NA's	:7	NA's	:3	NA's	:5	NA's	:24

app.while		app.after		app.understand		app.distracted		souvenir	
Min.	:1.000	Min.	:1.000	Min.	:1.000	Min.	:1.00	Min.	:1.00
1st Qu.:	5.000	1st Qu.:	2.000	1st Qu.:	5.000	1st Qu.:	2.50	1st Qu.:	2.00
Median	:6.000	Median	:2.000	Median	:6.000	Median	:4.00	Median	:4.00
Mean	:5.547	Mean	:2.949	Mean	:5.415	Mean	:3.81	Mean	:3.71
3rd Qu.:	6.000	3rd Qu.:	4.000	3rd Qu.:	6.000	3rd Qu.:	5.00	3rd Qu.:	5.00
Max.	:7.000	Max.	:7.000	Max.	:7.000	Max.	:7.00	Max.	:7.00
NA's	:18	NA's	:23	NA's	:17	NA's	:19	NA's	:13

recording		more		another		go		music	
Min.	:1.000	Min.	:2.000	Min.	:2.000	Min.	:2.000	Min.	:1.00
1st Qu.:	2.000	1st Qu.:	5.000	1st Qu.:	4.000	1st Qu.:	4.750	1st Qu.:	3.00
Median	:4.000	Median	:6.000	Median	:5.000	Median	:5.000	Median	:4.00
Mean	:4.058	Mean	:5.386	Mean	:4.681	Mean	:5.066	Mean	:3.61
3rd Qu.:	5.000	3rd Qu.:	7.000	3rd Qu.:	6.000	3rd Qu.:	6.000	3rd Qu.:	4.00
Max.	:7.000	Max.	:7.000	Max.	:7.000	Max.	:7.000	Max.	:5.00
NA's	:13	NA's	:12	NA's	:13	NA's	:6	NA's	:41

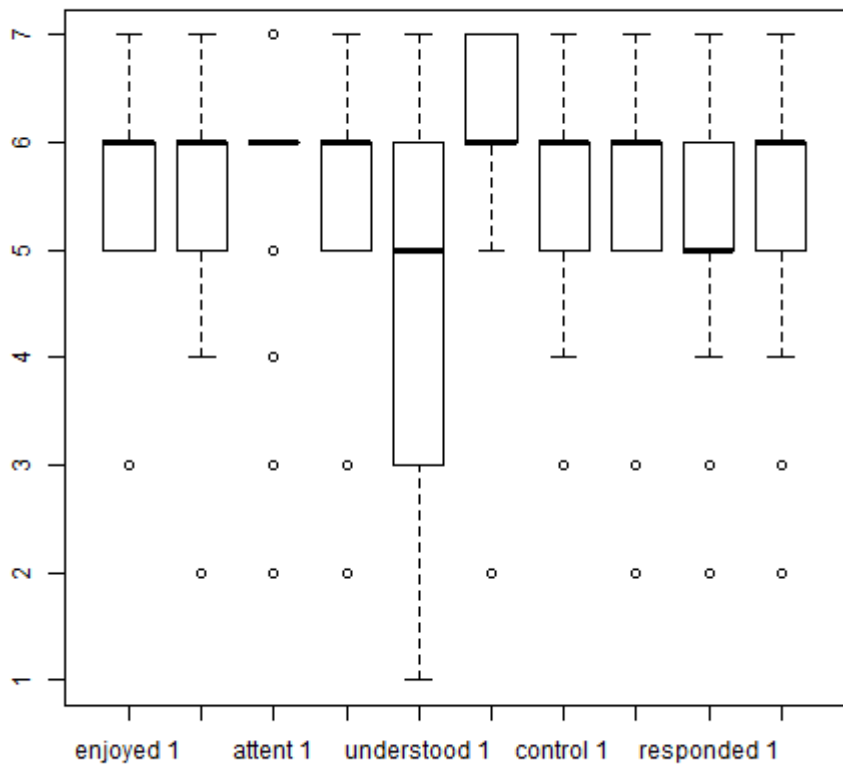
technology		sex		age		normally		similar		predictable	
Min.	:1.000	:	:42	Min.	:18.00	:	:43	Min.	:3.00	Min.	:2.000
1st Qu.:	2.000	f:	21	1st Qu.:	18.00	n:	29	1st Qu.:	5.00	1st Qu.:	3.000
Median	:3.500	m:	18	Median	:30.00	y:	10	Median	:6.00	Median	:4.000
Mean	:3.375	n:	1	Mean	:32.62			Mean	:5.59	Mean	:4.282
3rd Qu.:	5.000			3rd Qu.:	50.00			3rd Qu.:	6.50	3rd Qu.:	5.000
Max.	:5.000			Max.	:65.00			Max.	:7.00	Max.	:7.000
NA's	:42			NA's	:42			NA's	:43	NA's	:43

Note: 2 people left at half time (second ratings disregarded) - excluded from 1st/2nd performance comparisons, but first performance ratings included in overall responses

```

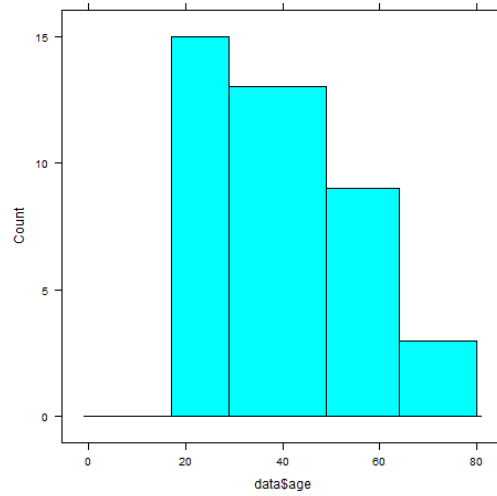
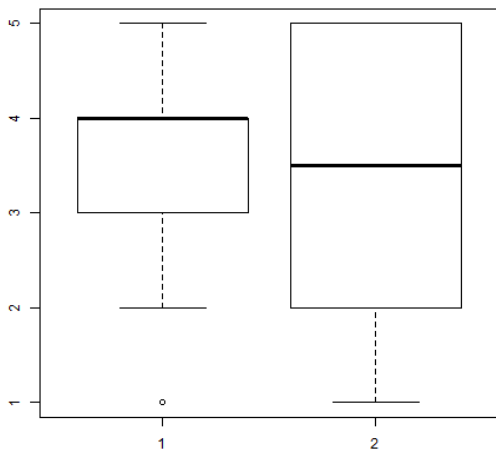
> boxplot(data$enjoyed[data$performance==1],data$enjoyed[data$performance==2],
data$attention[data$performance==1],data$attention[data$performance==2],
data$ understood [data$performance==1],data$ understood [data$performance==2],
data$ control [data$performance==1],data$ control [data$performance==2],
data$ responded [data$performance==1],data$ responded [data$performance==2],
names=list('enjoyed 1','enjoyed 2', 'attent 1','attent 2', 'understood 1', 'understood
2', 'control 1', 'control 2', 'responded 1', 'responded 2'),
ylab='response', boxwex=0.7, ylim = c(1,7))

