A failure to replicate the Ganong effect for tone continua
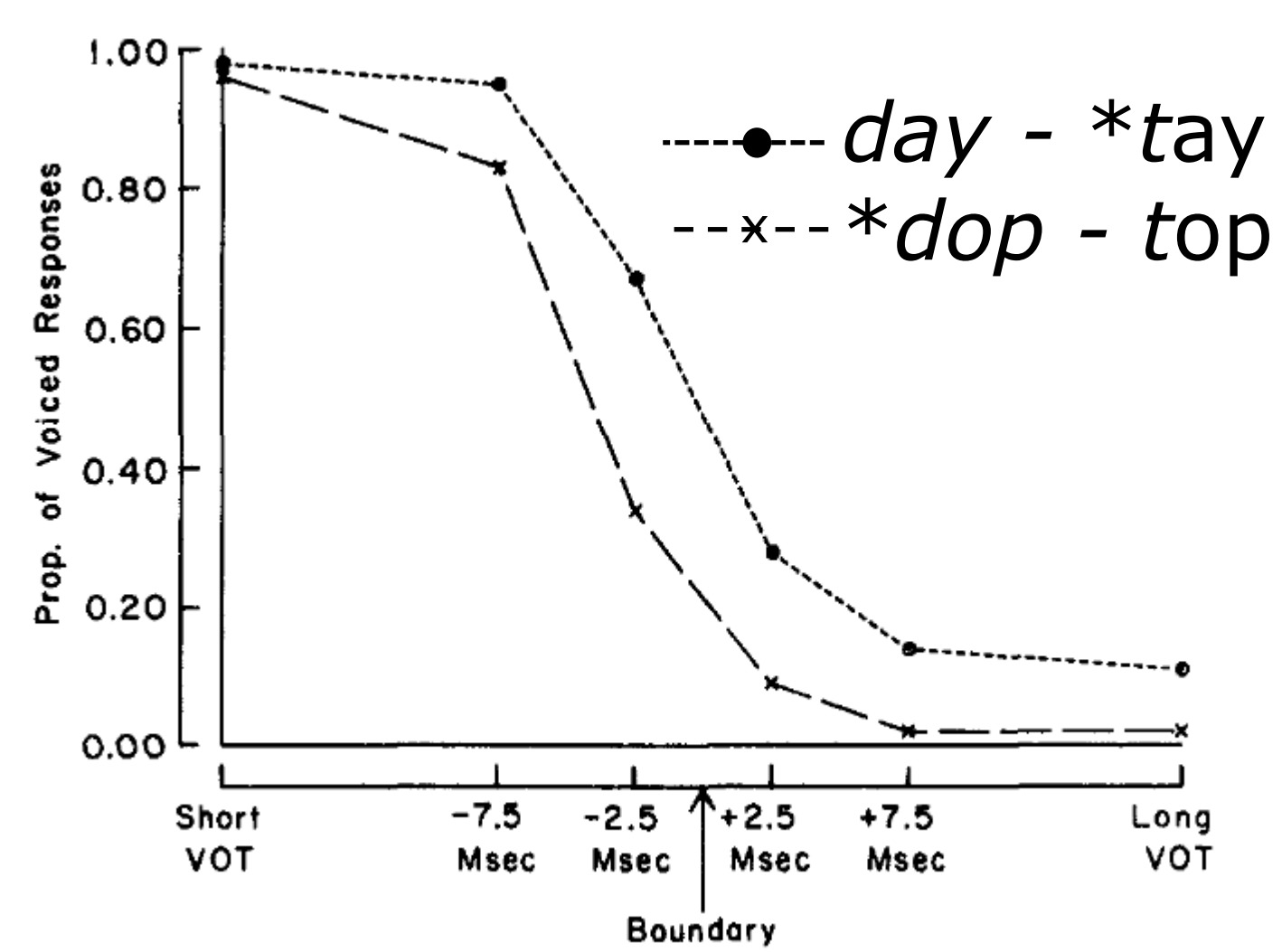
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Background

