‘Please say what this word is’, in the US and now again in the UK: Dialectal differences in a replication of Ladefoged and Broadbent (1957)

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Introduction

Ladefoged and Broadbent (1957) (L&B57) is a foundational study in speech perception research, showing that acoustic properties of earlier sounds alter perception of subsequent sounds.

- A context sentence with a lower F1 frequency promoted perception of a higher F1 in the target word (“bet”)
- A context sentence with a higher F1 frequency promoted perception of a lower F1 in the target word (“bit”)

Dozens of subsequent studies have provided direct or conceptual replications of this finding, but none reported effect magnitudes anywhere close to as large as those reported by L&B57. Why not?

- Different stimuli tested
- Different participants / linguistic backgrounds
- Different testing protocols (etc. etc.)

We conducted a good-faith replication of L&B57, presenting their original stimuli to listeners in the UK and US. We followed their methods as closely as possible, inferring likely methods when procedural details were missing.

Method

Participants

UK 1957: Citing data from the 60 listeners in L&B57
UK 2022: 34 native speakers of British English tested in a classroom
US 2022: 28 native speakers of American English tested in classrooms

Stimuli

Digitized versions of the original stimuli from L&B57

TABLE I. Differences in the six versions of the introductory sentence: *Please say what this word is.*

Sentence version	Differences from sentence 1	Frequency range in cps Formant 1	Formant 2
1	...	275–500	600–2500
2	F. 1. down	200–380	600–2500
3	F. 1. up	380–660	600–2500
4	F. 2. down	275–500	400–2100
5	F. 2. up	275–500	800–2900
6	F. 1. down F. 2. up	200–380	800–2900

TABLE II. The frequencies of the first two formants in the four test words.

Test word		Frequency in cps Formant one	Formant two
“bit”	*A*	375	1700
“bet”	*B*	450	1700
“bat”	*C*	575	1700
“but”	*D*	600	1300

Procedure

- 12 trials presenting a context sentence followed by the target word
- Each group heard trials in the same order
- 4AFC identification of the target word: “bit”, “bet”, “bat”, or “but”

Results

Original Study

L&B57 is best-known for the changes in perception of F1 in the target word

Test word A
- Neutral context (Sentence 1)
  - 88% (53/60) “bit” responses, 12% (7/60) “bet” responses
- Low-F1 context (Sentence 2)
  - 7% (4/60) “bit” responses, 90% (54/60) “bet” responses

Test word B
- Neutral context (Sentence 1)
  - 8% (5/60) “bit” responses, 92% (55/60) “bet” responses
- Low-F1 context (Sentence 2)
  - 2% (5/60) “bit” responses, 95% (57/60) “bet” responses
- High-F1 context (Sentence 3)
  - 97% (58/60) “bit” responses, 3% (2/60) “bet” responses

These are enormous (>80%) shifts in target word identification!

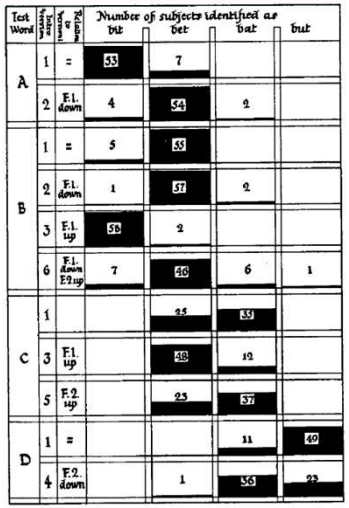


FIG. 2. Means of the responses of sixty subjects identifying the test words *A*, *B*, *C*, and *D* preceded by different versions of the introductory sentence.

