

# Effects on projectivity ratings by Embedding Operator and Trigger — Data Analysis

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November 30, 2022

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## 1 Introducing the dataset

```
> str(data)

'data.frame': 57160 obs. of 9 variables:
 $ workerid      : int  1 1 1 1 1 1 1 1 1 1 ...
 $ content       : chr  "charley" "danny" "emily" "emma" ...
 $ short_trigger : chr  "acknowledge" "hear" "reveal" "discover" ...
 $ ai_block      : chr  "block1" "block1" "block1" "block1" ...
 $ ai            : num  0.98 0.99 0.99 0.99 0.98 0.98 1 0.99 0.99 0.99 ...
 $ projective    : num  0.3 0.98 0.01 0.99 0.98 0.99 0.01 0.01 0.27 0.01 ...
 $ verb          : chr  "acknowledge" "hear" "reveal" "discover" ...
 $ op            : chr  "q" "q" "q" "q" ...
 $ exp_block     : int  1 1 1 1 1 1 1 1 1 1 ...

> data$workerid <- as.factor(data$workerid)
> length(levels(data$workerid))

[1] 2682
```

The dataset consists of 57160 observations from 2682 participants (recruited on the online platforms Prolific and Amazon Mechanical Turk), across 12 experiments.

We are interested in how highly participants rate speaker commitment to the truth of an embedded complement clause, coded as projective on a real-numbered sliding scale between 0 – 1.

The complement clause was embedded under an attitude verb, which in turn was embedded under an entailment-cancelling operator. Our fixed effects factors manipulate the following:

1. The choice of attitude verb (coded as verb)

## 2. The entailment-cancelling operator (coded as op)

The levels for our fixed effects factors are the following:

```
> data$verb <- as.factor(data$verb)
> levels(data$verb)

[1] "acknowledge" "admit"      "announce"   "be_annoyed" "be_right"
[6] "confess"     "confirm"    "demonstrate" "discover"    "establish"
[11] "hear"        "inform"     "know"       "pretend"     "prove"
[16] "reveal"      "say"        "see"        "suggest"     "think"

> length(levels(data$verb))

[1] 20

> data$op <- as.factor(data$op)
> levels(data$op)

[1] "c" "m" "n" "q"

> length(levels(data$op))

[1] 4
```

We are interested in the effect on projective of verb and op, as well as their interaction, corresponding to a  $20 \times 4$  factorial design, yielding

```
> length(levels(data$verb))*length(levels(data$op))

[1] 80
```

conditions.

We have 20 items, corresponding to the content of the complement clause.

```
> data$content <- as.factor(data$content)
> levels(data$content)

[1] "charley" "danny"    "emily"    "emma"     "frank"    "grace"
[7] "isabella" "jackson"  "jayden"   "jon"      "josh"     "josie"
[13] "julian"   "mary"     "mia"      "olivia"   "owen"     "sophia"
[19] "tony"     "zoe"

> length(levels(data$content))

[1] 20
```

We have roughly 36 observations by item and condition. This is an approximate number, because the op manipulation is a between-studies manipulation, and the number of participants differs by experiment:

```
> # n observations
> length(data[,1])

[1] 57160

> # observations by item
> length(data[,1])/length(levels(data$content))

[1] 2858

> table(data$content)
```

charley	danny	emily	emma	frank	grace	isabella	jackson
2858	2858	2858	2858	2858	2858	2858	2858
jayden	jon	josh	josie	julian	mary	mia	olivia
2858	2858	2858	2858	2858	2858	2858	2858
owen	sophia	tony	zoe				
2858	2858	2858	2858				

```
> # observations by verb
> length(data[,1])/length(levels(data$verb))
```

```
[1] 2858
```

```
> table(data$verb)
```

acknowledge	admit	announce	be_annoyed	be_right	confess
2858	2858	2858	2858	2858	2858
confirm	demonstrate	discover	establish	hear	inform
2858	2858	2858	2858	2858	2858
know	pretend	prove	reveal	say	see
2858	2858	2858	2858	2858	2858
suggest	think				
2858	2858				

```
> # observations by operator
> length(data[,1])/length(levels(data$op))
```

```
[1] 14290
```

```
> table(data$op)
```

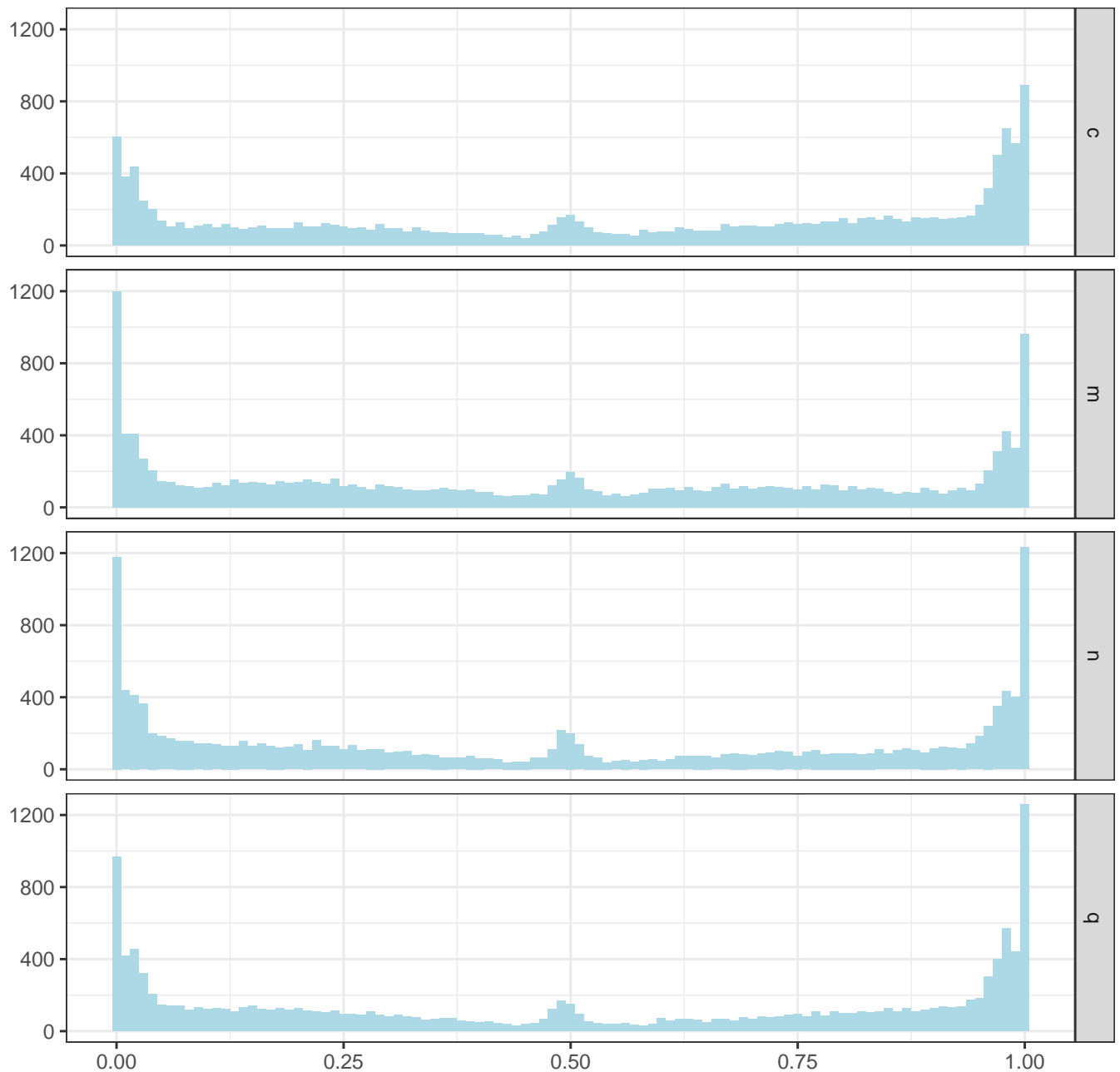
c	m	n	q
14400	14680	14340	13740

```
> # observations by item and condition
> length(data[,1])/length(levels(data$content))/
+ (length(levels(data$verb))*length(levels(data$op)))
```

```
[1] 35.725
```

