Effects of prosody on the perception of agreement

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Purpose of the experiement

This experiment examines the effects of prosodic contour on listener perception of interactional factors. The primary concern is its effect on the degree to which listners perceive agreement between interlocutors.

Expectations

We should expect the effects of prosodic contour (affirmative or contrastive) to interact differenleyt with adjectives of differing poles (positive and negative), such as in the following table:

Contour/Polarity	Positive	Negative
Affirmative Contour	+agree	-agree
Contrastive Contour	-agree	+agree

```
setwd("/Users/Chantal/Documents/Doctoral/Courses/Spring 2017/LIN 245/perception/results/Rscripts")
library(languageR)
library(lme4)
```

```
## Loading required package: Matrix
```

```
library(ggplot2)
theme_set(theme_bw())
```

Organizing the data

First, we only want to restrict the data to only those from critical trials (where the prosodic contour of the utterance was manipulated). And we want to remove the levels that are no longer required (8 topics, neutral prosody, and a few adjectives).

```
df = read.csv("complete_trials_reduced.csv")
crit_df <- df[df$filler == "False",]
crit_df$topic <- factor(crit_df$topic)
crit_df$prosody <- factor(crit_df$prosody)
crit_df$adj_2 <- factor(crit_df$adj_2)
```

Representation in the data

To be sure that we recieved sufficient responses for each pairing of factors, we can take a look at the distribution of the data in two ways:

- by prosodic contour (affirmative and contrastive) and adjective polarity (positive and negative)

```
##
##              neg pos
##   affirmative  46  38
```

```
##   contrastive  38  46
```

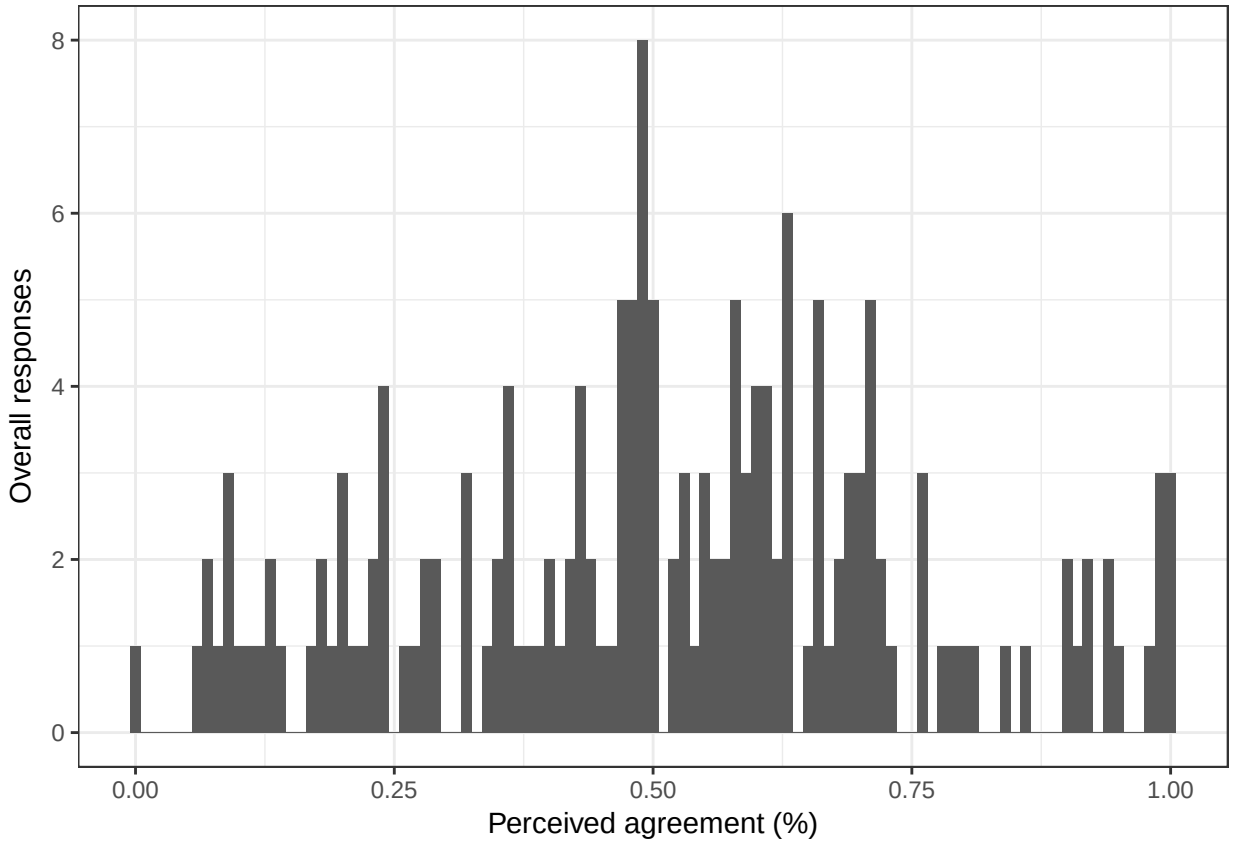
- by prosodic contour (affirmative and contrastive) and topic

```
##
##          affirmative contrastive
##   bad             17          11
##   boring          14          14
##   cozy            11          17
##   cute            13          15
##   dreary          15          13
##   good            14          14
```

We have roughly equal representation in all quadrants, so we're good to go!

