



## **Stylistically coherent variants: Cognitive representation of social meaning**

### ***Variantes estilisticamente coerentes: Representação cognitiva de significados sociais***

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**Abstract:** The perception of social meanings and styles is dependent upon the contributions of a constellation of multiple covarying sociolinguistic variants. This suggests that listeners maintain associations between stylistically coherent variants and their social meanings in mental representation. The present paper expands upon this notion, aiming to gain converging evidence from production as a way to explore the cognitive representations of variants and their social meanings more deeply. To do this, four American English speakers were asked to produce sentences containing (ING) words (as in *talking* vs. *talkin'*), in their *-in* and *-ing* variants, in a laboratory setting. Productions were acoustically analyzed to evaluate whether the speakers also manipulated other stylistically-linked variables, even though prompted only to manipulate (ING). The variant *-in* has been shown to index a range of social meanings in American English, including Southern and casual. Results demonstrate that speakers indeed modulated other variables beyond (ING) in ways that align with the Southern and casual social meanings of *-in*. That producing one variant (*-in*) could lead to stylistically congruent realizations of other variables suggests that speakers not only hold indexical linkages between variants and styles in mental representation, but that variants are also linked to variants of other variables through associations with those styles. A better understanding of social meaning in cognition provides an important base upon which to advance research on sociolinguistic perception.

**Keywords:** covariation; social meaning; cognitive representation; style.

**Resumo:** A percepção de significados sociais e de estilos depende das contribuições de uma constelação de múltiplas variantes sociolinguísticas em covariação. Isto sugere que os falantes mantêm associações entre variantes estilisticamente coerentes e seus significados sociais numa representação mental. O presente trabalho expande essa noção, com o objetivo de ganhar evidências advindas da produção como meio de explorar mais profundamente as representações cognitivas de variantes e de seus significados sociais. Para isso, quatro falantes de inglês norte-americano foram convidados a produzir sentenças que contêm variantes de (ING) (como em *talking* vs. *talkin'* ‘falando’), em contexto de laboratório. As produções foram acusticamente analisadas no sentido de avaliar se os falantes também manipularam estilisticamente outras variáveis, ainda que houvessem sido instruídos a manipular apenas (ING). Trabalhos anteriores já mostraram que a variante *-in* indicia uma grande extensão de significados sociais em inglês norte-americano, incluindo sotaque sulista e casualidade. Os resultados mostram que os falantes de fato modulam outras variáveis além de (ING) que se alinham a esses significados sociais de *-in*. O fato de que a produção de uma variante pode conduzir a realizações estilisticamente congruentes de variantes de outras variáveis sugere que os falantes não apenas detêm associações indiciais entre variantes e estilos em sua representação mental, mas também que variantes de diferentes variáveis estão ligadas entre si na sua associação a tais estilos. Entender melhor a significação social de múltiplas variáveis na cognição oferece uma base importante na qual deve avançar a pesquisa sobre percepção sociolinguística.

**Palavras-chave:** covariação; significado social; representação cognitiva; estilo.

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## 1 Introduction

The study of social meaning and style is a central focus in sociolinguistics, particularly in the third wave framework, which has seen increased interest in sociolinguistic perception. In this paper, we explore the cognitive representation of social meaning, in line with growing attention to the mental representation of socially meaningful variation (e.g., CAMPBELL-KIBLER, 2012; DRAGER; KIRTLEY, 2016; FOULKES; DOCHERTY, 2006; KLEINSCHMIDT; WEATHERHOLTZ; JAEGER, 2018; HAY *et al.*, 2019; TAMMINGA; MACKENZIE; EMBICK, 2016; NIEDZIELSKI; PRESTON, 2000; SUMNER *et al.*, 2014; VAUGHN; KENDALL, 2018). Specifically, we use a production-based methodology to investigate potential associations in mental representation between variants of multiple sociolinguistic

variables that may share congruent social meanings or styles. Prior work asking cognitive questions about social meaning has been primarily concerned with examining associations between linguistic forms and their indexical links to social structures, while questions regarding how covariation among multiple forms is represented cognitively have been underexamined (but see CAMPBELL-KIBLER, 2012). Better understanding the cognitive relationships between linguistic forms congruent in social meaning can help refine sociolinguistic theories of style and social meaning, and is essential groundwork for enhancing research on sociolinguistic perception.

In one prior study investigating relationships between sociolinguistic features in perception, Campbell-Kibler (2012) demonstrated that American English-speaking participants had implicit associations between (ING) (as in *talking* produced as *talkin'* [tɔkɪn] vs. *talking* [tɔkɪŋ]) and /aɪ/ monophthongization (as in *pie*, [pa:] vs. [paɪ]), but not between (ING) and /t/ release (as in *bat*, [bæt<sup>h</sup>] vs. [bæt<sup>ʔ</sup>]). This result (discussed in more detail in §2) suggests that listeners maintain associations between multiple stylistically coherent variants in representation, congruent with an account where styles, rather than individual variables, are the units being produced and perceived. In the present paper we expand upon this notion, investigating a similar set of variants but aiming to gain converging evidence across tasks and modalities, in order to consider the cognitive representation of social meaning in both perception and production. To do so, we investigate whether being asked to produce a marked variant of a salient variable (*-in*), indexically linked to Southern American English and casualness, triggers associations with other stylistically coherent variants (e.g., /aɪ/ monophthongization, /t/ realization), to the point that those variants also become a part of a speaker's performed production alongside *-in*. This task not only taps into how stylistically congruent variants may be represented, but can also gauge when these variants are used in production. Before discussing our data, we review prior literature about style, social meaning, and mental representation, as well as stylistic covariation among multiple features in perception and production. We intend for the present work to help advance the conversation on social meaning in cognition by pulling together the often disparate considerations of the cognitive representation of linguistic forms and the sociolinguistic exploration of social meaning. Further, we demonstrate ways in which the study of sociolinguistic perception can be enhanced by a stronger understanding of cognitive representation of sociolinguistic variation.

### 1.1. Social meaning, style, and their cognitive representations

The study of social meaning in sociolinguistics has advanced over the past several decades as researchers have increasingly turned attention to the many ways that language conveys meaning beyond the purely linguistic (e.g., CAMPBELL-KIBLER, 2009; D'ONOFRIO, 2018; PHARAO *et al.*, 2014; PODESVA *et al.*, 2015; VILLARREAL, 2018). For example, Campbell-Kibler (2009) demonstrated via a perception-based methodology that listeners make different inferences about a speaker's intelligence depending on their realization of variable (ING). Early work in the field focused on the social meaning of sociolinguistic variants as inferred from correlations of patterns of use in production. For instance, in Labov's ground-breaking (1963) study, island-oriented residents on Martha's Vineyard centralized the low diphthongs /aɪ/ and /aʊ/, so centralized /aɪ/ and /aʊ/ were interpreted as indexing an island-oriented identity. With the third wave framework's emphasis on indexicality, newer production studies have revealed even more nuanced facets of social meaning (e.g., ECKERT, 2011; PODESVA, 2007; ZHANG, 2008). For example, Podesva (2007) shows how falsetto phonation becomes a part of presenting a gay identity and associated with gay-sounding speech through that feature's role in contributing to an expressive meaning, which in turn leads to its connection to associated personae (e.g., diva). Thus, both perception and production methodologies have advanced and continue to advance the study of social meaning.

Despite this wide-ranging study of social meaning, relatively little work has examined its cognitive underpinnings, though this is a growing area of inquiry (e.g., CAMPBELL-KIBLER, 2012, 2016; DRAGER; KIRTLEY, 2016; HAY *et al.*, 2019; LEVON, 2014; NIEDZIELSKI; PRESTON, 2000). How do language users represent the social meaning of variants? How are these social meanings accessed in the course of language processing and social cognition? Much work in this area calls on exemplar theoretic frameworks that posit linkages in memory between linguistic forms and social information to account for mutual influence between the linguistic and the social (e.g., PIERREHUMBERT, 2001, 2006; SUMNER *et al.*, 2014). Under hybrid, dual-route implementations of exemplar models, for example, wordforms are stored with a detailed distribution of phonetic and social information alongside more abstracted forms of such information. Encountering new exemplars updates this distribution, and this representation is accessed, though in different ways, for perception and production.