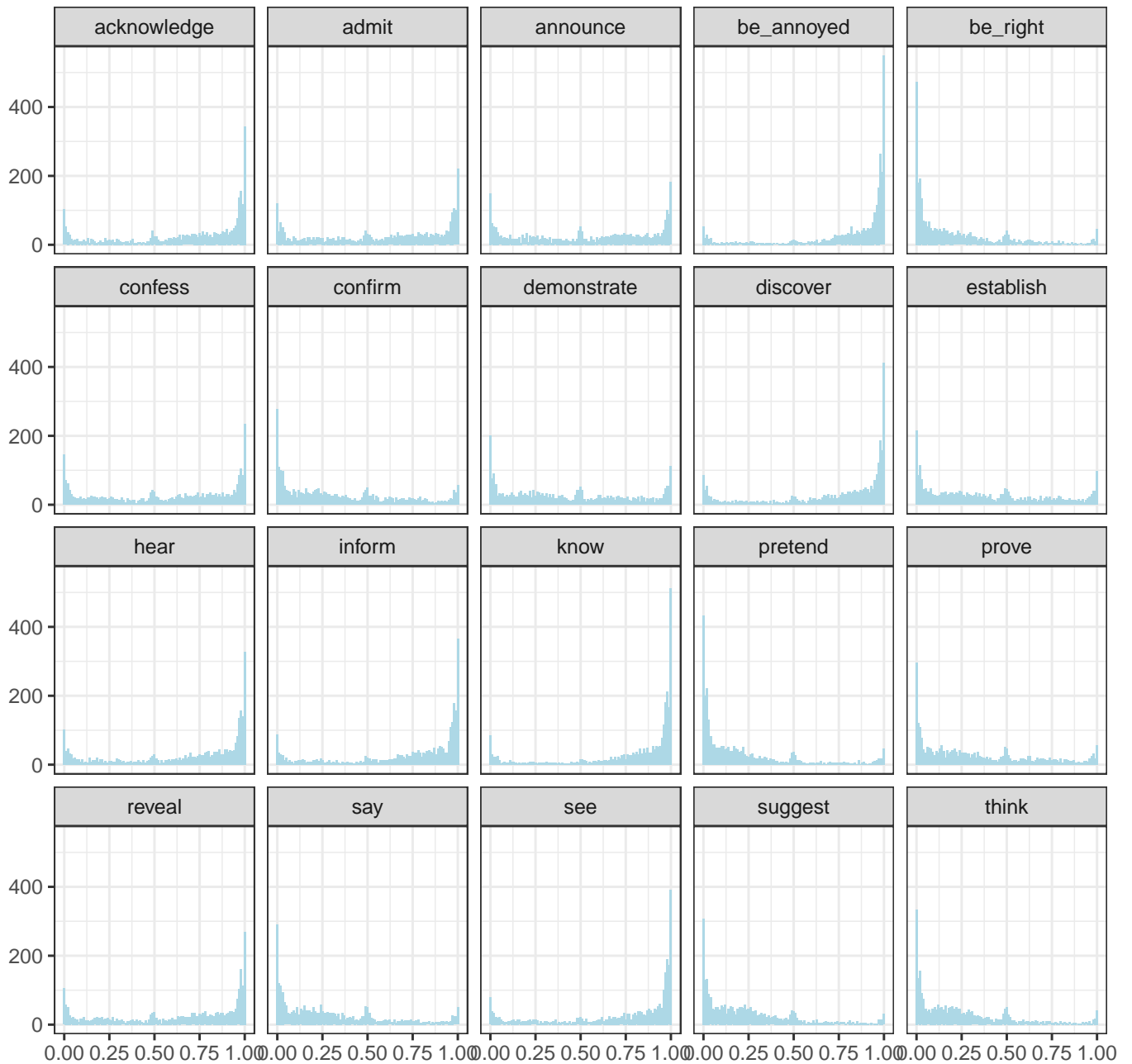
## 2 Data Overview and Statistical Summaries

### 2.1 Distribution of projectivity ratings by operator:



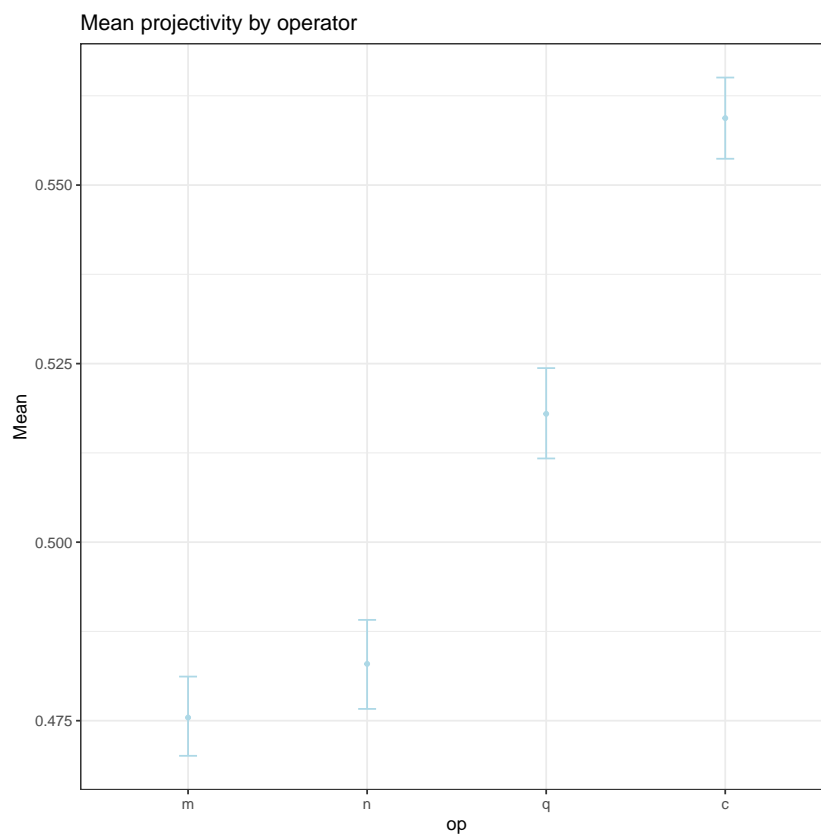
- These definitely do not look normal
- Maybe a beta-regression would be useful?
- But even that would be relying on some simplifying assumptions, since we might be ignoring the little bump in the middle

