

Jurriën Schuurman

# MinF' and the Analysis of Psycholinguistic Data

Seminar in Statistics and Methodology

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# Overview

- Statistical analysis in psycholinguistics
- The “language as a fixed effect” fallacy
- $\min F'$
- Example of application of  $\min F'$
- When to use  $\min F'$

# Analysis of behavioural data

- Commonly used:  $F_1 \times F_2$  criterion
- $F_1$  : Subject analysis
- $F_2$  : Item analysis
- If both  $F_1$  and  $F_2$  are significant, the overall result is considered significant

# “Language as fixed effect” fallacy

- Brought to the attention by Clark (1973)
- Language is not a fixed factor, it is a random factor
- Experimental words/sentences are a sample of all possible words/sentences you could have used

# F'

- In separate  $F_1$  and  $F_2$  analyses, one random factor is alternatively denied
- Solution: calculate  $F'$
- $F'$  approximates F distribution

# minF'

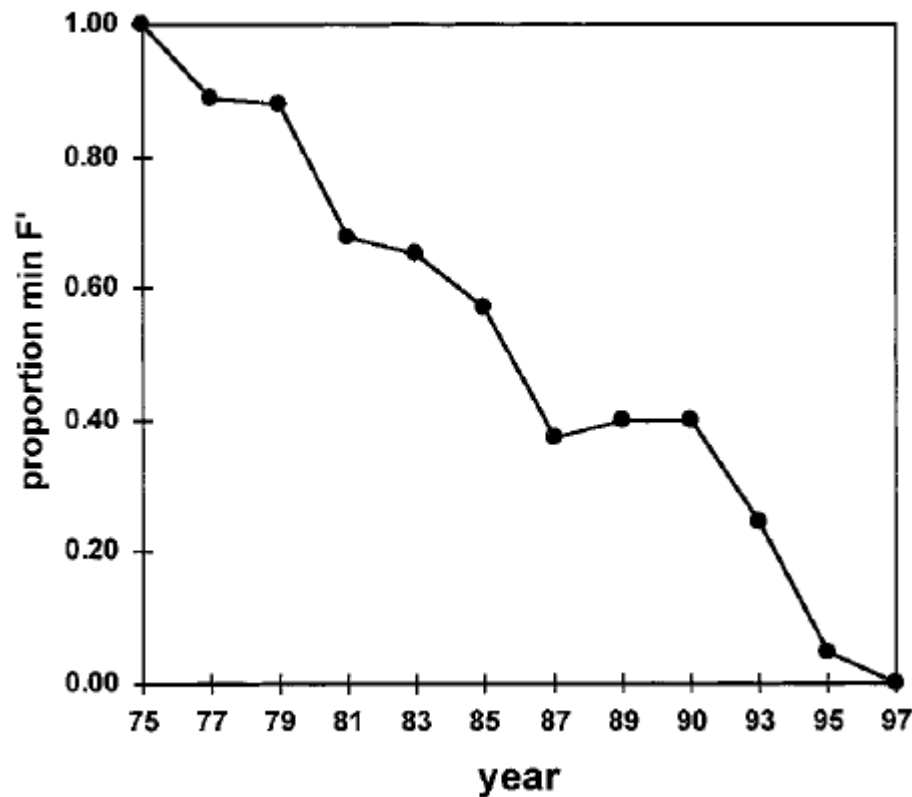
- Lower bound of  $F'$  (i.e., The lowest value  $F'$  could have given)
- Evaluates whether experimental manipulations are significant over subjects and items simultaneously

# Calculation of minF'

- $\min F' = \frac{F_1 * F_2}{F_1 + F_2}$
- $df = \frac{F_1 + F_2}{(F_1^2 / n_2) + (F_2^2 / n_1)}$
- $n_1$  and  $n_2$ : degrees of freedom of the error term of  $F_1$  and  $F_2$

# Use of minF' in published papers

- Raaijmakers et al. (1999)





# Luka & Barsalou (2005)

- Syntactic priming study
- Can judgment of grammaticality be influenced by previous exposure to identical sentences and sentences with similar structure?
- Exposure to sentence -> distractor task -> grammaticality judgment

# Luka & Barsalou (2005)

- 48 sentences
- 24 related sentences
- 12 of those sentences exactly the same and 12 of those sentences structurally similar
- Main effects of grammaticality, familiarity, and repetition type

# Luka & Barsalou (2005)

	$F_1$	$F_2$	min $F'$	df
Grammaticality	221.0*	77.0*	57.1*	65
Familiarity	10.5*	9.4*	4.96*	65
Repetition type	5.6*	1.7	1.32	63

- Main effect of repetition type significant for  $F_1$ , marginally significant for  $F_2$ . Not even close to significant for min $F'$  ( $p=.195$ )

# When to use $\min F'$

- Discussion in Raaijmakers et al. (1999) and Raaijmakers (2003)
- $F_1$  is biased due to variation between conditions being influenced by variability in item means
- Assumption that items within each condition are sampled randomly and independently

# When to use $\min F'$

- In practice, items are not always sampled randomly and independently
- Matching and counterbalancing reduces variation between groups caused by variability in item means
- Bias in  $F_1$  greatly reduced by matching and counterbalancing

# Conclusion

- Counterbalancing or matching not possible, or not sure if done well: calculate  $\min F'$
- Counterbalancing or matching conducted carefully:  $F_1$  suffices
- $F_1 \times F_2$  criterion unfounded in all cases

**Thank you for your attention!**

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# References

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