A cognitive framework provides an important backdrop for theorizing about the mechanisms necessary for linking linguistic and social information. For example, Niedzielski and Preston (2000) and Preston (2010) consider potential steps involved in making social judgments based on linguistic forms using a connectionist network as a schema. The authors posit that this task may involve the following steps (paraphrased from PRESTON, 2010): (1) A hearer notices a production of *pen* as [pɪn], (2) classifies that production as “Southern U.S.,” (3) retrieves caricatures of “Southerners” from mental representation and imbues the production of [ɪ] with them, and (4) responds with an evaluation. We note that such an approach shares some (but not all) characteristics with well-developed predictive models of person construal (e.g., FREEMAN; AMBADY, 2011) and stereotype formation and activation (MACRAE; BODENHAUSEN, 2001) in social psychology, where categories and attributes exist in linked networks. Preston suggests that a shortcut from steps 2-4 is taken when the variant is more directly associated with the evaluation due to frequency and salience of association between variant and group identity (e.g., when it has undergone iconization; IRVINE, 2001). In each case, the assumption underlying this approach is that variants have links to their social meanings in mental representation, derived from associations with groups of speakers or styles. This linkage raises a related question long-discussed by scholars of indexicality in language, but which has not been directly addressed cognitively: whether styles are built bottom-up, from variants (e.g., OCHS, 1992), or top-down, from registers (e.g., AGHA, 2003; SILVERSTEIN, 2003). We return to this question in §4. The present study does not constitute an empirical test of such models, but rather seeks to expand the range of sociolinguistic phenomena that cognitive models should account for. As the work reviewed here has demonstrated, richer models of how linguistic and social forms are cognitively represented are important for understanding both sociolinguistic production and perception.

## 1.2 Stylistic covariation in production and perception

A crucial observation in the study of social meaning and style is that individual variants do not exist in isolation, but rather show patterns of co-occurrence with other variants, which together make up a style (e.g., AGHA, 2003; AUER, 2007; ECKERT, 2008, 2012; ECKERT; RICKFORD, 2001; ERVIN-TRIPP, 1972; LEVON, 2007;

PODESVA, 2008, 2011; RICKFORD; MCNAIR-KNOX, 1994; SCHILLING-ESTES, 2004; SHARMA; RAMPTON, 2015; ZHANG, 2005, 2008). That is, in conversational settings, speakers manipulate a constellation of cues simultaneously. For instance, in their classic study Rickford and McNair-Knox (1994) demonstrate how a speaker, Foxy Boston, modulated several features of African American Vernacular English together across two interviews (and between different topics within interviews) in ways that patterned with differences between the interviewers. Zhang (2005) explores how local and non-local features of Mandarin were collectively manipulated by two different groups of Chinese professionals in Beijing in order to present different kinds of professional personae. Based on observations such as these, Eckert (2008) describes stylistic practice as a process of bricolage where speakers, and listeners, make use of the indexical associations (the indexical field) of variants to perform, enact, and interpret a range of identities.

Covariation among multiple features in speech has been an important focus not only in sociolinguistics but in phonetics more generally, which has demonstrated that the instantiation of different speech sounds is not completely independent, particularly within individual speakers (e.g., ALLEN; MILLER; DESTENO, 2003; CHODROFF; WILSON, 2017; NEWMAN; CLOUSE; BURNHAM, 2001; THEODORE; MILLER; DESTENO, 2009). The extent to which group-level phenomena like lects and coherent styles can be characterized by systematic covariation between features on a group vs. individual level has garnered mixed results (e.g., BECKER, 2016; BIGHAM, 2010; GREGERSEN; PHARAO, 2016; GUY, 2013; GUY; HINSKENS, 2016; TAMMINGA, 2014). However, characterizations of regional accents by analysts, of course, are made in terms of sets of co-occurring phonetic features (e.g., LABOV; ASH; BOBERG, 2006). Southern American English speech, for instance, is described by the phonetic properties of a range of vowels (e.g., FRIDLAND, 2001), by consonant features like /ɪ/-lessness (e.g., FEAGIN, 1990), by prosodic patterns such as slower speech rate (e.g., KENDALL, 2013) (and also by lexical, morphosyntactic, and pragmatic features; e.g., JOHNSTONE, 1999).

Further, recent work in perception has suggested that listeners may be aware of the cues that covary within styles (SUMNER *et al.*, 2013; VAUGHN; KENDALL, 2018), and that listeners can attach social meaning to such covariation (e.g., CAMPBELL-KIBLER, 2009, 2011;

LEVON, 2007, 2014; PHARAO *et al.*, 2014). Sumner *et al.* (2013) found that a variant's realization (i.e., word-medial /t/ as tapped or released) is processed by listeners with reference to the speaking style in which that variant usually occurs (i.e., casually or carefully). And, Vaughn and Kendall (2018) found that when listeners were asked to classify which variant of (ING) they heard in a sentence (*-ing* or *-in*), they were sensitive to cues in the signal beyond the variant itself. In that study, the carrier "frame" sentence (whether the speaker originally produced the sentence with *-ing* or *-in*) significantly interacted with the actual realization of the variable (cross-spliced *-ing* or *-in*) to influence listeners' classifications, suggesting that covarying cues were used by listeners.

In terms of perception of social meaning, Levon (2007) details how pitch range and sibilant duration work in tandem to affect listeners' ratings of speakers on an effeminate to masculine scale, supporting "a gestalt-like understanding of indexicality... whereby linguistic features are not only salient on their own but can also work in clusters to achieve social-indexical significance" (p. 546). Relatedly, prior work has shown that certain linguistic features are only effective indexical triggers when not "blocked" or "indexically bullet-proofed" by the presence of other features (CAMPBELL-KIBLER, 2011; LEVON, 2014; PHARAO *et al.*, 2014). Whether this phenomenon is because listeners display different degrees of attention to different features, or because the weighting of one feature's indexical meaning is dependent upon the presence of other features, is an open question (see discussion in LEVON, 2014), but the central point is that there is an interplay among multiple variants in the construction of social meaning. Findings such as these in perception, that listeners are sensitive to subtle covarying cues, and that social meaning is contextually mediated across multiple variants, indicate the likelihood of indexical linkages between variants, and invite further investigation into the relationship between such variants and related social meanings in the mind.

Despite the attention to social meaning in cognition (reviewed in §1.1), and the attention to stylistic covariation among multiple variants (reviewed in §1.2), thus far there is little work explicitly investigating the intersection of these areas, the relationships among multiple variants with shared indexical meanings in cognition (but see CAMPBELL-KIBLER, 2012). A related study, Kim and Drager (2017), found that being primed with a variant that signals a sound change in progress in Korean (and

thus points to the speaker being a certain age) facilitated listeners' lexical access to words congruent with the inferred age of the speaker. This is in line with work that more generally shows that expectations about talkers can affect speech perception (e.g., STRAND; JOHNSON, 1996; SZAKAY; BABEL; KING, 2016; VAUGHN, 2019; WALKER; HAY, 2011). Many open questions regarding the cognitive representation of covarying features remain, however. In particular, are multiple variants linked in mental representation via congruent social meanings? Given that listeners are able to identify styles and lects based on shared linguistic features (e.g., CLOPPER; PISONI, 2007; D'ONOFRIO, 2018), it is likely that such a pathway exists. Thus, to advance the study of sociolinguistic perception, it is crucial to better understand cognitive associations between multiple variants that share indexical links. In the next section, we discuss a study that has examined this question in detail, Campbell-Kibler (2012), before going on to describe the present study.

## 2 The present study

Campbell-Kibler (2012) used an Implicit Association Task to infer the existence of several links in mental representation, between variants and social meanings (Experiment 1), and between multiple variants sharing a social meaning (Experiment 2). The task, originally developed by social psychologists for understanding implicit biases, essentially measures the degree to which participants can un-link associations they have formed. More specifically, the test asks whether participants have associations between two constructs (e.g., gender, and ability in STEM fields) in a particular direction, as measured by the difference in reaction times when the two constructs are paired in one direction (e.g., males: good at STEM fields, females: bad at STEM) versus the other (e.g., males: bad at STEM, females: good at STEM). Campbell-Kibler (2012) used the methodology to demonstrate that participants had associations between *-in* variants and Southernness, and between *-in* variants and /aɪ/ monophthongization (which share an indexical link to Southernness), but not between *-in* variants and /t/ release (which she argued do not have as salient an indexical connection).

Such findings are suggestive of socially mediated cognitive connections between variants and are central for the advancement of understanding sociolinguistic perception. As a way to provide converging



evidence, and to build on the findings of Campbell-Kibler (2012), the present study considers how production data can be explicitly mobilized to address cognitive representation. To do this, we draw on recorded sentence productions from four non-Southern American English speakers who were asked to read a series of simple sentences, each of which contained one word with word-final (ING), in two guises—one with the (ING) word realized in its standard *-ing* form and one with the (ING) produced as *-in*. (We further explain the production task, the features we examine, and our findings in detail in the sections that follow.)

Although production analyses have been the mainstay of sociolinguistic research over the past half century, here we use a slightly different type of production task, sentence reading, for a new purpose, to make inferences about mental representation. We investigate whether, when asked simply to produce *-in* for *-ing* in a laboratory reading task, speakers employ other variants sharing a social meaning with *-in*. We measure the extent to which producing the variant *-in* leads to systematic shifts in the production of other variants, and use those findings as an indirect indication that coherence in social meaning can serve as a cognitive link between variants. Such a pattern, taken along with Campbell-Kibler's (2012) results, would add to the suggestion that "linguistic forms with similar social indexes are associated with one another" (CAMPBELL-KIBLER, 2012, p. 758). These potential patterns would be consonant with theories of enregisterment, discussed further in §4, which posit that variants in fact gain meaning by virtue of their being located within socially situated clusters or lects (AGHA, 2003; JOHNSTONE, 2016). We note that performance speech, related to but not identical to the elicited speech we analyze here, has been suggested as a useful site to examine features and their associations: "... there is evidence that the greater perceptual awareness speakers have of a given language feature (whether this awareness is at the conscious level or not), the greater the extent to which the feature will figure in their demonstrations and discussions of the language variety in question" (SCHILLING-ESTES, 1998, p. 64).