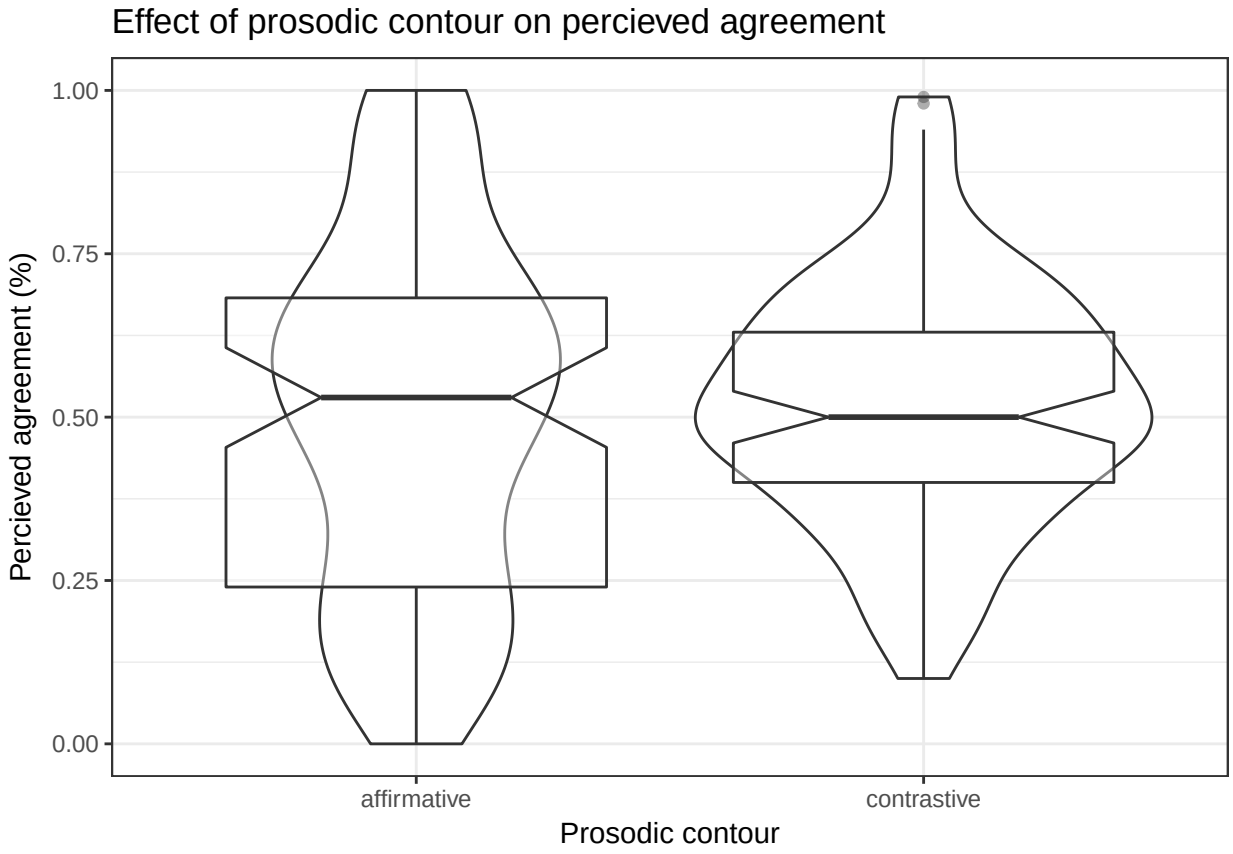
Exploring Agreement

First, let's plot the overall distribution of agreement responses:

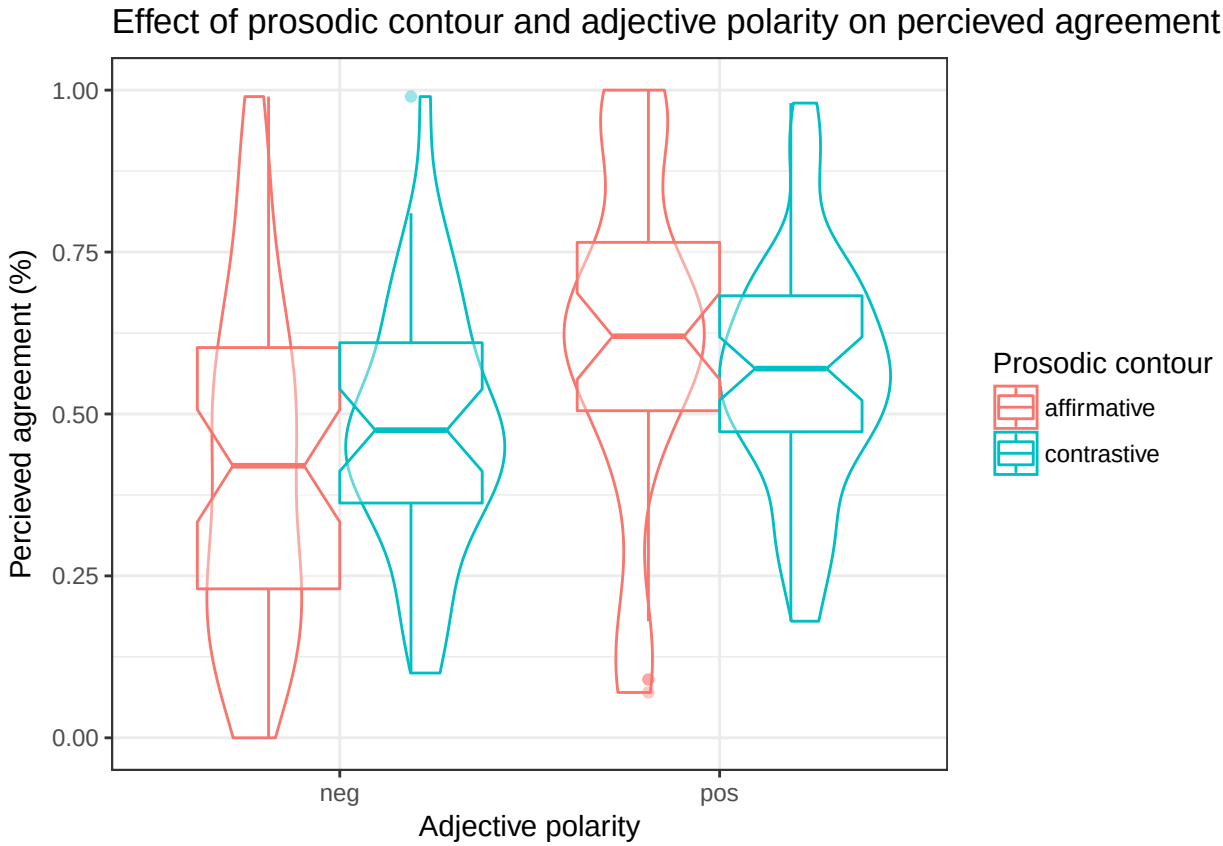


We see that the histogram is noramlly distributed around 0.5, even though we may have expected to see a binomial distribution pulled towards 'agree' (above 0.5) and 'disagree' (below 0.5).

This might simply be due to the responses for affirmative contours and contrastive contours falling around 0.5 quite evenly.



We see that this is the case, regardless of prosodic contour the data still pool around 0.5. Though this may seem problematic for our look at the effect of prosody on percieved agreement, we are actually more interesting in the interaction with adjective polarity (postivie or negative).



We see that there is such an interaction, such that:

- positive adjectives with contrastive prosody are perceived as showing **less agreement** than those with affirmative prosody
- negative adjectives with constrastive prosody are perceived as showing **more agreement** than those with affirmative prosody

Now we may want to take a look at what the model with these factors looks like, including workerid (the individual respondants) as a random factor. What follows is the summary and the computed R^2:

```
## Linear mixed model fit by maximum likelihood  ['lmerMod']
## Formula: agree ~ prosody * adj_1_pole + (1 | workerid)
##    Data: crit_df
##
##      AIC      BIC   logLik deviance df.resid
##    -38.5    -19.8     25.3    -50.5      162
##
## Scaled residuals:
##     Min      1Q  Median      3Q     Max
## -2.4843 -0.6670  0.0769  0.6506  2.4605
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  workerid (Intercept) 0.01399  0.1183
##  Residual             0.03540  0.1881
## Number of obs: 168, groups:  workerid, 28
##
## Fixed effects:
```

```
##                                   Estimate Std. Error t value
## (Intercept)                        0.40797    0.03595  11.348
## prosodycontrastive                 0.07686    0.04259   1.804
## adj_1_polepos                      0.21765    0.04259   5.110
## prosodycontrastive:adj_1_polepos -0.14950    0.06209  -2.408
##
## Correlation of Fixed Effects:
##             (Intr) prsdyc adj_1_
## prsdycntrst -0.536
## adj_1_polps -0.536  0.487
## prsdycn:_1_  0.391 -0.729 -0.729
```

```
## [1] 0.4560848
```

This R^2 is better (higher) compared to that of a simple linear model including only prosody:

```
## [1] 0.3524578
```

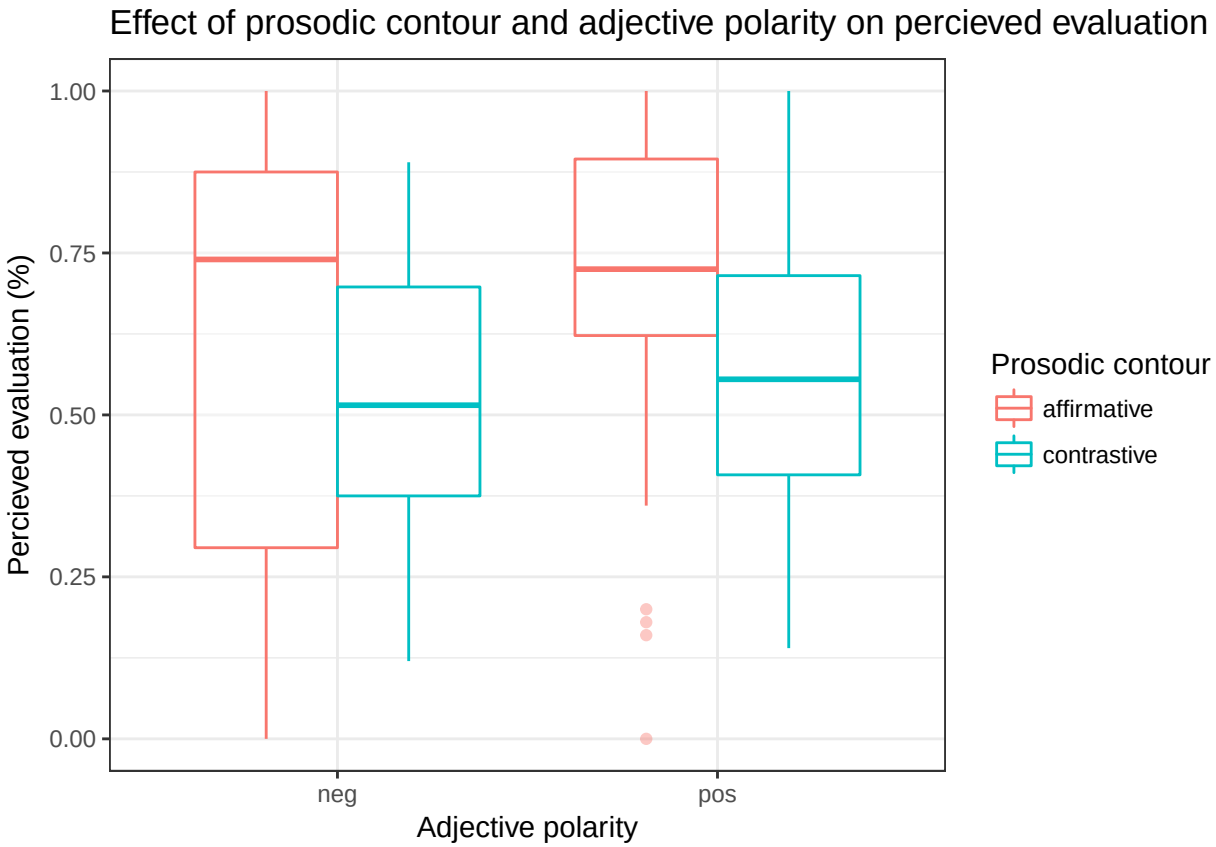
This model answers our first question, that is:

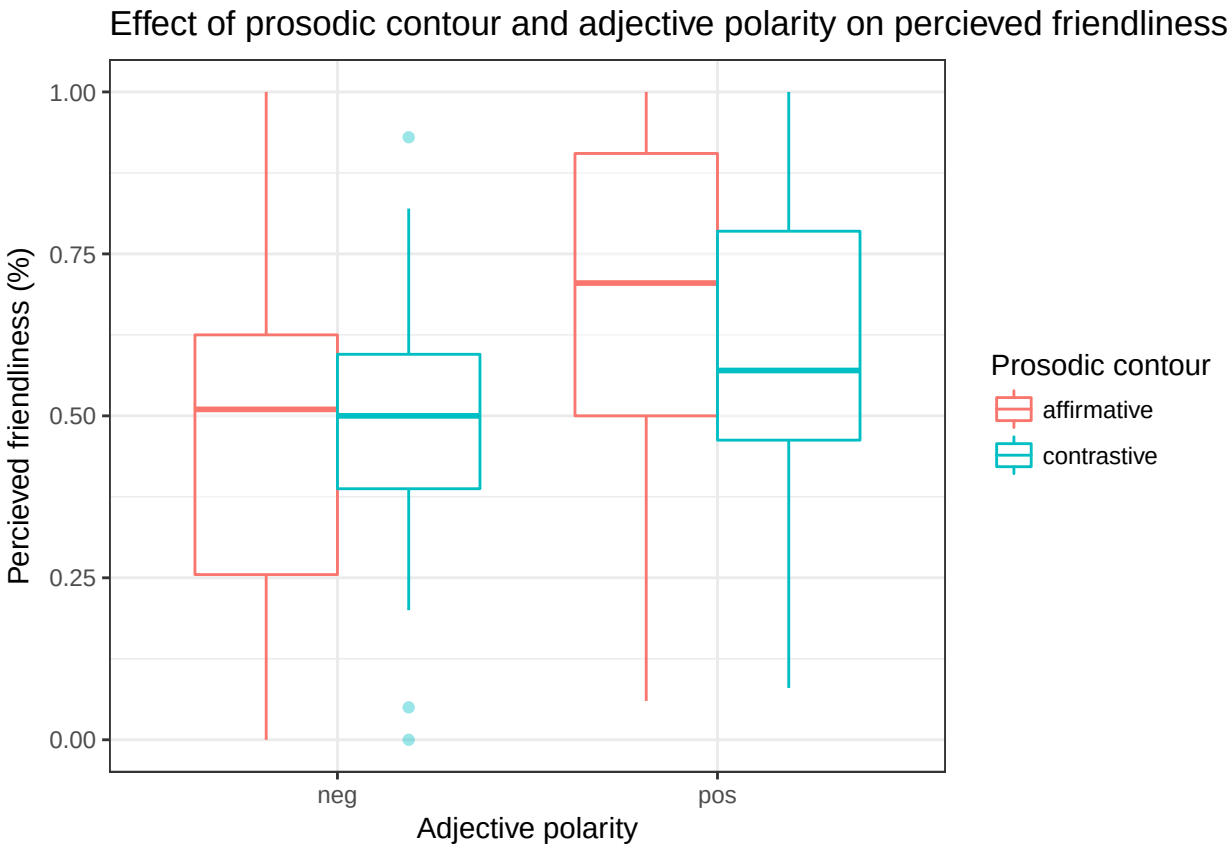
> Does variation in prosodic contour (from affirmative to contrastive) lead to a change in the utterances perceived agreement?