## 2.2 Distribution of projectivity ratings by verb:



- Some of these also show a higher mass around the middle of the scale
- but it looks the beta-distribution could be useful

## 2.3 Means and confidence intervals for projectivity rating by operator



The following generalizations emerge:

- Conditionals have the highest projectivity ratings
- Projectivity ratings for questions are higher than those for modals and negation, but lower than those for conditionals
- Modals and negation have the lowest projectivity ratings
- The ratings for negation look a little higher than for modals, but error bars overlap

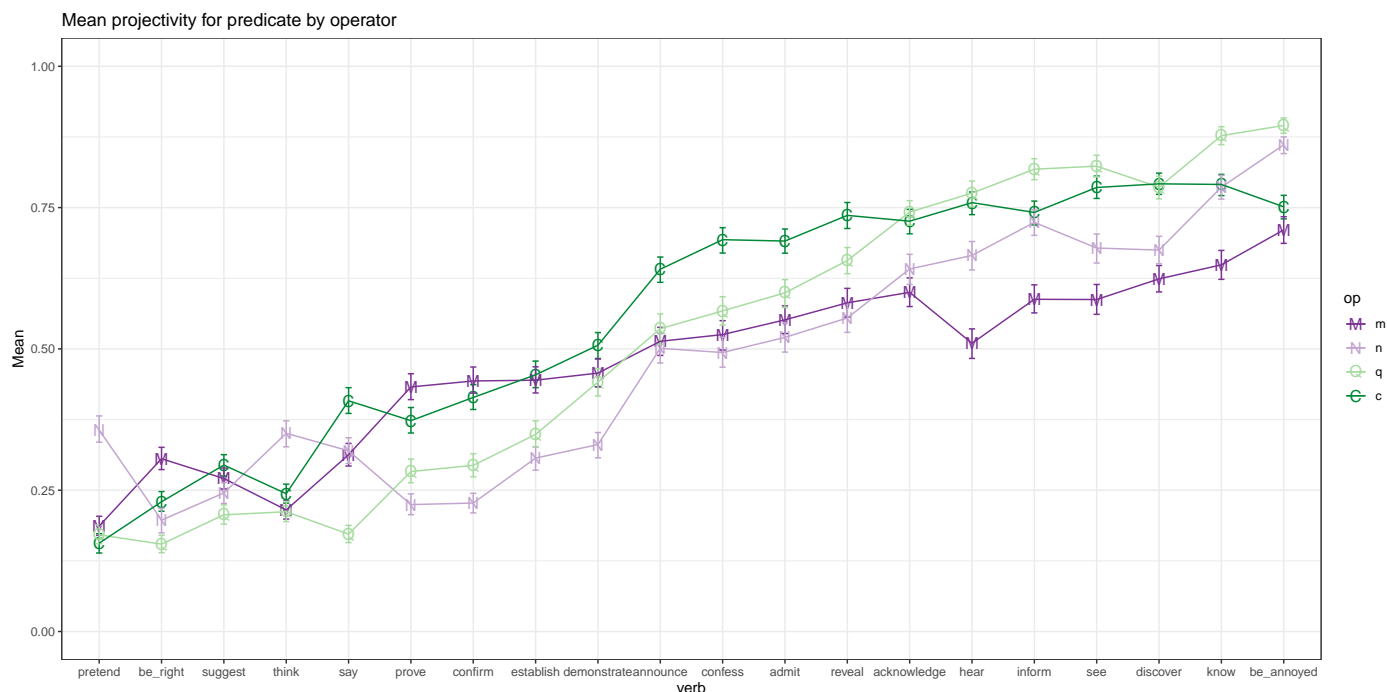
Although these differences appear to be significant, they are quite small.

## 2.4 Means and confidence intervals for projectivity rating by verb:

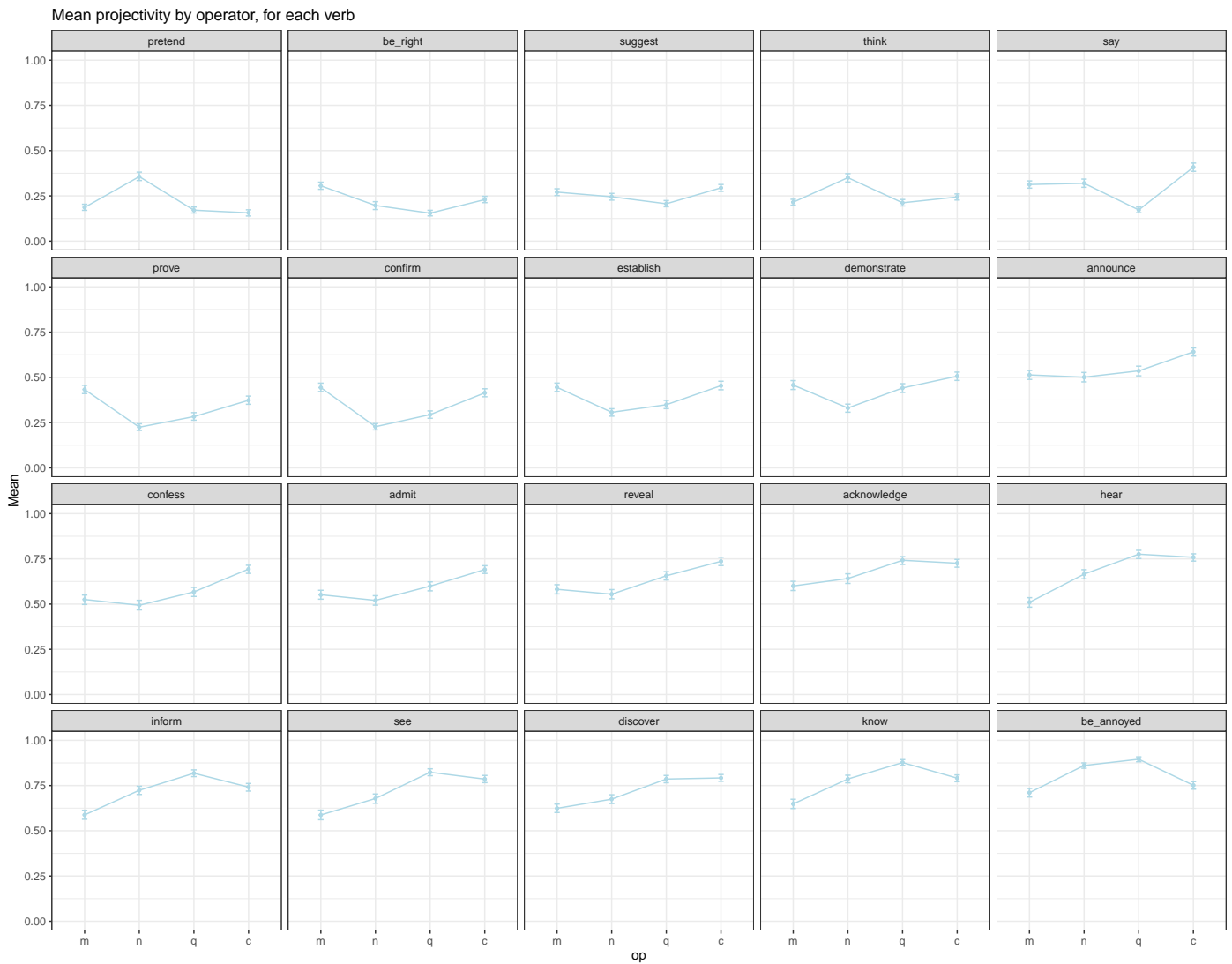
This will be replaced by violin-plot.