Following Campbell-Kibler (2012), in this study we focus on the *-in* variant of the sociolinguistic variable (ING). *-in* is a variant with a strongly documented set of social meanings, and English (ING) is one of the most well-studied variables in sociolinguistics, with robust reports of its patterns in speech from many English-speaking communities around

the world (e.g., FISCHER, 1958; FORREST, 2015; HAZEN, 2008; KENDALL, 2013; LABOV, 2001; TAGLIAMONTE, 2004). (ING) is useful for our purposes for numerous reasons, especially because there is evidence that the realization of (ING) has been shown to trigger different social evaluations of speakers. For example, as mentioned above, Campbell-Kibler (e.g., 2007, 2009) has shown that listeners' inferences about speakers across a range of dimensions (e.g., accented, casual, intelligent, Southern) are affected by a speaker's realization of (ING). Specifically, the *-in* variant is associated with Southern American English speech; Southernness has been consistently identified in the literature as being part of, and the strongest member of, the indexical field of *-in* (CAMPBELL-KIBLER, 2007, 2012; ECKERT, 2008), along with *-in*'s other meanings like lower perceived socioeconomic status, articulateness, and education. In fact, several of the (non-Southern) speakers in our study, overtly and unprompted, remarked on their associations between the *-in* variant and Southernness, noting when exiting the sound booth after their recording session that they felt like they "became Southern" by the end of the production task where they produced sentences with *-in* forms. Southern American English itself can be considered an enregistered variety (e.g., CAMPBELL-KIBLER, 2012; CRAMER, 2013; JOHNSTONE, 1999; LIPPI-GREEN, 2012; PRESTON, 1997), with certain features (including *-in* and /aɪ/ monophthongization; CAMPBELL-KIBLER, 2012; LABOV *et al.*, 2006) being more stereotypically associated with the variety than others. Work in perception has shown that the social meaning of different variants is moderated by the relative salience of the variant (LEVON; FOX, 2014), making *-in*'s strong associations with Southernness in the U.S. an important property for its use in this study. In sum, due to its well-established linkages with social meanings, and its status as a salient feature of an enregistered style, *-in* may be an especially effective trigger of stylistic covariation.

## 2.1 The task, speakers, and materials

In this study, we analyze production recordings collected as part of the stimulus creation process for Vaughn and Kendall (2018). 141 sentences were created, each containing one critical (ING) word (e.g., *I'm having a hard time with my homework*; see VAUGHN; KENDALL,

2018 for further details<sup>1</sup>). The 141 sentences included a total of 56 distinct (ING) word types (e.g., *morning*, *thinking*). The position of the (ING) word in the sentence varied across sentences, and sentences also varied along a range of (ING)'s internal conditioning factors, including grammatical category and phonological environment.

Four female native English speakers, all linguistics undergraduate students at the University of Oregon, were recruited to record the sentences. Two of the speakers were from Southern California (SA, age 18; SH, age 23), and two were from Oregon (HI and KY, both age 18). Three self-identified as Caucasian, and one self-identified as mixed race (Caucasian and Asian). Speakers were asked to produce the sentences as naturally as possible, and all were aware of and able to produce the difference between *-ing* and *-in* forms. No mention was made to the speakers of indexical associations or expectations about (ING) and its covariates.<sup>2</sup> Recordings were conducted with each speaker alone in a sound-attenuated booth using a Shure SM93 microphone and a Marantz PMD-661 recorder. Each speaker first read all 141 sentences as they were displayed on the screen in their *-ing* form (e.g., *I prefer swimming in the*

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<sup>1</sup> These sentence recordings were collected in order to create stimuli for Vaughn and Kendall (2018), a perception study examining listener sensitivity to the grammatical category conditioning of (ING). For that study, a subset of 24 unique sentences were selected for each speaker “based on naturalness, fluency, and prosodic similarity across frames” for a total of 96 sentences. We note that the selection of those 96 sentences was done impressionistically, not based on the acoustic measures examined in the present analysis. Importantly, the patterns of covariation uncovered in this paper for the entirety of the recorded sentences (N = 141 sentences x 2 variants = 282/speaker) are consistent with the frame/realization interaction found in Experiment 2 (VAUGHN; KENDALL, 2018) for the cross-spliced version of the selected subset of these stimuli, providing some suggestions about the basis of that interaction effect. The findings in the present paper cannot account, however, for the central question of interest in Vaughn and Kendall (2018) regarding listener sensitivity to the (ING) word's grammatical category.

<sup>2</sup> Nonetheless, due to the salience of *-in* and its representativeness of the enregistered Southern style, it is of course possible that speakers operationalized our instruction to produce the sentences with *-in* forms as an instruction to enact a style or persona associated with *-in*. Although we cannot rule out this possibility (which in fact supports the idea that variants accrue meaning in the context of styles), we do not believe that speakers began the task with this directive in mind, since speakers who overtly remarked on the fact that they “became Southern” seemed surprised by this behavior.

*ocean*), and then read all 141 sentences as they were displayed on the screen in their *-in* form (e.g., *I prefer swimmin' in the ocean*). We refer to these as different guises or versions of each sentence.

## 2.2 Additional sociolinguistic variants examined

In this paper, we ask whether these four speakers (who, importantly, were not speakers of Southern U.S. English) use more features associated with *-in* (especially via *-in*'s Southern social meaning) in sentences where they were asked to produce (ING) as *-in* than in sentences where they were asked to produce (ING) as *-ing*. Campbell-Kibler (2011) suggests that variants are the site of social meaning (e.g., *-in*), rather than variables (e.g., (ING)), and here we specifically examine the indexical field of the variant *-in*, the marked variant of variable (ING). Further, given the relatively formal task of producing sentences in a laboratory, our predictions center around the *-in* productions of these sentences, the variant that is not expected to be the norm in this more formal setting.

We examine speakers' productions of a range of phonetic features associated with the indexical field of *-in*, specifically Southernness but also casualness. Following Campbell-Kibler (2012), we investigate /aɪ/ glide length and /t/ realization, but also include a number of other features linked to the social meanings of *-in* to get a more complete picture, including features associated with Southernness like: proximity of /e/ and /ɛ/, duration of /ɛ/ and /t/, and speaking rate. Below, we discuss the known associations of these features with salient social meanings of *-in*, and include details about how each variant was measured in our production data. Predictions from prior literature about how each feature would be expected to co-vary with *-in* are summarized in Table 1; that is, for each variable, we offer predictions about the directions of any covariation effects if the measures were to show congruence with the social meanings of *-in* (again, primarily focusing on its primary association with Southernness). Any observed covariation in speech production in the direction predicted by stylistic congruence we take as converging evidence—with Campbell-Kibler's (2012) perception results—for connections in mental representation between variants and their social and stylistic meanings.

/aɪ/-glide length: /aɪ/ monophthongization is a commonly described feature of Southern American English, both in the research literature as a key piece of the Southern Vowel Shift (SVS) (FRIDLAND, 2003; KURATH; MCDAVID, 1961; LABOV *et al.*, 2006) and in popular awareness (NIEDZIELSKI; PRESTON, 2000). Shorter /aɪ/ glides, representing more monophthongal articulations, would be expected for more Southern-like productions. As noted above, Campbell-Kibler (2012) found associations between *-in* and /aɪ/ monophthongization in her Implicit Association Task. Thus, we ask: do shorter /aɪ/ glides co-occur with *-in* productions? In our data, glide lengths for /aɪ/ vowels were measured as the Euclidean distance between normalized F1 and F2 values at the 20% and 80% points in each /aɪ/ vowel's duration (corresponding to the Vector Length measurement of FOX; JACEWICZ, 2009 and FARRINGTON *et al.*, 2018).

Proximity of mid front vowels /e/ and /ɛ/: The Southern Vowel Shift (SVS) involves a spectral (near-)reversal of the positions of /e/ and /ɛ/. Several studies have suggested that /e/-/ɛ/ Euclidean distance is a useful measure of how Southern a speaker sounds (GUNTER; VAUGHN; KENDALL, under review; FARRINGTON *et al.*, 2018; KENDALL; FRIDLAND, 2012), with smaller /e/-/ɛ/ Euclidean distances corresponding to more Southern-like speech. So, do sentences with *-in* productions also show more proximal /e/-/ɛ/ vowels? In our data, relative positions of mid-front vowels were assessed through a measure of the Euclidean distance between each speaker's mean F1 and F2 for /e/ and for /ɛ/ for each guise.

