Processing of Scalar Implicatures and the Question Under Discussion

Replication of Degen 2013 Experiment 2a

Research Question

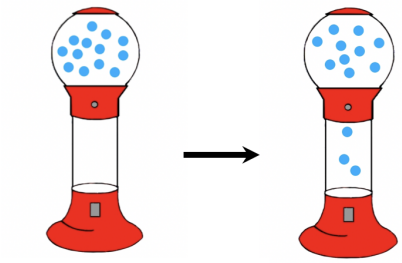
Does the relevance of the stronger alternative to a weak scalar item, manipulated by the implicit QUD, affect the rate of scalar implicatures and the speed of scalar implicature processing?

Hypothesis

When the stronger alternative is more relevant, there are more pragmatic responses and the speed of pragmatic processing is faster.

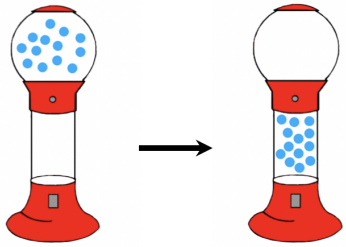
Task

- Web-based experiment using the gumball paradigm.
- Paricipants see a gumball machine with different number of gumballs in the upper chamber. After a brief delay, some of the gumballs drop to the lower chamber and participants hear a statement like "You got 5 gumballs" or "You got some gumballs". Depending on the condition that the participant is assigned to (all QUD, any QUD or no QUD) they see a cover story and are asked to respond by pressing one of two buttons to indicate that yes, they agree with, or no, they disagree with the spoken description.



"You got three gumballs"

- In this experiment, only the critical trials are of interest. In these trials, all 13 gumballs drop to the lower chamber and participants hear "You got some of the gumballs". The key dependent variables are response type(agree and disagree) and response time.



"You got some of the gumballs"

Stimuli

Quantifier	Set size 0	2	5	8	11	13	Total
some	4	1	1	1	1	8	16
alla	2	1	2	1	2	8	16
nunna	5*	1	0	1	0*	1	8
number	3	7 [6]	7 [3]	7 [5]	4* [2]	3	31*
Total	13*	10	10	10	7*	20	71*

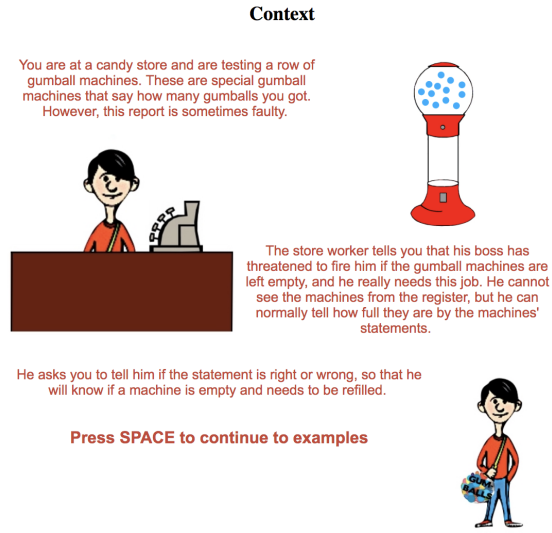
incorrect (30) correct (33) criticical trials (8)

*experimenter mistake - needs to change

Participants

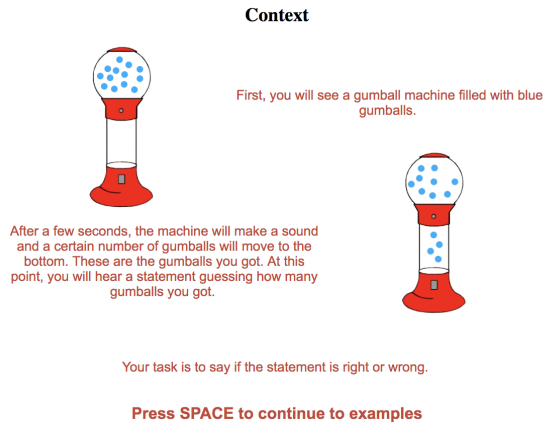
- 150 participants from Amazon Mechanical Turk.
- Each participant assigned to one of the three conditions (50 participants in each condition) and reads a cover story that sets up an implicit QUD (relevant QUD or less relevant QUD) or no QUD.

