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DOES STUDYING MULTIPLE SOCIOLINGUISTIC VARIETIES OF A SECOND LANGUAGE IMPACT LEARNING OUTCOMES? INVESTIGATING THE SIMULTANEOUS ACQUISITION OF VOCABULARY IN BOTH STANDARD AND EGYPTIAN ARABIC

Abstract:
Sociolinguistic variation is often ignored in standard language textbooks (Brown, 2011). Arabic, a diglossic language, exhibits considerable variation with a standardized formal register (Modern Standard Arabic, or MSA), and multiple spoken dialects (Badawi, 1973). Arabic foreign language programs have historically privileged MSA curricula at the expense of dialects. Recently, however, textbooks have begun integrating dialects and MSA. Although the integrated approach has been criticized for creating an unnecessary learning burden that inhibits acquisition, it has never been directly empirically evaluated.

The current study is a lab-operationalized comparison of Arabic L2 vocabulary acquisition in MSA-only and integrated curricula. Twenty-six L1 speakers of English studied twenty-four Arabic nouns in two counterbalanced conditions: MSA-only (one register), and MSA + Egyptian Colloquial Arabic (ECA) (two registers). Participants were tested on form and meaning recognition. Accuracy and log reaction times for each the register-condition combinations (MSA-only, MSA-integrated, and ECA-integrated) were compared using one-way repeated measures ANOVAs. Results indicated no significant differences between any of the groups for either accuracy or reaction time apart from reaction time for form recognition. Results are discussed in light of theoretical models of the bilingual mental lexicon and pedagogical implications for the L2 classroom.

Keywords: Arabic ◆ vocabulary ◆ mental lexicon ◆ diglossia ◆ second language acquisition

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Introduction

All natural languages exhibit a degree of sociolinguistic variation. This variation can present challenges for non-native speakers not only in terms of pragmatic function (which registers, or varieties, are appropriate to use in any given social situation), but furthermore in the cognitive processing of such variation. In this study I look at how novice second language (L2) learners of Arabic, a diglossic language with considerable variation, can acquire and process cognate vocabulary items in two distinct registers.

Literature review

Sociolinguistic variation and second language acquisition

Although sociolinguistic variation is often ignored in standard language textbooks (Brown, 2011), research on variation is growing in the field of second language acquisition (Geeslin & Long, 2014; Knouse, 2013; Regan, Howard, & Lemée, 2009). The majority of this research is conducted in Spanish-language study abroad settings, with results indicating that time spent abroad does not necessarily lead to the acquisition of variation (Geeslin & Gudmestad, 2011; George, 2012; Ringer-Hilfinger, 2012). For example, although Knouse (2013) found that study abroad learners were more likely to produce the Castilian realization of [θ] than at-home learners, none of the participants fully integrated the spoken phoneme into their speech production. George (2014) found that only one fifth of the participants produced Castilian variants of [θ] and [x] at the end of their study abroad, with higher proficiency levels predicting more frequent usage of the spoken variety [x].

Although sociolinguistic variation is arguably greater for diglossic languages such as Arabic (Ferguson, 1959; Horesh & Cotter, 2016), far fewer studies have been conducted in this language. Raish (2015) found that L2 learners of Arabic studying abroad in Egypt were more likely to adopt the Egyptian spoken variant [g] as a function of how long they had spent in-country. Sociolinguistic variation of Arabic extends into phonology, vocabulary, and morphosyntax (Al-Wer & Horesh, 2019; Al-Wer, Jong, & Holes, 2009). Exploring the acquisition of spoken variants of Arabic can thus shed light on the generalizability of current variationist theories. Documenting and analyzing these processes will have wide implications ranging from foreign language curricula development to theoretical models on morphosyntactic processing and the bilingual lexicon.

Another relevant area of interest to the acquisition of sociolinguistic variation is cross-variety identification and processing. Research in this area explores whether or not learners explicitly notice instructed sociolinguistic variation as different, and, moreover, if learners process and store varieties differently. In the classroom, explicit instruction and exposure to regional Spanish varieties was found to increase cross-variety comprehension in a fourth-semester classroom (Schoonmaker-Gates, 2017). Schmidt (2018) found that contact with regional varieties through study abroad, social circles, and metalinguistic training predicted L2 Spanish learners' perceptions of sociolinguistic variations. These studies partially answer questions about variety identification. They demonstrate that learners can become aware of variety differences, but information on how learners process and store this information is mostly lacking.

Research on L2 Arabic cross-variety processing is sparse. Trentman (2011) examined the transferability of variety intelligibility for 58 Arabic L2 learners of varying proficiency levels and background exposure. Although the author acknowledged that it is difficult to separate Modern Standard Arabic (MSA) and colloquial variety listening abilities, the results indicated that students who had learned one colloquial variety of Arabic were better able to understand an unfamiliar colloquial variety than students who had only learned (MSA). In a follow-up study improving on methodology, Trentman and Shiri (2020) found that variety identification ability, and not spoken colloquial proficiency, was a predictor of unfamiliar variety comprehension in intermediate-level listening passages. Finally, Soliman (2014) explored the utility of explicit strategy instruction on L2 unfamiliar variety comprehension. All five advanced learners in her study improved their listening scores after the training, from an average of 51% accuracy on the pre-test to 71% accuracy on the post-test.

Arabic diglossia

Arabic is traditionally characterized as a highly diglossic language (Ferguson, 1959; Holes, 2004; Versteegh, 2014). In this dichotomy, spoken Arabic colloquial varieties are used for everyday communication in informal or intimate settings, whereas MSA is used for formal communicative purposes such as political speeches and news broadcasts, as well as for religious purposes. It is generally considered highly inappropriate to write in the colloquial variety, although this attitude has become more lenient over time with the advent of social media (Høigilt & Mejdell, 2017). Badawi, in his 1973 study of spoken Cairene Arabic, noted no less than five distinct registers in use in contemporary Egyptian society. Speakers may shift across varieties, sometimes within a single sentence, depending on context (Holes, 2004). Spoken dialects across the Arabic-speaking world are generally, but not always, mutually intelligible (Abu-Melhim, 2014; Abunasser, 2015; Čéplö et al., 2016; S'hiri, 2002). Spoken varieties can differ from one another in the realms of phonology, morphosyntax, and vocabulary. In the case of lexicon, some translation-equivalent words have completely different forms across registers, as in the example of the interrogative particle "what?" (see Table 1).

Table 1. Examples of sociolinguistic variation across lexical items in Arabic

	Type of Lexical Variation		
	Form	*Consonantal*	*Vocalic*
MSA	mæːðæ*; mæː**	qataʕ	naːʃif
Beiruti variety	ʃuː	ʔataʕ	neːʃef
Cairene variety	ʔe	ʔataʕ	naːʃif
Translation	"what"	"to cut"	"dry"

* verb sentences only ** verb-less sentences only

While many high frequency translation-equivalent words have different forms, the majority of lexical items differ only phonetically across varieties. Only one study has been conducted on the rates of cognation (overlapping to a large extent in both form and meaning; this term is more thoroughly discussed in the following section) between different Arabic varieties. Using the Swadesh List, Cadora (1976) calculated that shared cognation ranged from 86% (between Levantine and Cairene Arabic) to 68% (between Levantine and Casablancan Arabic), while cognation between Levantine and MSA was 91% (Cadora, 1976). Varietal cognates can still show consonantal and / or vocalic differences (see Table 1), making them more difficult for L2 learners to recognize.