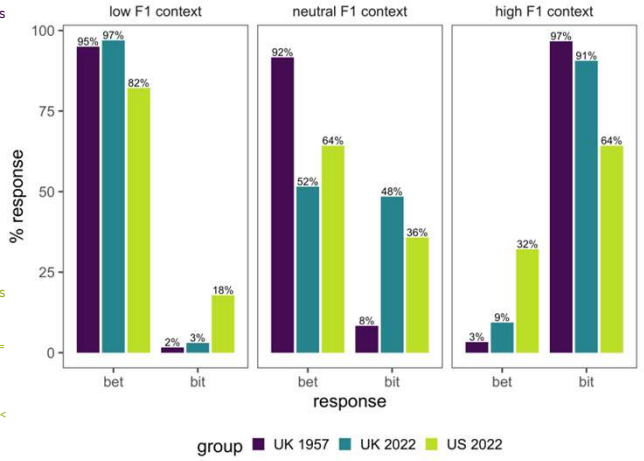
Present Study

Logistic regression analyzed “bit” (coded as 1) and “bet” (coded as 0) responses to test word B (the only word to be preceded by neutral, low-F1, and high-F1 contexts in the imbalanced design).

UK 1957
- No change across neutral-F1 & low-F1 contexts ($\beta = -1.65$, $p = .14$)
- Change across neutral-F1 & high-F1 contexts ($\beta = 5.77$, $p < .001$)

UK 2022
- Change across neutral-F1 & low-F1 contexts ($\beta = -3.41$, $p < .01$)
  - Similar to UK 1957’s shift ($\beta = 1.76$, $p = .25$)
- Change across neutral-F1 & high-F1 contexts ($\beta = 2.33$, $p < .001$)
  - Smaller than UK 1957’s shift ($\beta = 3.44$, $p < .01$)

US 2022
- No change across neutral-F1 & low-F1 contexts ($\beta = -0.94$, $p = .14$)
  - Similar shift to UK 1957 ($\beta = 0.71$, $p = .58$), smaller than UK 2022 ($\beta = 2.47$, $p < .05$)
- Change across neutral-F1 & high-F1 contexts ($\beta = 1.28$, $p < .05$)
  - Smaller than UK 1957 ($\beta = 4.48$, $p < .001$), similar to UK 2022 ($\beta = 1.05$, $p = .24$)



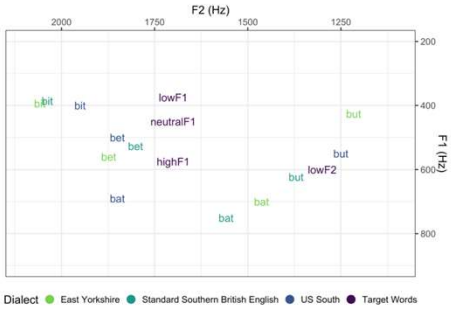
Discussion

All groups exhibited shifts in word identification due to acoustic properties of the context sentences, but results patterned differently by group.

- UK 1957: Near-unanimous shifts in responses
- UK 2022: Similar to UK 1957 but not to the same extremes
- US 2022: Responses were mixed, shifts much smaller

Why were the large shifts exhibited by UK 1957 not replicated?

- Missing methodological details from L&B57 made direct replication impossible
- The UK 2022 group (tested in York, England) might differ from the UK 1957 group (assumed to be tested in Edinburgh, Scotland)
- Generational differences are possible
- Vowel spaces differ across UK English and US English, as reported by Ferragne and Pellegrino (2010) and Clopper et al. (2005):



Contributions of linguistic experience on these context effects are unclear

- Sjerps and Smiljanić (2013): shifts in /o/-/u/ categorization were similar for Spanish, English, Dutch, and Spanish-English-bilingual listeners
- Kang, Johnson, and Finley (2016): shifts in /s/-/ʃ/ categorization when followed by /a/, /u/, or French /y/ differed for English versus French listeners
- Here, UK and US listeners have categories for /ɪ/ and /ɛ/, but differences in how they are realized and potentially how listeners perceptually weight that information might affect their susceptibility to context effects

Conclusion

- Acoustic properties of earlier sounds shape perception of later sounds, but the magnitudes of these effects are shaped by various higher-level factors (e.g., dialect, generation, linguistic experience). Thus, bottom-up acoustic and top-down experiential contributions to perception should be considered in tandem.