- Because of phonological alternations, listeners may hear sound sequences that only occur as surface forms of other underlying forms
- For example: Mandarin has a morpheme $yong^3$ and no morpheme $yong^2$. But in some contexts, Tone 3 morphemes like $yong^3$ are pronounced as Tone 2 instead:
  $yong^3\ gan^3$ ("brave") → $yong^2\ gan^3$
- Are these surface-only forms, like $yong^2$, processed as real words or as pseudowords?
  - **Evidence that they are like pseudowords:** There are no citation forms pronounced $yong^2$, and Mandarin speakers will often report that they don't know any morpheme with this pronunciation.
  - **Evidence that they are like words:** Listeners do have experience hearing and producing these forms. In lexical decision, these forms are difficult to reject as pseudowords (Wiener & Turnbull, 2013).
- We wanted to use the Ganong effect to see if these are treated as real words or pseudowords (figure adapted from Ganong 1980):

Prop. of Voiced Responses
*day - *tay
*dop - top
Short VOT / −7.5 Msec / −2.5 Msec / +2.5 Msec / +7.5 Msec / Long VOT
Boundary

Design

- Continua from Tone 2 to Tone 1:
  - T1 – T2* (e.g. *yue*) "T1-biased"
  - T1* – T2 (e.g. *lan*) "T2-biased"
  - T1 – T2? (e.g. *yong*)
  - T1* – T2? (e.g. *nuan*)
  - T1-T2 (e.g., *die*) "neutral"
  - T1*-T2* (e.g., *te*) "neutral*"
- We know people should choose Tone 1 more in the "T1-biased" condition than in the "T2-biased" condition. The predictions for the next two conditions are as follows:

If $yong^2$ is treated like a real word…
If $yong^2$ is treated like a pseudoword…
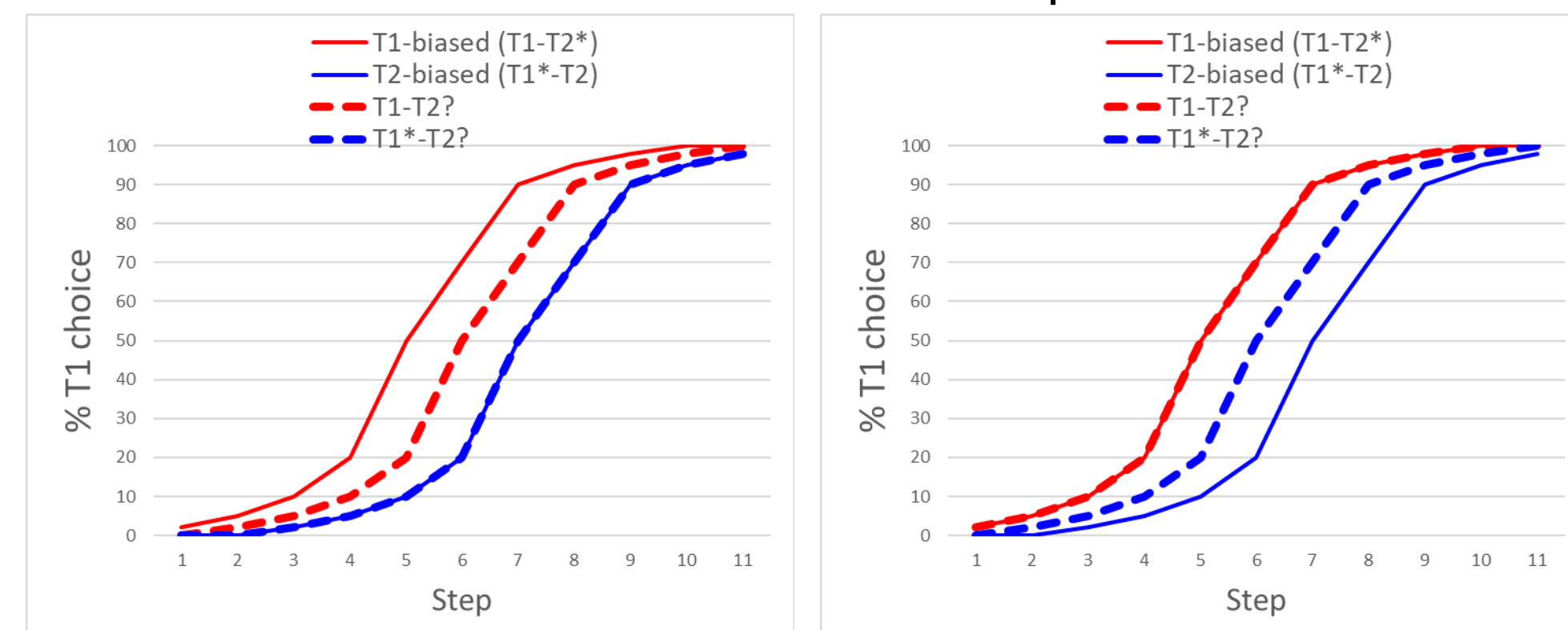
% T1 choice vs Step
- T1-biased (T1-T2*)
- T2-biased (T1*-T2)
- T1-T2?
- T1*-T2?