```



Expertese: music, tech

```
> boxplot(data$music, data$tech)
> histogram(data$age, breaks=c(0, 17, 29, 49, 64, 80), type='count')
```

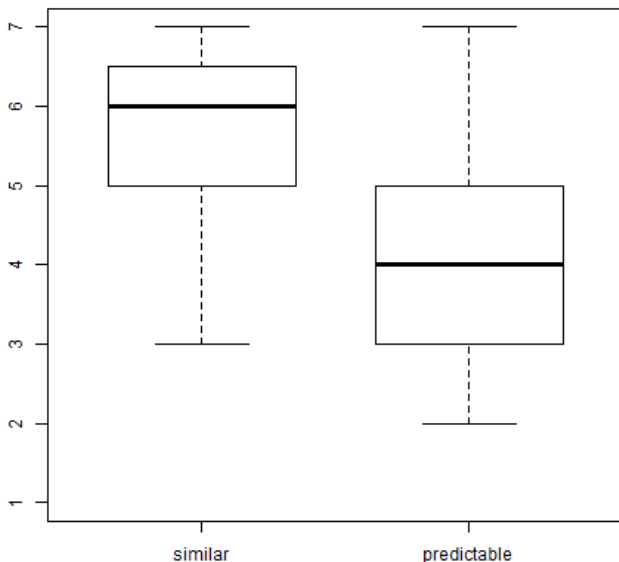


Ages (nb counts not area adjusted)

```
> summary(data$sex[data$performance==1])
  f  m  n
1 21 18  1
```

```
> summary(data$normally[data$performance==1])
  n  y
2 29 10
```

```
> boxplot(data$similar, data$predictable, names=list('similar', 'predictable'),
  ylab='response', boxwex=0.7, ylim = c(1,7))
```



```

> windows.options(width=4,height=6)
> histogram(~ enjoyed | factor(performance), data=data, breaks = seq_len(8)-0.5,
type='count')
> summary(data$enjoyed[data$performance==1])
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
 3.000  5.000  6.000  5.675  6.000  7.000     1
> summary(data$enjoyed[data$performance==2])
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
 2.000  5.000  6.000  5.632  6.000  7.000     3

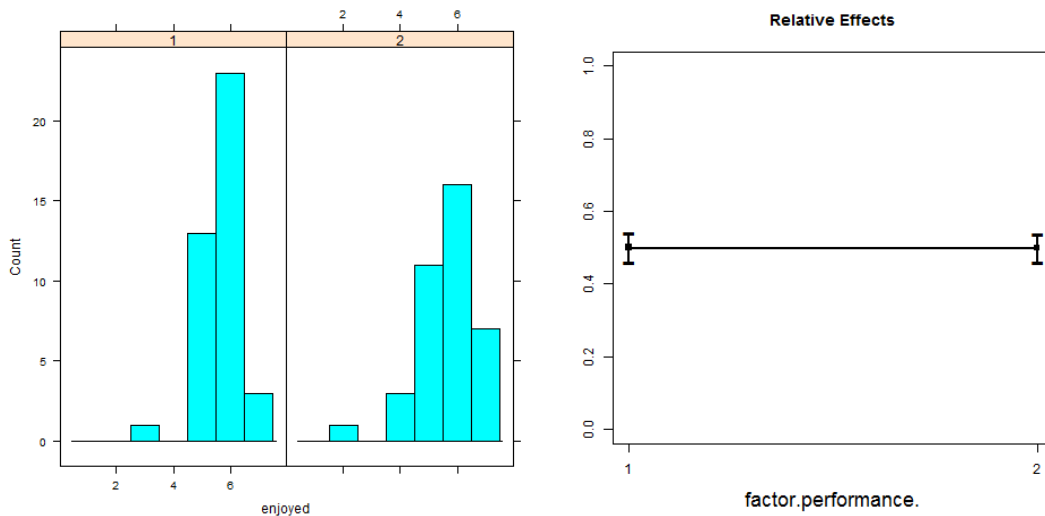
```

Note: include only participants responding to qn on both questionnaires for within-subjects

```

> enjoyedok = !is.na(data$enjoyed)
> for (i in 1:length(enjoyedok)) {
enjoyedok [i] = enjoyedok [i - ((i-1) %% 2)] & enjoyedok [i - ((i-1) %% 2) + 1]
}
> enjoyed<-nparLD( enjoyed ~ performance, data=data[enjoyedok,], 'participant' )
> plot(enjoyed)