All QUD



Any QUD

No QUD



Exclusions

Language: Non native speakers are excluded

number of participants excluded:

Practice Trials: Participants who got at least two practice trials wrong are exluded

number of participants excluded:

```
## [1] 32
```

Audio check: Participants who got the audio check wrong more than once are exluded

number of participants excluded

```
## [1] 0
```

Comprehension check: Participants who got the second comprehension question wrong more than twice are excluded

number of participants excluded

```
## [1] 0
```

Accuracy check: Participants with accuracy of lower than 85% on non-critical trials are excluded

number of participants excluded

```
## [1] 4
```

Response time: Trials with logRT>20 are excluded, participants with more than 5 trials that have logRT>20 are exluded

number of participants exluded:

```
## [1] 0
```

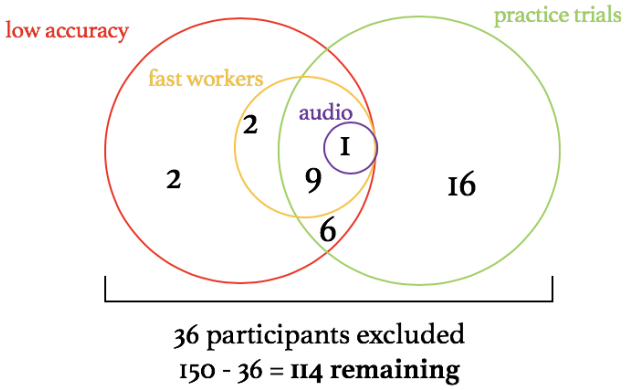
number of trials excluded:

```
## [1] 3
```

Exclusion Summary

Number of participants left

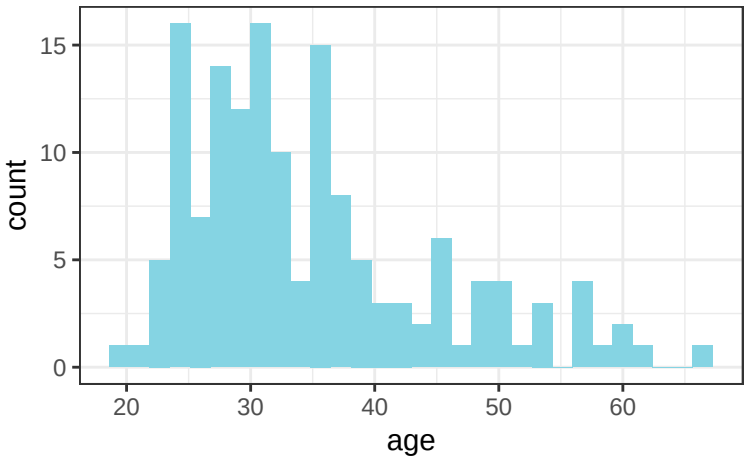
```
## [1] 114
```



##General Results

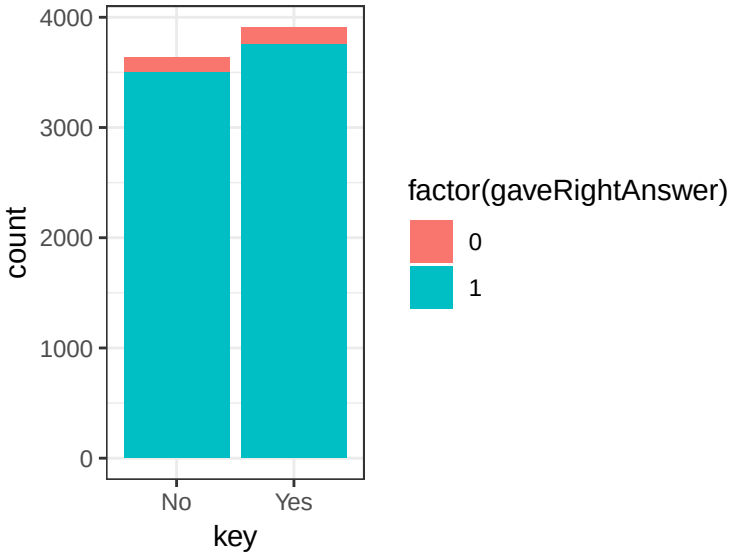
Age Distribution

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

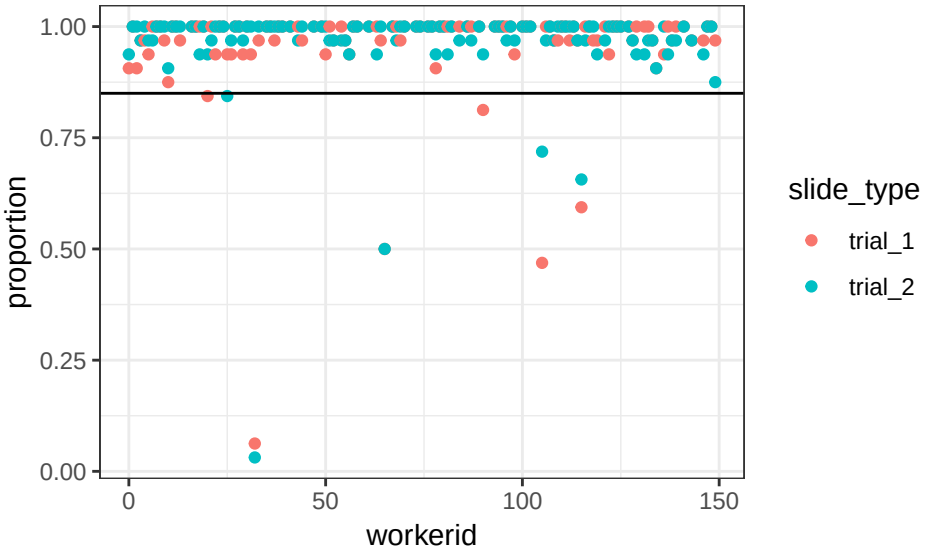



```
##
## 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 42 43 44 45
##  1  1  3  2  7  9  7  8  6 12  9  7  5  5  4  7  8  4  4  5  3  3  1  1  5
## 46 47 48 49 50 51 52 53 54 56 57 59 60 61 67
##  1  1  3  1  2  2  1  2  1  2  2  1  2  1  1
```