Arabic second language acquisition

Due to a variety of ideological (e.g. perceived prestige and appropriateness) and practical reasons (e.g. limited time and resources), students of Arabic as a foreign language are traditionally only taught MSA (Al Masaeed, 2020; Hashem-Aramouni, 2011; Isleem, 2018). Spoken varieties might be covered as an elective course, or else it is assumed that students can easily "pick them up" during study abroad (Younes & Huntley, 2019). This traditional approach has been criticized for preventing students from fully participating in Arab society once abroad (Palmer, 2007; Trentman, 2013) and for preventing students from reaching advanced levels of proficiency (Ryding, 2013).

As an alternative to MSA-only teaching, recent textbooks of Arabic have tried to integrate the spoken and standard varieties into the same curriculum (Al-Batal, 2018; Younes, 2015). This curriculum has become known as the "integrated approach." The two most popular spoken varieties for integration are Egyptian Colloquial Arabic (ECA) and Levantine Colloquial Arabic (LCA) (Al-Batal & Belnap, 2006). In the integrated approach, MSA and spoken colloquial might be presented as side-by-side translation equivalents, or else classroom and textbook activities will be matched for register (i.e. reading exercises are done in MSA, while follow-up discussion is conducted in a spoken colloquial) (Al-Batal, 2018). Thus, compared to a traditional approach which focuses entirely on MSA, class time and learning activities are split between standard and spoken varieties in the integrated approach.

The integrated approach has been critiqued on a theoretical level for creating an unnecessary learning burden that inhibits acquisition (Alhawary, 2013). This statement has been challenged by research documenting the evolving linguistic repertoires of students in an integrated curriculum (i.e. Leddy-Cecere, 2018; Nassif & Al Masaeed, 2020). However, no known studies have directly investigated such psycholinguistic claims for Arabic. The goal of the current study is to fill this gap by exploring how multiple registers, represented lexically, are processed when studied simultaneously. In doing so, broader conclusions can be drawn for how sociolinguistic variability can be acquired from a cognitive perspective.

Competing paradigms for acquisition of variability

There are currently no theoretical frameworks which directly speak to the phenomenon of acquiring variation in a second language. However, existing learning paradigms and cognitive models contain elements which can help frame hypotheses on how variation affects vocabulary learning.

Paired associate learning and repetition

Paired association is a repetition-based paradigm in which learners repeatedly encounter corresponding elements (i.e. L2 word form and L1 translation or picture representation). It is a commonly used training method in lab-based psycholinguistic research because of its highly controlled scope. Through recurring exposure, corresponding elements will be associated together such that the cue of one element will bring about the recall of the other (De Groot & Van Hell, 2005). Although it would be difficult to overstate the effect of repetition in vocabulary acquisition (e.g. Webb & Nation, 2017), not all repetition opportunities are created equally; tasks effects (such as retrieval opportunities, spacing, elaboration), lexical factors (i.e. phonotactic congruency, concreteness, degree of overlap in form and meaning), and individual differences (i.e. attention, motivation, aptitude) may all mitigate the effects of repetition (see Rice and Tokowicz [2019] for a discussion of these issues).

In L2 vocabulary acquisition research, paired associate training builds connections between phonological, orthographic, and semantic knowledge of a novel word. If a learner already has some degree of familiarity with any of these elements, the theorized learning burden of acquiring the word is decreased (Webb & Nation, 2017). Rogers, Webb, and Nakata explored the differential effects of prior form-meaning knowledge on learning burden in their 2015 study on the acquisition of loan words. They hypothesized that the cognacy characteristics of English loan words in Japanese would make them easier to learn than non-cognate words for L2 learners of English. Results from the paired associate learning experiment showed that participants had greater relative gains on cognates than non-cognates in form-recall posttests. This finding suggests that the overlap in form and meaning between cognates, as compared to non-cognates, may indeed decrease the learning burden (Rogers et al. 2015).

In the Rogers et al. study, loan words were easier to learn because participants had less to acquire — they already had partial knowledge of the pairs they were associating. If this assumption is true, then, conversely, increasing the amount of novel information to be acquired would likewise increase the learning burden. Such might be the case for the acquisition of L2 variability such as Arabic diglossia. Mapping multiple phonological forms to one concept is likely more difficult (there may also be a difference in orthographic forms, but, as previously discussed, Arabic dialects are generally not represented in writing). Likewise, semantic knowledge may be complexified by pragmatic constraints on usage for each register. Thus, adding one register would require learners associate additional form and usage knowledge to each concept. This hypothesized increase in learning burden may be what Alhawary (2013) was referring to. From a paired associate learning perspective, the simultaneous acquisition of two registers is likely more difficult because it increases the number of forms mapped to each meaning.

Cognates and the bilingual mental lexicon

As previously discussed, there is a high degree of form and meaning overlap between vocabulary across Arabic varieties such that these words may be considered cognates of one another. The formal definition of cognates depends on the field of inquiry. Historical linguists look for evidence of a shared etymology, while the field of psycholinguistics is more concerned with the degree of phonological, orthographic, and semantic overlap between lexical items (Carroll, 1992; Helms-Park & Dronjic, 2012). Researchers in second language acquisition have exploited these shared formal characteristics between cognates to investigate the nature of the bilingual lexicon from a processing perspective (Kroll, Bobb, & Hoshino, 2014). Numerous studies point to a cognate facilitation effect, whereby cognates are processed and named more quickly than non-cognates (Costa, Caramazza, & Sebastian-Galles, 2000; Lotto & de Groot, 1998; Peeters, Dijkstra, & Grainger, 2013; Vanhove & Berthele, 2017). Evidence for this effect includes the fact that cognates are identified faster than non-cognates (Guasch, Ferré, & Haro, 2017; Lemhöfer, Dijkstra, & Michel, 2004) and are less subject to attrition (De Groot & Keijzer, 2000) even when occurring across different scripts (Degani, Prior, & Hajajra, 2018; Hoshino & Kroll, 2008).