```



```

> summary(enjoyed)
Model:
LD F1 Model

Call:
enjoyed ~ factor(performance)

Relative Treatment Effect (RTE):
      RankMeans Nobs      RTE
factor.performance.1  37.59459  37 0.5012783
factor.performance.2  37.40541  37 0.4987217

Wald-Type Statistic (WTS):
      Statistic df  p-value
factor.performance. 0.004401505  1 0.9471041

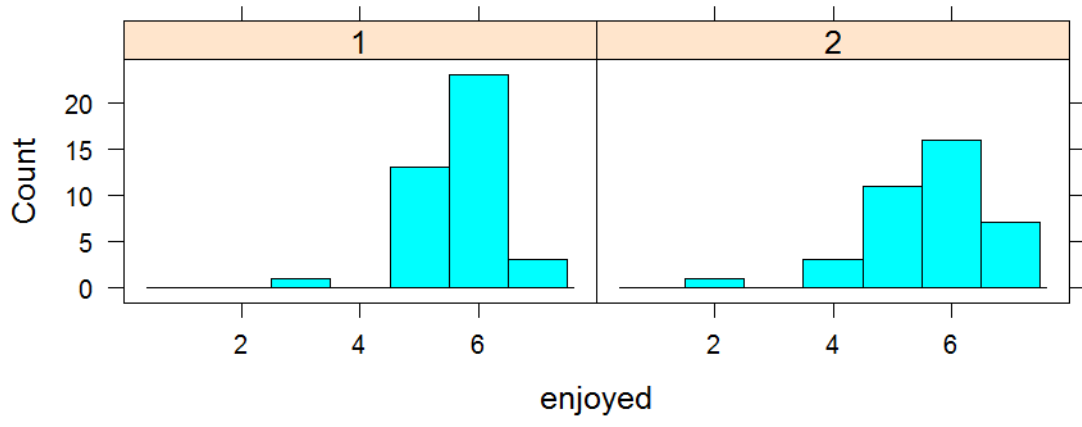
ANOVA-Type Statistic (ATS):
      Statistic df  p-value
factor.performance. 0.004401505  1 0.9471041

```

```

> png('enjoyed-hist.png',width=900, height=400, res=150)
> histogram(~ enjoyed | factor(performance), data=data, breaks = seq_len(8)-0.5,
type='count', layout=c(2,1),scales=list(alternating=c(1,1)))
> dev.off()

```



```

> histogram(~ understood| factor(performance), data=data, breaks = seq_len(8)-0.5,
type='count')
> summary(data$understood[data$performance==1])
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
 1.000  3.000  5.000  4.421  6.000  7.000     3

> summary(data$understood[data$performance==2])
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
 2.000  6.000  6.000  6.135  7.000  7.000     4

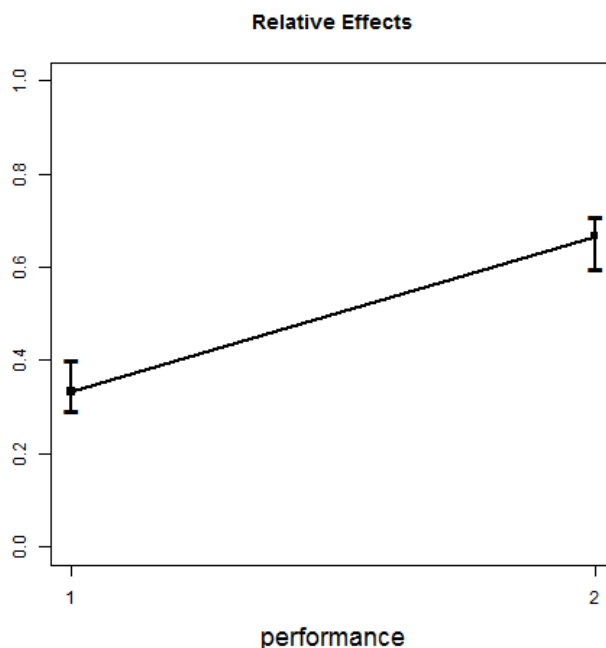
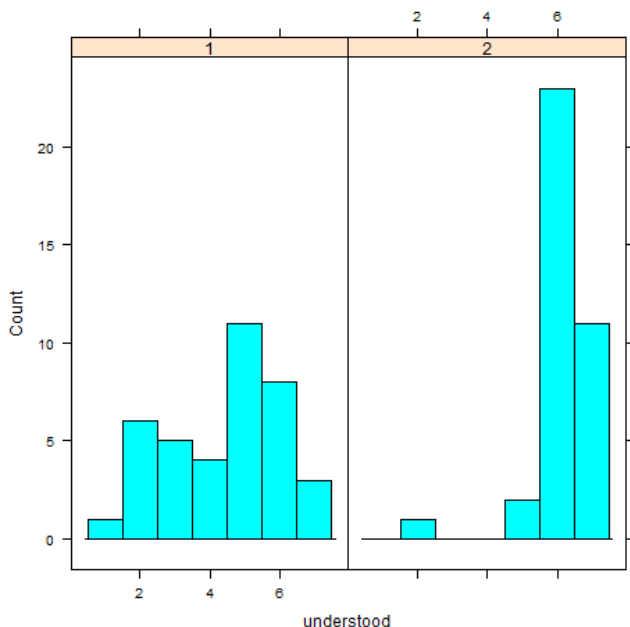
```

Only respondents to both performances:

```

> understoodok = !is.na(data$understood)
> for (i in 1:length(understoodok)) {
understoodok [i] = understoodok [i - ((i-1) %% 2)] & understoodok [i - ((i-1) %% 2) +
1]
}
> understood<-nparLD( understood ~ factor(performance), data=data[understoodok,],
'participant' )
> plot(understood)