Duration of lax vowels /ɛ/ and /ɪ/: The lax front vowels /ɛ/ and /ɪ/ are known to be lengthened in Southern speech (CLOPPER *et al.*, 2005; FRIDLAND *et al.*, 2014). We ask: are /ɛ/ and /ɪ/ vowels longer in the *-in* versions of sentences? Durations were measured for all tokens of the lax vowels /ɛ/ and /ɪ/ with primary stress (as such, no tokens of /ɪ/ came from productions of the (ING) variants [ɪŋ] or [ɪn]), and were natural log transformed for analysis.

Speaking rate: In addition to containing long lax vowels, Southern speech is described as being slower overall than non-Southern speech (e.g., JACEWICZ *et al.*, 2010; KENDALL, 2013). Therefore, will we observe slower speech in *-in* versions of sentences? Speaking rate was calculated as the number of syllables produced in each sentence divided by the temporal duration of the sentence. Syllables were counted using

an automated script from Kendall (2013). (Although several other temporal measures could be relevant here, such as overall utterance length or average word length, these measures are entirely correlated with speaking rate in our stimuli since the *-ing* and *-in* sentence productions were matched word-for-word. Thus, we limit our examination of gross temporal measures to speaking rate.)

Intervocalic /t/ realizations: As noted earlier, Campbell-Kibler (2012) examined but did not find associations between *-ing* and /t/ release in her Implicit Association Task. Here we also examine realizations of /t/ to assess its covariation with (ING) realization in our production data. In American English, word-medial, intervocalic /t/s are often produced as flaps or taps (e.g., PATTERSON; CONNINE, 2001; SUMNER *et al.*, 2013), and in laboratory phonetics work, intervocalic /t/ realizations are often considered and measured on a cline from flapped (highly reduced, short, etc.) to released (more intense, long, etc.) (e.g., BYRD, 1994; WARNER; TUCKER, 2011). In sociolinguistics, /t/ realization has often been measured as released vs. not released (e.g., CAMPBELL-KIBLER, 2012; PODESVA *et al.*, 2015). We thus assess /t/ realizations in each of the two following ways:

Prior sociolinguistic work on /t/ variation and social meaning has primarily focused on characteristics of /t/ release (BENOR, 2001; PODESVA *et al.*, 2015; WOLFRAM *et al.* 2016), which has been associated with meanings such as intelligence and articulateness. Hence, /t/ releases were expected by Campbell-Kibler (2012) to co-occur with *-ing*. Podesva *et al.* (2015) find that word-medial /t/ release (e.g., *butter*) is perceived as more socially meaningful than word-final /t/s (e.g., *closet*). Thus, we analyzed all word-medial intervocalic /t/ realizations following the methods of Podesva *et al.* (2015): each word-medial intervocalic /t/ in the stimuli was manually coded into one of four categories (released, flapped, glottalized, or deleted), based on a combination of auditory and spectrographic evidence. Following prior work on /t/ release, we consider the use of released word-medial /t/ relative to all other realizations (flapped, glottalized, or deleted).

We also examine /t/ realization in a more gradient, phonetic way. Another part of *-in*'s indexical field, casualness, would predict shorter and more reduced /t/ in intervocalic position. Warner and Tucker (2011) quantified /t/ realizations in terms of reduction using several measures including intensity difference, the difference between the

average intensity of the surrounding vowels' maximum intensity and the intervocalic /t/'s minimum intensity. We implemented the intensity difference measure following the methods of Warner and Tucker (2011) as a gradient metric of /t/ realization, calculated for all instances of intervocalic /t/ in the dataset. Reduced /t/s, as indicated by less intensity difference, would be expected in more casual speech.

TABLE 1 – Phonetic features included in analysis, with predictions and selected citations

<i>Phonetic feature</i>	<i>Prediction and citations</i>
<i>/aɪ/-glide length</i>	Shorter = Co-occur with <i>-in</i> (Southern meaning of <i>-in</i> ) E.g., FRIDLAND, 2003; KURATH; MCDAVID, 1961
<i>Proximity of mid front vowels /e/ and /ɛ/</i>	More proximate = Co-occur with <i>-in</i> (Southern meaning of <i>-in</i> ) E.g., FARRINGTON <i>et al.</i> 2018; KENDALL; FRIDLAND, 2012
<i>Duration of lax vowels /e/ and /ɪ/</i>	Longer = Co-occur with <i>-in</i> (Southern meaning of <i>-in</i> ) E.g., CLOPPER <i>et al.</i> , 2005; FRIDLAND <i>et al.</i> , 2014
<i>Speaking rate</i>	Slower = Co-occur with <i>-in</i> (Southern meaning of <i>-in</i> ) E.g., JACEWICZ <i>et al.</i> , 2010; KENDALL, 2013
<i>Intervocalic /t/ realization</i>	Fewer /t/ releases = Co-occur with <i>-in</i> (Less articulate meaning of <i>-in</i> ) E.g., BENOR, 2001; PODESVA <i>et al.</i> , 2015 More reduction (less intensity difference) = Co-occur with <i>-in</i> (Casual meaning of <i>-in</i> ) E.g., BYRD, 1994; WARNER; TUCKER, 2011

### 2.3 Acoustic analysis procedure

Analysis began by first RMS amplitude normalizing all recordings to 70 dB SPL in Praat (BOERSMA; WEENINK, 2018). Then, we created phone-level alignments for all sentence productions for the four speakers (141 sentences x 2 guises x 4 speakers = 1,128 sentences), using the Montreal Forced Aligner (MFA; MCAULIFFE *et al.*, 2017). MFA was configured using the standard English phonological model and a customized dictionary that included all of the words in our stimuli along with two pronunciations for each (ING) word, one ending in /ŋ/ and one ending in /n/. The output of the forced alignment process was checked by hand but after determining that the alignment

appeared accurate no changes were made to the alignment boundaries. Following alignment, a combination of Praat and R (R DEVELOPMENT CORE TEAM, 2018) scripts were used to extract many measures. The Penn FAVE-extract suite (ROSENFELDER *et al.*, 2011) was used to extract formant measures. Vowel formant data were normalized using the Lobanov method (LOBANOV, 1971) using the vowels.R package (KENDALL; THOMAS, 2009). In addition to making formant data more comparable across speakers, this normalization technique also puts F1 and F2 on more comparable scales, making Euclidean distance measures appropriate for vowel data (KENDALL; FRIDLAND, 2012, fn. 7).

### 3 Findings

We analyzed the phonetic features described in §2.2 in these recordings in order to explore what happens when a speaker is asked to perform or enact not a style, but a single feature (*-ing* or *-in*). Is the realization of other features linked to *-in* via social meanings also affected? Before examining overall statistical models, we begin by considering how much each individual speaker's productions conform to the stylistic covariation predictions from Table 1 for each feature. We do this by visualizing and impressionistically describing the data by speaker. To examine the vocalic spectral features, Figure 1 displays vowel plots for each speaker, highlighting /aɪ/-glide length and the relative positions of /e/ and /ɛ/. From the figure, we observe that for three speakers (all but SH) /aɪ/ glides are shorter for *-in* versions of the sentences (in blue) than for the *-ing* versions (in red), showing stylistic congruence for those speakers. /e/ and /ɛ/ are visibly more proximate in the *-in* sentences for all four speakers, also suggesting socially meaningful coherence between variants.



FIGURE 1 – Vowel plots by speaker, highlighting /aɪ/-glide length and /e/-/ɛ/ spectral positions for *-in* and *-ing* sentences. Shorter /aɪ/ glides and more proximate /e/-/ɛ/ are congruent with more Southern-like productions.

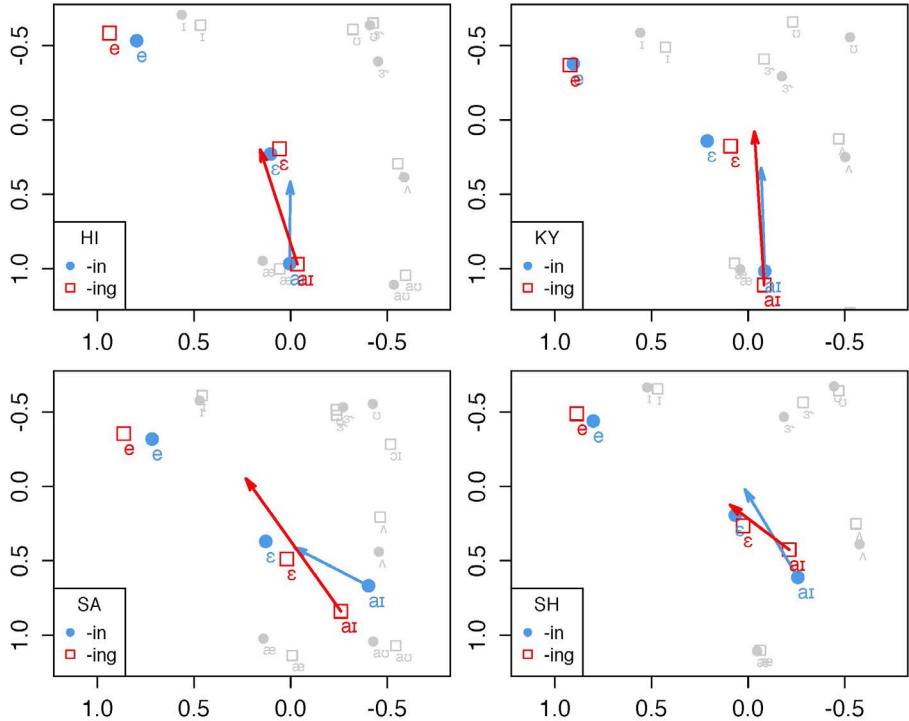


Figure 2 displays a boxplot of durations of the front lax vowels for each speaker. The figure suggests that two speakers, HI and KY, conform to the predictions for Southern style, realizing longer (more Southern-like) lax vowels in *-in* sentences than *-ing*. The vowel durations for the other two speakers, SA and SH, however, appear to be relatively similar across sentence guises. Altogether, the vocalic features show a tendency for some speakers to realize more Southern-styled vowels in their *-in* sentences than in their *-ing* versions of the same sentences.

