

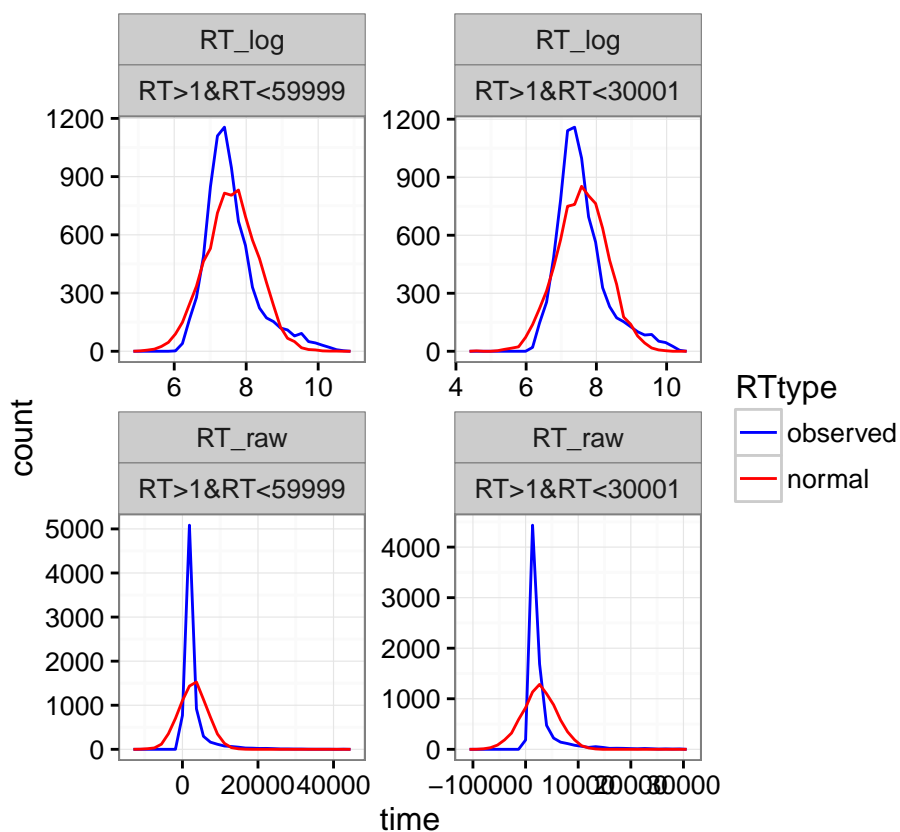
Experiment 2 (of 4)

Matt Green

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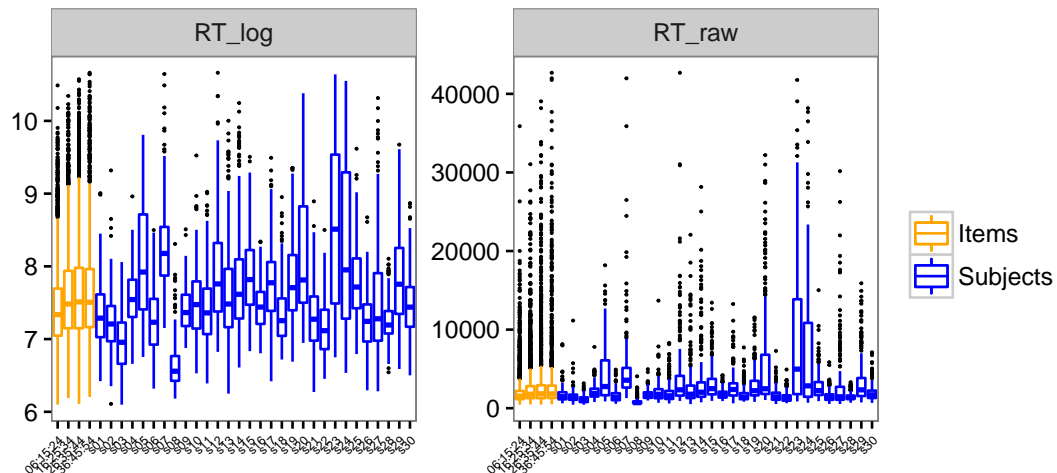
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Compare distributions of the various transformations of RT against random samples from normal distributions with the same mean and sd to see which transformations best approximate normal distributions.



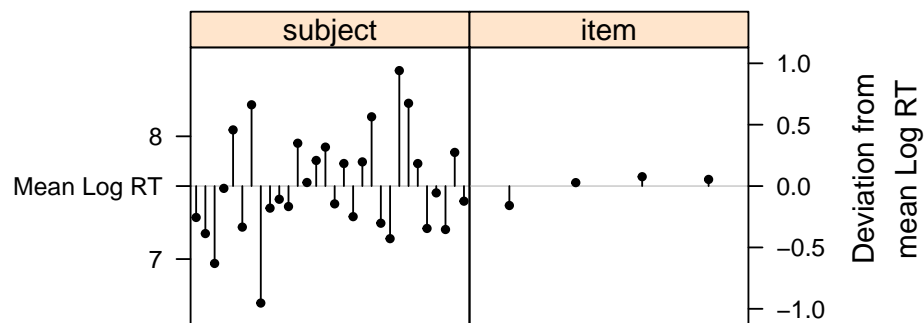
Now working with a data set without impossible trials.

Show how transformations of RT affect distribution of times, and how they affect which times are outliers.



Show how mean times for individual subjects and items vary with respect to the grand mean Log RT.