```



```

> summary(understood)
Model:
LD F1 Model

Call:
understood ~ factor(performance)

Relative Treatment Effect (RTE):
              RankMeans Nobs      RTE
factor.performance.1  24.68571  35 0.3455102
factor.performance.2  46.31429  35 0.6544898

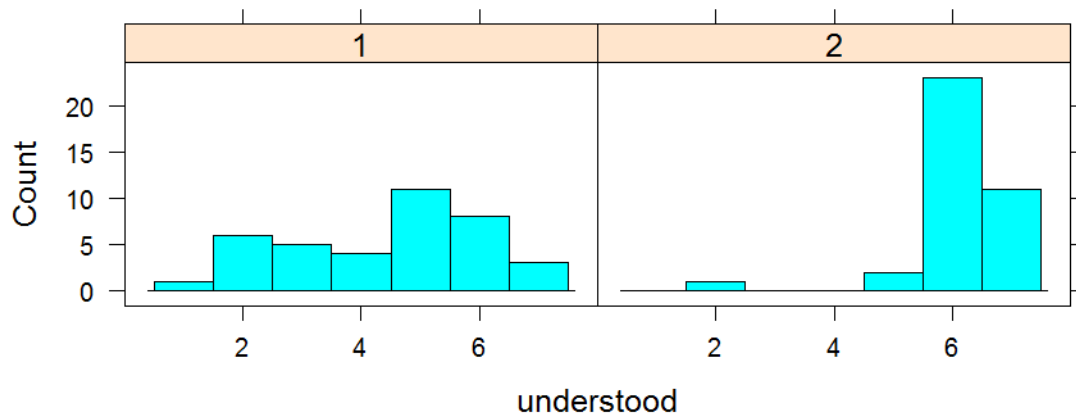
Wald-Type Statistic (WTS):
              Statistic df      p-value
factor.performance.  45.10176  1 1.870575e-11

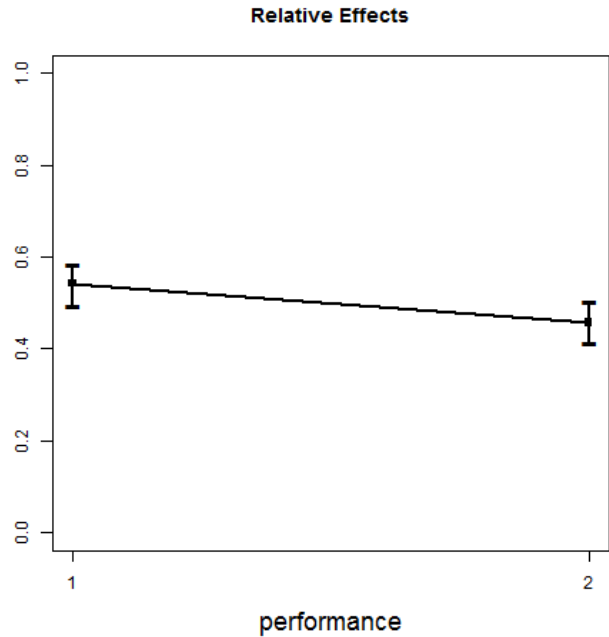
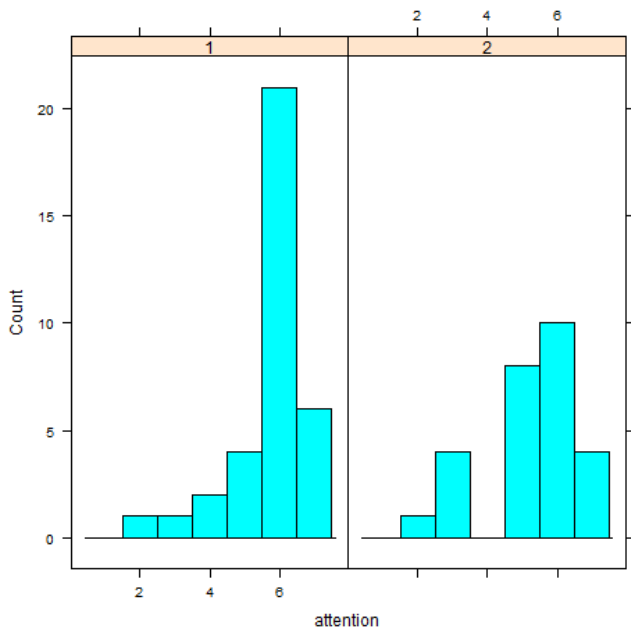
ANOVA-Type Statistic (ATS):
              Statistic df      p-value
factor.performance.  45.10176  1 1.870575e-11

```

Significant increase in understanding

```
> png('understood-hist.png',width=900, height=400, res=150)
> histogram(~understood | factor(performance), data=data, breaks = seq_len(8)-0.5,
type='count', layout=c(2,1),scales=list(alternating=c(1,1)))
> dev.off()
```





```

> summary(data$attention[data$performance==1])
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
 2.000  6.000  6.000  5.743  6.000  7.000     6
> summary(data$attention[data$performance==2])
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
 2.000  5.000  6.000  5.259  6.000  7.000    14
> attentionok = !is.na(data$attention)
> for (i in 1:length(attentionok)) {
attentionok[i] =attentionok[i - ((i-1) %% 2)] & attentionok[i - ((i-1) %% 2) + 1]
}
> attention<-nparLD( attention ~ factor(performance), data=data[attentionok,],
'participant' )