Many theoretical models undergirding the cognate facilitation effect rely on *inter*lingual explanations: it is believed that the L2 cognate is easier to process because it shares so many features with its already-known first language (L1) counterpart (Van Hell & Poarch, 2012). This is the case with the Revised Hierarchical Model (RHM) (Kroll & Stewart, 1994), a model of the bilingual lexicon which posits that novel L2 words are lexically mediated via the known L1 equivalent during the word association stage (Jiang, 2000). As the L2 learner increases in proficiency, L2 words gradually become more and more directly mediated via the concept, similar to L1 words (Kroll, Van Hell, Tokowicz, & Green, 2010). Evidence in support of the RHM is the general conclusion that receptive testing (receiving the L2 form and translating into the L1) yields faster and more accurate results than productive testing (producing the L2 form from an L1 prompt) (De Groot & Keijzer, 2000; Laufer & Goldstein, 2004). Many bilingual processing studies have found that the cognate facilitation effect is generally stronger in L2 naming tasks (which the RHM posits to be more difficult, as conceptual mediation via the L1 must first occur) than in L1 naming tasks (Costa et al., 2000; Poarch & van Hell, 2012). Given the strict focus on mappings of L1-L2 pairs at the form and meaning level, it is unclear how the RHM would predict initial processing of L2 cognates - an *intra*lingual situation - as would be the case in the acquisition of sociolinguistic variation.

Connectionist models, which explore the lexical and sublexical information activated during word encounters, may offer insight into how newly learned L2 cognates are processed. The most prominent of these models is the Bilingual Interaction Activation + (BIA+) model (Dijkstra & Van Heuven, 2002; van Heuven, Dijkstra, & Grainger, 1998). The BIA+ theorizes a cascading model of activation in word recognition from orthography to phonology to semantics. The presentation of input (i.e. written letters) induces the parallel activation of orthographic, phonological, and semantic codes for all potential matches at the word string level, then at the lexical level. In an integrated, non-selective bilingual lexicon, the most viable word candidates are then matched with language node. A match with the most appropriate node will suppress the lexical competitors. Through a process of top-down inhibition, the desired word is recognized and selected (Dijkstra, 2005). The BIA+ assumes that that the resting level of activation depends on subjective frequency and recency of exposure; thus, for unbalanced bilinguals the more dominant language node will be more quickly activated (Dijkstra, Van Jaarsveld, & Brinke, 1998). Results from several studies have shown that words with many orthographic neighbors (even from other languages) are processed more slowly than words with fewer or none (Midgley et al.,, 2008; van Heuven et al., 1998). These “neighborhood effects” are interpreted as evidence for the sublexical influences predicted by the BIA+. The inhibitory orthographic neighborhood effects on bilingual processing can be interpreted as the flip side of the cognate facilitation effect: when many formally similar words compete for recognition, lexical access will be slower (Vanlangendonck et al., 2019)

Although the BIA+ is a processing model for proficient bilinguals, it is worth considering how the activation of orthographic, phonological, and semantic codes in connectionist models may impact the acquisition of cognates (for a discussion of lesser-known connectionist models which incorporate acquisition, see Thomas and Van Heuven [2005]). Exposure to two overlapping variations of an L2 form at the same time, such as ɾad͡ʒul and ɾɑ:gil ('man' in MSA and Cairene Arabic respectively), could potentially strengthen the connections between sublexical nodes such that exposure to one variant reinforces the representation of the other. On the other hand, from a processing perspective the overlap in form could induce inhibitory neighborhood density effects for learners trying to decide which register to use in a given context.

Acoustic variability

Acquiring knowledge of L2 variation may entail mapping multiple forms, along with knowledge of their appropriate pragmatic usage, to the same meaning. For the acquisition of Arabic Diglossia, the most salient difference between lexical items across language registers is often phonetic. As discussed in the previous section, such variation in phonetic realization could pose challenges for L2 learners by increasing the learning burden of vocabulary items. On the other hand, from an L2 processing perspective, phonetic variation could also have a facilitative effect. A series of studies have investigated the effects of phonetic variation in the form of training with multiple talkers compared to a single talker. These studies have consistently shown that input variability in the form of multiple talkers improves acquisition of novel contrastive consonants, both in terms of perception (e.g. Logan, Lively, & Pisoni, 1991, 1993; Shehata, 2013) and production (e.g. Bradlow et al., 1999; Bradlow et al. 1997; Kartushina & Martin, 2019). Interestingly, L1 studies on the effects of input variability have generally found the opposite to be true: an increase in the number of talkers is associated with decreased performance in perception (e.g. Mullennix, Pisoni, & Martin, 1989; Nygaard, Sommers, & Pisoni, 1994), recall (e.g. Martin et al., 1989; Nygaard, Sommers, & Pisoni, 1995).

Barcroft and Sommers (2005) extended the line of inquiry on L2 input variability to the acquisition of vocabulary. They investigated the effect of multiple voice types (neutral, loud, whispered, excited, child-like, and nasal) and multiple talkers on second language vocabulary learning for beginning L2 Spanish learners. Vocabulary learning with rotated multiple voice types resulted in higher L2 recall scores and shorter reaction times (RTs) for L2 recall and L1 translation. Increased talker variability produced even more robust results, with higher accuracy and lower RTs for both picture-to-L2 and L2-to-L1 recall. These findings indicate a positive effect of acoustic variability on L2 vocabulary.

The elaborative processing hypothesis (Barcroft, 2001) theorizes that learning conditions which demand more elaboration will lead to stronger and more robust representation of lexical items in the learner's mind. From a connectionist perspective, exposure to multiple variants would diversify and strengthen the connections between form and meaning in the bilingual mental lexicon (but see Sinkeviciute et al.,(2019) for a discussion on the differential effects of acoustic variation by age group and learner capacity). Could exposure to multiple varieties of a word (sociolinguistic variation) bring about similar benefits that exposure to multiple talkers does? The elaborative processing hypotheses suggests that it might.

The current study

The goal of the current study is to see how participants process and recognize novel vocabulary items that are learned in one in two different variants (i.e. lexical cognates across different registers) as compared to only one. It is a lab operationalization of learning in a traditional L2 Arabic curriculum (where 100% of the curriculum focuses on MSA) as compared to in an integrated curriculum (where 50% of the curriculum focuses on MSA and 50% focuses on a spoken colloquial). Thus, the current study explores the following research questions:

1. Does learning vocabulary in one register (mapping one register-form to meaning) versus two registers (mapping two register-forms to one meaning) affect accuracy and reaction times (RTs) for form recognition?
2. Does learning vocabulary in one register versus two registers affect accuracy and RTs for meaning recognition?

Based on the findings from paired-associate training, it is hypothesized that learning vocabulary in one register will lead to greater accuracy scores and faster RTs than in two registers. The increased learning burden of associating an additional register-form to one meaning will inhibit acquisition. However, the research into cognate facilitate suggests that the cognacy characteristics of Arabic variants will somewhat mitigate the burden of additional forms and registers. Within a connectionist framework such as that proposed by the BIA + (Dijkstra & Van Heuven, 2002), exposure to one variety will activate and strengthen phonetic and semantic knowledge of the other. Likewise, the increased acoustic variability (Barcroft, 2001) afforded by the cognates may strengthen participants' mental representation of novel vocabulary items.