Methods

- Continua used:
  - T1 – T2* (*diu, hei, yue*) "T1-biased"
  - T1* – T2 (*qiong, lan, nong, mai*) "T2-biased"
  - T1 – T2? (*bang, gan, gao, yong*)
  - T1* – T2? (*dei, gun, nuan, niao*)
  - T1-T2 (*die, shao, you, guo*) "neutral"
  - T1*-T2* (*te, ce, kuai, ruo*) "neutral*"
- For each continuum we recorded natural tokens in both Tone 1 and tone 2, and created a 7-step continuum by interpolating the F0 and duration in between the two endpoints in five equal steps. The *nong* continuum is shown below.
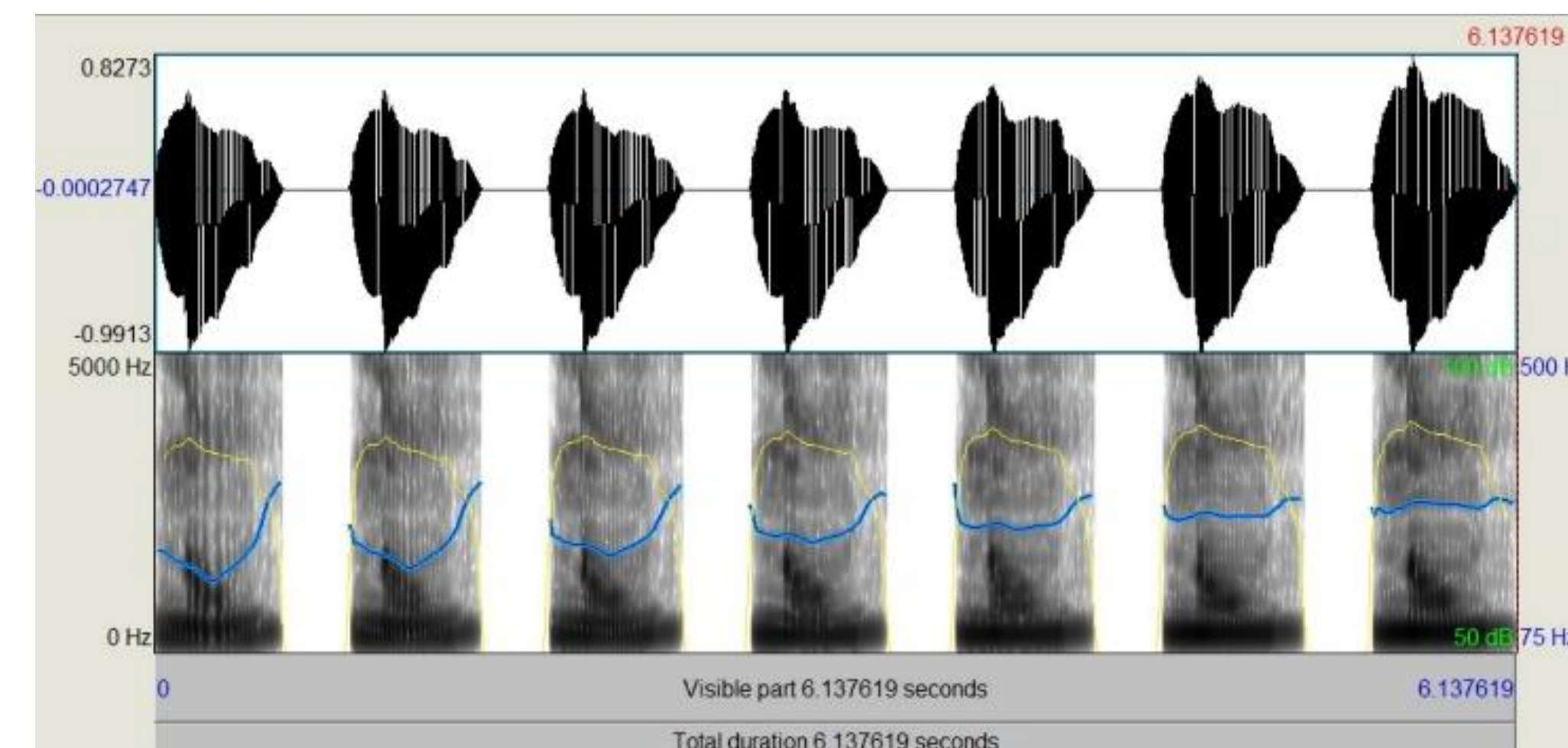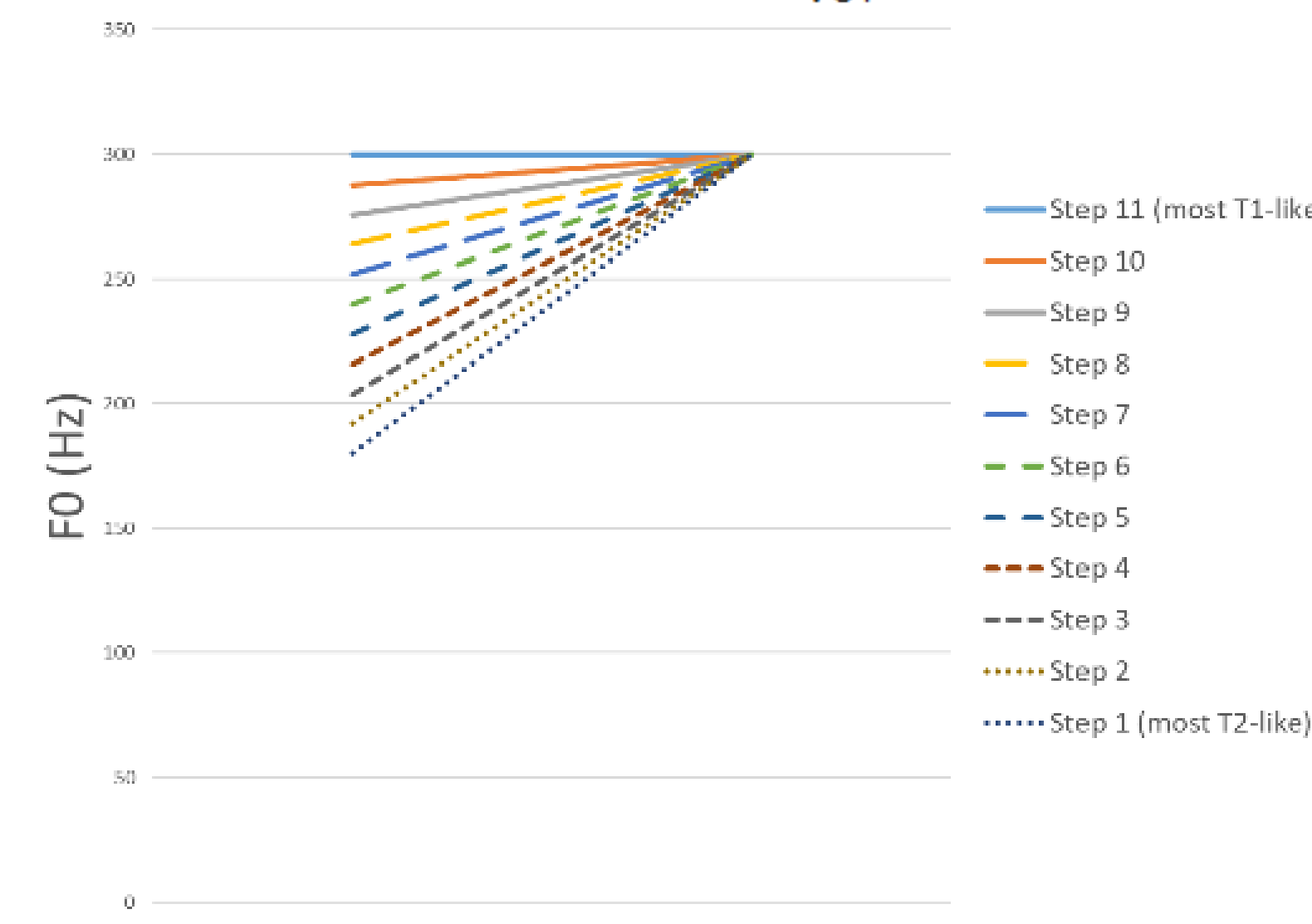
Issues with creating continua