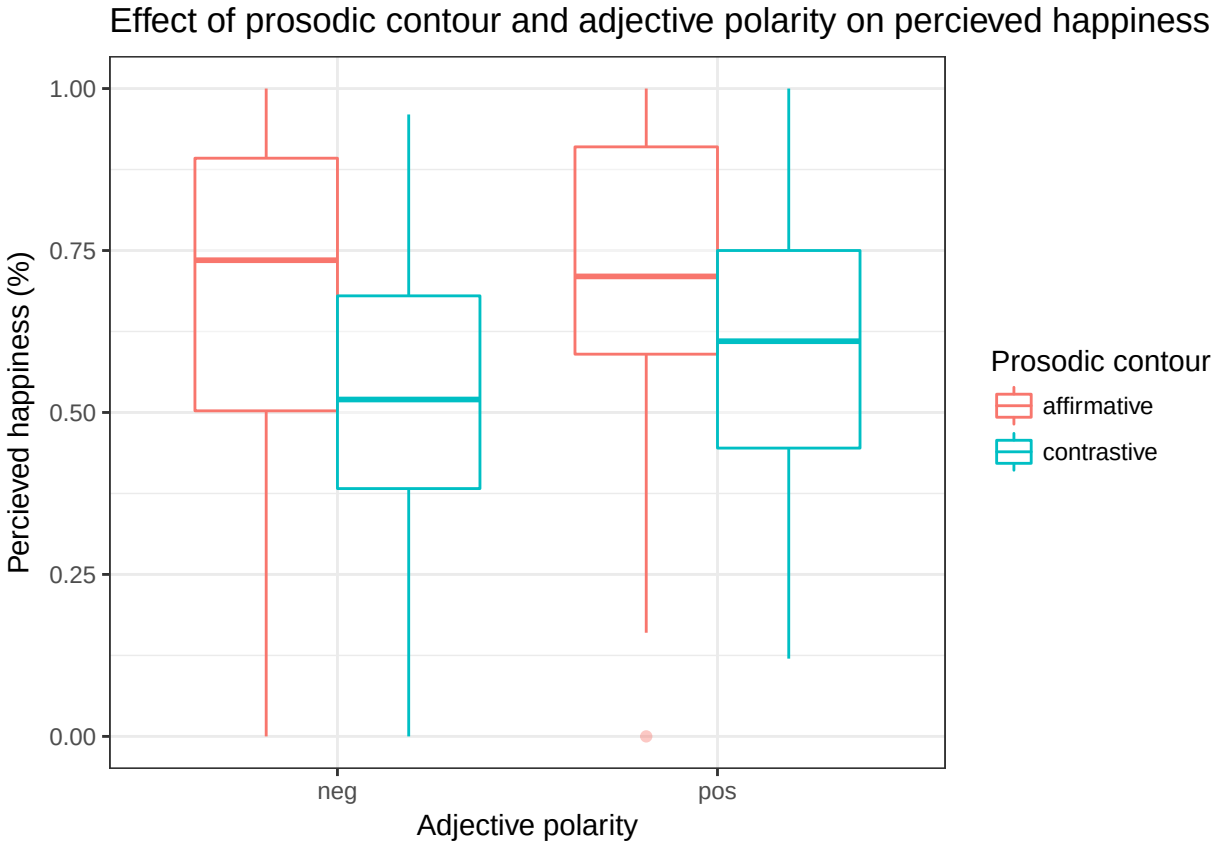
It would seem that the asnwer to this question is: Yes, but only when adjective polarity is taken into account. Indeed, adjective polarity on its own is a better predictor of percieved agreement, though the reason has not be explored.

However, there is more that should be explained. The predictability of each prosodic contour is not only related to agreement, but may also be related to **evaluation**, **friendliness** and **happiness**.

Below are the visualizations of these influences.




Effect of prosodic contour and adjective polarity on percieved friendliness
Percieved friendliness (%)
1.00
0.75
0.50
0.25
0.00
neg
pos
Adjective polarity
Prosodic contour
affirmative
contrastive


Effect of prosodic contour and adjective polarity on percieved happiness
Percieved happiness (%)
1.00
0.75
0.50
0.25
0.00
neg
pos
Adjective polarity
Prosodic contour
affirmative
contrastive

We see that: + both negative and positive adjectives are percieved as being evaluated more positivly (being more liked) when uttered in an affirmative contour + negative adjectives have no influence on percieved friendliness, regarless of prosodic contour + positive adjectives are percieved as being more friendly in tone when uttered with affirmative prosody (or the speak is more friendly when she uses affirmative prosody on positive adjectives) + both negative and positive adjectives are percieved as being happier in tone when uttered with affirmative prosody (or the speak is more happy when she uses affirmative prosody)

However, are these influences significant? The following model takes them all into account.

```
## Linear mixed model fit by maximum likelihood  ['lmerMod']
## Formula: agree ~ prosody * adj_1_pole + like + friendly + happy + (1 |
##     workerid)
##    Data: crit_df
##
##      AIC      BIC   logLik deviance df.resid
##    -64.7    -36.6     41.4    -82.7      159
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -1.94552 -0.57401 -0.00009  0.67848  2.42605
##
## Random effects:
##  Groups   Name        Variance Std.Dev.
##  workerid (Intercept) 0.01245  0.1116
##  Residual             0.02893  0.1701
## Number of obs: 168, groups:  workerid, 28
##
## Fixed effects:
##                                  Estimate Std. Error t value
## (Intercept)                       0.14577    0.05847   2.493
## prosodycontrastive                0.10654    0.03950   2.697
## adj_1_polepos                     0.16873    0.04082   4.134
## like                              0.29779    0.05745   5.183
## friendly                          0.01554    0.06407   0.242
## happy                             0.12752    0.06299   2.024
## prosodycontrastive:adj_1_polepos -0.12185    0.05680  -2.145
##
## Correlation of Fixed Effects:
##             (Intr) prsdyc adj_1_ like   frndly happy
## prsdycntrst -0.406
## adj_1_polps -0.092  0.457
## like        -0.489  0.095 -0.099
## friendly    -0.124 -0.140 -0.264 -0.192
## happy       -0.492  0.192  0.002  0.020 -0.402
## prsdycn:_1_  0.141 -0.711 -0.728  0.046  0.118 -0.018
```

```
## [1] 0.5504713
```