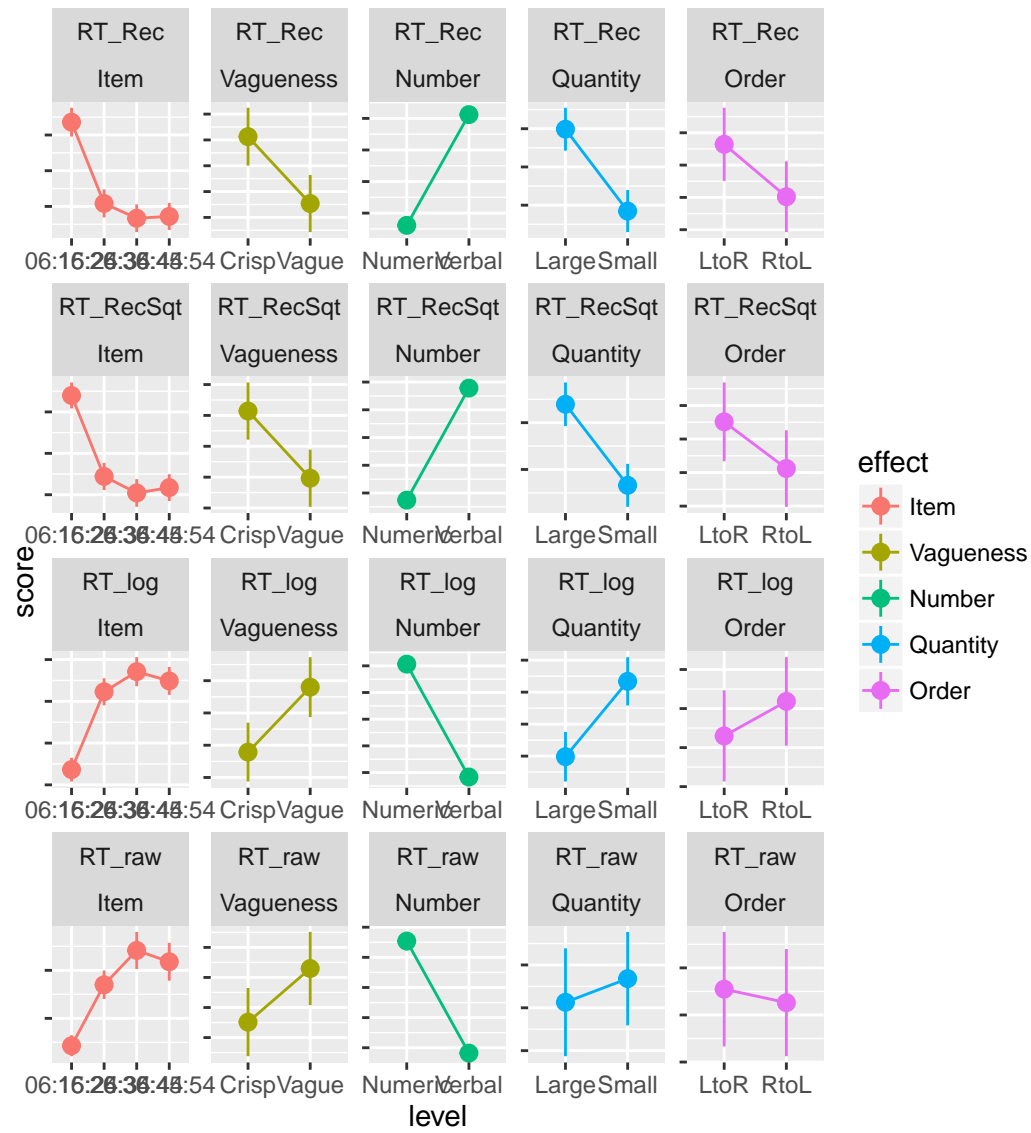
How mean times for individual subjects and items vary with respect to the grand mean Log RT