Continua are typically created like this, using absolute endpoints, so a given step of one continuum "matches" a given step of another continuum:

dask dask dask dask dask dask dask

desk desk desk desk desk desk desk
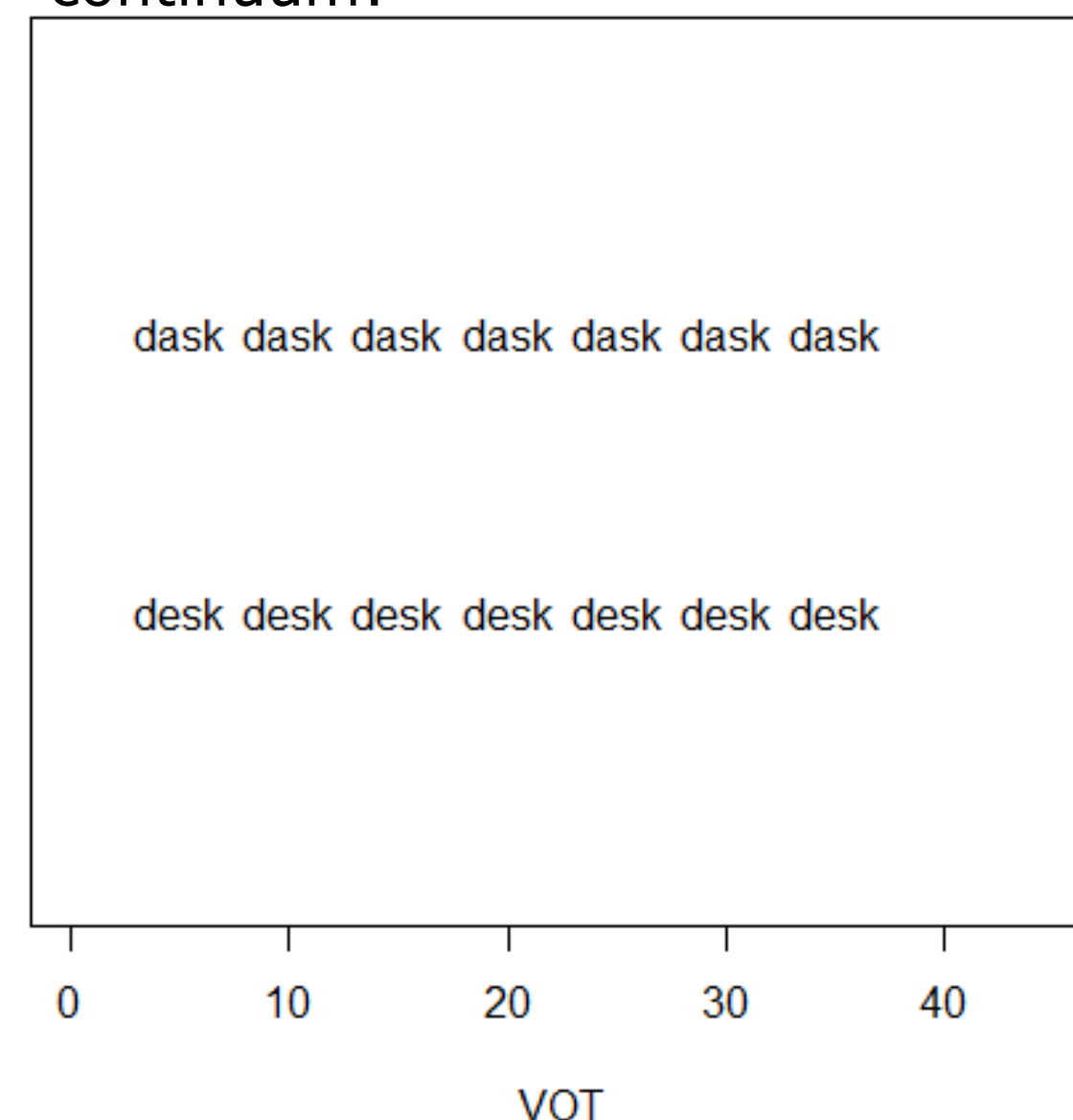
Our procedure, however, made continua more like this, where e.g. the 6th step of one continuum may be "lower" than the 5th step of another continuum…