Methods

Materials

This study was designed to explore the effect of variation on L2 vocabulary acquisition. Variation was operationalized as consonantal differences between MSA and in ECA (selected as the sociolinguistic variant because of the researcher's familiarity). From among the major phonetic differences occurring between MSA and ECA (Khalil, 2020; Nydell, 1993; Watson, 2002), four were selected based off saliency and frequency of occurrence: /d͡ʒ/ → /g/, /q/ → /ʔ/, interdental → alveolar (θ/ → /t/, /ð/ → /d/, /ðˤ/ → /dˤ/), and interdental → sibilant (/θ/ → /s/, /ð/ → /z/, /ðˤ/ → /zˤ/). Stimuli were designed to create two comparable lists of concrete nouns representing each of these four phonetic differences in one of three positions (word-initial, word-medial, and word-final). Thus, 24 words (ranging in length from one to three syllables) were identified and divided into two lists of comparable length (24 and 22 syllables), following the design in Barcroft (2001) and Barcroft and Sommers (2005). Additionally, 24 distractor words were selected for the form recognition posttest. Distractors words were selected to match target words as closely as possible in terms of length and syllable structure (see Tables A.1 and A.2 in the appendix). All target and distractor words were checked by two native ECA speakers trained in applied linguistics, who verified the appropriateness of their selection.[1]

Participants

Participants were recruited through an online portal curated by the psychology department at a large public university in the Midwest. The portal targets people affiliated with the university as well as residents of communities in the greater metropolitan area. To be eligible, participants needed to indicate on the background questionnaire that they 1) are native speakers of English, 2) have normal or corrected-to-normal hearing and vision, and 3) have no background in Arabic, Turkish, or Farsi (Persian). They were offered compensation of 12 USD for the 75 minutes it took to complete the experiment. Twenty-eight people (13 self-identified males) in total participated in the experiment. Their ages ranged from 19 to 39 years old (M = 26.75, SD = 6.45). The participants had, on average, 4.25 years (SD = 2.37) of post-graduate education beyond high school. Finally, the majority of participants reporting that they spoke at least one second language (M = 1.18, SD = 0.61).

1 Although the stimuli were reviewed by two educated native ECA speakers, an anonymous reviewer argued that the items "necklace", "fingernail", "puppy", and "wallet" were not representative of cognate lexical items across Arabic registers. I subsequently re-ran the analyses with these items removed, and obtained the same inferential results. Thus, I am reporting on the original analyses and data.

Procedure

The current study employed a paired associates learning paradigm with two learning conditions: MSA-only (representing a traditional curriculum) or Integrated (representing an integrated curriculum in which instruction time is divided between ECA and MSA, which are taught side-by-side). All Egyptian words were presented with a yellow background, and all Standard words were presented with a blue background. The use of consistent background colors for each register throughout all phases of the study was an intentional lab operationalization of contextualized instruction that students would receive in class.

Participants learned words primarily through the auditory modality, which was deemed to be the most appropriate shared modality between registers (see previous discussion). For the MSA audio, two male and two female speakers from Saudi Arabia recorded the stimuli (both the vocabulary items and prompts to cue recognition for the posttests). A pair of Egyptian Arabic speakers (one male and one female) recorded the audio for the ECA stimuli. Hence, in each condition participants heard four different voices, either two MSA and two ECA or all four MSA. Their order and pairing (both the prompt and the lexical item) were pseudo-randomized across trials within each block. All stimuli recordings were captured in a sound-proof studio. Initial pilot testing revealed that the auditory modality alone was not sufficient for learning to occur; thus, transliterations were added to the first four blocks (see Table A.3 in the appendix). Transliterations were designed to minimize the use of unknown symbols as much as possible when representing unfamiliar phonemes (Showalter & Hayes-Harb, 2015; Tseng, Doppelt, & Tokowicz, 2018). The transliteration in each register contained four unfamiliar symbols in total: MSA used the grapheme ⟨Đ⟩ for /ðˤ/, ECA used the grapheme ⟨ʻ⟩ for /ʔ/, and both registers used ⟨ʕ⟩ for /ʕ/ and ⟨Ħ⟩ for /x/.

The training portion of the current study consisted of eight blocks. Participants were exposed to target words 1-12 in odd-numbered blocks (1, 3, 5, 7) and target words 13-24 in even-numbered blocks (2, 4, 6, 8). A within-subjects design was employed so that all participants were exposed to both conditions: MSA-only (one register) or Integrated (two registers, MSA and ECA) (see Figure 1). The within-subjects design furthermore mitigates the effects of individual differences, as each participant serves as her own control in across the two conditions. Each condition consisted of four counterbalanced blocks: half of the participants (Group A) learned words 1-12 in MSA-only (4 exposures) and words 13-24 in both MSA (2 exposures) and ECA (2 exposures). The other half (Group B) learned words 1-12 in both MSA (2 exposures) and ECA (2 exposures) and words 13-24 in MSA-only (4 exposures). Within each block presentation (a group of 12 trials) word order was randomized, and within each trial the target word was repeated twice. The experiment was built using SuperLab (Abboud, 2018).

Figure 1. Counterbalancing of Registers in Training Blocks.

Group	**Condition (word set)**	**Block Number - Register (target item example)**			
A	*Integrated (1-12)*	***1 - ECA*** *(timsaal)*	***3 - MSA*** *(timthaal)*	***5 - ECA*** *(timsaal)*	***7 - MSA*** *(timthaal)*
	MSA-only (13-24)	**2 - MSA** (jaru)	**4 - MSA** (jaru)	**6 - MSA** (jaru)	**8 - MSA** (jaru)

B	MSA-only (1-12)	**1 - MSA** (timthaal)	**3 - MSA** (timthaal)	**5 - MSA** (timthaal)	**7 - MSA** (timthaal)
	Integrated (13-24)	***2 - ECA*** *(garu)*	***4 – MSA*** *(jaru)*	***6 - ECA*** *(garu)*	***8 - MSA*** *(jaru)*

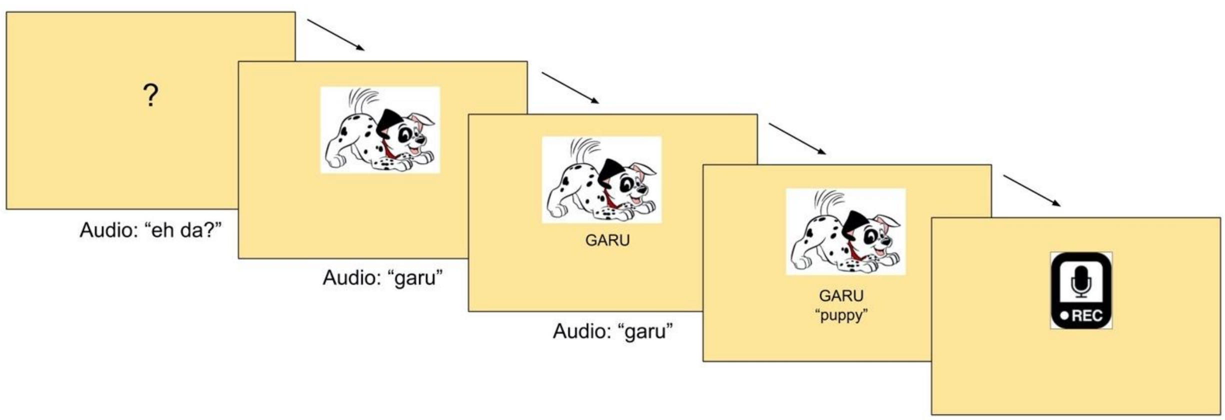
Note: Example of counterbalanced rotation of training blocks for both experimental groups (yellow = ECA block, blue = MSA block). MSA-only operationalizes a traditional curriculum (100% MSA), whereas Integrated operationalizes a curriculum in which both registers are taught side-by-side (50% MSA and 50% ECA).