- We see gradual differences in projectivity between verbs

## 2.5 Means and confidence intervals for projectivity rating by verb and operator:



- We see interactions between verb and operator
- Two verbs show highest projectivity under negation: the anti-veridical *pretend*, and the non-veridical *think*. These are verb with relatively low overall projectivity.
- More projective verbs ('*announce*' and above) have  $C > M$
- Highly projective verbs ('*hear*' and above) have  $N > M$
- We do not see any group of verbs that could be characterized as 'semi-factive' in the sense of Karttunen.
  - Specifically, *discover* does not follow the predicted pattern: It is not more projective under negation, but most projective in conditionals and questions.
  - For Karttunen's 'factives', no difference between operators is expected.
  - Kajsa Djärv about this distinction: cognitive predicates are semi-factive, and emotives are factive. The pattern suggested by karttunen is also not found here (if anything, it might be the other way round)
- For more generalizations, let's look at the same information plotted differently: By-operator projectivity for each verb



Some more generalizations: We find different ‘profiles’ for different verbs, of how embedding operators affect projectivity based on the verb. Groups of verbs show similar profiles:

- *pretend, think*: **anti-veridical profile**  
 $N > M, Q, C$ , overall low projectivity
- *acknowledge, hear, inform, see, discover, know, be annoyed*: **‘factive’ profile**  
 $Q > N, C > M$ , overall high projectivity (it may be possible to find further subgroups here)
- *prove, confirm, establish, demonstrate, (announce), confess, admit, reveal*: **veridical profile**  
 $M, C > Q > N$ , overall med-lo to med-hi projectivity
- *be right, suggest*: **reportative profile**  
 $M, N, C > Q$

Maybe these can have better names, not trying to suggest that verbs can neatly divided in factive v non-factive, but potentially this class / profile is what prompted intuitions in previous literature, and naming in this tradition could make sense, but can be changed depending on our rhetoric, of course.

### 3 Analysis

We are interested in how the response (projectivity ratings) depends on the verb and embedding operator, and whether the above generalizations can be supported statistically.

Exploring a couple of models



### 3.1 Linear frequentist with suggest/m as baseline

```
> # our independent variables
> ## inference-triggering predicate, coded as "verb"
> data$verb <- as.factor(data$verb)
> levels(data$verb)

[1] "acknowledge" "admit"      "announce"    "be_annoied"  "be_right"
[6] "confess"     "confirm"    "demonstrate" "discover"    "establish"
[11] "hear"        "inform"     "know"        "pretend"     "prove"
[16] "reveal"      "say"        "see"         "suggest"     "think"

> # contrasts(data$verb)
> ### dummy coding with "suggest" as baseline
> data$verb <- relevel(data$verb, ref = "suggest")
> # contrasts(data$verb)
>
> ## embedding operator, coded as "op"
> data$op <- as.factor(data$op)
> levels(data$op)

[1] "c" "m" "n" "q"

> # contrasts(data$op)
> ### dummy coding with "m" as baseline
> data$op <- relevel(data$op, ref = "m")
> # contrasts(data$op)
>
> # coding random effects as factors
> data$workerid <- as.factor(data$workerid)
> data$content <- as.factor(data$content)
>
> library(lme4)
> library(lmerTest)
>
> # glmm1 <- lmer(projective ~ verb * op + (1 | workerid) +
> #               (1 | content), data=data)
>
> # save.image("../.../results/main/meta-analyses/projectivity/rscripts/linear-models.RData")
> load("../.../results/main/meta-analyses/projectivity/rscripts/linear-models.RData")
> print(summary(glmm1), cor=F, dig=3)
```

Linear mixed model fit by REML. t-tests use Satterthwaite's method [lmerModLmerTest]

Formula: projective ~ verb \* op + (1 | workerid) + (1 | content)  
Data: data

REML criterion at convergence: 12825.3

Scaled residuals:

	Min	1Q	Median	3Q	Max
	-4.034	-0.653	0.039	0.659	4.254

Random effects:

Groups	Name	Variance	Std.Dev.
workerid	(Intercept)	0.026816	0.1638
content	(Intercept)	0.000269	0.0164
Residual		0.065256	0.2555

