# How Learners of French and Mandarin Produce Stop Consonants in Each Language

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## What are stop consonants?

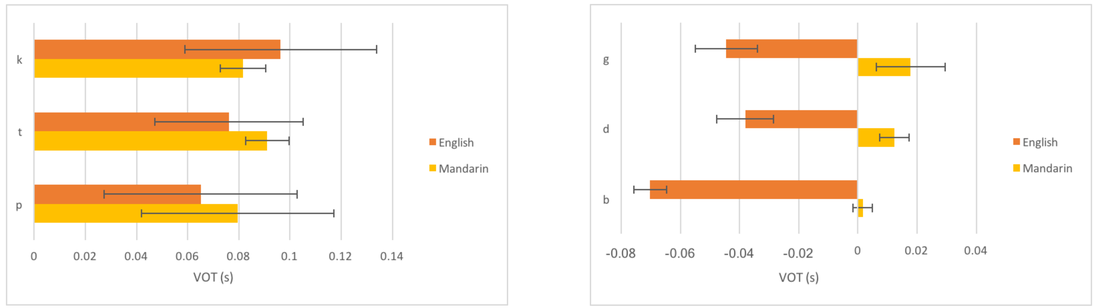
They are consonants made by briefly *stopping* the airstream from the lungs. English, French, and Mandarin all have three pairs of stop consonants.

- **/p b/** are **bilabial stops** (the *lips* stop the airstream).
- **/t d/** are **alveolar stops** (the tongue stops the airstream at the *alveolar ridge*).
- **/k g/** are **velar stops** (the tongue stops the airstream at the *velum*).

## Introduction

In many languages, stop consonants come in pairs. The contrast within the pair is best quantified by voice-onset time (VOT).[1] Cross-linguistic studies have shown that the exact VOT for each consonant can differ significantly from language to language. For example, stops in French have a shorter VOT than stops in English.[1, 2] Studies have also been conducted on how bilingual speakers produce the consonant pairs of their two languages. Overall, age of learning (AOL) seems to affect how speakers pronounce the consonants of their second language.[3, 4, 5] My study investigates if the VOTs of a speaker change over a semester of learning a second language in a university classroom setting. The specific second languages I look into are French and Mandarin Chinese.

## VOT in English and Mandarin




(a) /p t k/ (b) /b d g/

Figure: Average VOT of some native speakers, with 95% confidence intervals

## Materials

The materials are audio recordings and written sentences containing target words beginning with stop consonants and distractor words beginning with other sounds. There is one set for each language: English, French, and Mandarin.

## Participants

All participants are students in the following courses at Carnegie Mellon University:

- **82-101** Elementary French I
- **82-103** Elementary French I Online
- **82-131** Elementary Chinese I

## Methods

The participants are recorded at four points during the 2018-2019 academic year. In each recording session, the participants are given the following in both English and the second language they are learning:

1. audio material to listen to and repeat
2. written material to read aloud

All the recordings take place in Dr. Seth Wiener's Language Acquisition, Processing, and Pedagogy (LAPP) Lab. The finished recordings are processed with the phonetics software Praat. The target words are identified, and the VOT of the stop consonants are measured.

## What exactly is voice-onset time (VOT)?

Sounds made with the vocal folds vibrating are called **voiced** sounds. Sounds made without such vibration are called **voiceless** sounds. For example, **vowels** are voiced, but **/p t k/** are voiceless. **Voice onset time** is the time between the end of a stop consonant and the *onset* (beginning) of the nearest voiced sound.

## References

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