Introduction and training phases

At the start of the experiment, all participants learned that the purpose of the study was to learn vocabulary in Egyptian and Standard Arabic, and that color, along with instructions at the start of each block, indicate register. They were also told that they may see unfamiliar symbols in the word spelling (with examples), and that they should listen for the sound if they weren't sure how to pronounce the symbol.

The first training phase familiarized participants with picture representations and transliterations of the target words. Participants were exposed to four blocks of vocabulary (two for each word set). Each trial consisted of a prompt in the appropriate register asking "What is this?" depicted by a question mark, followed by an audio recording of the word and a picture representing its meaning. Then, participants saw a transliteration of the word accompanied by a repetition of the audio recording, followed by an English translation. At the end of each trial, participants saw a recording symbol prompting them to repeat the word out loud one time (see Figure 2).

Figure 2. Trial Sequence From the First Training Phase in an ECA-Integrated Block

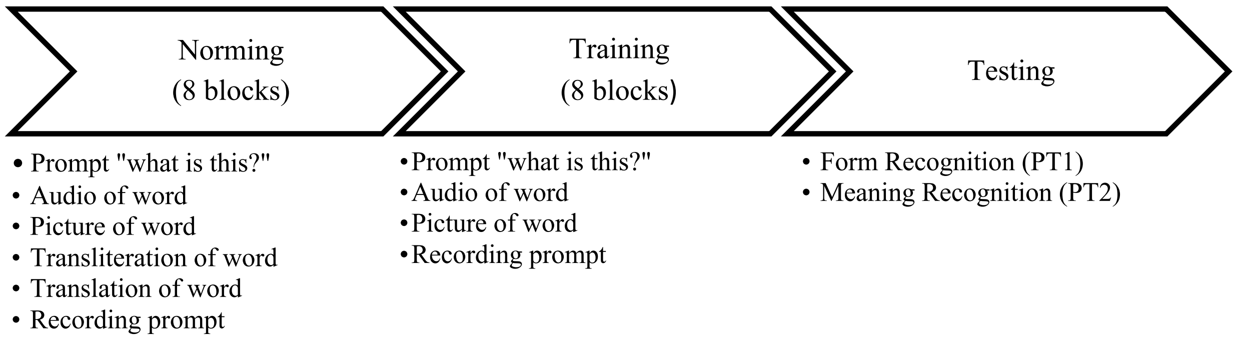


After completion of the first training phase, participants began the second training phase. This phase consisted of four additional blocks of vocabulary. The second training phase trial events were identical to the first phase trial events except that the transliteration and translation did not appear here (see Figure 3).

Testing phase

In the testing phase both groups took the same tests (form recall, form recognition, meaning recall, and meaning recognition), to ensure that participants had equal exposure and time on test items. Due to experimental error, the recall data will not be analyzed. Similar to the practice blocks, the ordering of all vocabulary was randomized within blocks and registers were not mixed within blocks.

Figure 3. Summary of the Experimental Procedure



Posttest 1 was a form recognition test (auditory lexical decision task). Participants heard 72 word recordings: 24 MSA vocabulary items, 24 ECA vocabulary items, and 24 distractor words (see Tables A.1 and A.2 in the appendix). Due to the within-subjects design, 12 of the 24 ECA vocabulary items were novel encounters of a word that participants had previously only heard in MSA, these items were not included in the analyses (see Figure 4). Participants had five seconds to indicate on the response pad if they had heard the word in the training session or not. The experiment moved on to the next trial after an answer was given or after five seconds, whichever occurred first.

Figure 4. Illustration of Posttest Items for Both Counterbalanced Training Conditions

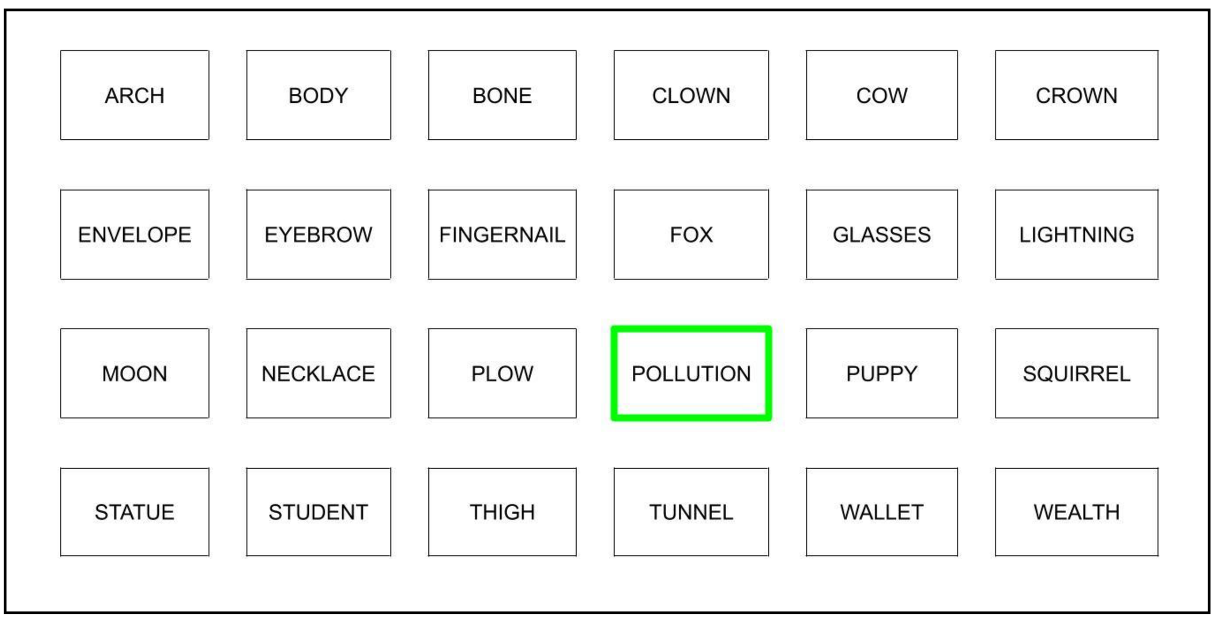
Group A	**Posttest Item**	**Group B**
Familiar *(Integrated exposure)*	ECA (timsaal)	**Novel** (previous encounter in MSA-only)
Familiar *(Integrated exposure)*	MSA (timthaal)	Familiar (MSA-only exposure)
Novel (previous encounter in MSA-only)	ECA (garu)	*Familiar* *(Integrated exposure)*
Familiar (MSA-only exposure)	MSA (jaru)	*Familiar* *(Integrated exposure)*
Novel	Distractor	**Novel**