dask dask dask dask dask dask dask
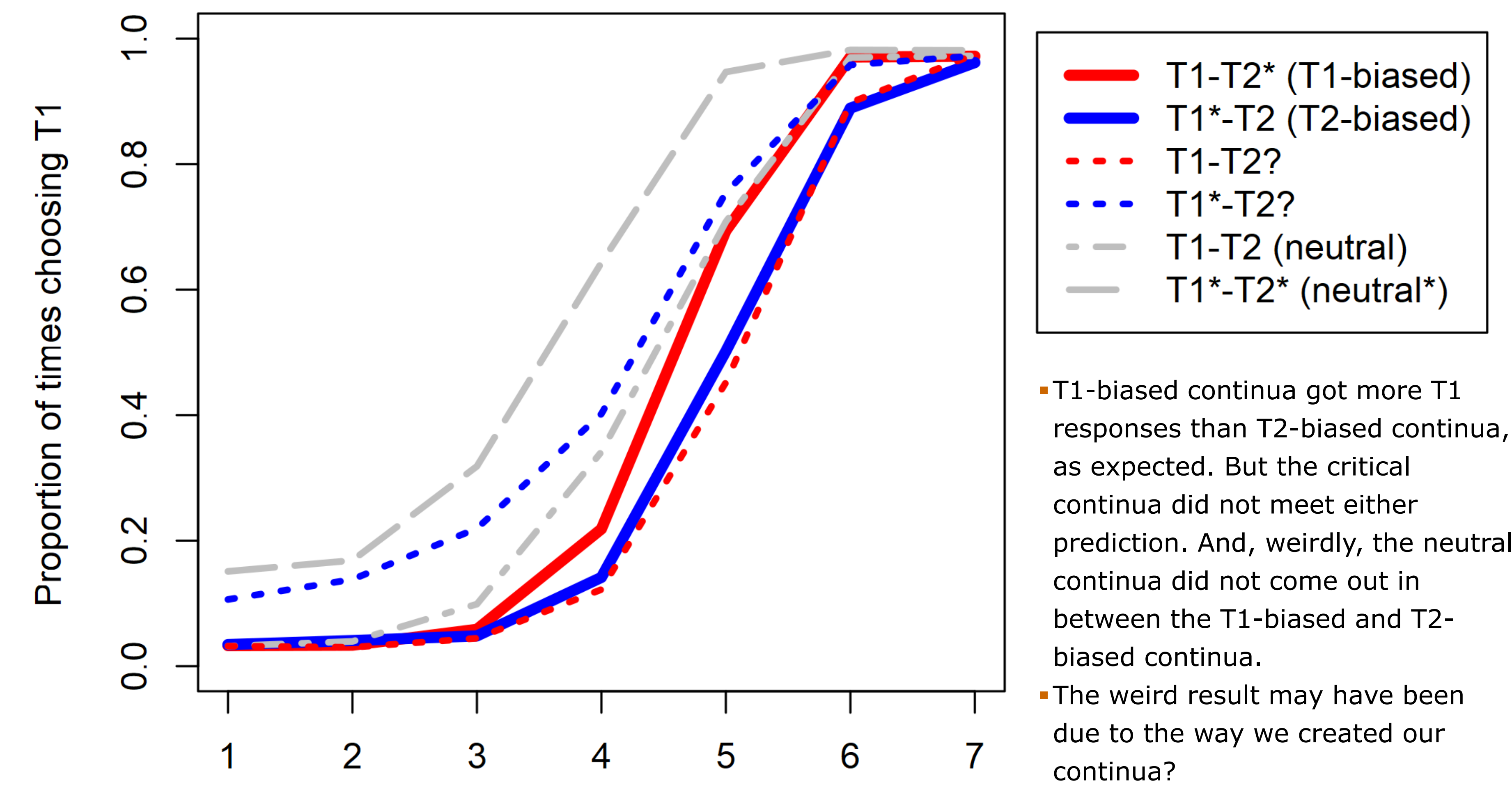
deskdeskdeskdeskdeskdeskdesk
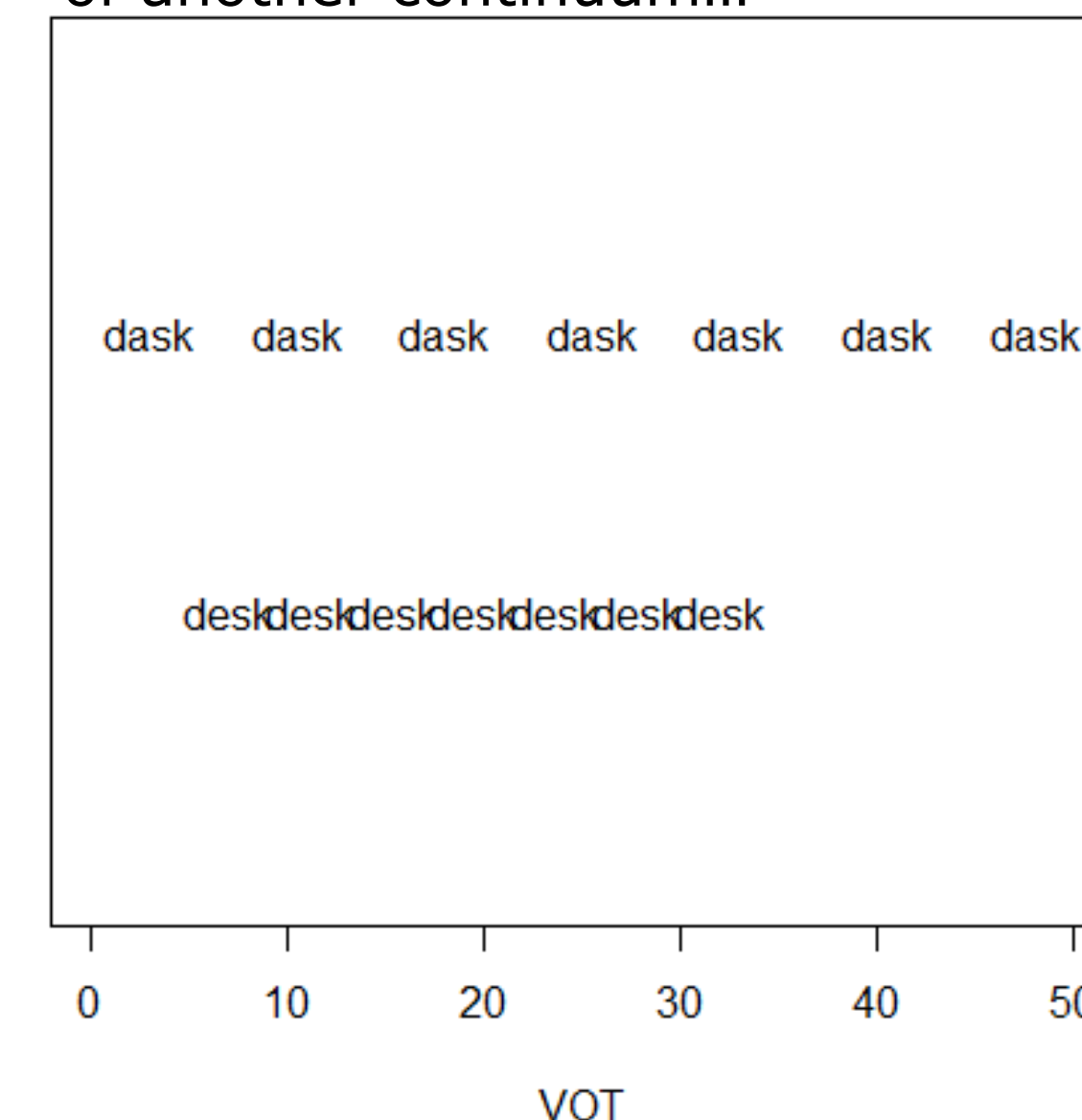
Therefore, for Experiment 2, we made continua using absolute endpoints, rather than using natural tokens as endpoints. This