FIGURE 2 – Lax vowel (/ɛ/ and /ɪ/) durations by speaker, for *-in* and *-ing* sentences. Longer durations for lax vowels are more congruent with Southern-like productions.

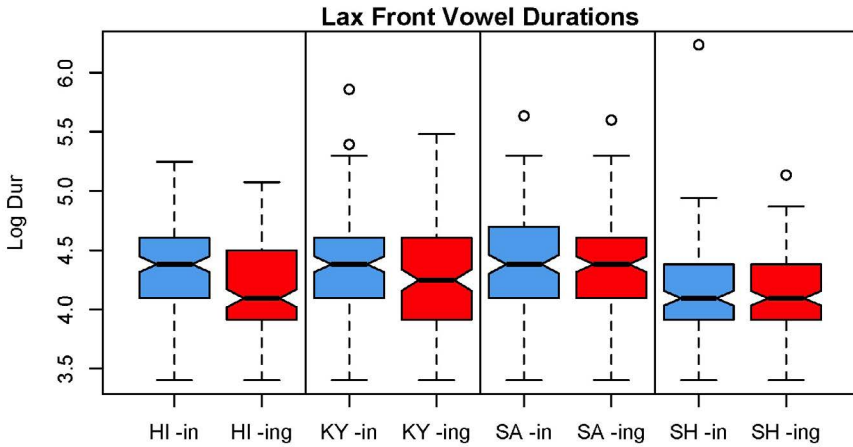
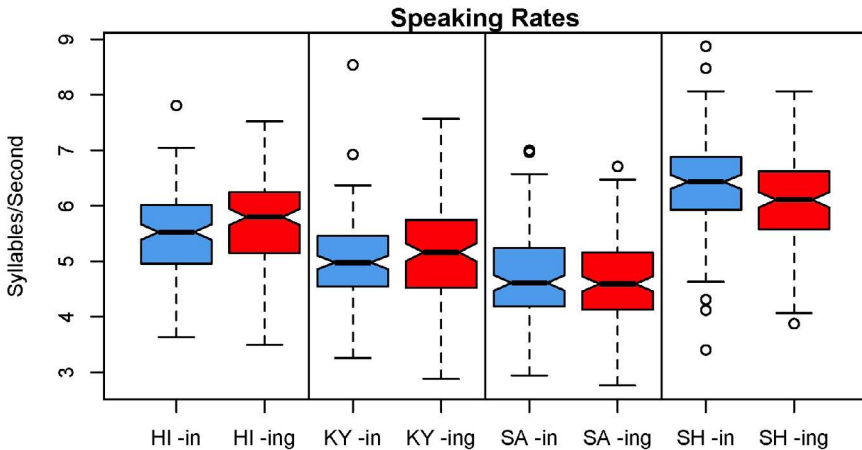


Figure 3 displays a boxplot of the speaking rate data. Speakers HI and KY appear to align with the stylistic prediction for speaking rate, producing *-in* sentences at slower rates than *-ing* sentences. SH, on the other hand, patterns in the opposite direction, speaking faster in *-in* sentences than in *-ing* sentences. SA produces both sets of sentences with similar rates. Thus, our speakers realize all three possibilities for speaking rate.

FIGURE 3 – Speaking rate by speaker, for *-in* and *-ing* sentences. Lower (slower) speaking rate values are more congruent with Southern-like productions.



Finally, Figure 4 displays the distribution of intervocalic /t/ realizations and Figure 5 displays intervocalic /t/ reduction as measured by intensity differences between the /t/ and its surrounding vowels. Figure 4 shows that all four speakers release /t/s much more often in *-ing* sentences than in *-in* sentences, and glottalize and delete /t/s much more often in the *-in* sentences. The impressionistic data of Figure 4 is congruent with Warner and Tucker’s (2011) acoustic measure of /t/ reduction, shown in Figure 5; to varying degrees, the speakers show more intervocalic /t/ reduction in terms of larger intensity differences in *-in* sentences than in *-ing* sentences. This corresponds to the prediction that intervocalic /t/s would show greater evidence of associations with casual speech in *-in* sentences, although we also observe substantial intraspeaker variation in this measure.

FIGURE 4 – Intervocalic /t/ realizations by speaker, for *-in* and *-ing* sentences. Fewer released intervocalic /t/s are congruent with more casual-like productions.

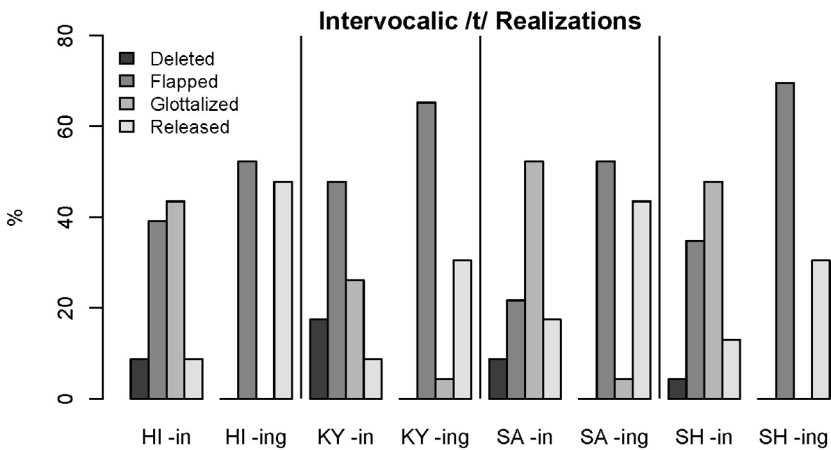
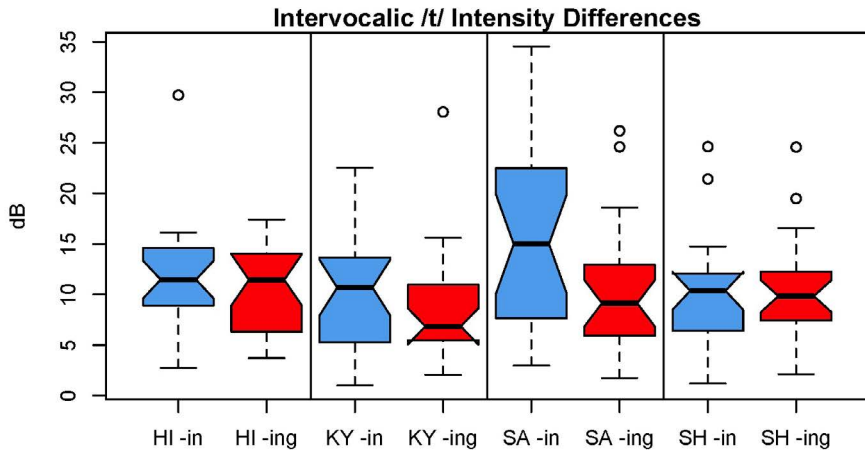


FIGURE 5 – Intervocalic /t/ reduction by speaker, for *-in* and *-ing* sentences. Larger values are more reduced, more congruent with casual-like productions.



In general, we observe many instances of stylistic congruence across speakers, with a certain amount of by-speaker variation. As discussed above, such individual variation is expected given that speakers have unique linguistic and social backgrounds, leading to unique sociolinguistic repertoires of variants and styles. Having reviewed the general patterns of these features in *-in* vs. *-ing* versions of sentences for individual speakers, we now consider what patterns arise as significant behaviors across all speakers. Table 2 displays the results from statistical analyses of the measures for the whole dataset. Recordings were analyzed for whether each acoustic measure significantly differed according to (ING) realization, *-in* vs. *-ing*, in line with predictions about stylistic covariation (from Table 1, relisted in Table 2). Details about the analysis and statistical modeling for each feature are listed in the Appendix.