This model turns out to be significantly better than the previous one, which did not include the other interactional factors. This asnwers our second question:

> Does a contrastive prosodic contour indicate more than just disagreement, influencing other interactional meanings?

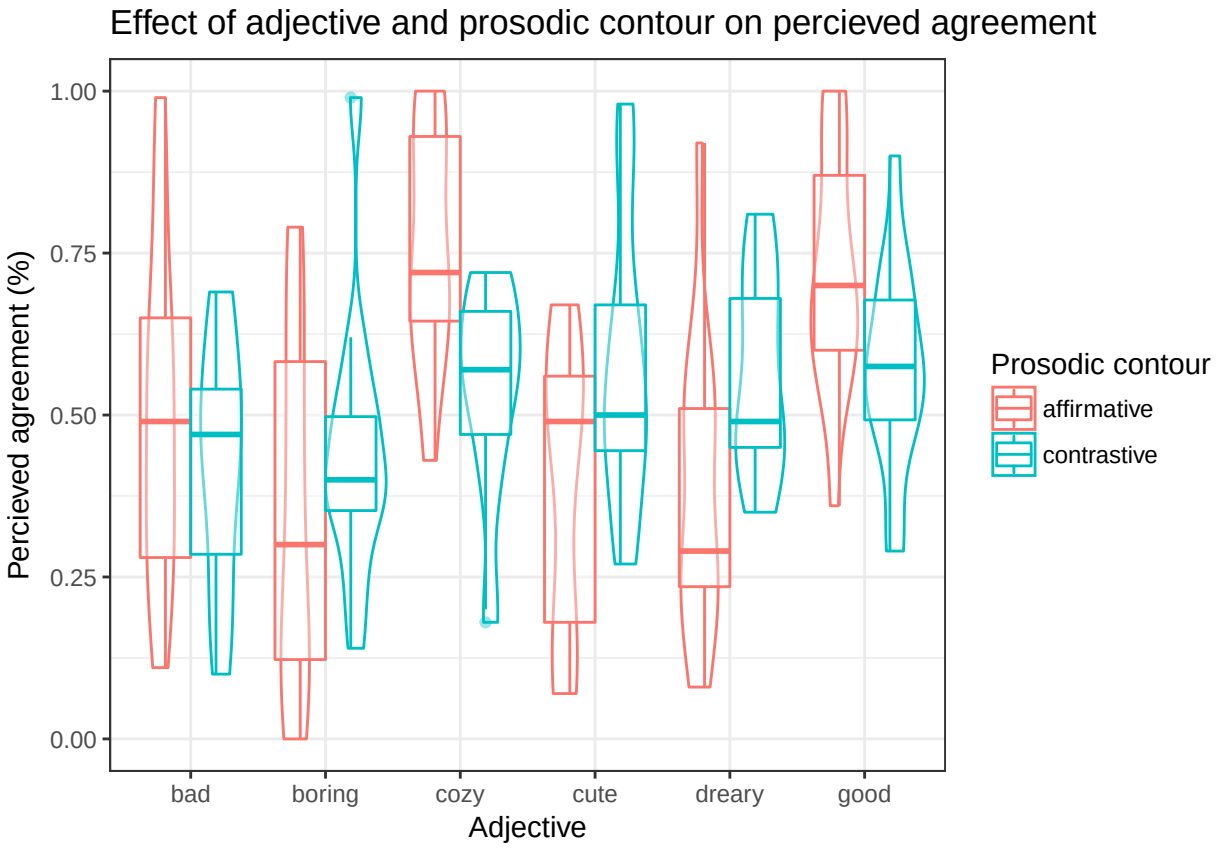
I would appear that this data shows that there are various interactional meanings at play when listeners hear contrastive prosodic contours.

Interesting interactions in the data

While exploring the data, I came across a few interesting aspects influencing data variability.

Adjectives

The particular adjective being evaluated influenced the perception of agreement, evaluation, friendliness and happiness.