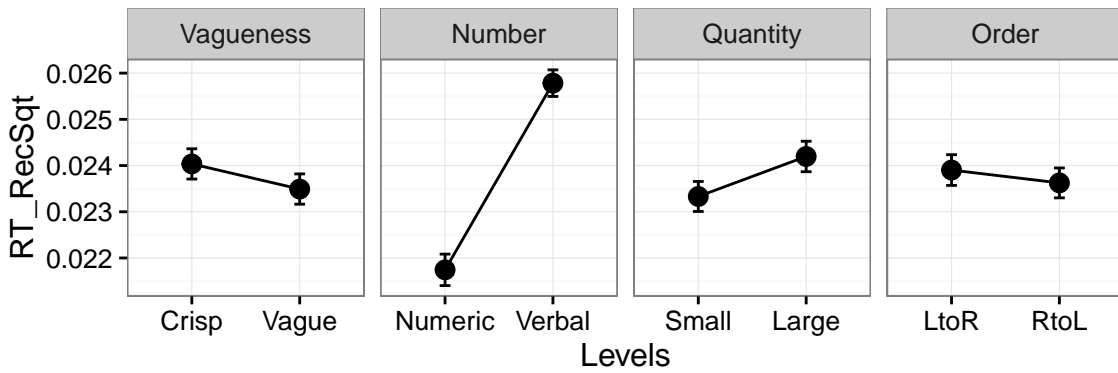
Plot main effects and interactions

Main effects

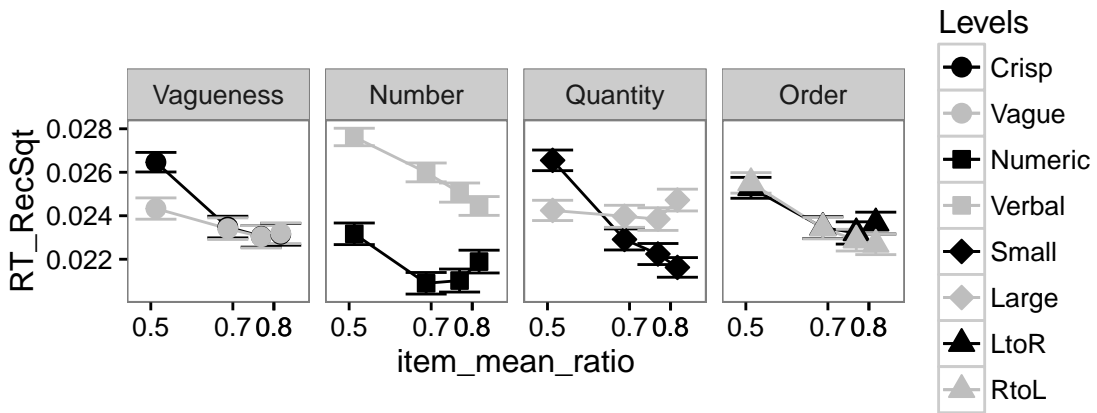
Plot main effects on several transformations



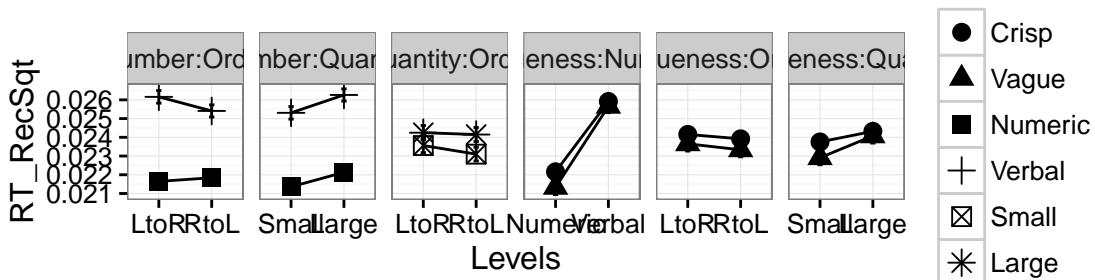
Main effects



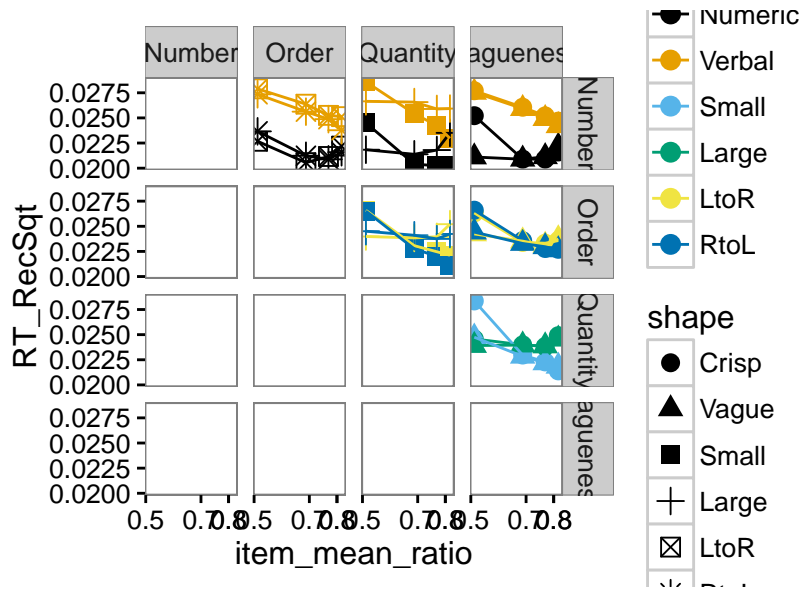
Main effects over items



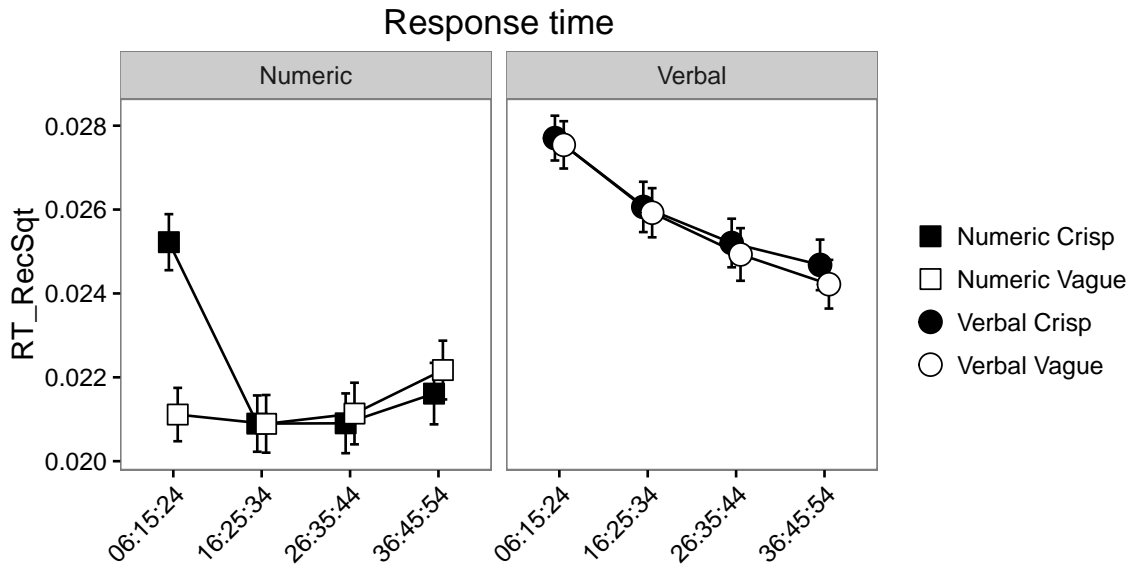
2 way interactions not involving items.