	(sunbuur)	

Note: Figure 4 illustrates of how participants in each group, due to the counterbalanced training conditions, would encounter the target items in the posttests (yellow = ECA register, blue = MSA register).Novel items only included as artifacts of testing (counterbalancing, lexical decision task, and were not analyzed further

Posttest 2 was a meaning recognition multiple choice test (selecting the correct English translation from a table of all 24 translated target items). Participants first familiarized themselves with the alphabetically-ordered table. Once the testing began, they saw a question mark on the screen and heard the prompt "what is this?", followed by the Arabic recording. Participant had up to ten seconds to select an answer. After each trial, the box containing the correct answer was highlighted in green as a form of feedback (see Figure 5). After an answer was supplied or ten seconds had passed, the experiment automatically proceeded to the next trial. Participants heard 48 word recordings, 24 MSA vocabulary items, and 24 ECA vocabulary items. Due to the counterbalanced nature of the study design, 12 of the 24 total ECA vocabulary items were novel encounters of a word that participants had previously heard in MSA only.

Figure 5. Visual of Posttest 2 (Meaning Recognition) Multiple Choice with Feedback



Analysis

Scoring and trimming

For both tests, accuracy (score) and reaction times (latency) were measured. Results from novel exposures (i.e. items encountered in ECA on the posttests which the participants had only encountered in MSA during the training) and distractors were removed before scoring; thus, only words to which participants had been exposed were examined. Accuracy scoring was binary (zero points for incorrect and non-responses; one point for correct responses). Test reliabilities were calculated for all four subtests (PT1 accuracy Cronbach's α =.62, PT1 RT Cronbach's α = .82, PT2 accuracy Cronbach's α =.69, and PT2 rt Cronbach's α =.73). RT data was then cleaned with the trimr package (Grange, 2015) using the R suite for statistical programming (R Core Team, 2020). Trials were trimmed as follows: first, erroneous trials were removed, then trials in which RTs beyond three standard deviations of each participant's mean were trimmed. Finally, trials in which RTs fell below 300 ms were removed (Jiang, 2013; Lachaud & Renaud, 2011). The remaining RT data were then log-transformed to reduce positive skew ahead of performing parametric analyses (Baayen & Milin, 2010; Godfroid, 2020a) (see the supplementary material for detailed trimming information).

Statistical analyses

The two training conditions (MSA-only and integrated), result in three types of learning: 1) MSA items learned in MSA-only, 2) MSA items learned in the integrated condition, and 3) ECA items learned in the integrated condition[2]. These three types will be referred to as "exposures." To test for statistical differences in the accuracy and reaction times of the three exposures, I conducted a series of one-way, repeated measures analyses of variance (ANOVA) at α =.05. I first checked the data for normality of distribution and homogeneity of variances (see the online supplementary material for detailed results). The data met the assumptions for ANOVA apart from results for PT2 (meaning recognition) accuracy for the MSA-integrated exposure, which approached bimodality.

Because of this departure in modality, the data were bootstrapped (resampled with 2000 replacements with 20% trimmed means) (Field & Wilcox, 2017) using the rmanovab function of the WRS2 package in R (Mair, 2018; Mair & Wilcox, 2019a). Unfortunately, the rmanovab function does not provide effect sizes or exact *p*-values (Norouzian & Plonsky, 2018). Instead, rmanovab returns test statistics, critical values, and whether or not the results are significant at α

[2] I had originally planned to create a composite score for the integrated condition by averaging or weighting item scores and RTs across MSA-integrated and ECA-integrated exposures. However, upon further reflection this seemed problematic (is there a good theoretical basis for assigning weights?) and potentially misleading (if the outcomes differ between MSA- and ECA-integrated, an average score would artificially flatten those results). Hence, I decided to analyze words learned in the integrated exposures separately.

=.05. Posthoc linear contrasts for bootstrapped trimmed means were conducted using the pairdepsb function of the WRS2 package, using Hochberg's procedure to control family-wise error rates (Mair & Wilcox, 2019b). In lieu of effect sizes and exact *p*-values, I will report test statistics and critical values as well results from all pairwise contrasts (whether significant or not) to assist the reader's interpretation.

Post-test 1: Form recognition

Participants on average scored highest on words learned in the MSA-only exposure (M = 0.842, SD = 0.131), followed by the ECA-integrated exposure (M = 0.801, SD = 0.201) and the MSA-integrated exposure (M = 0.756, SD = 0.201) in PT1 (see Table 2 and Figure 6).

Table 2. PT1 Form Recognition Descriptive Statistics

Exposure	N	Mean	95% CI	Median	SD
Accuracy					
MSA (MSA-only)	28	0.842	[0.791, 0.893]	0.875	0.131
MSA (integrated)	28	0.756	[0.678, 0.834]	0.750	0.201
ECA (integrated)	28	0.801	[0.723. 0.878]	0.917	0.201
RT					
MSA (MSA-only)	28	1456	[1330, 1582]	1384	325
MSA (integrated)	28	1568	[1423, 1713]	1499	374
ECA (integrated)	28	860	[691, 1028]	713	435
Log RT					
MSA (MSA-only)	28	7.262	[7.183, 7.341]	7.233	0.204
MSA (integrated)	28	7.332	[7.244, 7.42]	7.313	0.227
ECA (integrated)	28	6.665	[6.506, 6.824]	6.569	0.411

Surprisingly, the participants were, overall, quicker to correctly recognize forms in the ECA-integrated exposure (M = 6.665 ms_{log}, SD = 0.411 ms_{log}) compared to the MSA-only (M = 7.262 ms_{log}, SD = 0.204 ms_{log}) and the MSA-integrated forms (M = 7.332 ms_{log}, SD_t = 0.227 ms_{log}) (see Figure 7).