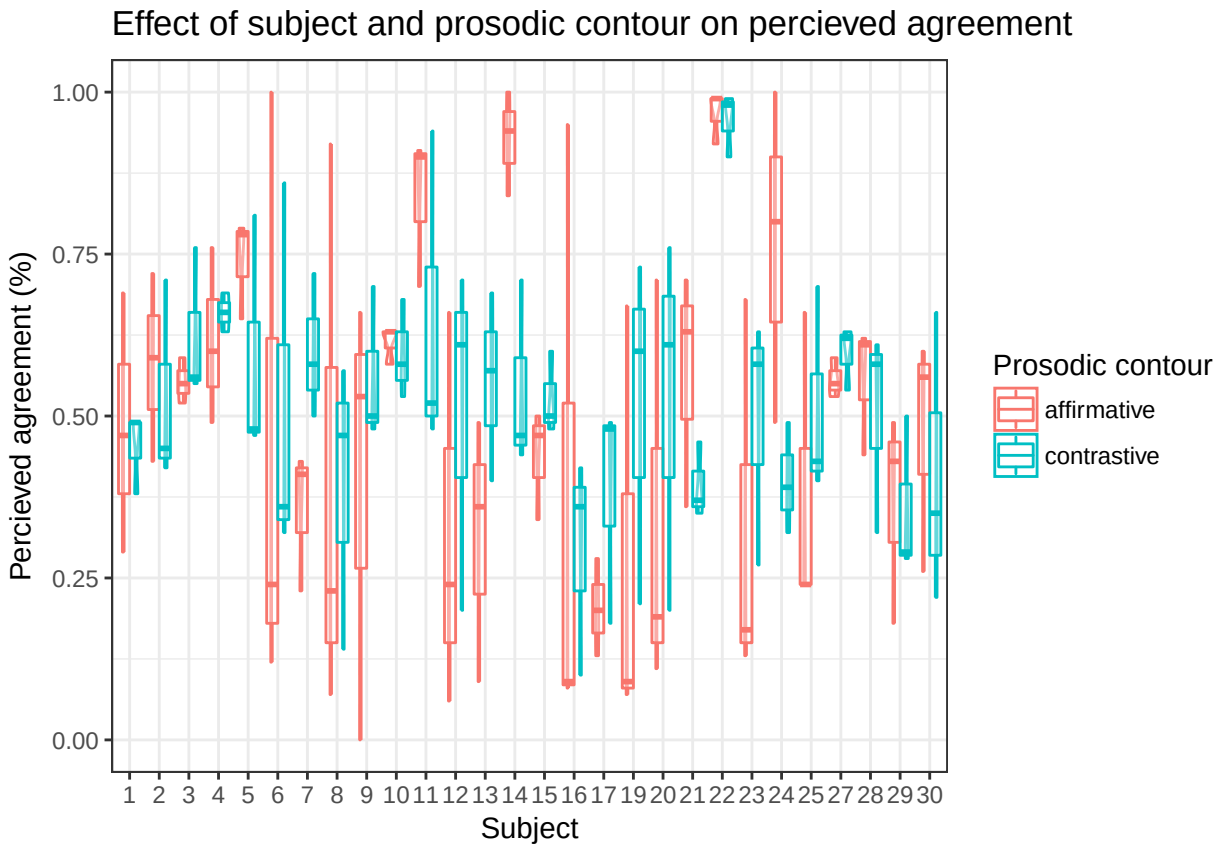


We find that not all adjectives pattern as expected. While the positive adjectives **cute** and **good** are percieved as showing less agreement when uttered with a constrastive contour, the positive adjective **cute** shows no such change.

Similarly, while the negative adjectives **boring** and **dreary** are percieved as showing more agreement when uttered with a contrastive contour, the negative adjective **bad** shows no such change.