Number of obs: 57160, groups: workerid, 2682; content, 20

## Fixed effects:

	Estimate	Std. Error	df	t value	Pr(> t )	
(Intercept)	2.71e-01	1.18e-02	1.62e+03	22.99	< 2e-16	***
verbbe_annoyed	4.40e-01	1.33e-02	5.44e+04	32.97	< 2e-16	***
verbacknowledge	3.29e-01	1.33e-02	5.44e+04	24.69	< 2e-16	***
verbadmit	2.80e-01	1.33e-02	5.44e+04	21.03	< 2e-16	***
verbannounce	2.42e-01	1.33e-02	5.44e+04	18.16	< 2e-16	***
verbbe_right	3.40e-02	1.33e-02	5.44e+04	2.55	0.01078	*
verbconfess	2.55e-01	1.33e-02	5.44e+04	19.13	< 2e-16	***
verbconfirm	1.72e-01	1.33e-02	5.44e+04	12.91	< 2e-16	***
verbdemonstrate	1.87e-01	1.33e-02	5.44e+04	14.05	< 2e-16	***
verbdiscover	3.53e-01	1.33e-02	5.44e+04	26.50	< 2e-16	***
verbestablish	1.73e-01	1.33e-02	5.44e+04	13.00	< 2e-16	***
verbhear	2.39e-01	1.33e-02	5.44e+04	17.95	< 2e-16	***
verbinform	3.16e-01	1.33e-02	5.44e+04	23.72	< 2e-16	***
verbknow	3.78e-01	1.33e-02	5.44e+04	28.32	< 2e-16	***
verbpretend	-8.47e-02	1.33e-02	5.44e+04	-6.35	2.1e-10	***
verbprove	1.61e-01	1.33e-02	5.44e+04	12.09	< 2e-16	***
verbreveal	3.11e-01	1.33e-02	5.44e+04	23.29	< 2e-16	***
verbsay	4.29e-02	1.33e-02	5.44e+04	3.22	0.00130	**
verbsee	3.16e-01	1.33e-02	5.44e+04	23.72	< 2e-16	***
verbthink	-5.59e-02	1.33e-02	5.44e+04	-4.19	2.8e-05	***
opq	-6.90e-02	1.57e-02	2.68e+04	-4.39	1.1e-05	***
opc	2.37e-02	1.59e-02	2.08e+04	1.49	0.13679	
opn	-2.02e-02	1.56e-02	2.63e+04	-1.29	0.19575	
verbbe_annoyed:opq	2.50e-01	1.92e-02	5.44e+04	13.05	< 2e-16	***
verbacknowledge:opq	2.08e-01	1.92e-02	5.44e+04	10.82	< 2e-16	***
verbadmit:opq	1.13e-01	1.92e-02	5.44e+04	5.91	3.5e-09	***
verbannounce:opq	8.88e-02	1.92e-02	5.44e+04	4.63	3.6e-06	***
verbbe_right:opq	-8.55e-02	1.92e-02	5.44e+04	-4.46	8.2e-06	***
verbconfess:opq	1.06e-01	1.92e-02	5.44e+04	5.53	3.3e-08	***
verbconfirm:opq	-8.47e-02	1.92e-02	5.44e+04	-4.41	1.0e-05	***
verbdemonstrate:opq	4.74e-02	1.92e-02	5.44e+04	2.47	0.01357	*
verbdiscover:opq	2.26e-01	1.92e-02	5.44e+04	11.80	< 2e-16	***
verbestablish:opq	-3.14e-02	1.92e-02	5.44e+04	-1.64	0.10139	
verbhear:opq	3.31e-01	1.92e-02	5.44e+04	17.24	< 2e-16	***
verbinform:opq	2.95e-01	1.92e-02	5.44e+04	15.38	< 2e-16	***
verbknow:opq	2.94e-01	1.92e-02	5.44e+04	15.34	< 2e-16	***
verbpretend:opq	5.01e-02	1.92e-02	5.44e+04	2.61	0.00899	**
verbprove:opq	-8.46e-02	1.92e-02	5.44e+04	-4.41	1.0e-05	***
verbreveal:opq	1.40e-01	1.92e-02	5.44e+04	7.31	2.7e-13	***
verbsay:opq	-7.64e-02	1.92e-02	5.44e+04	-3.98	6.8e-05	***
verbsee:opq	3.02e-01	1.92e-02	5.44e+04	15.73	< 2e-16	***
verbthink:opq	6.20e-02	1.92e-02	5.44e+04	3.23	0.00123	**
verbbe_annoyed:opc	1.72e-02	1.90e-02	5.44e+04	0.91	0.36469	
verbacknowledge:opc	1.02e-01	1.90e-02	5.44e+04	5.37	8.1e-08	***
verbadmit:opc	1.16e-01	1.90e-02	5.44e+04	6.14	8.1e-10	***
verbannounce:opc	1.04e-01	1.90e-02	5.44e+04	5.50	3.8e-08	***
verbbe_right:opc	-9.86e-02	1.90e-02	5.44e+04	-5.20	2.0e-07	***
verbconfess:opc	1.45e-01	1.90e-02	5.44e+04	7.63	2.4e-14	***
verbconfirm:opc	-5.28e-02	1.90e-02	5.44e+04	-2.78	0.00536	**
verbdemonstrate:opc	2.42e-02	1.90e-02	5.44e+04	1.28	0.20104	
verbdiscover:opc	1.44e-01	1.90e-02	5.44e+04	7.60	3.1e-14	***
verbestablish:opc	-1.37e-02	1.90e-02	5.44e+04	-0.72	0.46985	
verbhear:opc	2.23e-01	1.90e-02	5.44e+04	11.79	< 2e-16	***
verbinform:opc	1.31e-01	1.90e-02	5.44e+04	6.91	5.0e-12	***
verbknow:opc	1.18e-01	1.90e-02	5.44e+04	6.25	4.1e-10	***

verbpretend:opc	-5.36e-02	1.90e-02	5.44e+04	-2.83	0.00468	**
verbprove:opc	-8.29e-02	1.90e-02	5.44e+04	-4.38	1.2e-05	***
verbreveal:opc	1.31e-01	1.90e-02	5.44e+04	6.90	5.4e-12	***
verbsay:opc	7.05e-02	1.90e-02	5.44e+04	3.72	0.00020	***
verbsee:opc	1.75e-01	1.90e-02	5.44e+04	9.25	< 2e-16	***
verbthink:opc	4.94e-03	1.90e-02	5.44e+04	0.26	0.79433	
verbbe_annoyed:opn	1.77e-01	1.90e-02	5.44e+04	9.31	< 2e-16	***
verbacknowledge:opn	6.66e-02	1.90e-02	5.44e+04	3.51	0.00045	***
verbadmit:opn	-4.46e-03	1.90e-02	5.44e+04	-0.24	0.81416	
verbannounce:opn	1.33e-02	1.90e-02	5.44e+04	0.70	0.48300	
verbbe_right:opn	-8.16e-02	1.90e-02	5.44e+04	-4.30	1.7e-05	***
verbconfess:opn	-7.10e-03	1.90e-02	5.44e+04	-0.37	0.70823	
verbconfirm:opn	-1.90e-01	1.90e-02	5.44e+04	-10.00	< 2e-16	***
verbdemonstrate:opn	-1.02e-01	1.90e-02	5.44e+04	-5.36	8.2e-08	***
verbdiscover:opn	7.64e-02	1.90e-02	5.44e+04	4.03	5.7e-05	***
verbestablish:opn	-1.11e-01	1.90e-02	5.44e+04	-5.87	4.4e-09	***
verbhear:opn	1.81e-01	1.90e-02	5.44e+04	9.55	< 2e-16	***
verbinform:opn	1.62e-01	1.90e-02	5.44e+04	8.56	< 2e-16	***
verbknow:opn	1.64e-01	1.90e-02	5.44e+04	8.62	< 2e-16	***
verbpretend:opn	1.96e-01	1.90e-02	5.44e+04	10.33	< 2e-16	***
verbprove:opn	-1.81e-01	1.90e-02	5.44e+04	-9.56	< 2e-16	***
verbreveal:opn	-1.36e-04	1.90e-02	5.44e+04	-0.01	0.99427	
verbsay:opn	3.14e-02	1.90e-02	5.44e+04	1.66	0.09775	.
verbsee:opn	1.17e-01	1.90e-02	5.44e+04	6.18	6.5e-10	***
verbthink:opn	1.62e-01	1.90e-02	5.44e+04	8.54	< 2e-16	***