TABLE 2 – Overall statistical results by acoustic feature, given in relation to predictions from Table 1. See Appendix for statistical details.

<i>Phonetic feature</i>	<i>Predictions</i>	<i>N</i>	<i>Results</i>
<i>/aɪ/-glide length</i>	Shorter = Co-occur with <i>-in</i>	692 (≈173/speaker)	Shorter co-occurred with <i>-in</i> <i>-in</i> : $\beta = -0.118$ , $\chi^2 = 4.98$ , $p = 0.026$
<i>Positions of mid front vowels /e/ and /ɛ/</i>	More proximate = Co-occur with <i>-in</i>	8 Euclidian distance values (1 calculated per-guise per-speaker)	More proximate co-occurred with <i>-in</i> Mean of diff: -0.183; $t = -5.11$ , $p = 0.014$
<i>Duration of lax vowels /e/ and /ɪ/</i>	Longer = Co-occur with <i>-in</i>	1,169 (≈152 /ɪ/ per speaker, ≈141 /e/ per speaker)	Longer co-occurred with <i>-in</i> <i>-in</i> : $\beta = 0.093$ , $\chi^2 = 27.18$ , $p < 0.001$
<i>Speaking rate</i>	Slower = Co-occur with <i>-in</i>	1,128 (282/speaker)	Did not sig. co-occur with <i>-in</i>
<i>Intervocalic /t/ realization</i>	Fewer /t/ releases = Co-occur with <i>-in</i>  More reduction = Co-occur with <i>-in</i>	184 (46/speaker)	Fewer /t/ releases with <i>-in</i> <i>-in</i> : $\beta = -1.996$ , $\chi^2 = 17.50$ , $p < 0.001$  More reduction co-occurred with <i>-in</i> <i>-in</i> : $\beta = 2.080$ , $\chi^2 = 8.42$ , $p = 0.004$

The overall patterns, as seen in Table 2, demonstrate that speakers indeed show significant stylistic covariation in line with indexical links to *-in* via Southern and casual styles, for most of the examined features. In sentences produced with (ING) as *-in* (compared to those produced with *-ing*), speakers produced variants with significantly shorter /aɪ/ glides, more proximate mid-front vowels, longer lax front vowels, fewer intervocalic /t/ releases, and more reduced intervocalic /t/s. As shown in Figure 3, individual speakers patterned differently from one another for speaking rate—two demonstrating slower speaking rates with *-in*, and one with faster speaking rates with *-in*—leading to no overall group pattern.

## 4 Discussion

While the data examined here only come from four speakers, and therefore the findings should be interpreted accordingly, the patterns uncovered demonstrate that, when simply asked to change the realization of (ING) across two productions of a set of sentences, these speakers manipulated features of their speech beyond solely the realizations of (ING). Specifically, when asked to produce sentences with the *-in* variant of (ING) words, speakers realized other features in a manner congruent with social meanings of *-in* (especially its association with Southernness). We interpret this covariation in production as evidence that speakers have formed cognitive links between variants, connected via shared social meanings. Indeed, as mentioned earlier, several of the speakers in the present study overtly remarked after the recording session that they felt like they “became Southern” by the end of the production task, during the *-in* production portion.

These overall patterns relate in important ways to Campbell-Kibler’s (2012) results asking similar questions using a perception methodology. Like that study, we also observed an association between *-in* and /aɪ/ monophthongization. Additionally, our speakers illustrated that they had an association between *-in* and fewer /t/ releases (and more /t/ reduction), a pattern not observed in Campbell-Kibler’s study. This discrepancy may perhaps be due to the fact that we limited our investigation of /t/ to word-medial contexts, which Podesva *et al.* (2015) found to have more salient social meanings to listeners, whereas Campbell-Kibler’s /t/ stimulus was word-final. Beyond the two covarying features investigated by Campbell-Kibler, we also found consistent associations between *-in* and two other vocalic variants (more proximate /e/ and /ɛ/ and longer /ɛ/ and /ɪ/ vowels). We did not find significant covariation overall between *-in* and slower speaking rate, but note that individual speakers patterned differently from one another for this feature, a point we return to below.

Again, we emphasize that the data examined here represent just a small foray into potential empirical work in this domain. That said, we believe they speak to important open questions. For the rest of the paper, we explore potential implications of these patterns for advancing our understanding of sociolinguistic perception, cognition, covariation, and social meaning, with the goal to inspire more work in the intersection of these areas.

To begin, we offer an analogy from another stylistic modality often compared to linguistic style, namely fashion (e.g., CAMPBELL-KIBLER, 2011; ECKERT, 2000). Consider a person, say a young American man in particular, getting dressed and deciding to wear a salmon pink polo shirt (analogous here to producing *-in*). That shirt decision may invoke the style “preppy”, which calls to mind other articles of clothing also associated with a “preppy” style. For instance, the dresser may then decide to wear khaki pants and loafers (wearing articles of clothing that co-occur stylistically). Of course, that person could have also ended up wearing the same outfit by first thinking “I want to dress preppy today” (analogous here to a directive to a speaker to, e.g., “talk Southern”, see EVANS, 2002), which then led them to select the individual articles of clothing. Our findings, however, suggest that it is possible to initiate the style “preppy”, and subsequent fashion choices, by an initial shirt selection. Producing *-in*/wearing a salmon pink shirt may call to mind a Southern/preppy style, which can affect other variant/clothing selections.

Thus, style shifting involving multiple variables may be achieved in a top-down or bottom-up way. A speaker could aim to convey a particular style (Southern/preppy) using a suite of stylistically covarying features (shorter /aɪ/ glides/khaki pants) to achieve that end, top-down. Or, stylistic covariation may be achieved bottom-up, where the use of a sufficiently prototypical or enregistered variant (*-in*/pink polo shirt) is linked to a style (Southern/preppy), which is associated with stylistically covarying features (again, shorter /aɪ/ glides/khaki pants) which can be optionally produced. Here we do not make claims about the degree of agentivity or awareness involved in this process, but simply note that the indexical links between variants sharing related social meanings are available to speakers upon the production of a particular salient form. With this analogy in mind, we explore the implications of these results for several areas, focusing especially on the mental representation of social meaning and on implications for sociolinguistic perception.

Our findings suggest that cognitive models positing links between linguistic variables and social meanings (e.g., DRAGER; KIRTLEY, 2016; FOULKES; DOCHERTY, 2006; KLEINSCHMIDT; WEATHERHOLTZ; JAEGER, 2018; NIEDZIELSKI; PRESTON, 2000; PIERREHUMBERT, 2001, 2006; SUMNER *et al.*, 2014) should also attempt to account for relationships among variants. That is, although much work has been

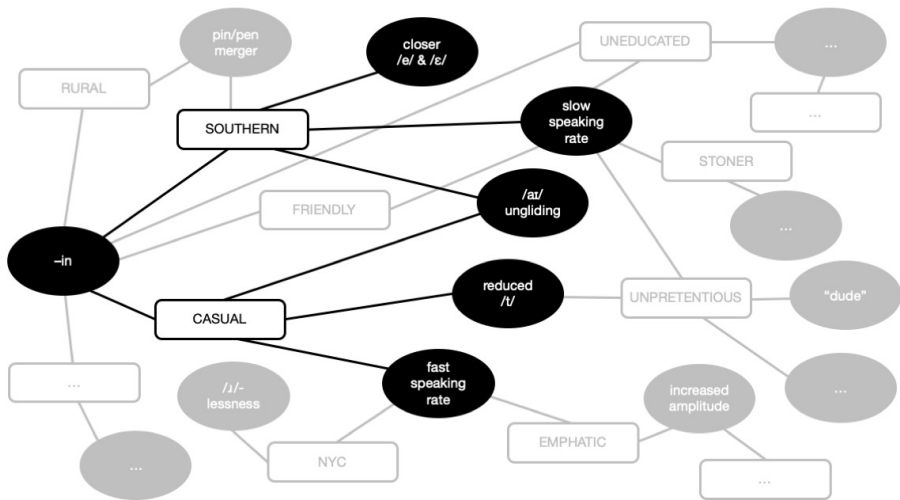
devoted to understanding patterns of socially-mediated covariation among variables in production (e.g., BECKER, 2016; BIGHAM, 2010; GUY, 2013; GUY; HINSKENS, 2016; GREGERSEN; PHARAO, 2016; TAMMINGA, 2014), and to exploring how multiple variants together affect social evaluations of speakers in perception (e.g., CAMPBELL-KIBLER, 2011; LEVON, 2007, 2014) the present findings push us to ask questions about the cognitive representation of such patterns. Figure 6 offers a visualization of one potential web of relationships between variants, as connected via social meanings. We suggest that our results support the notion that a variant of a variable (such as *-in*; ovals in Figure 6) may be linked in representation with variants of other variables that share social meanings (in rectangles). Encountering a variant (in this case by producing it) invokes an exemplar cloud populated with many speech forms that are congruent with that variant's social meaning. Importantly, in this view, relationships between variants and their social meanings are bidirectional, where it may be possible under some circumstances (see further discussion below) for each to activate the other. The bidirectional relationship between a variant and its social meaning is not only evident from this study, but also from prior work. For example, among other studies, Campbell-Kibler's prior work (2007, 2009, 2012) has shown that listeners can infer a social meaning after being presented with the variant *-in*. And, work showing that non-Southern speakers can imitate aspects of Southern speech when prompted (e.g., EVANS, 2002) demonstrates that speakers activate variants after being presented with the meaning "Southern". Further, this figure is compatible with findings that social meaning is listener-mediated, is emergent and constructed situationally, and is dependent on multiple variants and factors (CAMPBELL-KIBLER, 2011; ECKERT, 2008, 2012; LEVON, 2014; OCHS, 1992; PHARAO *et al.*, 2014); for the listener whose indexical associations are depicted in the figure, a fast speaking rate in concert with /ɪ/-lessness and other features may evoke a "New York City" style, while a fast speaking rate in concert with reduced /t/ may instead lead to an inference that the speaker is in a casual mode.