Accuracy in all trials

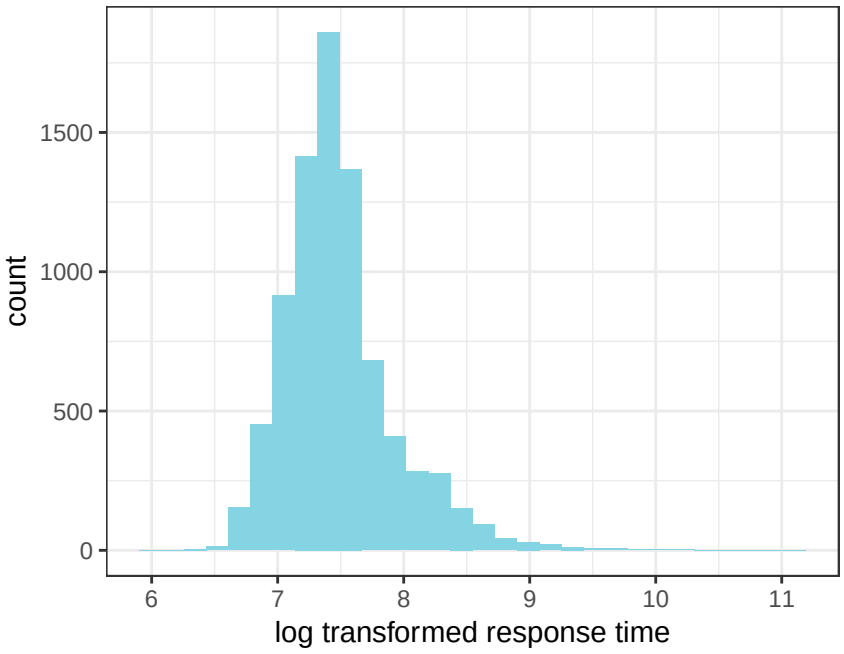


Accuracy by trial order

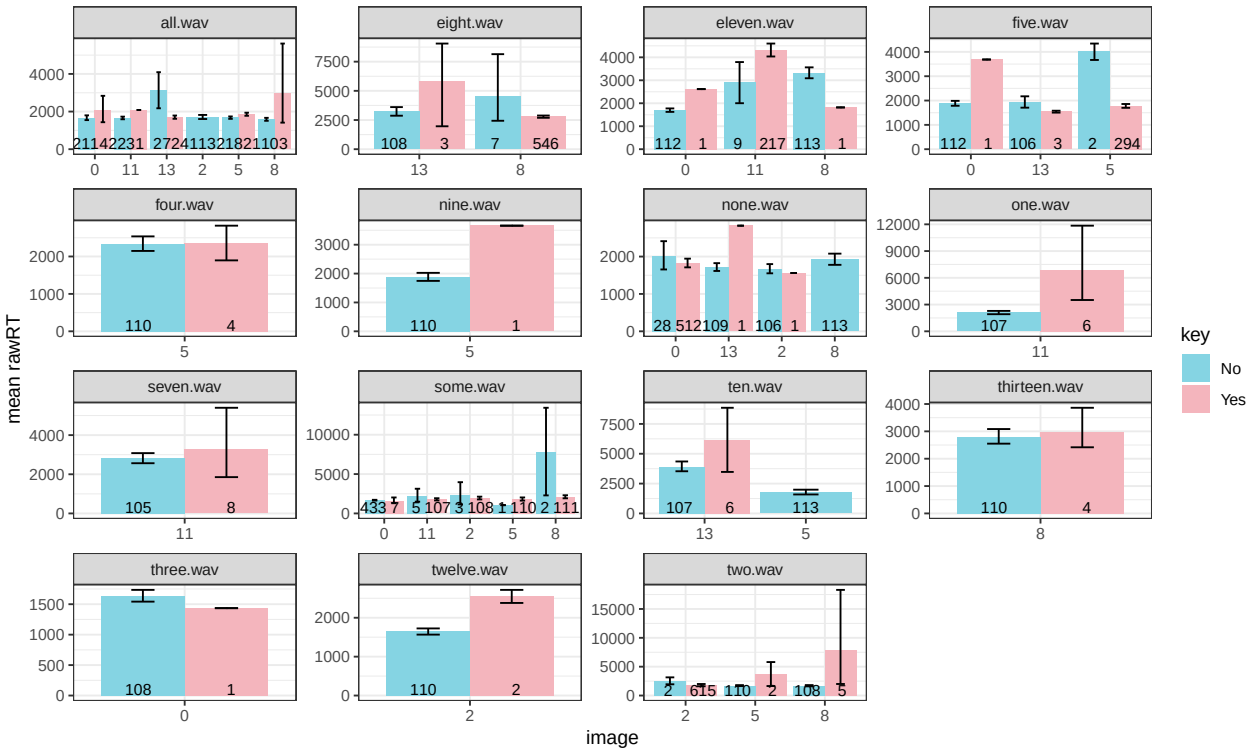


Response time distribution -for all trials

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



Response time distribution -for non-critical trials



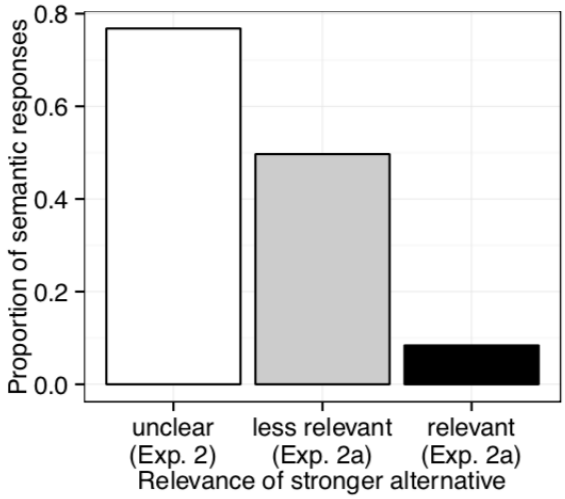
Critical Trials

number of data points (# of participants x 8)

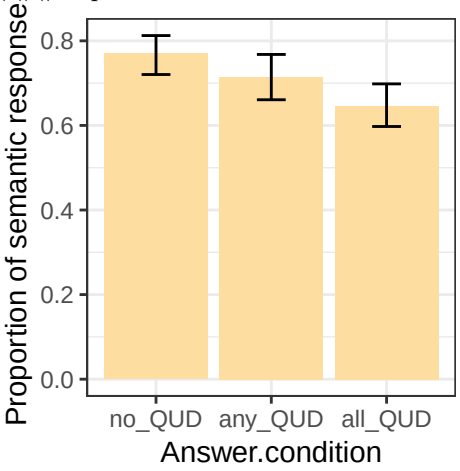
```
## [1] 912
```

Response Type

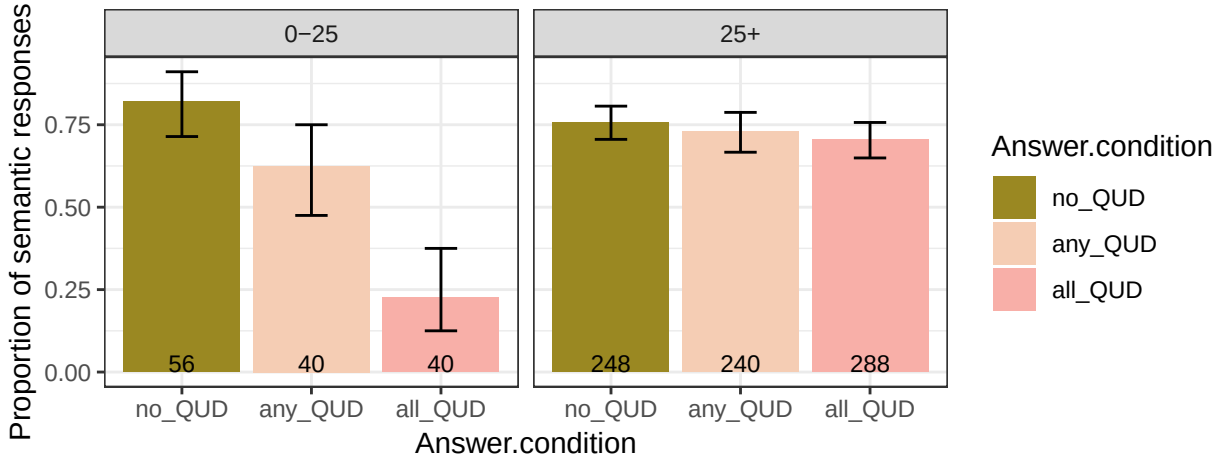
Original Experiment:



###Replication:



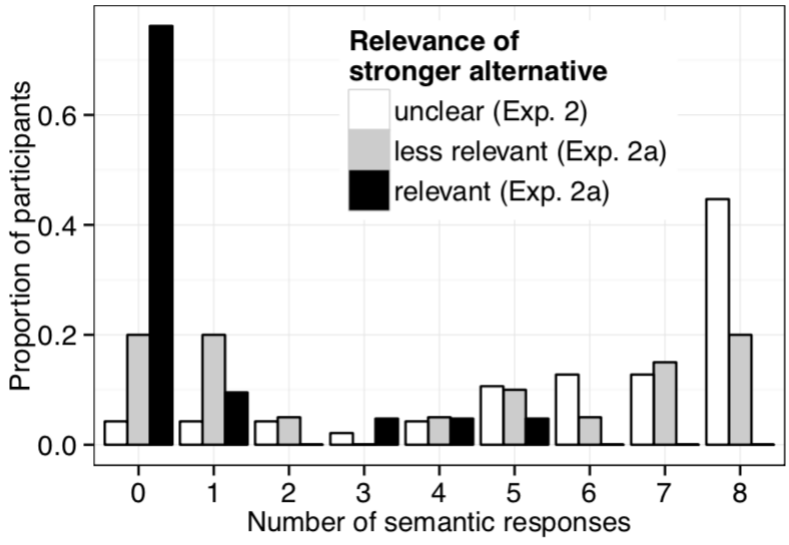
Replication - age effect:



Proportion of Semantic Responses

```
##
##              0  1  2  3  4  5  6  7  8
##    no_QUD    6  1  1  0  0  0  1  7 22
##    any_QUD   5  0  2  1  3  2  0  5 17
##    all_QUD   8  4  1  0  3  0  1  4 20
```

Original Experiment:



###Replication:

```
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```
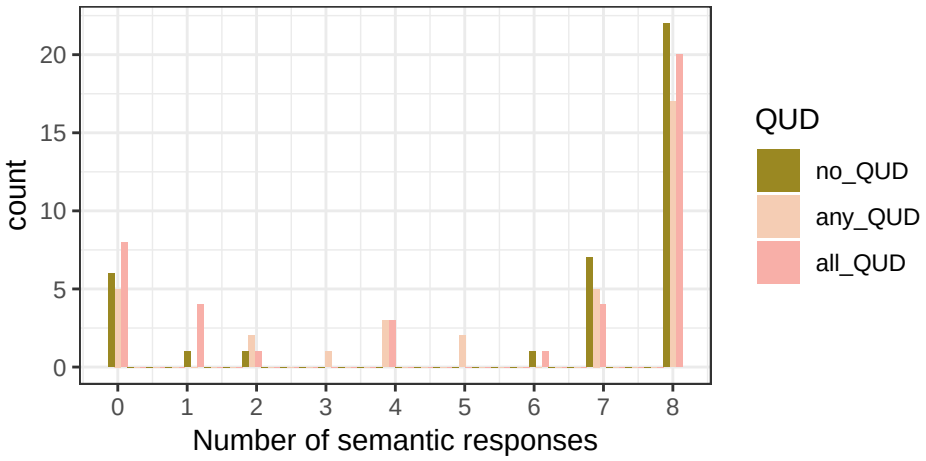
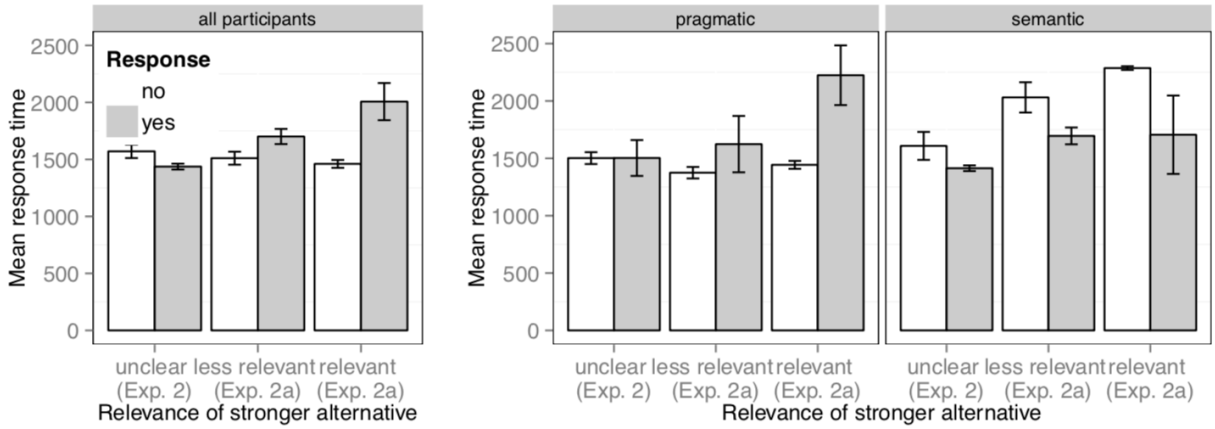
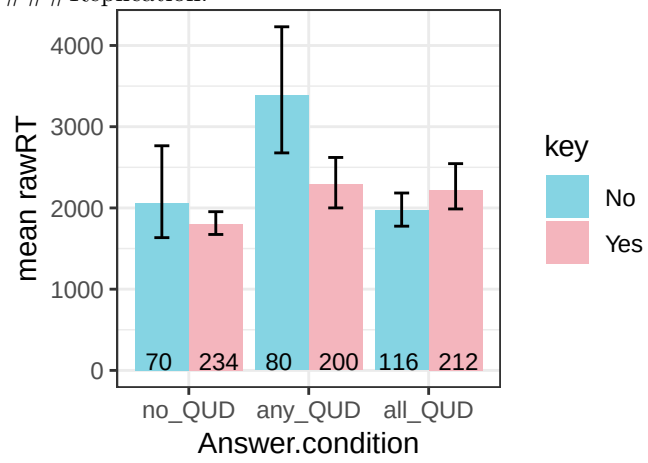



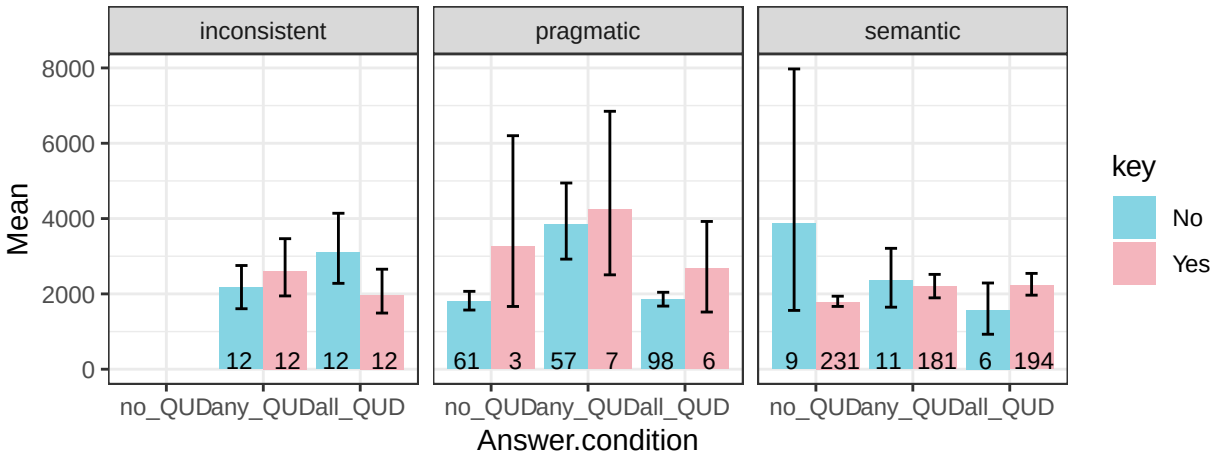
Response Time:

Original Experiment:

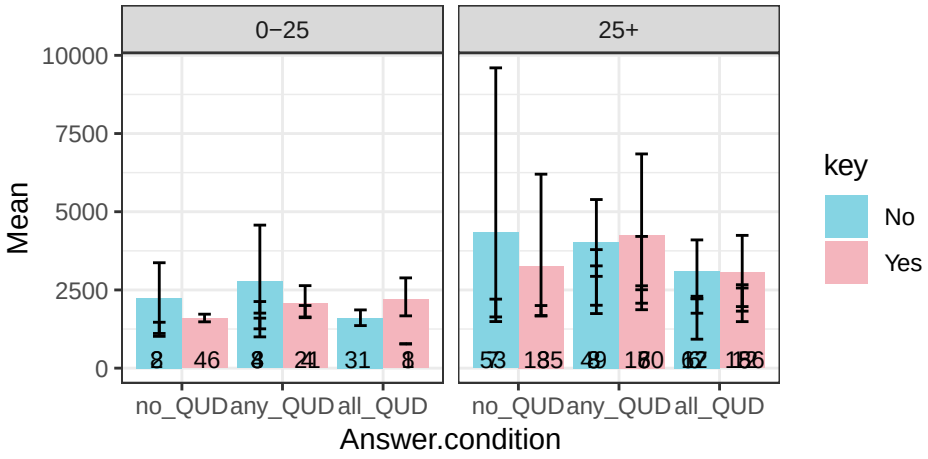