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

## 3.2 Linear frequentist with annoyed/q as baseline

```
> # dummy coding for "verb" with "suggest" as baseline
> data$verb <- relevel(data$verb, ref = "be_annoyed")
>
> ### dummy coding for "op" with "q" as baseline
> data$op <- relevel(data$op, ref = "q")
>
> # glmm2a <- lmer(projective ~ verb * op + (1 | workerid) +
> #               (1 | content), data=data)
>
> # save.image("../.../results/main/meta-analyses/projectivity/rscrips/linear-models.RData")
> # load("../.../results/main/meta-analyses/projectivity/rscrips/linear-models.RData")
> print(summary(glmm2a), cor=F, dig=3)
```

Linear mixed model fit by REML. t-tests use Satterthwaite's method [lmerModLmerTest]  
Formula: projective ~ verb \* op + (1 | workerid) + (1 | content)  
Data: data

REML criterion at convergence: 12825.3

Scaled residuals:

Min	1Q	Median	3Q	Max
-4.034	-0.653	0.039	0.659	4.254

Random effects:

Groups	Name	Variance	Std.Dev.

```

workerid (Intercept) 0.026816 0.1638
content (Intercept) 0.000269 0.0164
Residual            0.065256 0.2555
Number of obs: 57160, groups: workerid, 2682; content, 20

```

Fixed effects:

	Estimate	Std. Error	df	t value	Pr(> t )	
(Intercept)	8.92e-01	1.16e-02	1.58e+03	76.67	< 2e-16	***
verbsuggest	-6.90e-01	1.38e-02	5.44e+04	-50.06	< 2e-16	***
verbacknowledge	-1.53e-01	1.38e-02	5.44e+04	-11.11	< 2e-16	***
verbadmit	-2.96e-01	1.38e-02	5.44e+04	-21.49	< 2e-16	***
verbannounce	-3.59e-01	1.38e-02	5.44e+04	-26.04	< 2e-16	***
verbbe_right	-7.42e-01	1.38e-02	5.44e+04	-53.80	< 2e-16	***
verbconfess	-3.29e-01	1.38e-02	5.44e+04	-23.85	< 2e-16	***
verbconfirm	-6.03e-01	1.38e-02	5.44e+04	-43.71	< 2e-16	***
verbdemonstrate	-4.55e-01	1.38e-02	5.44e+04	-33.03	< 2e-16	***
verbdiscover	-1.10e-01	1.38e-02	5.44e+04	-8.00	1.3e-15	***
verbestablish	-5.48e-01	1.38e-02	5.44e+04	-39.76	< 2e-16	***
verbhear	-1.20e-01	1.38e-02	5.44e+04	-8.71	< 2e-16	***
verbinform	-7.87e-02	1.38e-02	5.44e+04	-5.71	1.2e-08	***
verbknow	-1.79e-02	1.38e-02	5.44e+04	-1.30	0.19324	
verbpretend	-7.25e-01	1.38e-02	5.44e+04	-52.57	< 2e-16	***
verbprove	-6.13e-01	1.38e-02	5.44e+04	-44.50	< 2e-16	***
verbreveal	-2.39e-01	1.38e-02	5.44e+04	-17.35	< 2e-16	***
verbsay	-7.24e-01	1.38e-02	5.44e+04	-52.49	< 2e-16	***
verbsee	-7.19e-02	1.38e-02	5.44e+04	-5.22	1.8e-07	***
verbthink	-6.84e-01	1.38e-02	5.44e+04	-49.61	< 2e-16	***
opm	-1.81e-01	1.57e-02	2.68e+04	-11.53	< 2e-16	***
opc	-1.41e-01	1.58e-02	2.68e+04	-8.89	< 2e-16	***
opn	-2.49e-02	1.43e-02	5.68e+04	-1.74	0.08167	.
verbsuggest:opm	2.50e-01	1.92e-02	5.44e+04	13.05	< 2e-16	***
verbacknowledge:opm	4.28e-02	1.92e-02	5.44e+04	2.23	0.02579	*
verbadmit:opm	1.37e-01	1.92e-02	5.44e+04	7.15	9.0e-13	***
verbannounce:opm	1.62e-01	1.92e-02	5.44e+04	8.42	< 2e-16	***
verbbe_right:opm	3.36e-01	1.92e-02	5.44e+04	17.51	< 2e-16	***
verbconfess:opm	1.44e-01	1.92e-02	5.44e+04	7.53	5.3e-14	***
verbconfirm:opm	3.35e-01	1.92e-02	5.44e+04	17.47	< 2e-16	***
verbdemonstrate:opm	2.03e-01	1.92e-02	5.44e+04	10.59	< 2e-16	***
verbdiscover:opm	2.40e-02	1.92e-02	5.44e+04	1.25	0.21058	
verbestablish:opm	2.82e-01	1.92e-02	5.44e+04	14.69	< 2e-16	***
verbhear:opm	-8.02e-02	1.92e-02	5.44e+04	-4.18	2.9e-05	***
verbinform:opm	-4.46e-02	1.92e-02	5.44e+04	-2.33	0.02005	*
verbknow:opm	-4.40e-02	1.92e-02	5.44e+04	-2.29	0.02193	*
verbpretend:opm	2.00e-01	1.92e-02	5.44e+04	10.44	< 2e-16	***
verbprove:opm	3.35e-01	1.92e-02	5.44e+04	17.46	< 2e-16	***
verbreveal:opm	1.10e-01	1.92e-02	5.44e+04	5.74	9.3e-09	***
verbsay:opm	3.27e-01	1.92e-02	5.44e+04	17.04	< 2e-16	***
verbsee:opm	-5.14e-02	1.92e-02	5.44e+04	-2.68	0.00735	**
verbthink:opm	1.88e-01	1.92e-02	5.44e+04	9.82	< 2e-16	***
verbsuggest:opc	2.33e-01	1.93e-02	5.44e+04	12.10	< 2e-16	***
verbacknowledge:opc	1.27e-01	1.93e-02	5.44e+04	6.60	4.0e-11	***
verbadmit:opc	2.36e-01	1.93e-02	5.44e+04	12.26	< 2e-16	***
verbannounce:opc	2.49e-01	1.93e-02	5.44e+04	12.90	< 2e-16	***
verbbe_right:opc	2.20e-01	1.93e-02	5.44e+04	11.42	< 2e-16	***
verbconfess:opc	2.72e-01	1.93e-02	5.44e+04	14.10	< 2e-16	***
verbconfirm:opc	2.65e-01	1.93e-02	5.44e+04	13.76	< 2e-16	***
verbdemonstrate:opc	2.10e-01	1.93e-02	5.44e+04	10.90	< 2e-16	***
verbdiscover:opc	1.51e-01	1.93e-02	5.44e+04	7.82	5.2e-15	***