As a schematic representation of variants and social meaning, we recognize that Figure 6 in some way resembles an indexical field (ECKERT, 2008). However, our proposal explicitly does *not* suggest that indexical fields exist as cognitive representations in the mind; the indexical field is an analyst's construct, useful for delineating the



numerous social meanings a variant can take on across many speakers, across many contexts. Instead, our proposal pertains to the relationships between variants and their social meanings that an individual has formed throughout their history of sociolinguistic experiences.

FIGURE 6 – Cloud of indexically linked variants (ovals) and social meanings (rectangles). Black items are explicitly discussed in the current paper, gray items are based on prior literature. Ovals and rectangles containing “...” indicate that the web of variants and social meanings that an individual may have represented in their minds extends outward beyond what is shown in the figure.



In this study, we have shown evidence suggestive of stylistically congruent associations between variants in production, just as Campbell-Kibler (2012) has shown in perception. Establishing these links is an important step, but we note that this evidence and our schematic in Figure 6 do not presuppose that these associations will be used in the same way in production and in perception. That is, production and perception are not necessarily mirror images of the same process (PIERREHUMBERT, 2001, 2006; SUMNER; SAMUEL, 2009). Future work should more systematically test the mechanisms associated with this potential cognitive architecture. For example, it may be that associations among variants with a strongly activated social meaning may be a part of what weights speakers’ exemplar clouds toward the production of

stylistically congruent covariates (see PIERREHUMBERT, 2001). And, it may be that variants that covary with particularly prototypical variants of a given style may be more strongly encoded in the first place (see HAY *et al.*, 2015). In general, we suggest that further engagement with the social psychological literature regarding person perception and stereotype activation (e.g., FREEMAN; AMBADY; 2011, MACRAE; BODENHAUSEN, 2001), as has been undertaken in some sociolinguistic studies (e.g., CAMPBELL-KIBLER, 2009, 2012, 2016; LEVON, 2014), will point the way toward developing predictive models of indexical meaning that generate testable hypotheses.

Another line of prior work has implications for how multiple variants may be represented cognitively (TAMMINGA, 2014; TAMMINGA *et al.*, 2016). Tamminga (2014) finds different patterns of covariation in production among two variables, coronal stop deletion and /ð/-stopping, across stretches of talk for two speakers: for one speaker, more stop deletion covaries with more stopping of /ð/, and for the other, more stop deletion covaries with less stopping of /ð/. Tamminga *et al.* (2016) note that such covariation patterns can be caused by multiple factors. Among these potential sources are a speaker's implicit or explicit attempts at dynamic social positioning (which fall under their heading of *s-conditioning*), reliant on the activation of social or stylistic categories as in Niedzielski and Preston (2000), as well as sources like self-priming, a more speaker-internal cognitive factor (falling under their heading of *p-conditioning*). Indeed, as mentioned above, much work in experimental phonetics has shown that certain features covary for structural (e.g., articulatory and/or cognitive p-conditioning-like) reasons (e.g., ALLEN; MILLER; DESTENO, 2003; CHODROFF; WILSON, 2017; NEWMAN *et al.*, 2001; THEODORE *et al.*, 2009). Taken together with Tamminga *et al.*'s (2016) framework, then, we raise the possibility that some stylistic covariation across variants that share social meanings may be due to factors like priming.

Cognitive processes like priming, or associative learning and accessibility (e.g., KAPATSINSKI, 2018), are important pieces to consider in understanding representation, perception, and production as they relate to social meaning. Instances of variants sharing social meanings are likely to commonly co-occur, and those links are reinforced by societal language ideologies. Thus, if a social meaning of a given form, and other forms linked via that social meaning, are readily accessible

upon the production of that form, those associations will likely strengthen with repeated use. Of course, neither our results nor Campbell-Kibler's (2012) can tease apart the exact source of the association between variants (e.g., *-in* and /aɪ/ monophthongization). As just mentioned, such links may emerge associatively from their high co-occurrence frequency, or links may include additional levels of abstraction, explicitly labeling the relationship between variants into categories like "Southern" or "casual". In interpreting their results showing that age-congruent phonetic cues can prime age-associated target words, Kim and Drager (2017) argue for an account where forms that are likely to be produced by the same speakers are directly linked, without necessitating activation of the mental representations of the indexically linked social information.

Relatedly, from the patterns in the data examined here, we cannot determine whether the use of *-in* individually activates links to specific other variants, or abstract styles, or whether the use of *-in* instead invokes a speech setting more holistically. For instance, it could be argued that covariation with *-in* is the result of an overall casual/hypospeech setting for the *-in* sentences, rather than an indexically-mediated association with a style. In fact, since all *-in* sentence productions occurred after *-ing* sentence productions, the expectations for hypospeech and general reduction patterns are heightened for *-in* due to phenomena like second mention reduction (e.g., BAKER; BRADLOW, 2009; BYRD, 1994; FOWLER; HOUSUM, 1987; WARNER; TUCKER, 2011). This interpretation is indeed a possibility. In fact, Eckert (2008; ECKERT; LABOV, 2017) suggests that these two interpretations are not entirely at odds, positing that hypo- and hyperspeech "phonetic classes" may be broadly stylistically meaningful (see also SUMNER *et al.*, 2013; PRATT, 2018). A strong version of the holistic casual speech setting account would predict that all features examined would show more casual/reduced realizations in *-in* sentences. Although several of our results are in line with this account (e.g., /aɪ/ glide length, /t/ realization), we note that the speech setting explanation cannot by itself account for all of our results. For example, lax vowel durations were *longer* in *-in* sentences, and the vowel plots in Figure 1 indicate that overall vowel productions in *-in* sentences were not more reduced in comparison to *-ing* sentences. Further, as illustrated in Figure 6, *-in* would be expected to covary with slower speaking rate via a Southern social meaning, but a faster speaking

rate with a casual/hypospeech social meaning or general speech setting.<sup>3</sup> In fact, one speaker (SH) indeed exhibited speaking rate patterns more aligned with a casual/hypospeech pattern than a Southern pattern (where speaking rate was slower in *-ing* sentences than in *-in* sentences). Thus, we suspect that each explanation is exerting an influence, and we expect that the relative degree to which holistic speech settings are adopted are likely to vary from speaker to speaker and situation to situation. More generally, the present findings underscore recent calls that the study of style and social meaning would do well to carefully cognitive factors alongside social ones (e.g., CAMPBELL-KIBLER, 2016; LEVON, 2014; SHARMA; MCCARTHY, 2018; TAMMINGA *et al.*, 2016).

We note that the existence of cognitive links between variants sharing social meaning, and cognitive processes like priming and associative learning, may in fact relate to the ways in which certain styles get reproduced and enregistered (AGHA, 2003; JOHNSTONE, 2016). Although this proposed cognitive architecture does not entirely account for the process of enregisterment, it may enhance certain social and interactional processes already at work: repeatedly encountering a variant with a particularly salient social meaning may activate in the mind other variants with similar social meanings such that those variants are more accessible for use in production. Of course, we do not claim that *all* stylistic practice works this way, since adopting coherent, identifiable, or enregistered styles is only one of many types of stylistic practice a speaker can enact (ECKERT, 2008).

We underscore that our claim is not that every time a speaker uses *-in*, they are code-switching to a Southern style. A benefit of using the *-in* variant in our production task, in fact, is that it is a part of these non-Southern speakers' repertoires already. And, just because producing *-in can* lead to covariation among other cues does not suggest that speakers would always or automatically activate stylistic templates upon producing *-in* or another stereotypical variant. Rather, our data are consistent with

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<sup>3</sup> It is also possible that slower speaking rate for *-in* sentences could be accounted for by hypothesizing that increased cognitive load is associated with producing *-in* in a laboratory setting, which is likely incongruent with *-in*'s more typical context for production (e.g., SHARMA; MCCARTHY, 2018). This possibility, which would require independent empirical support to verify, further underscores the necessity of considering cognitive and social accounts of style in concert.

the idea that speakers deploy stylistic packages that are appropriate for their goals in the current context (e.g., ECKERT, 2008, 2012; LEVON, 2006; SCHILLING-ESTES, 2004). If the pink polo shirt owner was dressing for a business meeting, for example, the social meanings that same shirt would invoke (and thus the covariants it activates) may be different than if they were about to go work in the yard. Likewise, for our speakers, *-in* triggered particular styles and covariants appropriate to their context: our speakers were asked to read 141 sentences in a row with an *-in* form, and to pay attention to the *-in* form, so the task likely especially encouraged speakers to perform a style congruent with the social associations they have with *-in*.