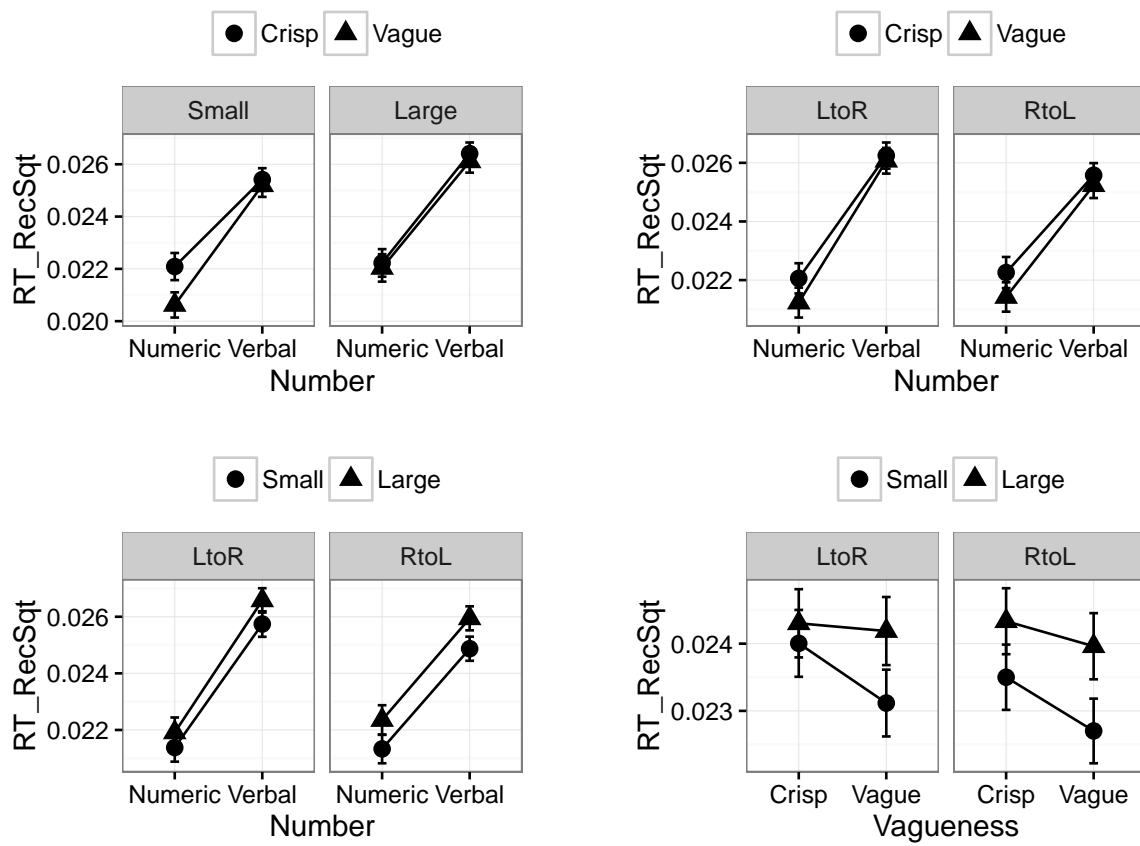
Plot 2 way interactions over items



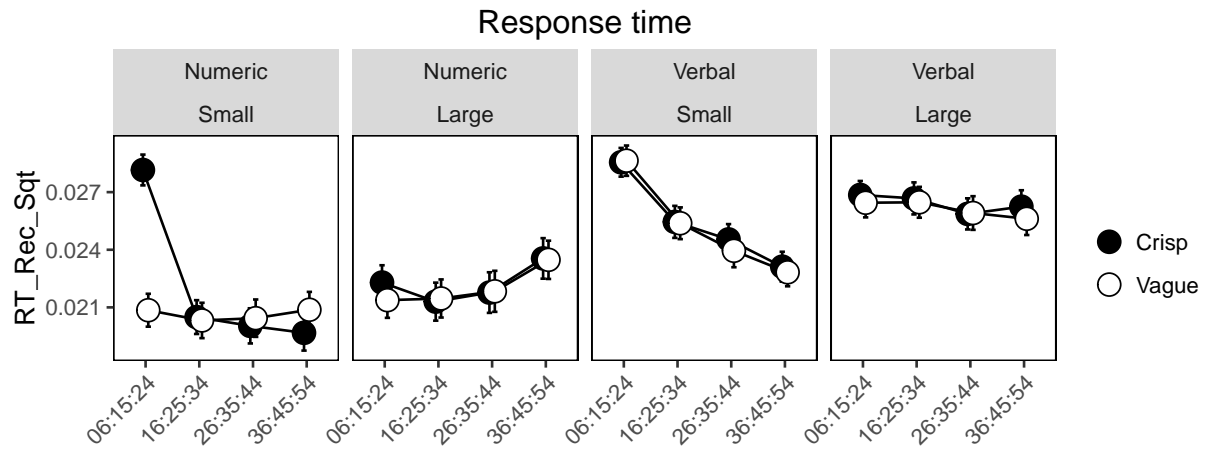
Plot vagueness by number interaction over items