verbestablish:opc	2.51e-01	1.93e-02	5.44e+04	13.02	< 2e-16	***
verbhear:opc	1.26e-01	1.93e-02	5.44e+04	6.54	6.2e-11	***
verbinform:opc	6.91e-02	1.93e-02	5.44e+04	3.59	0.00034	***
verbknow:opc	5.73e-02	1.93e-02	5.44e+04	2.97	0.00294	**
verbpretend:opc	1.29e-01	1.93e-02	5.44e+04	6.72	1.9e-11	***
verbprove:opc	2.35e-01	1.93e-02	5.44e+04	12.19	< 2e-16	***
verbreveal:opc	2.24e-01	1.93e-02	5.44e+04	11.61	< 2e-16	***
verbsay:opc	3.80e-01	1.93e-02	5.44e+04	19.72	< 2e-16	***
verbsee:opc	1.07e-01	1.93e-02	5.44e+04	5.54	3.1e-08	***
verbthink:opc	1.76e-01	1.93e-02	5.44e+04	9.14	< 2e-16	***
verbsuggest:opn	7.38e-02	1.93e-02	5.44e+04	3.82	0.00013	***
verbacknowledge:opn	-6.73e-02	1.93e-02	5.44e+04	-3.49	0.00049	***
verbadmit:opn	-4.40e-02	1.93e-02	5.44e+04	-2.28	0.02254	*
verbannounce:opn	-1.75e-03	1.93e-02	5.44e+04	-0.09	0.92758	
verbbe_right:opn	7.77e-02	1.93e-02	5.44e+04	4.03	5.7e-05	***
verbconfess:opn	-3.94e-02	1.93e-02	5.44e+04	-2.04	0.04128	*
verbconfirm:opn	-3.13e-02	1.93e-02	5.44e+04	-1.62	0.10483	
verbdemonstrate:opn	-7.54e-02	1.93e-02	5.44e+04	-3.91	9.4e-05	***
verbdiscover:opn	-7.62e-02	1.93e-02	5.44e+04	-3.95	7.8e-05	***
verbestablish:opn	-6.16e-03	1.93e-02	5.44e+04	-0.32	0.74945	
verbhear:opn	-7.56e-02	1.93e-02	5.44e+04	-3.92	8.9e-05	***
verbinform:opn	-5.88e-02	1.93e-02	5.44e+04	-3.05	0.00232	**
verbknow:opn	-5.70e-02	1.93e-02	5.44e+04	-2.95	0.00315	**
verbpretend:opn	2.20e-01	1.93e-02	5.44e+04	11.39	< 2e-16	***
verbprove:opn	-2.31e-02	1.93e-02	5.44e+04	-1.20	0.23153	
verbreveal:opn	-6.66e-02	1.93e-02	5.44e+04	-3.45	0.00056	***
verbsay:opn	1.82e-01	1.93e-02	5.44e+04	9.41	< 2e-16	***
verbsee:opn	-1.11e-01	1.93e-02	5.44e+04	-5.75	9.2e-09	***
verbthink:opn	1.74e-01	1.93e-02	5.44e+04	9.01	< 2e-16	***

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Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

### 3.3 Linear frequentist with know/m as baseline

```
> # dummy coding for "verb" with "prove" as baseline
> data$verb <- relevel(data$verb, ref = "know")
>
> ### dummy coding for "op" with "n" as baseline
> data$op <- relevel(data$op, ref = "m")
>
> # glmm4 <- lmer(projective ~ verb * op + (1 | workerid) +
> #               (1 | content), data=data)
> #
> # save.image("../.../results/main/meta-analyses/projectivity/rscripits/linear-models.RData")
> # load("../.../results/main/meta-analyses/projectivity/rscripits/linear-models.RData")
> print(summary(glmm4), cor=F, dig=3)
```

Linear mixed model fit by REML. t-tests use Satterthwaite's method [lmerModLmerTest]  
Formula: projective ~ verb \* op + (1 | workerid) + (1 | content)  
Data: data

REML criterion at convergence: 12825.3

Scaled residuals:

Min	1Q	Median	3Q	Max
-----	----	--------	----	-----

-4.034 -0.653 0.039 0.659 4.254

Random effects:

Groups	Name	Variance	Std.Dev.
workerid	(Intercept)	0.026816	0.1638
content	(Intercept)	0.000269	0.0164
	Residual	0.065256	0.2555

Number of obs: 57160, groups: workerid, 2682; content, 20

Fixed effects:

	Estimate	Std. Error	df	t value	Pr(> t )	
(Intercept)	6.49e-01	1.18e-02	1.62e+03	55.04	< 2e-16	***
verbprove	-2.17e-01	1.33e-02	5.44e+04	-16.24	< 2e-16	***
verbbe_annoyed	6.19e-02	1.33e-02	5.44e+04	4.64	3.5e-06	***
verbsuggest	-3.78e-01	1.33e-02	5.44e+04	-28.32	< 2e-16	***
verbacknowledge	-4.85e-02	1.33e-02	5.44e+04	-3.64	0.00028	***
verbadmit	-9.73e-02	1.33e-02	5.44e+04	-7.29	3.1e-13	***
verbannounce	-1.36e-01	1.33e-02	5.44e+04	-10.16	< 2e-16	***
verbbe_right	-3.44e-01	1.33e-02	5.44e+04	-25.78	< 2e-16	***
verbconfess	-1.23e-01	1.33e-02	5.44e+04	-9.19	< 2e-16	***
verbconfirm	-2.06e-01	1.33e-02	5.44e+04	-15.42	< 2e-16	***
verbdemonstrate	-1.90e-01	1.33e-02	5.44e+04	-14.28	< 2e-16	***
verbdiscover	-2.43e-02	1.33e-02	5.44e+04	-1.82	0.06803	.
verbestablish	-2.04e-01	1.33e-02	5.44e+04	-15.33	< 2e-16	***
verbhear	-1.38e-01	1.33e-02	5.44e+04	-10.38	< 2e-16	***
verbinform	-6.14e-02	1.33e-02	5.44e+04	-4.60	4.2e-06	***
verbpretend	-4.62e-01	1.33e-02	5.44e+04	-34.67	< 2e-16	***
verbreveal	-6.71e-02	1.33e-02	5.44e+04	-5.03	4.8e-07	***
verbsay	-3.35e-01	1.33e-02	5.44e+04	-25.11	< 2e-16	***
verbsee	-6.14e-02	1.33e-02	5.44e+04	-4.61	4.1e-06	***
verbthink	-4.34e-01	1.33e-02	5.44e+04	-32.52	< 2e-16	***
opn	1.43e-01	1.56e-02	2.63e+04	9.20	< 2e-16	***
opq	2.25e-01	1.57e-02	2.68e+04	14.32	< 2e-16	***
opc	1.42e-01	1.59e-02	2.08e+04	8.93	< 2e-16	***
verbprove:opn	-3.45e-01	1.90e-02	5.44e+04	-18.19	< 2e-16	***
verbbe_annoyed:opn	1.30e-02	1.90e-02	5.44e+04	0.69	0.49308	
verbsuggest:opn	-1.64e-01	1.90e-02	5.44e+04	-8.62	< 2e-16	***
verbacknowledge:opn	-9.71e-02	1.90e-02	5.44e+04	-5.12	3.1e-07	***
verbadmit:opn	-1.68e-01	1.90e-02	5.44e+04	-8.86	< 2e-16	***
verbannounce:opn	-1.50e-01	1.90e-02	5.44e+04	-7.92	2.4e-15	***
verbbe_right:opn	-2.45e-01	1.90e-02	5.44e+04	-12.93	< 2e-16	***
verbconfess:opn	-1.71e-01	1.90e-02	5.44e+04	-9.00	< 2e-16	***
verbconfirm:opn	-3.53e-01	1.90e-02	5.44e+04	-18.62	< 2e-16	***
verbdemonstrate:opn	-2.65e-01	1.90e-02	5.44e+04	-13.99	< 2e-16	***
verbdiscover:opn	-8.72e-02	1.90e-02	5.44e+04	-4.60	4.3e-06	***
verbestablish:opn	-2.75e-01	1.90e-02	5.44e+04	-14.49	< 2e-16	***
verbhear:opn	1.76e-02	1.90e-02	5.44e+04	0.93	0.35260	
verbinform:opn	-1.14e-03	1.90e-02	5.44e+04	-0.06	0.95186	
verbpretend:opn	3.24e-02	1.90e-02	5.44e+04	1.71	0.08742	.
verbreveal:opn	-1.64e-01	1.90e-02	5.44e+04	-8.63	< 2e-16	***
verbsay:opn	-1.32e-01	1.90e-02	5.44e+04	-6.97	3.3e-12	***
verbsee:opn	-4.64e-02	1.90e-02	5.44e+04	-2.45	0.01445	*
verbthink:opn	-1.55e-03	1.90e-02	5.44e+04	-0.08	0.93470	
verbprove:opq	-3.79e-01	1.92e-02	5.44e+04	-19.75	< 2e-16	***
verbbe_annoyed:opq	-4.40e-02	1.92e-02	5.44e+04	-2.29	0.02193	*
verbsuggest:opq	-2.94e-01	1.92e-02	5.44e+04	-15.34	< 2e-16	***
verbacknowledge:opq	-8.67e-02	1.92e-02	5.44e+04	-4.52	6.2e-06	***
verbadmit:opq	-1.81e-01	1.92e-02	5.44e+04	-9.44	< 2e-16	***

verbannounce:opq	-2.06e-01	1.92e-02	5.44e+04	-10.71	< 2e-16	***
verbbe_right:opq	-3.80e-01	1.92e-02	5.44e+04	-19.80	< 2e-16	***
verbconfess:opq	-1.88e-01	1.92e-02	5.44e+04	-9.82	< 2e-16	***
verbconfirm:opq	-3.79e-01	1.92e-02	5.44e+04	-19.76	< 2e-16	***
verbdemonstrate:opq	-2.47e-01	1.92e-02	5.44e+04	-12.88	< 2e-16	***
verbdiscover:opq	-6.80e-02	1.92e-02	5.44e+04	-3.54	0.00040	***
verbestablish:opq	-3.26e-01	1.92e-02	5.44e+04	-16.98	< 2e-16	***
verbhear:opq	3.63e-02	1.92e-02	5.44e+04	1.89	0.05859	.
verbinform:opq	6.51e-04	1.92e-02	5.44e+04	0.03	0.97292	
verbpretend:opq	-2.44e-01	1.92e-02	5.44e+04	-12.73	< 2e-16	***
verbreveal:opq	-1.54e-01	1.92e-02	5.44e+04	-8.03	9.6e-16	***
verbsay:opq	-3.71e-01	1.92e-02	5.44e+04	-19.33	< 2e-16	***
verbsee:opq	7.46e-03	1.92e-02	5.44e+04	0.39	0.69729	
verbthink:opq	-2.32e-01	1.92e-02	5.44e+04	-12.11	< 2e-16	***
verbprove:opc	-2.01e-01	1.90e-02	5.44e+04	-10.63	< 2e-16	***
verbbe_annoyed:opc	-1.01e-01	1.90e-02	5.44e+04	-5.34	9.1e-08	***
verbsuggest:opc	-1.18e-01	1.90e-02	5.44e+04	-6.25	4.1e-10	***
verbacknowledge:opc	-1.68e-02	1.90e-02	5.44e+04	-0.88	0.37636	
verbadmit:opc	-2.00e-03	1.90e-02	5.44e+04	-0.11	0.91585	
verbannounce:opc	-1.42e-02	1.90e-02	5.44e+04	-0.75	0.45443	
verbbe_right:opc	-2.17e-01	1.90e-02	5.44e+04	-11.45	< 2e-16	***
verbconfess:opc	2.61e-02	1.90e-02	5.44e+04	1.38	0.16773	
verbconfirm:opc	-1.71e-01	1.90e-02	5.44e+04	-9.03	< 2e-16	***
verbdemonstrate:opc	-9.42e-02	1.90e-02	5.44e+04	-4.97	6.7e-07	***
verbdiscover:opc	2.55e-02	1.90e-02	5.44e+04	1.35	0.17843	
verbestablish:opc	-1.32e-01	1.90e-02	5.44e+04	-6.97	3.1e-12	***
verbhear:opc	1.05e-01	1.90e-02	5.44e+04	5.54	3.0e-08	***
verbinform:opc	1.25e-02	1.90e-02	5.44e+04	0.66	0.51096	
verbpretend:opc	-1.72e-01	1.90e-02	5.44e+04	-9.08	< 2e-16	***
verbreveal:opc	1.23e-02	1.90e-02	5.44e+04	0.65	0.51800	
verbsay:opc	-4.79e-02	1.90e-02	5.44e+04	-2.53	0.01144	*
verbsee:opc	5.68e-02	1.90e-02	5.44e+04	3.00	0.00271	**
verbthink:opc	-1.14e-01	1.90e-02	5.44e+04	-5.99	2.1e-09	***
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Signif. codes:	0	'***'	0.001	'**'	0.01	'*' 0.05 '.' 0.1 ' ' 1