Factors in Letter Naming Speed

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Introduction

The speed at which an individual can name letters in isolation and serially is heavily correlated to reading ability. However, uncertainty lies in what factors are driving this relationship. Reaction times are faster for words with voiced and labiodental, dental, or bilabial phonemes (Kessler, Treiman, & Mullennix, 2002). Sonorants elicit quicker responses than obstruents, while high and front vowel's slow reaction times (Kessler, Treiman, & Mullennix, 2002). Irregular words result in longer response times than regular words (Kawamoto et al., 1998) and the "own-name advantage" suggests children had a higher recognition of letters matching their first-name initials (Justice et al., 2006; Treiman et al., 2012; Pence Turnbull et al., 2010). Research investigating voicing, POA, MOA, vowel categorizations, and letter-sound correspondence in reaction time is mostly limited to word-naming. Additionally, the relationship between first-name initials and recognition is well-documented, but its impact on adult reaction times to letters lacks exploration.

This study aims to answer the following questions regarding isolated letter naming. Will letters being voiced or voiceless account for variance in reaction time? Can letter-naming speed vary based off differences in POA, MOA, vowel classifications, first sound (consonant or vowel), and letter-sound correspondence? Additionally, do the initials of individuals' first and last name also predict the speed in which letters can be named?

Methods

Within the Department of Psychology at Florida State University, 100 undergraduate students were granted 0.5 pool credits for participating in a 35-minute study. This was part of a larger study approved by the IRB and informed consent was obtained. Participants were required to name 26 letters for 3 sequences with a fixation point appearing 750 MS before each letter. The letter appeared for 1000 MS and a voice key was used to measure reaction time.

Table 1

Letter Categorizations of English Consonants

Letter	Voicing	Places	Manner	Tongue Height	Tongue Advancement	Lip Rounding	Correspondence	First Sound (CV)
B	Voiced	Bilabial	Plosive				1	1
C	Voiceless	Alveolar	Fricative				1	1
D	Voiced	Alveolar	Plosive				1	1
F	Voiced			Mid	Front	Unrounded	1	0
G	Voiced	Postalveolar	Affricate				0	1
H	Voiced			Mid	Front	Unrounded	0	0
J	Voiced	Postalveolar	Affricate				1	1
K	Voiceless	Velar	Plosive				1	1
L	Voiced			Mid	Front	Unrounded	1	0
M	Voiced			Mid	Front	Unrounded	1	0
N	Voiced			Mid	Front	Unrounded	1	0
P	Voiceless	Bilabial	Plosive				1	1
Q	Voiceless	Velar	Plosive				1	1
R	Voiced			Low	Back	Unrounded	1	0
S	Voiced			Mid	Front	Unrounded	1	0
T	Voiceless	Alveolar	Plosive				1	1
V	Voiced	Labiodental	Fricative				1	1
W	Voiced	Alveolar	Plosive				0	1
X	Voiced			Mid	Front	Unrounded	1	0
Y	Voiced	Labiovelar	Approximant				0	1
Z	Voiced	Alveolar	Fricative				1	1

Note. Displayed is the fashion in which English consonants were coded based off initial phoneme in categories of voicing, POA, MOA, and vowel categorizations such as tongue height, tongue advancement, and lip rounding if the letter began with a vowel sound.

Table 2

Letter Categorizations of English Vowels

Letter	Voicing	Places	Manner	Tongue Height	Tongue Advancement	Lip Rounding	Correspondence	First sound (CV)
A	Voiced			Mid	Front	Unrounded	1	0
E	Voiced			High	Front	Unrounded	1	0
I	Voiced			Low	Central	Unrounded	1	0
O	Voiced			Mid	Back	Rounded	1	0
U	Voiced	Palatal	Approximant	High	Front	Unrounded	1	0

Note. Displayed are categorizations of English vowels which are categorized by tongue height, tongue advancement, and lip rounding with the exception of the letter "u".

Results

Table 4

Means & SDs

Factor	Levels	Mean	SD
Letter in FN	No	485.9	99.2
	Yes	473.1	104.4
Letter in LN	No	485.6	99.1
	Yes	480.7	106.3
Letter in FN or LN	No	486.2	98.9
	Yes	475.9	106
Voicing	Voiced	485.5	97.6
	Voiceless	485.2	107
Manner	Affricate	492.9	85
	Approximate	475.5	92.8
	Fricative	502.7	111.4
	Plosive	486.2	99.6
Places	Alveolar	495.5	101.3
	Bilabial	487.8	101
	Labiodental	503.5	110.6
	Palatal	466.1	90.3
	Postalveolar	429.9	85
	Velar	476	103.6
Correspondence	No	488.4	86.7
	Yes	484.9	101.6
Tongue Advancement	Back	475.1	94.6
	Central	480.9	102.1
	Front	480.7	98.8
Tongue Height	High	473.4	93.24
	Low	477.8	95.8
	Mid	481.8	100.1
Lip Rounding	Rounded	475.5	99.9
	Unrounded	480.2	98.3
First Sound (CV)	No	479.9	98.4
	Yes	491	100.1

Note. Letter in FN refers to whether or not the target letter was also the initial of the participants first name. Letter in LN refers to whether or not the target letter was also the initial of the participant's last name. Letter in FN or LN accounts for if the target letter was an initial of the participant's first or last name.

Table 5

Results of Cross-Classified Random Effects

Factor	NumDF	DenDF	F value	p(>F)
Letter in FN	1	2721.4	2.82	0.09
Letter in LN	1	2709.6	1.23	0.26
Letter in FN or LN	1	2720.4	4.05	0.04*
Voicing	1	25.29	0	0.97
Manner	3	13.25	2.79	0.08
Places	5	13.21	2.7	0.06
Correspondence	1	25.29	0.15	0.7
Tongue Height	2	12.49	0.2	0.82
Tongue Advancement	2	12.5	0.08	0.92
Lip Rounding	1	12.49	0.06	0.81
First Sound (CV)	1	25.26	3.34	0.08

Note. Factors demonstrate significance at $p<0.05$*.

Analysis

A series of cross-classified random-effects models was used with subjects crossed with letters and both subjects as well as letters fit as random effects. The first unconditional model investigated whether there was significant variance in both subjects and letters. Following this, 11 conditional models were used to investigate whether letter naming speed can be predicted from differences in speech-sound production and whether a letter appears in the initial of subjects' first or last name. After completion of multi-level regressions, target letters under Letter in FN or LN was shown to be a statistically significant predictor ($p < 0.04$) in letter naming speed. Participants were 8.79 MS faster at naming a target letter under this condition.

Discussion

This study supports the own-name advantage (Justice et al., 2006; Treiman et al., 2012; Pence Turnbull et al., 2010) and extends it to last name initials, likely due to adults' frequent exposure to them in text. Researchers should consider participants' initials when studying isolated naming speed. A limitation of this study is the use of voice keys, which may introduce error (Rastle & Davis, 2002), though 3 trials helped ensure consistency. Future research should examine the relationship between first or last name initials and letter naming speed in both adults and early primary school children to inform literacy curriculum adjustments.

References