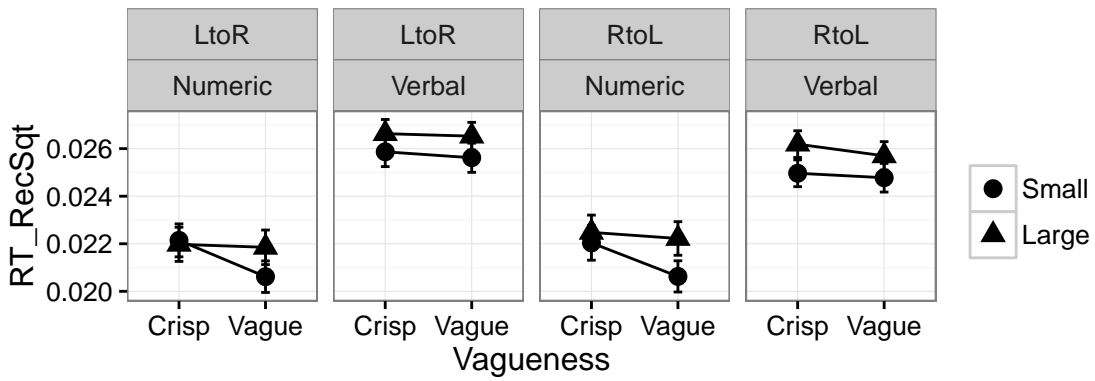
3 way interactions



Plot vagueness by number by quantity over items.