Figure 6. Boxplot of PT1 (Form Recognition) Accuracy Across Exposures

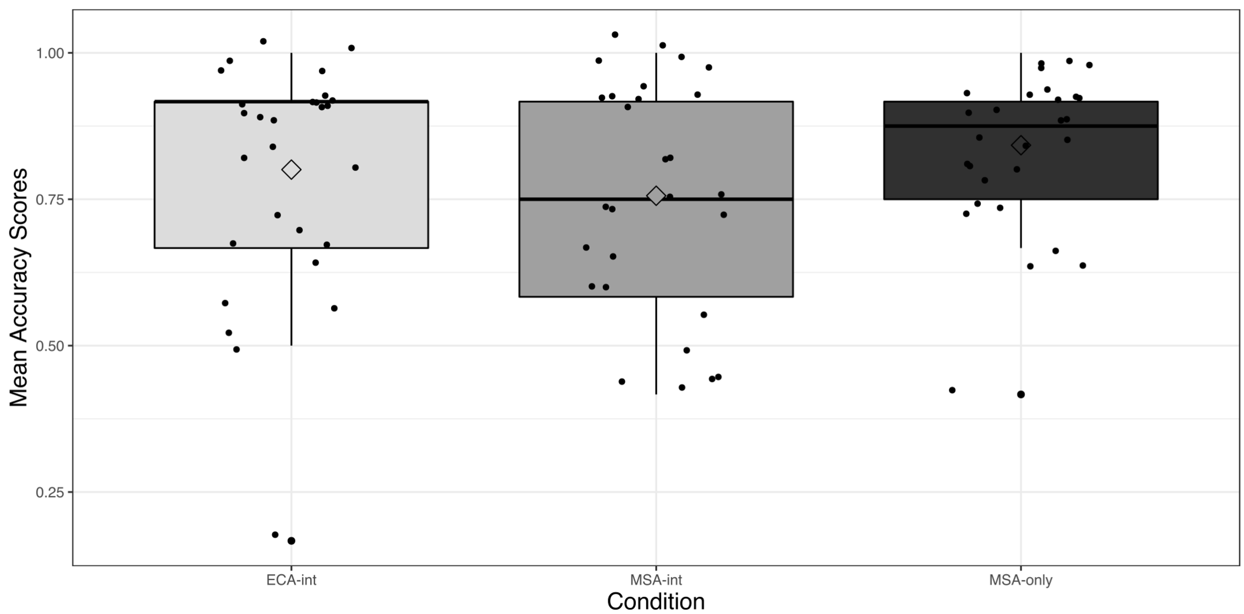
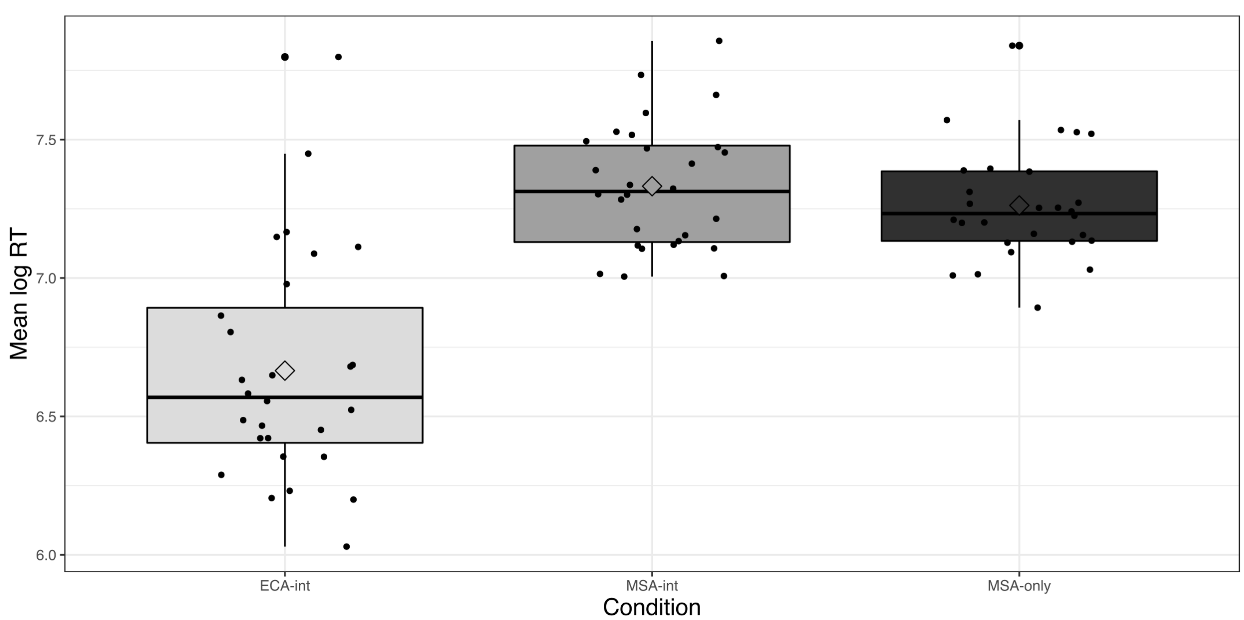


Figure 7. Boxplot of PT1 (Form Recognition) Log RT Across Exposures



A series of one-way repeated measures ANOVAs were conducted on the PT1 form recognition to determine if there were statistically significant differences between the three exposures. For PT1 accuracy, no statistical differences were found between the bootstrapped, 20% trimmed mean for the three exposure groups, Ft = 2.138, Fcrit = 2.952 , n.s. (see Table 3). There was, however, a significant difference between the bootstrapped trimmed means log RT for the three groups, Ft = 80.036, Fcrit = 3.625, $p < .05$. The pairwise comparisons for mean log RT revealed significant differences between the two ECA-int linear contrasts: between the MSA-only and ECA-integrated exposures, $\hat{\psi} = 0.628$ [0.444, 0.813], and between the MSA-int and ECA-int exposures, $\hat{\psi} = 0.704$ [0.521, 0.886]. No significant difference was found between the MSA-only and MSA-integrated exposures, $\hat{\psi}$ = -0.076 [-0.174, -0.023], The results indicate that participants were, on the whole, faster in producing correct answers for the ECA-integrated exposure than for either of the MSA exposures.

Table 3. ANOVA and Post-hoc Tests Results for PT1 Bootstrapped, Trimmed Means

Test	Mean Difference	95% CI	Test statistic	Critical Value
PT1 Accuracy (omnibus)			2.138	2.952
MSA-only vs. MSA-int	0.083	(-0.032, 0.197)	1.909	2.610
MSA-only vs. ECA-int	0.023	(-0.077, 0.123)	0.605	2.610
MSA-int vs. ECA-int	-0.060	(-0.172, -0.051)	-1.409	2.610
PT1 Log RT (omnibus)			80.036*	3.625
MSA-only vs. MSA-int	-0.076	(-0.174, 0.023)	-2.015	2.648
MSA-only vs. ECA-int	0.628	(0.444, 0.813)	8.939*	2.648
MSA-int vs. ECA-int	0.704	(0.521, 0.886)	10.108*	2.648

* Significant at $p < .05$

Thus, the results of the ANOVAs suggest that participants were equally accurate in recognizing the target item forms for all three exposures, but that their recognition was significantly faster for ECA target items as compared to MSA target items in both exposures (integrated and MSA-only).

Post-test 2: Meaning recognition

The descriptive statistics from PT2 show that, similar to form recognition, participants were on average more accurate in recognizing the meaning of MSA-only lexical items (M = 0.468, SD = 0.199) compared to the items in integrated condition (see Table 4 and Figure 8). Within the integrated condition, mean accuracy scores for the ECA-integrated exposure (M = 0.447, SD = 0.251) were again slightly higher than those for MSA-integrated exposure (M = 0.404, SD = 0.251) lexical items.