```

N = 24 (not all completed both)

```

> summary(attention)
Model:
LD F1 Model

Call:
attention ~ factor(performance)

Relative Treatment Effect (RTE):
              RankMeans Nobs      RTE
factor.performance.1 26.54167  24 0.5425347
factor.performance.2 22.45833  24 0.4574653

Wald-Type Statistic (WTS):
              Statistic df    p-value
factor.performance. 3.811374  1 0.05090567

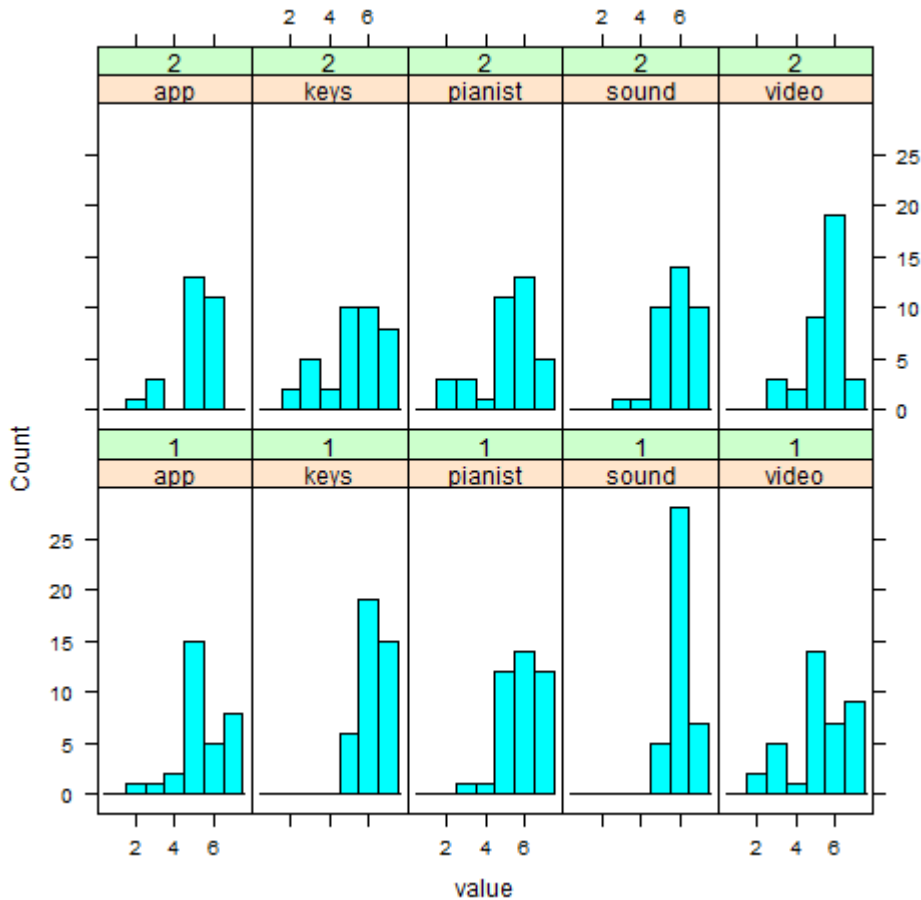
ANOVA-Type Statistic (ATS):
              Statistic df    p-value
factor.performance. 3.811374  1 0.05090567

```

Marginal drop in attention

Attention

```
> value=c(data$sound, data$video, data$keys, data$app, data$pianist)
> subject=c(rep('sound',length(data$participant)),
rep('video',length(data$participant)), rep('keys',length(data$participant)),
rep('app',length(data$participant)), rep('pianist',length(data$participant)))
> attention <-
data.frame(list(value=value,subject=factor(subject),performance=factor(c(data$performance,
data$performance,data$performance,data$performance,data$performance)),participant=factor(c(data$participant,
data$participant, data$participant, data$participant,
data$participant))))
> histogram(~ value | subject + performance, data=attention, breaks = seq_len(8)-0.5,
type='count')
```



Keys...

```
> summary(data$keys[data$performance==1])
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
 5.000  6.000  6.000  6.225  7.000  7.000     1
> summary(data$keys[data$performance==2])
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
 2.000  5.000  5.000  5.216  6.000  7.000     4
> keysok = !is.na(data$keys)
> for (i in 1:length(keysok)) {
keysok [i] = keysok [i - ((i-1) %% 2)] & keysok [i - ((i-1) %% 2) + 1]
}
> keys<-nparLD( keys ~ factor(performance), data=data[keysok,], 'participant' )
> plot(keys)
> summary(keys)
Model:
LD F1 Model
```

Call:
keys ~ factor(performance)

Relative Treatment Effect (RTE):

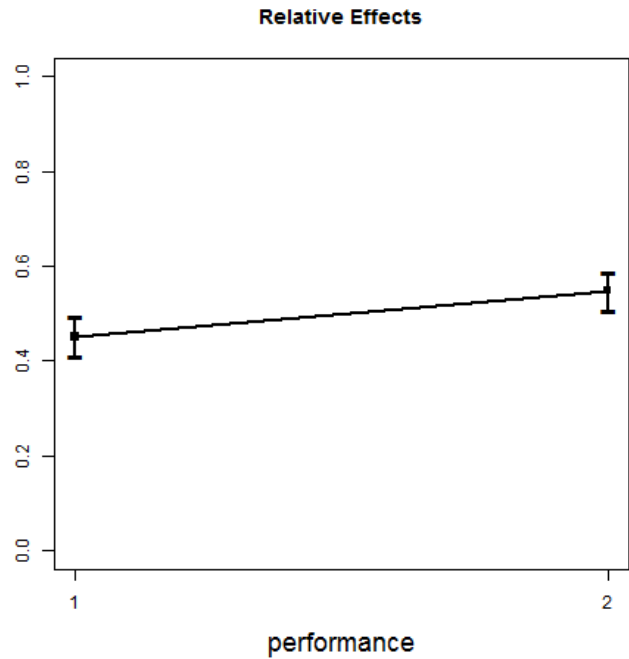
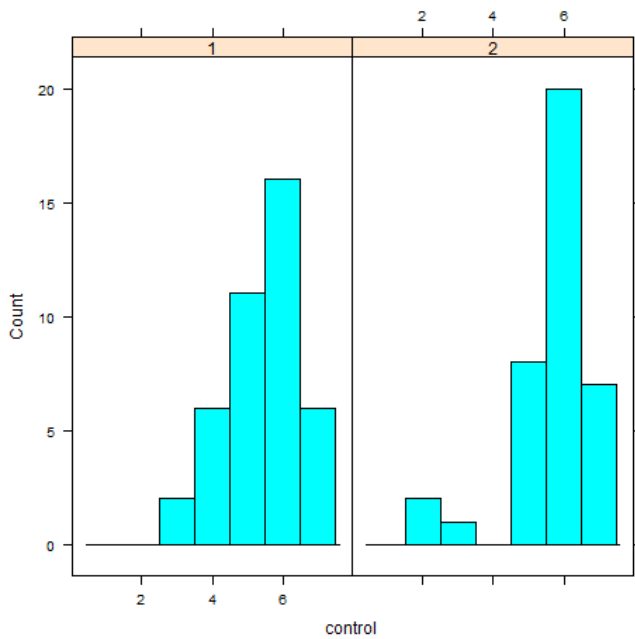
	RankMeans	Nobs	RTE
factor.performance.1	44.81081	37	0.5987947
factor.performance.2	30.18919	37	0.4012053