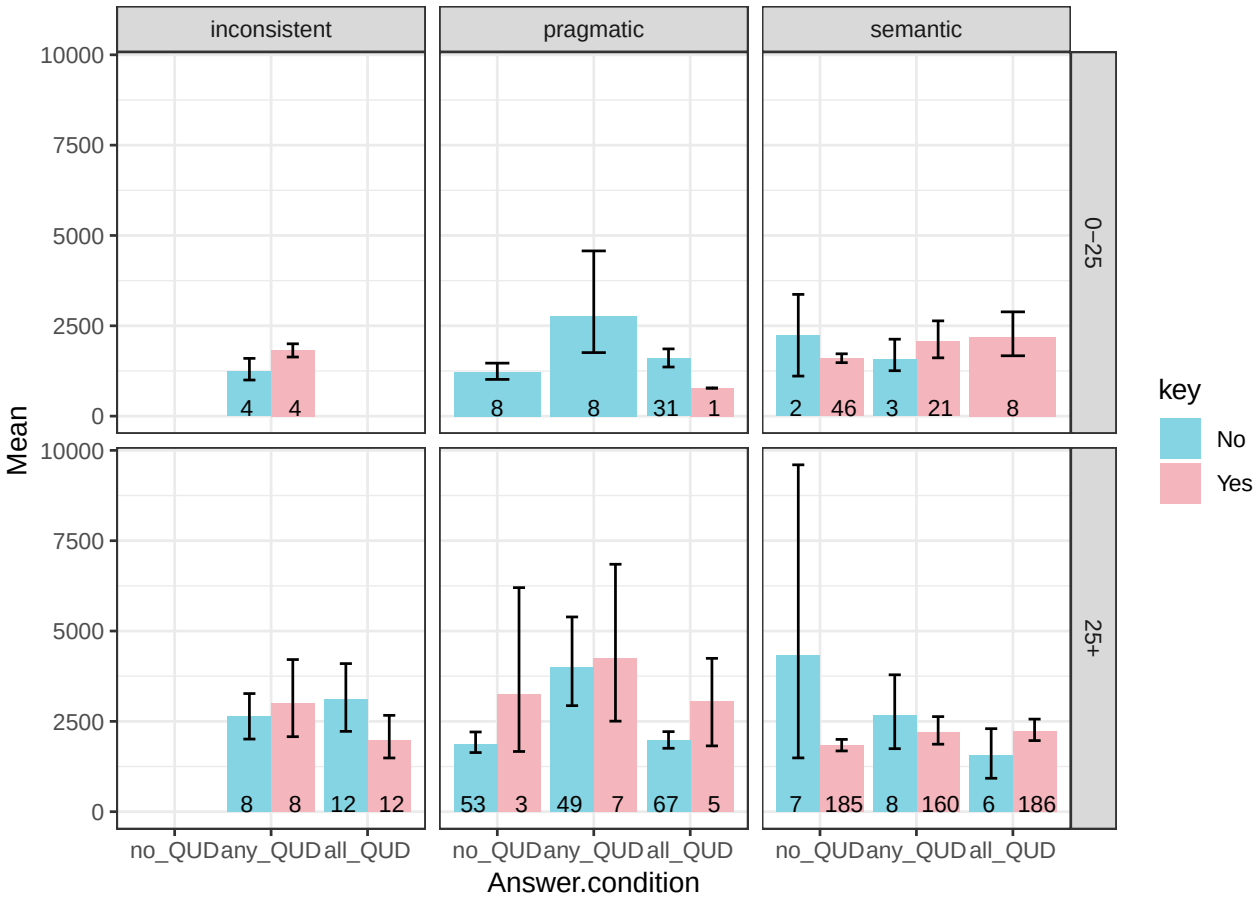
###Replication:



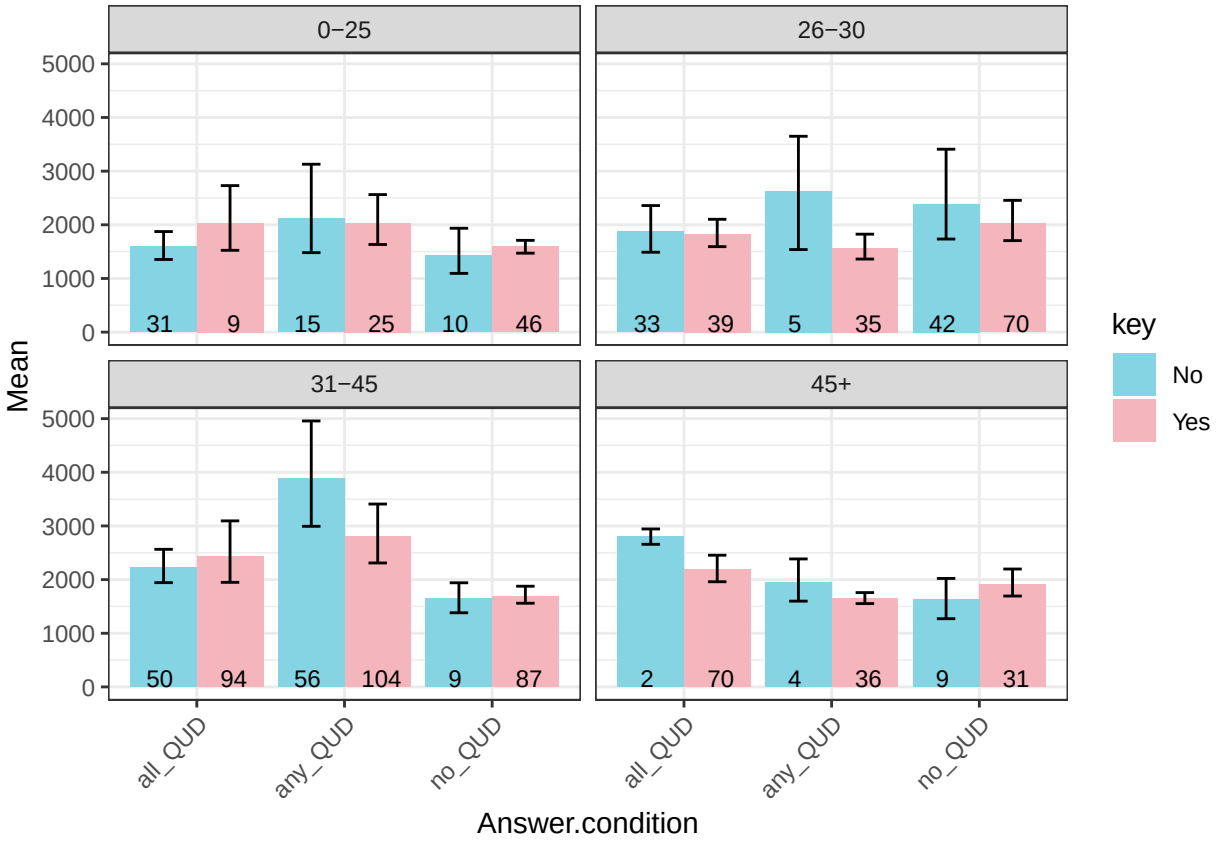


Replication - age effect:




inconsistent
pragmatic
semantic
0–25
25+
Mean
10000
7500
5000
2500
0
4 4
8 8 31 1
2 46 3 21 8
8 8 12 12
53 3 49 7 67 5
7 185 8 160 6 186
no_QUD
any_QUD
all_QUD
Answer.condition
key
No
Yes

Only age effect (without responder type):



Analysis

1) Mixed effects logistic regression predicting response from fixed effects of QUD
Prediction given Degen(2013): Main effect of QUD such that there are more pragmatic responses for all-QUD compared to any-QUD and no-QUD