ensures that a given step has an identical F0 contour across all continua.
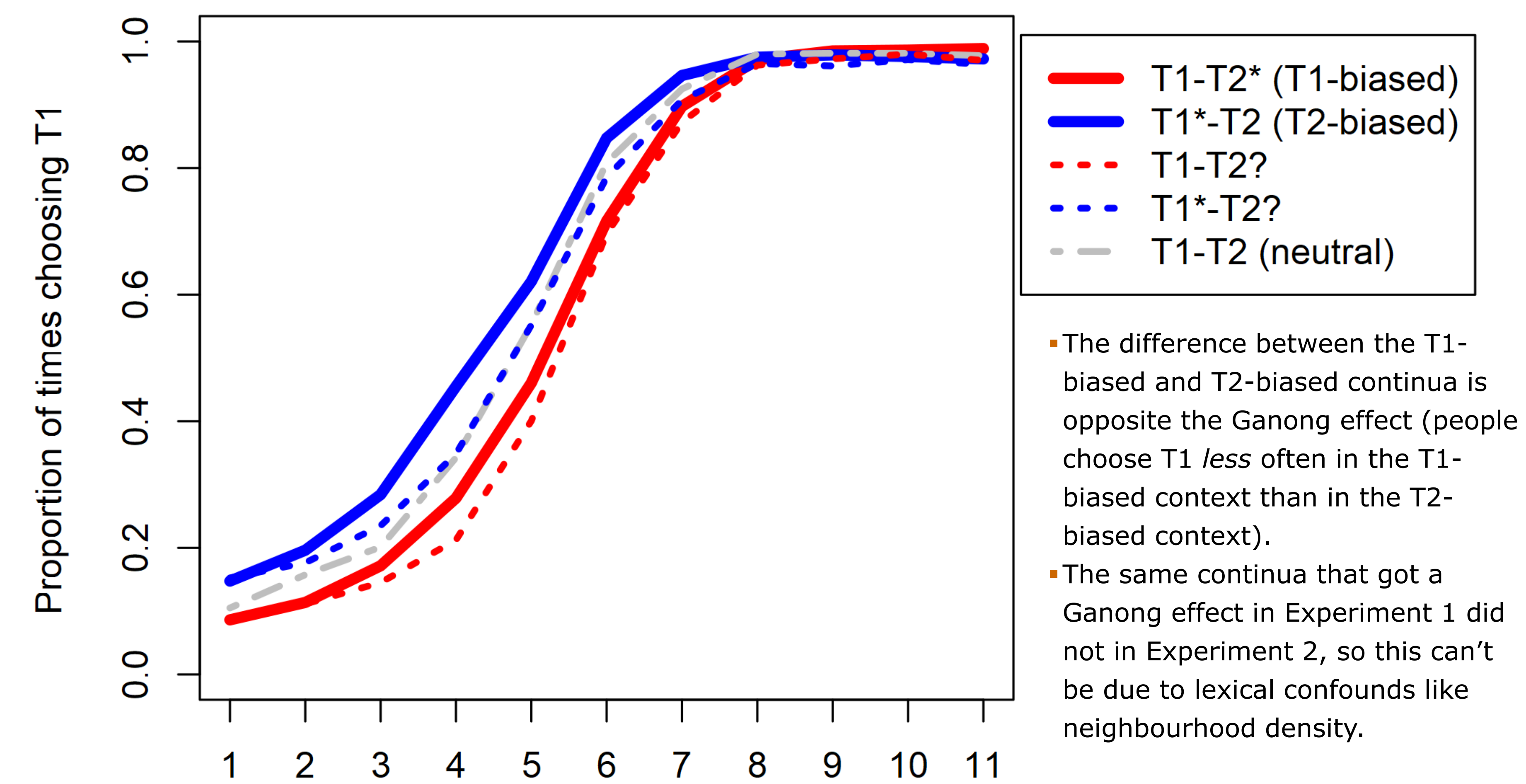
F0 (Hz)
- Step 11 (most T1-like)
- Step 10
- Step 9
- Step 8
- Step 7
- Step 6
- Step 5
- Step 4
- Step 3
- Step 2
- Step 1 (most T2-like)