Wald-Type Statistic (WTS):

	Statistic	df	p-value
factor.performance.	10.86965	1	0.0009775305

ANOVA-Type Statistic (ATS):

	Statistic	df	p-value
factor.performance.	10.86965	1	0.0009775305



```

> histogram(~control | factor(performance), data=data, breaks = seq_len(8)-0.5,
type='count')
> summary(data$control[data$performance==1])
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 3.000  5.000  6.000  5.439  6.000  7.000
> summary(data$control[data$performance==2])
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
 2.000  5.000  6.000  5.684  6.000  7.000      3
> controlok = !is.na(data$control)
> for (i in 1:length(controlok)) {
controlok [i] = controlok [i - ((i-1) %% 2)] & controlok [i - ((i-1) %% 2) + 1]
}
> control <-nparLD(control ~ factor(performance), data=data[controlok,], 'participant'
)

```

```

> summary(control)

```

Model:
LD F1 Model

Call:
control ~ factor(performance)

Relative Treatment Effect (RTE):

	RankMeans	Nobs	RTE
factor.performance.1	34.77632	38	0.4510042
factor.performance.2	42.22368	38	0.5489958

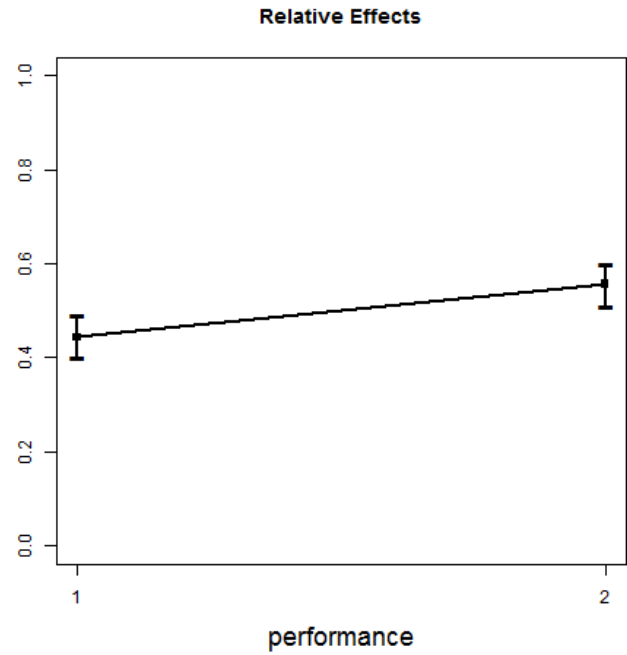
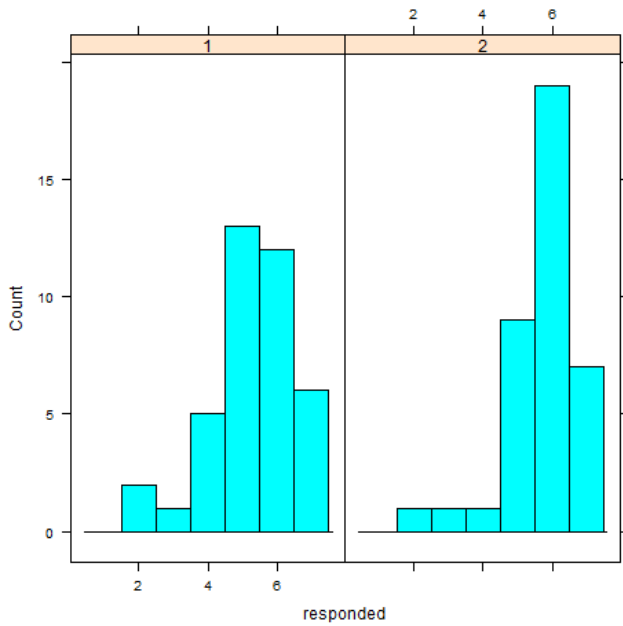
Wald-Type Statistic (WTS):

	Statistic	df	p-value
factor.performance.	4.947934	1	0.02612186

ANOVA-Type Statistic (ATS):

	Statistic	df	p-value
factor.performance.	4.947934	1	0.02612186

Small but significant increase in second performance



```

> summary(data$responded[data$performance==1])
  Min. 1st Qu.  Median    Mean 3rd Qu.  Max.   NA's
 2.000  5.000  5.000  5.282  6.000  7.000     2
> summary(data$responded[data$performance==2])
  Min. 1st Qu.  Median    Mean 3rd Qu.  Max.   NA's
 2.000  5.000  6.000  5.711  6.000  7.000     3
> respondedok = !is.na(data$responded)
> for (i in 1:length(respondedok)) {
  respondedok[i] = respondedok[i - ((i-1) %% 2)] & respondedok[i - ((i-1) %% 2) + 1]
}
> responded <- nparLD( responded ~ factor(performance), data=data[respondedok,],
'participant' )
> summary(responded)
Model:
LD F1 Model

Call:
responded ~ performance

```

Relative Treatment Effect (RTE):

	RankMeans	Nobs	RTE
performance1	32.44444	36	0.4436728
performance2	40.55556	36	0.5563272

Wald-Type Statistic (WTS):