```
## Generalized linear mixed model fit by maximum likelihood (Laplace
##   Approximation) [glmerMod]
##  Family: binomial  ( logit )
## Formula: key ~ Answer.condition + (1 | workerid)
##    Data: critical
##
##      AIC      BIC   logLik deviance df.resid
##    570.6    589.8   -281.3    562.6      908
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -2.79577 -0.15156  0.04982  0.06098  2.45869
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  workerid (Intercept) 44.76    6.691
## Number of obs: 912, groups:  workerid, 114
##
```

```
## Fixed effects:
##                          Estimate Std. Error z value Pr(>|z|)
## (Intercept)                 4.268      7.021   0.608    0.543
## Answer.conditionany_QUD     0.844      2.163   0.390    0.696
## Answer.conditionno_QUD      1.933      2.943   0.657    0.511
##
## Correlation of Fixed Effects:
##                   (Intr) Answr.cndtnny_QUD
## Answr.cndtnny_QUD -0.597
## Answer.cndtnn_QUD -0.894  0.698
```

2) Linear mixed effects regression predicting log response time from fixed effects of QUD, response type and their interaction
Prediction given Degen(2013):Interaction of QUD and response such that the more relevant the alternative, the faster the pragmatic responses become and the slower the semantic responses become.

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: logRT ~ Answer.condition * key + (1 | workerid)
##    Data: critical
##
## REML criterion at convergence: 1072.3
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.7898 -0.5643 -0.1768  0.3033  5.5914
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  workerid (Intercept) 0.07658  0.2767
##  Residual             0.15237  0.3903
## Number of obs: 912, groups:  workerid, 114
##
## Fixed effects:
##                                Estimate Std. Error t value
## (Intercept)                     7.50389    0.06802 110.322
## Answer.conditionany_QUD         0.22002    0.10140   2.170
## Answer.conditionno_QUD         -0.04345    0.10936  -0.397
## keyYes                          0.03172    0.07410   0.428
## Answer.conditionany_QUD:keyYes -0.15357    0.10593  -1.450
## Answer.conditionno_QUD:keyYes  -0.08779    0.11671  -0.752
##
## Correlation of Fixed Effects:
##                     (Intr) Answr.cndtnny_QUD Answer.cndtnn_QUD keyYes
## Answr.cndtnny_QUD   -0.671
## Answer.cndtnn_QUD   -0.622  0.417
## keyYes              -0.704  0.472             0.438
## Answr.cndtnny_QUD:Y  0.493 -0.711            -0.306            -0.700
## Answr.cndtnn_QUD:kY  0.447 -0.300            -0.768            -0.635
##                     Answr.cndtnny_QUD:Y
## Answr.cndtnny_QUD
## Answer.cndtnn_QUD
## keyYes
## Answr.cndtnny_QUD:Y
## Answr.cndtnn_QUD:kY  0.444
```