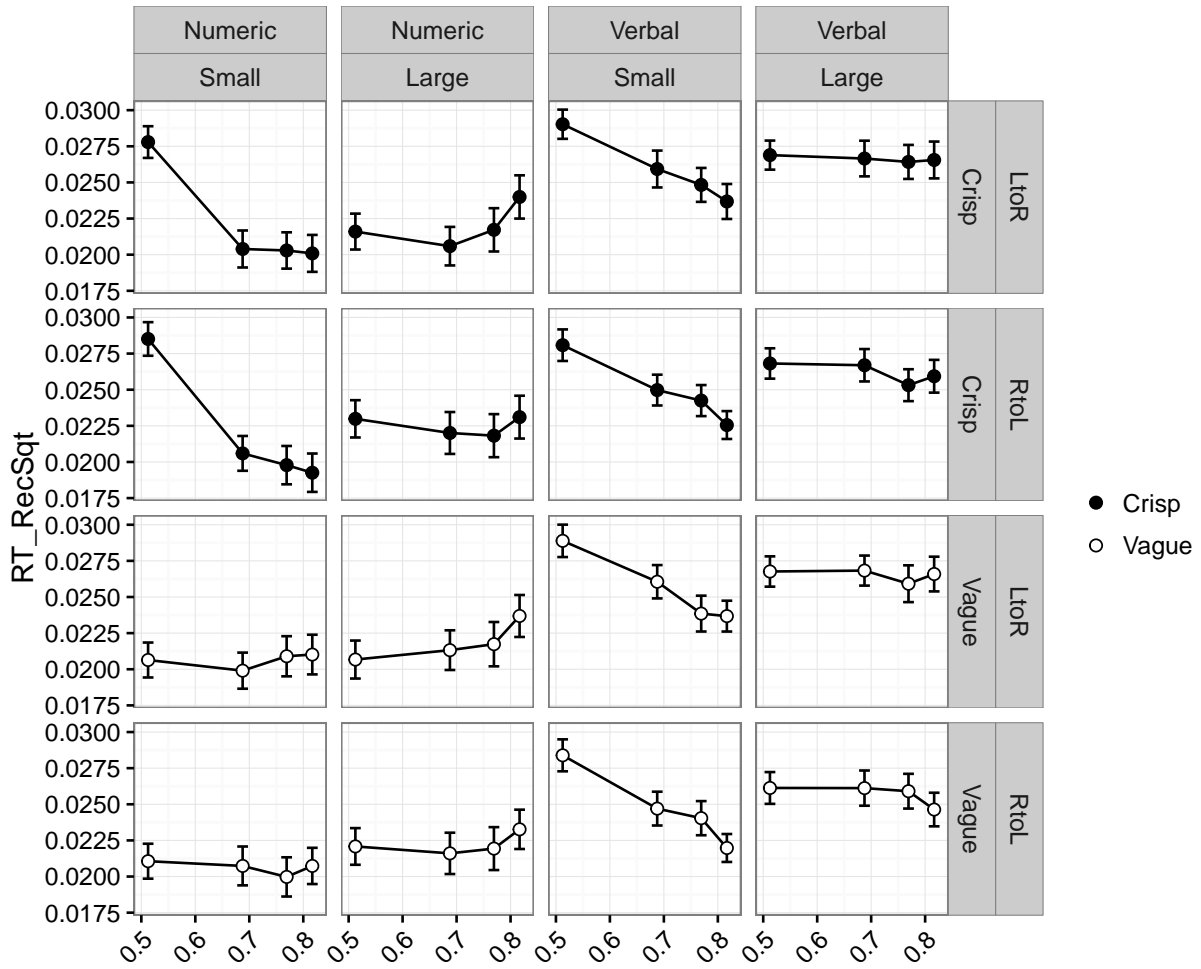


4 way interaction



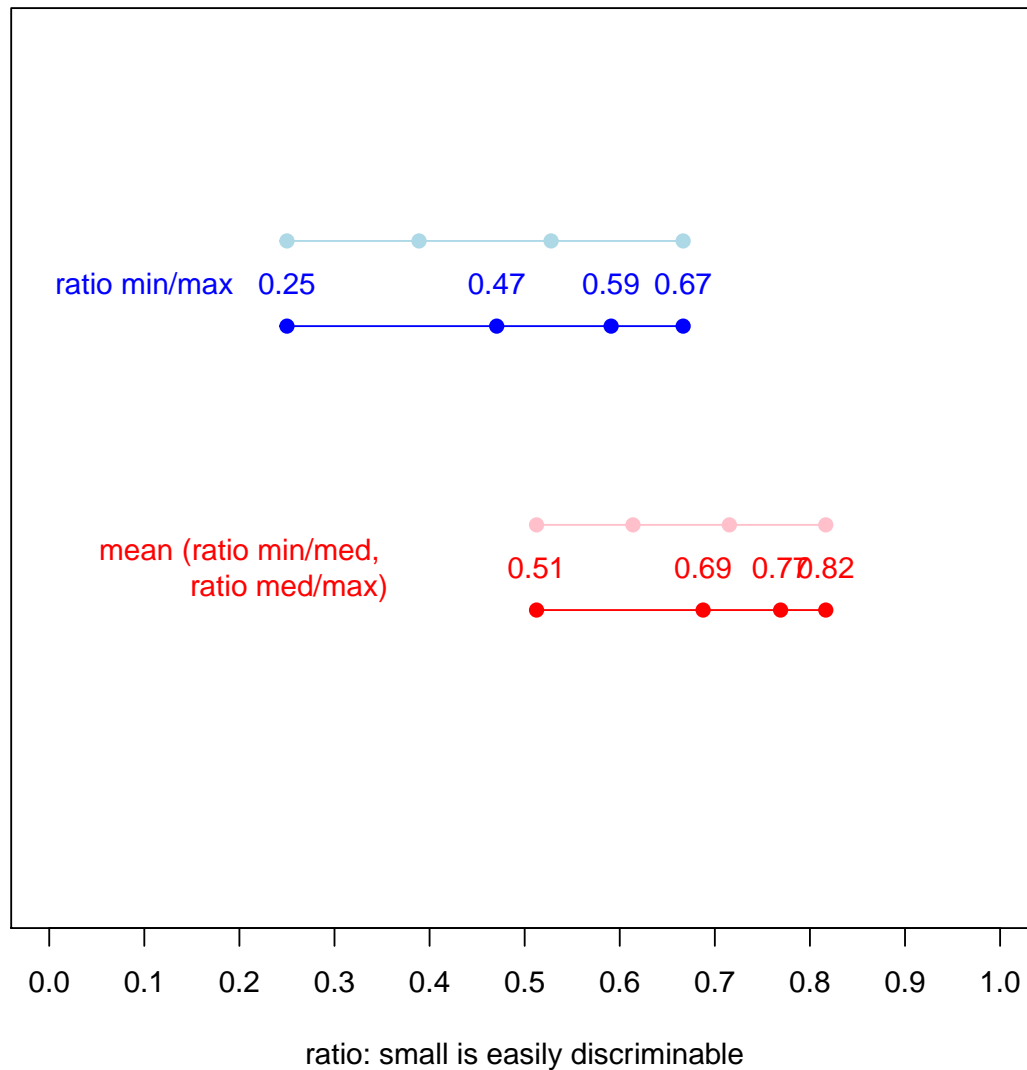
4 way interaction split over items

Number * Vagueness * Quantity * Order



Show compression of item ratios

Discriminability of each item, expressed as ratios between array magnitud



Lmer model

```
load("data_processed.Rda")
```

```
v5 <- lmerTest::lmer(data=dd,  
  RT_log ~  
    c_Vag + c_Num + c_Qty + c_Ord +  
    c_Num:c_Vag:c_Qty +  
    item_mean_ratio +
```

```

      s_Trl +
      RTprev_log +
      nchar_instr +
      (1+c_Vag + c_Num + c_Qty + c_Ord|Subject))
v5b <- lme4::lmer(data=dd,
  RT_log ~
    c_Vag + c_Num + c_Qty + c_Ord +
    c_Num:c_Vag:c_Qty +
    item_mean_ratio +
    s_Trl +
    RTprev_log +
    nchar_instr +
    (1+c_Vag + c_Num + c_Qty + c_Ord|Subject))

summary(v5)

## Linear mixed model fit by REML t-tests use Satterthwaite approximations
## to degrees of freedom [lmerMod]
## Formula: RT_log ~ c_Vag + c_Num + c_Qty + c_Ord + c_Num:c_Vag:c_Qty +
## item_mean_ratio + s_Trl + RTprev_log + nchar_instr + (1 +
## c_Vag + c_Num + c_Qty + c_Ord | Subject)
## Data: dd
##
## REML criterion at convergence: 11474.8
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -4.5470 -0.6351 -0.0955  0.5372  5.0914
##
## Random effects:
##   Groups   Name                Variance Std.Dev. Corr
##   Subject  (Intercept)  0.153949  0.39236
##             c_Vag       0.001546  0.03932   0.69
##             c_Num       0.165314  0.40659  -0.67 -0.64
##             c_Qty       0.008148  0.09027   0.16  0.26 -0.34
##             c_Ord       0.001559  0.03949  -0.13  0.02 -0.39 -0.52
##   Residual                0.249734  0.49973
## Number of obs: 7677, groups: Subject, 30
##
## Fixed effects:
##              Estimate Std. Error      df t value Pr(>|t|)
## (Intercept)    6.400e+00  1.252e-01 2.600e+02  51.112 < 