	Statistic	df	p-value
performance	6.195688	1	0.01280619

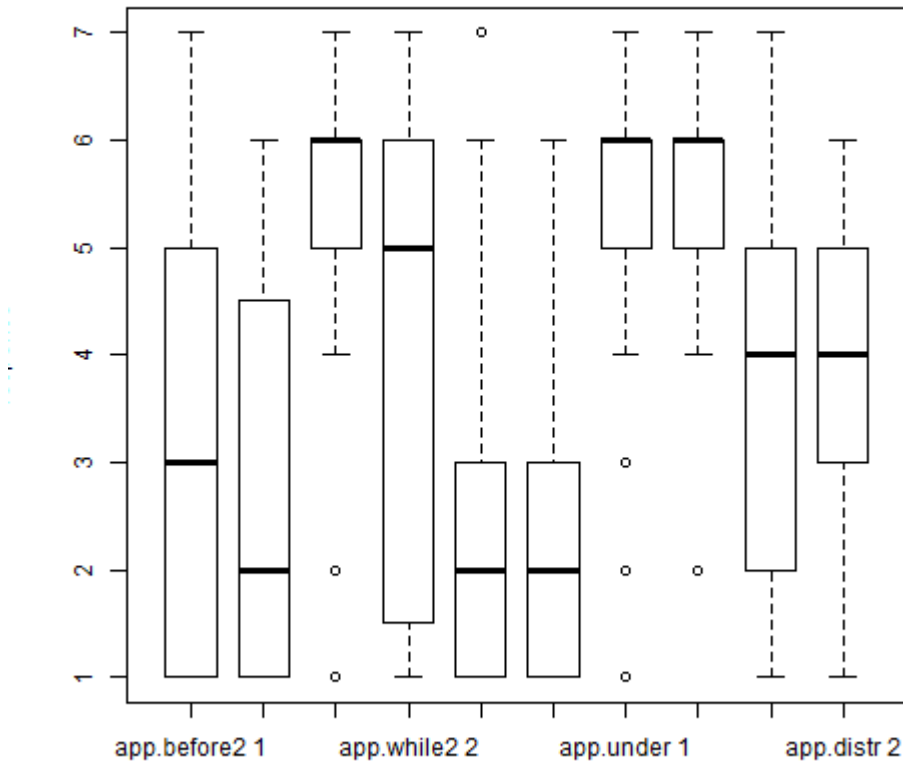
ANOVA-Type Statistic (ATS):

	Statistic	df	p-value
performance	6.195688	1	0.01280619

Slightly bigger increase in sense of system responding.

App before/during/after; helped understand/distracted

```
> boxplot(data$ app.before [data$performance==1],data$ app.before
[data$performance==2],
  data$ app.while [data$performance==1],data$ app.while [data$performance==2],
  data$ app.after [data$performance==1],data$ app.after [data$performance==2],
  data$ app.understand [data$performance==1],data$ app.understand [data$performance==2],
  data$ app.distracted [data$performance==1],data$ app.distracted [data$performance==2],
names=list('app.before 1', 'app.before 2', 'app.while 1', 'app.while 2', 'app.after 1',
'app.after 2', 'app.understand 1', 'app.understand 2', 'app.distracted 1',
'app.distracted 2'),
ylab='response', boxwex=0.7, ylim = c(1,7))
```



```

> summary(data$app.understand[data$performance==1])
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
 1.000  5.000  6.000  5.343  6.000  7.000    6
> summary(data$app.understand[data$performance==2])
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
  2.0    5.0    6.0    5.5    6.0    7.0    11

> summary(data$app.distract[data$performance==1])
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
 1.000  2.000  4.000  3.794  5.000  7.000    7
> summary(data$app.distract[data$performance==2])
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.   NA's
 1.000  3.000  4.000  3.828  5.000  6.000   12

```

excludes people who left at half time (39 subjects); treats NAs as 1 (strongly disagree) (e.g. if didn't have app)

```

> present <- !is.na(data$enjoyed) | !is.na(data$sound)
> data$app.before2 <- ifelse(!is.na(data$app.before), data$app.before, ifelse(present,
rep(1, length(present)), NA))
> data$app.while2 <- ifelse(!is.na(data$app.while), data$app.while, ifelse(present,
rep(1, length(present)), NA))
> data$app.after2 <- ifelse(!is.na(data$app.after), data$app.after, ifelse(present,
rep(1, length(present)), NA))

```

```

> appok = present
> for (i in 1:length(appok)) {
appok [i] = appok [i - ((i-1) %% 2)] & appok [i - ((i-1) %% 2) + 1]
}
> subapp <- data.frame(list(participant=c(data$participant[appok],
data$participant[appok], data$participant[appok]),
performance=c(data$performance[appok], data$performance[appok],
data$performance[appok]),
value=c(data$app.before2[appok], data$app.while2[appok], data$app.after2[appok]),
subject=c(rep('before', length(data$participant)) [appok],
rep('while', length(data$participant)) [appok], rep('after', length(data$participant))
[appok])
))
> app <- nparLD( value ~ factor(performance) * factor(subject), data=subapp,
'participant' )
> summary(app)

```

Model:
LD F2 Model

Call:
value ~ factor(performance) * factor(subject)

Relative Treatment Effect (RTE):

	RankMeans	Nobs	RTE
factor.performance.1:factor.subject.before	115.87179	39	0.4930419
factor.performance.1:factor.subject.while	163.43590	39	0.6963073
factor.performance.1:factor.subject.after	89.84615	39	0.3818212
factor.performance.2:factor.subject.before	102.98718	39	0.4379794
factor.performance.2:factor.subject.while	142.69231	39	0.6076594
factor.performance.2:factor.subject.after	90.16667	39	0.3831909
factor.performance.1	123.05128	117	0.5237234
factor.performance.2	111.94872	117	0.4762766
factor.subject.before	109.42949	78	0.4655106
factor.subject.while	153.06410	78	0.6519833
factor.subject.after	90.00641	78	0.3825060

Wald-Type Statistic (WTS):

	Statistic	df	p-value
factor.performance.	4.899019	1	2.687196e-02

```

factor.subject.                65.595470  2 5.703280e-15
factor.performance.:factor.subject.  3.611649  2 1.643389e-01

```

ANOVA-Type Statistic (ATS):