More generally, there is a host of potential reasons why individuals differed in the degree of covariation they employed. First, although we expect that Southern and casual are coherent styles well-known even to our Western U. S. speakers (CAMPBELL-KIBLER, 2012; LIPPI-GREEN, 2012; NIEDZIELSKI; PRESTON, 2000; PRESTON, 1997), as discussed above, each speaker's unique linguistic background contributes to their stored representations of variables and their social meanings (e.g., SUMNER; SAMUEL, 2009). And, every speaker has their own particular repertoire of variants and styles they command in production. The speaker's repertoire (or dresser's closet) is important. We expect that speakers would likely only enact styles that they have access to, not only in their mental representations, but in their production repertoire. That is, if a person decides to wear a salmon polo shirt, and that invokes the preppy style in the person's mind, if they do not own khaki pants and loafers, there is less of a chance to dress in congruence with the preppy style. The stylistic covariation produced by the speakers in our data alongside *-in* does not exclusively call on their own vernacular, but rather reflects the indexical associations that speakers have with variant *-in* from their broader experience of American society. This is an important difference between our analysis of linguistic performative production and Schilling-Estes' (1998) study of performance speech, for example. In this study, the variant *-in* was part of speakers' repertoires, but not all of the associated variants may have been. Again, it is likely that our task, which asked speakers to repeat the *-in* variant over and over again, potentially heightening the salience of their indexical links, perhaps led them to extend their production repertoire beyond what they would use in the course of regular conversation. We emphasize that each

speaker's mental representation of variants, and those variants' social meanings and associations with other variants, will not be identical, nor will each speaker's willingness or ability to use those forms in production.

Finally, our findings speak to the salience of certain variables and styles, highlighting an important open question about the kinds of variables that participate in stylistic covariation. As Schilling-Estes (1998) suggests in the quotation included in the opening of §2, performance speech can be helpful in determining the degree of associations that speakers have made between a variant and its social meaning. Just as a salmon pink polo shirt might readily invite the stylistic label "preppy" in certain contexts, *-in* may have been an ideal triggering variant: it is salient, easy to produce, expected to be already in variation in our speakers' own production repertoires, and strongly associated with an enregistered style that our speakers were undoubtedly aware of (CAMPBELL-KIBLER, 2007, 2012). That is, *-in* is a prototypical variant of the styles with which it is associated, like a salmon pink polo shirt is to its styles. But, the relationship amongst variants may be asymmetrical; initially putting on khaki pants may have activated styles like "business casual" in addition to "preppy", just like asking speakers to produce a slow speaking rate, for example, may not have invoked the Southern style as strongly because of its indexical links to many other styles. Empirical tests of this hypothesis await future work. Other aspects of language may also function as strong triggers of stylistic shifts. For example, Jaffe and Walton (2000) found that speakers differed in their reading performances of the same text depending on whether the text was written in standard or non-standard orthography. And, Preston (1996) found that performances of a dialect outside of one's own are improved by the use of an indexically related "catch phrase". It may be that the ability to trigger stylistic covariation is a property of variants on the stereotype end of the stereotype-marker-indicator continuum (LABOV, 1972), or of variants that are especially emblematic of an enregistered variety (e.g., JOHNSTONE, 2016). Investigating the salience of particular variants to particular lects or styles is an important part of understanding sociolinguistic perception (e.g., LLAMAS; WATT; MACFARLANE, 2016), and our study illustrates a converging approach to this question.

## 5 Conclusion

As sociolinguists have increasingly examined perception, important questions have emerged about how social meaning and linguistic forms are represented. This study addresses these questions using an elicited production methodology, and we hope demonstrates the value of using a range of approaches to better understand sociolinguistic cognition more broadly. When asked to produce sentences containing (ING) words as *-in* or *-ing*, speakers in our study sometimes (but not always) modulated other variables beyond (ING) in line with styles and social meanings associated with the *-in* and *-ing* variants. Although stylistic covariation has long been documented by sociolinguists, and Campbell-Kibler (2012) demonstrated associations between multiple variants in perception, this study shows that certain variants may carry enough stylistic meaning to induce some speakers to produce other stylistically congruent variants. Even in a sound booth in a lab setting, we find evidence that speakers carry indexically mediated associations of variants with them.

Developing a model of the cognitive architecture underlying the relationship between variants and social meanings is an important part of understanding sociolinguistic perception and production, and investigating each modality is necessary to complete the picture. For example, hypothesizing about how variants are related to social meanings and one another in representation helps to explain how results in sociolinguistic perception involving multiple variants, such as Levon's (2007) findings, arise cognitively. Further, the underlying cognitive associations proposed here can be used to generate novel predictions about sociolinguistic perception. For example, the existence of socially-mediated links between variants in representation predicts that, within a stylistically situated context, listeners exposed to a production of a particularly stylistically salient variant would expect the speaker to also use other stylistically congruent variants of other variables. In sum, the study of sociolinguistic perception can be enhanced by a stronger understanding of cognitive representation, and we look forward to future work that relates perception with production and representation in sociolinguistics.

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## Authorship statement

Both authors contributed to all parts of the project, but CV led in study design and writing the manuscript, and TK led in acoustic and statistical analysis.

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## Appendix: Statistical modeling

Statistical tests were conducted on the measured phonetic features in order to determine what group-level statistical patterns emerged. The total numbers of tokens for each feature, the statistical test used, the factors considered, and the best model for regressions (determined using likelihood ratio tests; `anova()` in R) are described here.

/aɪ/-glide length:  $N = 692$  (ave. 173/speaker). Glide lengths were analyzed by mixed-effect linear regression, with random intercepts for speaker and for word. Modeling considered the following independent variables: Guise (*-ing* or *-in*; the factor of interest), onset F1 and F2 (Lobanov normalized values), (log) vowel duration, and following environment (voiced consonant, voiceless consonant, or none), as well as two-way interactions between guise and the other variables. The best model was:  $/aɪ\text{-glide length} \sim \text{Guise} + \text{F1} + \text{FolEnv} + (1|\text{Spkr}) + (1|\text{Word})$ .

Proximity of mid front vowels /e/ and /ɛ/:  $N = 8$  (1 per-guise per-speaker). Since  $/e/-/ɛ/$  Euclidean distance measures are calculated on a per-guise per-speaker basis, this measure was analyzed using a paired t-test.

Duration of lax vowels /ɛ/ and /ɪ/:  $N = 1,169$  (ave. 152 /ɪ/ per speaker, 141 /ɛ/ per speaker). The logged durations of the lax vowels, /ɪ/ and /ɛ/, were analyzed using mixed-effect linear regression, with random intercepts for speaker and for word. Modeling considered guise (*-ing* or *-in*; the factor of interest), vowel identity (/ɪ/ or /ɛ/), and the voicing of the following consonant as factors, as well as two-way interactions. The best model was:  $\text{LogDur} \sim \text{Guise} + (1|\text{Spkr}) + (1|\text{Word})$ .

Speaking rate:  $N = 1,128$  (282/speaker). Speaking rates were analyzed using mixed-effect linear regression, with random intercepts for speaker. Modeling considered guise (*-ing* or *-in*) as the sole fixed-effect predictor. The best model was:  $\text{SpkRate} \sim \text{Guise} + (1|\text{Spkr})$ .

Intervocalic /t/ release:  $N = 184$  (46/speaker). /t/ realizations, coded into the four categories of released, flapped, glottalized, or deleted, were analyzed using mixed-effect logistic regression, with random intercepts for speaker and for word. The dependent variable was whether the /t/ realization was released, and modeling considered guise (*-ing* or *-in*; the factor of interest) and following environment (whether the following vowel was stressed or unstressed). However, all /t/s before stressed vowels ( $N = 16$ ) were released so this factor was dropped from modeling. The best model was:  $\text{TReleased} \sim \text{Guise} + (1|\text{Spkr}) + (1|\text{Word})$ .

Intervocalic /t/ reduction:  $N = 184$  (46/speaker). /t/ intensity differences were analyzed using mixed-effect linear regression, with random intercepts for speaker and for word. Modeling considered guise (*-ing* or *-in*; the factor of interest) and following environment (whether the following vowel was stressed or unstressed), as well as the interaction of these two factors. The best model was:  $\text{TIntDiff} \sim \text{Guise} + \text{FolVStress} + (1|\text{Spkr}) + (1|\text{Word})$ .