2e-16 ***
## c_Vag           6.094e-02  1.387e-02  3.300e+01   4.393 0.000112 ***
## c_Num          -4.336e-01  7.515e-02  2.900e+01  -5.770 2.97e-06 ***
## c_Qty          -6.907e-02  2.005e-02  2.900e+01  -3.445 0.001743 **
## c_Ord           1.796e-02  1.350e-02  5.100e+01   1.331 0.189164
## item_mean_ratio  7.714e-01  4.927e-02  7.551e+03  15.658 < 2e-16 ***
## s_Trl          -1.070e-01  5.807e-03  7.558e+03 -18.421 < 2e-16 ***
## RTprev_log      6.047e-02  9.692e-03  7.594e+03   6.239 4.63e-10 ***
## nchar_instr     6.086e-03  1.944e-03  7.551e+03   3.131 0.001749 **
## c_Vag:c_Num:c_Qty 1.049e-01  4.607e-02  7.551e+03   2.278 0.022742 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##

```

```
## Correlation of Fixed Effects:
##          (Intr) c_Vag  c_Num  c_Qty  c_Ord  itm_m_ s_Trl  RTprv_ nchr_n
## c_Vag      0.083
## c_Num     -0.360 -0.337
## c_Qty      0.067  0.117 -0.278
## c_Ord     -0.051  0.007 -0.206 -0.228
## item_mean_rt -0.257 -0.004  0.001  0.000 -0.001
## s_Trl     -0.104  0.003 -0.001 -0.002  0.006 -0.017
## RTprev_log -0.587  0.006 -0.004 -0.003  0.019 -0.015  0.185
## nchar_instr -0.505  0.237 -0.034  0.018  0.000 -0.017  0.000  0.006
## c_Vg:c_N:_Q  0.070 -0.033  0.005 -0.003  0.000  0.002 -0.001 -0.002 -0.138
```

```
print(xtable(coef(summary(v5b))))
```

% latex table generated in R 3.3.1 by xtable 1.8-2 package % Sun Aug 7 14:45:42 2016

	Estimate	Std. Error	t value
(Intercept)	6.40	0.13	51.11
c_Vag	0.06	0.01	4.39
c_Num	-0.43	0.08	-5.77
c_Qty	-0.07	0.02	-3.45
c_Ord	0.02	0.01	1.33
item_mean_ratio	0.77	0.05	15.66
s_Trl	-0.11	0.01	-18.42
RTprev_log	0.06	0.01	6.24
nchar_instr	0.01	0.00	3.13
c_Vag:c_Num:c_Qty	0.10	0.05	2.28

```
cat("R^2")
```

```
## R^2
```

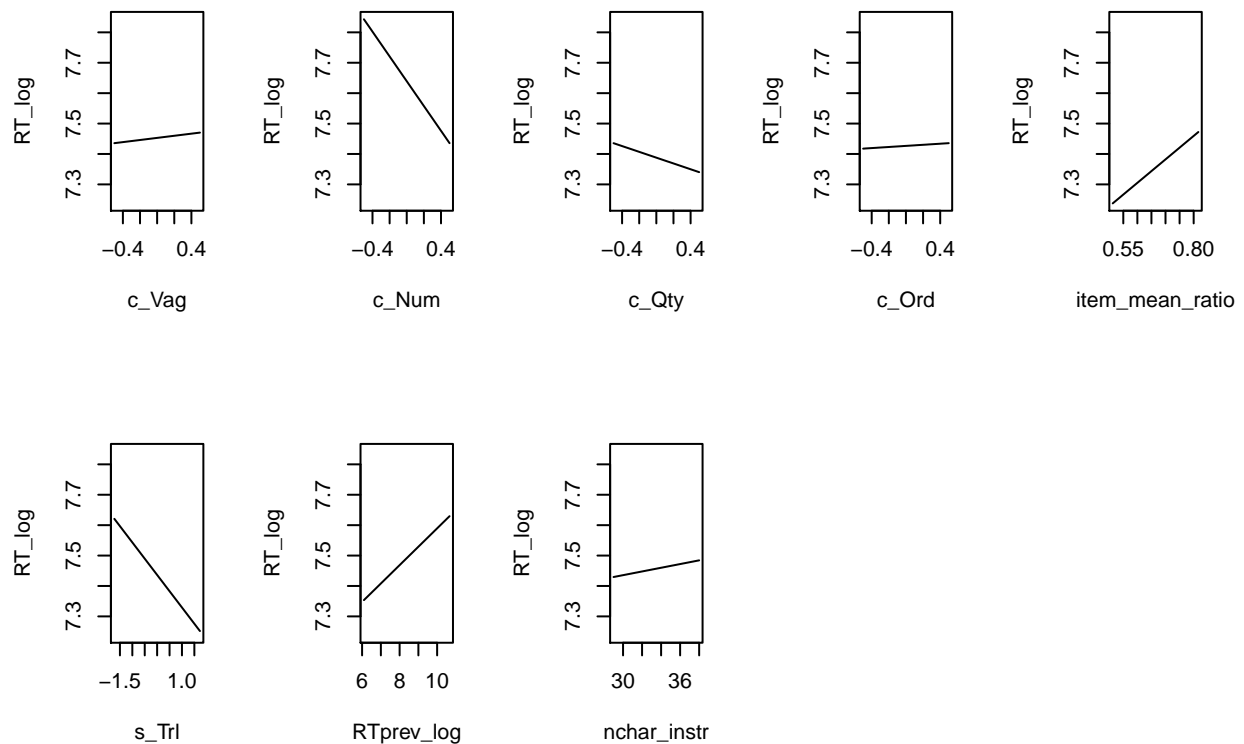
```
cor(fitted(v5), dd$RT_RecSqt)^2
```

```
## [1] 0.5095834
```

```
par(mfrow=c(2,5))
```