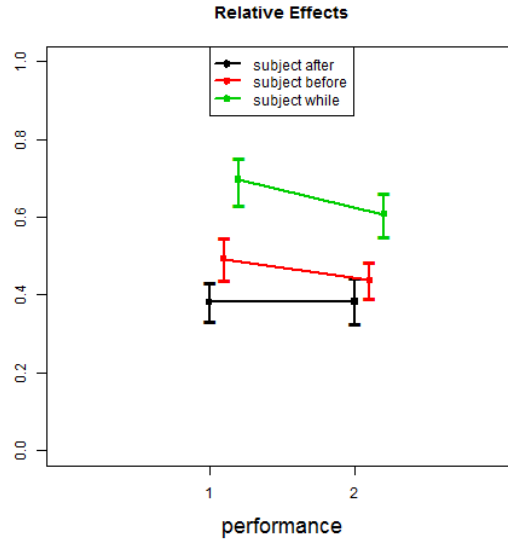
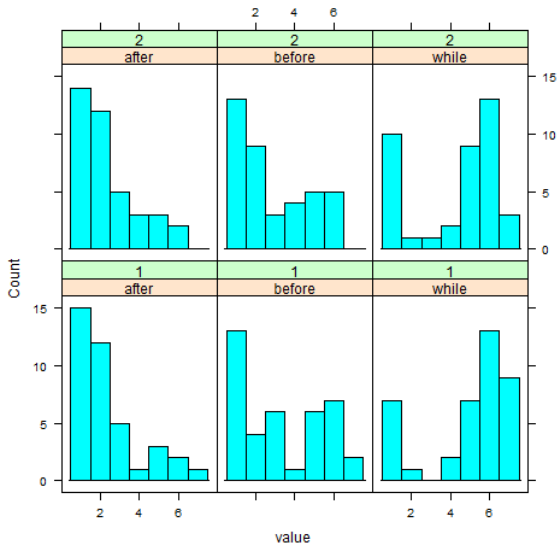
	Statistic	df	p-value
factor.performance.	4.899019	1.000000	2.687196e-02
factor.subject.	36.277956	1.948670	4.002438e-16
factor.performance.:factor.subject.	1.707785	1.976493	1.816661e-01

```

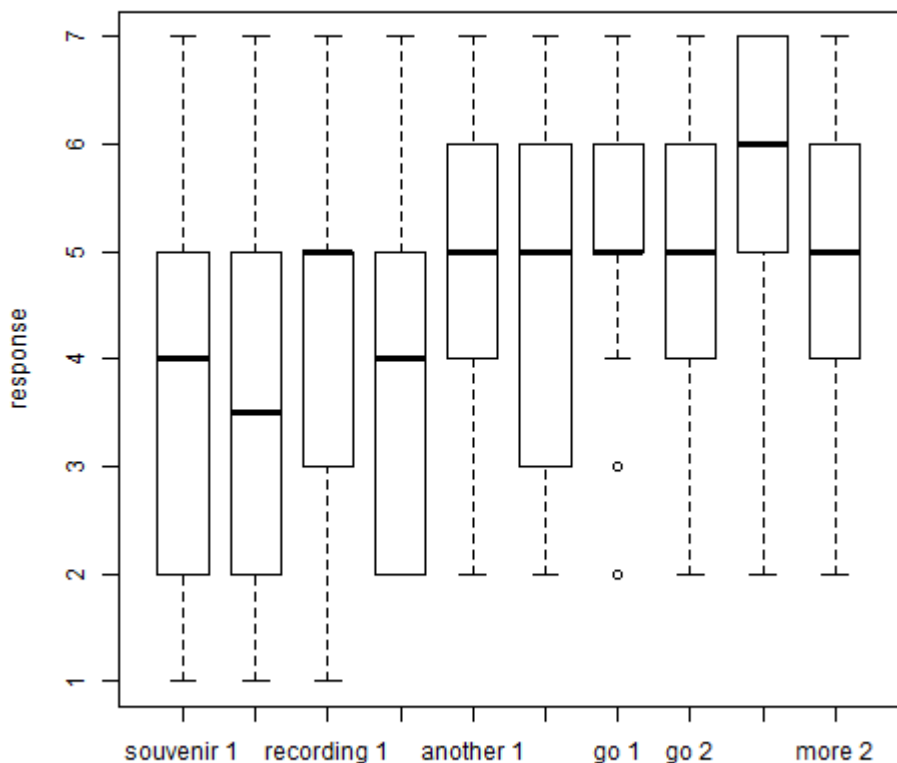
> histogram(~ value | factor(subject) + factor(performance), data=subapp, breaks =
seq_len(8)-0.5, type='count')

```

Less app use in second performance, mainly use during the performance




```
> boxplot(data$ souvenir[data$performance==1],data$ souvenir[data$performance==2],
  data$ recording[data$performance==1],data$ recording[data$performance==2],
  data$ another [data$performance==1],data$ another[data$performance==2],
  data$ go[data$performance==1],data$ go[data$performance==2],
  data$ more[data$performance==1],data$ more[data$performance==2],
names=list('souvenir 1', 'souvenir 2', 'recording 1', 'recording 2', 'another 1',
'another 2', 'go 1', 'go 2', 'more 1', 'more 2'),
ylab='response', boxwex=0.7, ylim = c(1,7))
```



```
> likeok = !is.na(data$souvenir) & !is.na(data$recording) & !is.na(data$more) &
!is.na(data$another) & !is.na(data$go)
> for (i in 1:length(likeok)) {
likeok [i] = likeok [i - ((i-1) %% 2)] & likeok [i - ((i-1) %% 2) + 1]
}
> sublike <- data.frame(list(participant=factor(c(data$participant[likeok],
data$participant[likeok], data$participant[likeok], data$participant[likeok],
data$participant[likeok])),
performance=factor(c(data$performance[likeok], data$performance[likeok],
data$performance[likeok], data$performance[likeok], data$performance[likeok])),
value=c(data$more[likeok],data$go[likeok], data$another[likeok],
data$recording[likeok],data$souvenir[likeok]),
subject=factor(c(rep('1. know more',length(data$participant)) [likeok], rep('2. go
again',length(data$participant)) [likeok], rep('3. another
recording',length(data$participant)) [likeok], rep('4. this
recording',length(data$participant)) [likeok], rep('5.
souvenir',length(data$participant)) [likeok]))
))
> png('like-re.png', width=960, height=960, res=144)
> like <- nparLD( value ~ performance * subject, data=sublike, 'participant' )
> summary(like)
```

Relative Effects