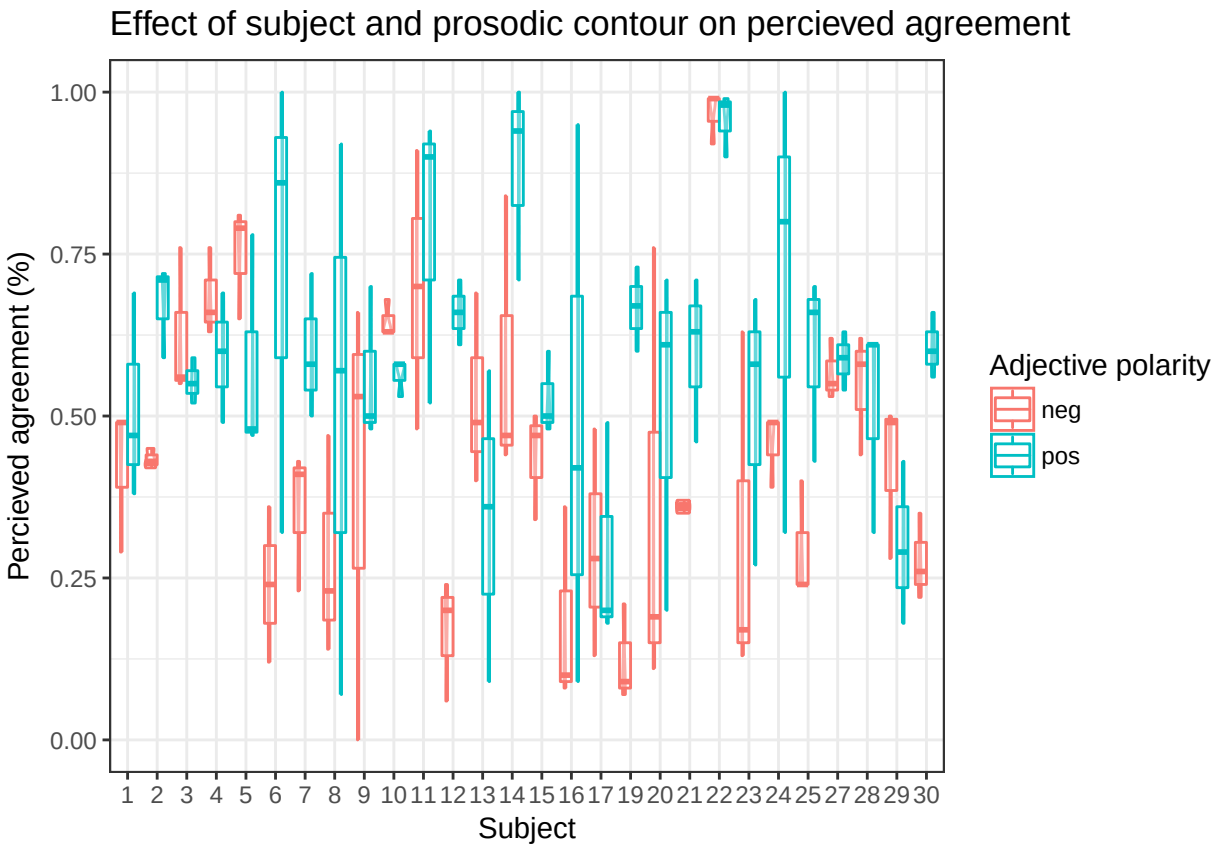
Subject

There is a large amount of variability between subjects, as well as differing degrees of intra-subject variability.



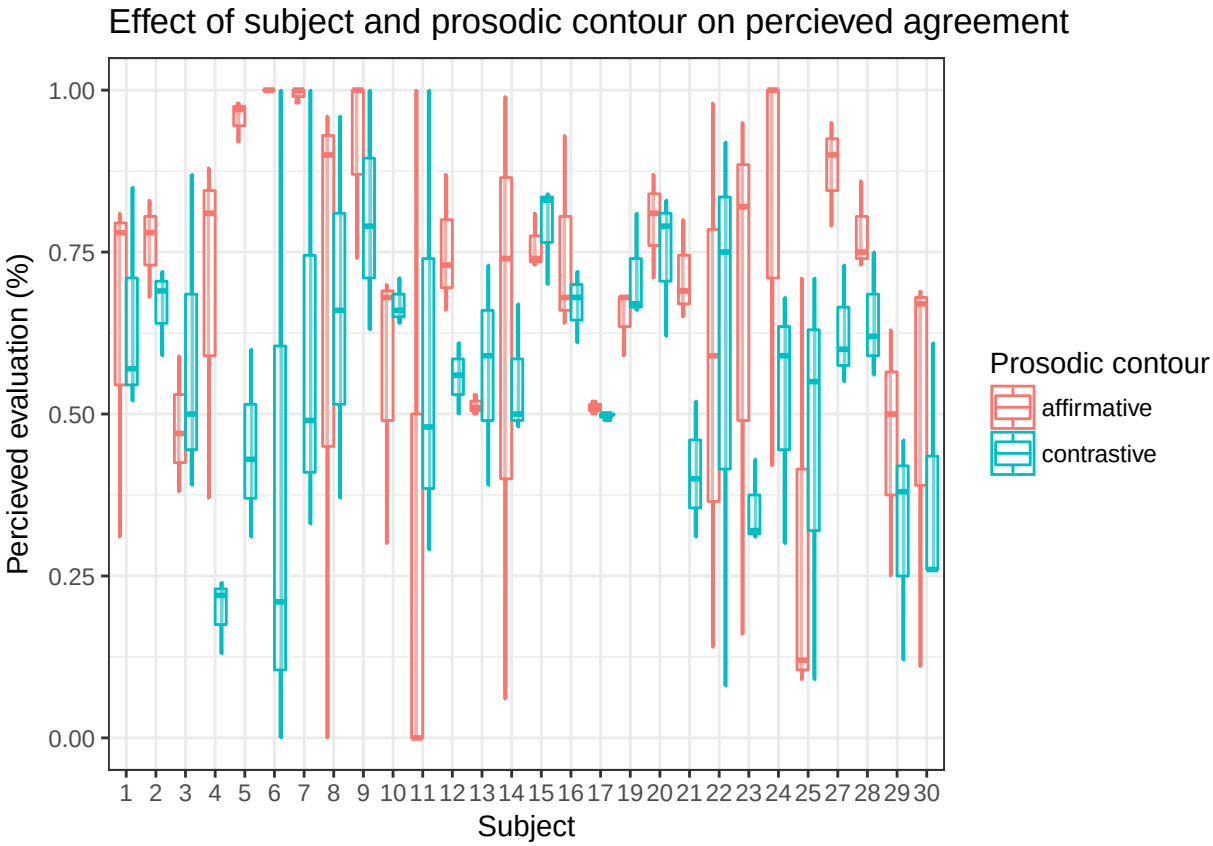
As we see, respondents differ on their perception of agreement given prosodic contours, with many respondents finding affirmative contours to be, on average, indicative of less agreement.

This variability is not just notable in their assessments of prosodic contours, but also their assessments of adjective polarity:



This means that across subjects, some found negative adjectives to be more indicative of agreement and others found the same polarity to be indicative of disagreement.

Appart from understanding the degree of variability between subjects, we are also able to to glimps the degree of intra-subject variability. For example, in the above graphs we see that subject 22 feels that both types of prosodic contours and both types of adjectives are equally indicative of high agreement. While this seems to point to an unreliable subject, examining the data in this way for other factors reveals that they seem to be reliable, and are simply not variable when it comes to percieved agreement (see graph below of percieved XYZ).


Effect of subject and prosodic contour on percieved agreement
Percieved evaluation (%)
1.00
0.75
0.50
0.25
0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 19 20 21 22 23 24 25 27 28 29 30
Subject
Prosodic contour
affirmative
contrastive