Experiment 1 (N=100)

Results and discussion

Proportion of times choosing T1
- T1-T2* (T1-biased)
- T1*-T2 (T2-biased)
- T1-T2?
- T1*-T2?
- T1-T2 (neutral)
- T1*-T2* (neutral*)

- T1-biased continua got more T1 responses than T2-biased continua, as expected. But the critical continua did not meet either prediction. And, weirdly, the neutral continua did not come out in between the T1-biased and T2-biased continua.
- The weird result may have been due to the way we created our continua?

Experiment 2 (N=100)

Results and discussion

Proportion of times choosing T1
- T1-T2* (T1-biased)
- T1*-T2 (T2-biased)
- T1-T2?
- T1*-T2?
- T1-T2 (neutral)

- The difference between the T1-biased and T2-biased continua is opposite the Ganong effect (people choose T1 *less* often in the T1-biased context than in the T2-biased context).
- The same continua that got a Ganong effect in Experiment 1 did not in Experiment 2, so this can't be due to lexical confounds like neighbourhood density.

- We do not know why we failed to reliably observe typical Ganong effects in the present experiment.
- Yang et al. (2019) had a similar pattern as ours: Ganong effect with the more "natural" stimulus manipulation (like our Experiment 1) and no Ganong effect with the more "controlled" manipulation (like our Experiment 2)
- But Fox & Unkefer (1985) and Wiener & Liu (2021) used a manipulation like our Experiment 2 and still got Ganong effects
- It's a real head-scratcher. Maybe Ganong effects for tone continua are not very reliable, or maybe there is some other hidden moderator we have not yet considered.