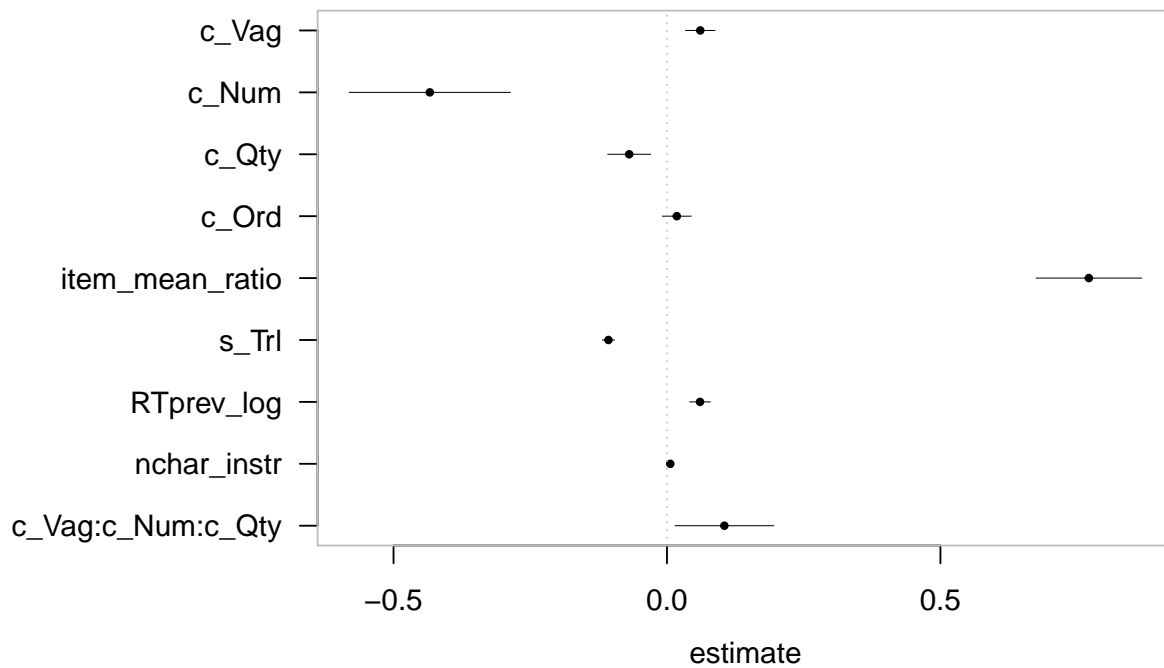
```
plotLMER.fnc(v5)
```

```
## effect size (range) for c_Vag is 0.03470056
## effect size (range) for c_Num is 0.4073765
## effect size (range) for c_Qty is 0.09530422
## effect size (range) for c_Ord is 0.0179595
## effect size (range) for item_mean_ratio is 0.2346348
## effect size (range) for s_Trl is 0.369093
## effect size (range) for RTprev_log is 0.2759498
## effect size (range) for nchar_instr is 0.05477539
```



Plot model coefficients and ci's

```
e=data.frame(coef=summary(v5)$coef[-1,1]) # estimates, without intercept
q=as.data.frame(confint(v5, method='Wald')[18:26,1:2])
eq=cbind(e,q)
y=eq[rev(rownames(eq)),]
par(mar=c(4,10,1,1))
plot(y=1:nrow(y), x=y$coef, xlim=range(y$"2.5 %", y$"97.5 %"), type='n', axes=F, xlab="", ylab="")
segments(y0=1:nrow(y), y1=1:nrow(y), x0=y$"2.5 %", x1=y$"97.5 %", lwd=.55)
points(y=1:nrow(y), x=y$coef, pch=20, cex=.75)
abline(v=0, lty=3, col='grey')
axis(2, labels=row.names(y), at=1:nrow(y), las=1)
axis(1, las=1)
mtext("estimate", side=1, line=2.5, cex.lab=1, las=1)
box(col='grey')
```



Model criticism baayen plots

```
# Baayen 4-plot model criticism
par(mfrow=c(1,4), pty='s')
# create scaled residuals
dd$rstand = as.vector(scale(resid(v5)))
# plot scaled residuals density
plot(density(dd$rstand))
# plot sample quantiles versus theoretical quantiles
qqnorm(dd$rstand, cex=.5)
qqline(dd$rstand)
# plot standardised residuals versus fitted values
plot(dd$rstand ~ fitted(v5), pch='.')
# absolute standardised residuals greater than 2.5 are candidates for being outliers, the abline identi
abline(h=c(-2.5,2.5))
```