Table 4. PT2 Descriptive Statistics by Exposure

Exposure	N	Mean	95% CI	Median	SD
Accuracy					
MSA (MSA-only)	28	0.468	[0.391, 0.546]	0.500	0.199
MSA (integrated)	28	0.404	[0.309, 0.5]	0.333	0.247
ECA (integrated)	28	0.447	[0.35, 0.545]	0.438	0.251
RT					
MSA (MSA-only)	27	2214	[1860, 2567]	2193	894
MSA (integrated)	27	2416	[2111, 2721]	2418	771
ECA (integrated)	27	2328	[1959, 2698]	2191	934
Log RT					
MSA (MSA-only)	27	7.629	[7.475, 7.784]	7.693	0.391
MSA (integrated)	27	7.746	[7.629, 7.864]	7.791	0.298
ECA (integrated)	27	7.670	[7.504, 7.837]	7.692	0.422

Unlike the log RT scores from PT1, the average log RTs in the MSA-only exposure (M = 7.629 ms_{log}, SD = 0.391 ms_{log}) and the ECA-integrated exposure (M = 7.670 ms_{log}, SD = 0.422 ms_{log}) were nearly equal, and were both slightly faster than the MSA-integrated exposure (M = 7.746 ms_{log}, SD = 0.298 ms_{log}) (see Figure 9).

Figure 8. Boxplot of PT2 (Meaning Recognition) Accuracy Across Exposures

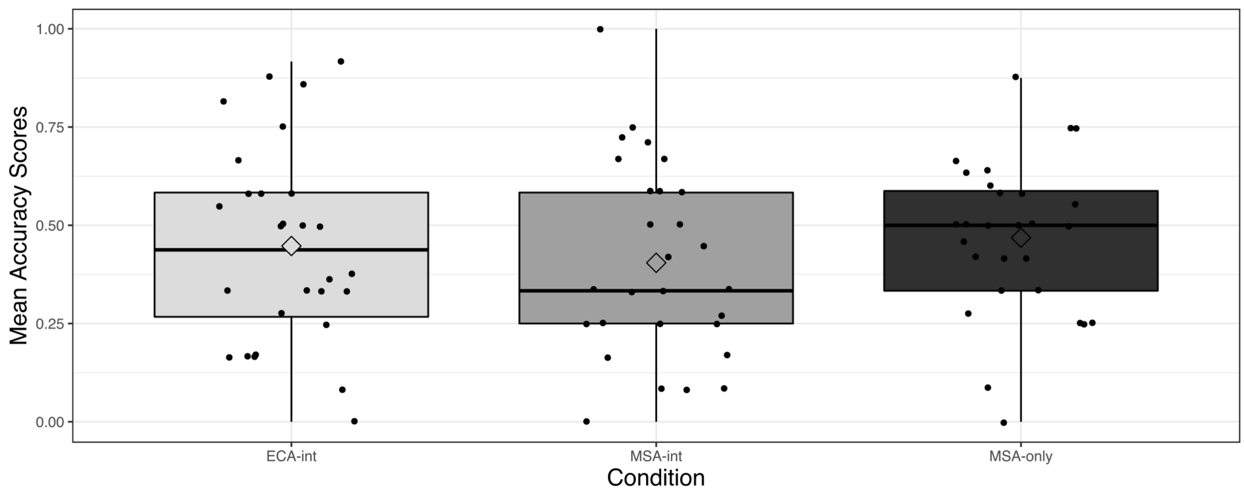
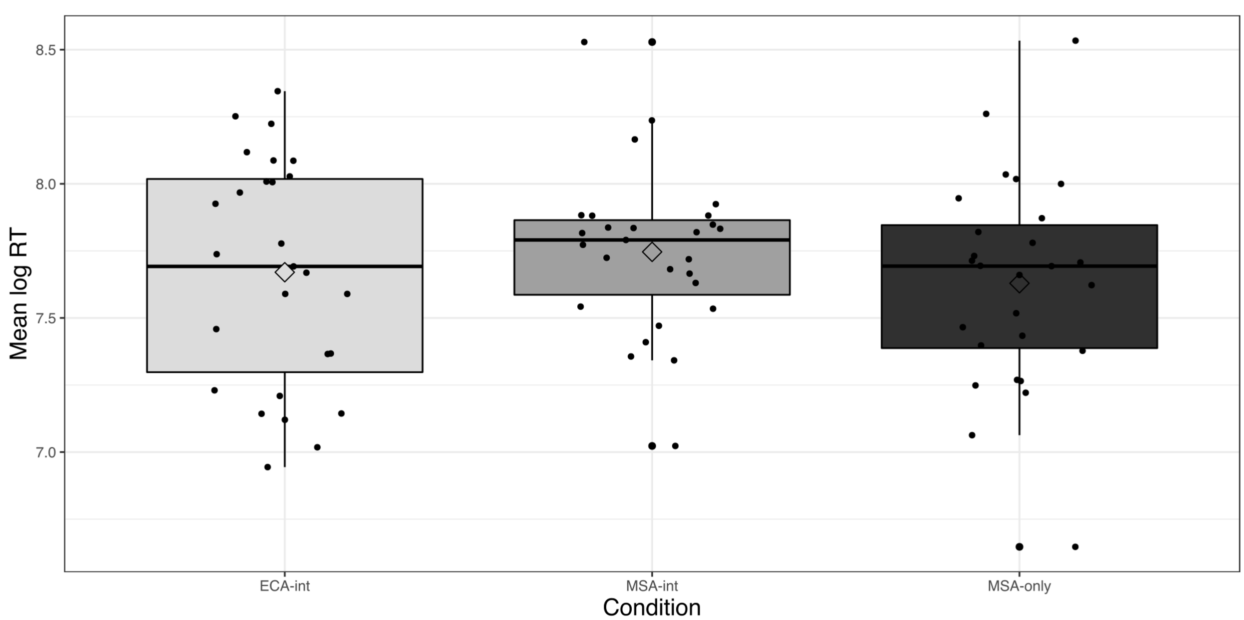


Figure 9. Boxplot of PT2 (Meaning Recognition) Log RT Across Exposures



The one-way, repeated measures ANOVA found no statistically significant differences in meaning recognition between the three exposures for either accuracy, $F_t = 2.235$, $F_{crit} = 3.02$, n.s., or log RT, $F_t = 0.799$, $F_{crit} = 3.413$, n.s. (see Table 5). The results of the analysis on meaning recognition indicate that there was no statistically significant difference between exposure groups. The meanings of lexical items were recognized and processed equally well regardless of whether words were learned in the MSA-only condition or the integrated conditions.

Table 5. ANOVA and Post-hoc Tests Results for PT2 Bootstrapped, Trimmed Means

Test	Mean Difference	95% CI	Test statistic	Critical Value
PT2 Accuracy (omnibus)			2.165	3.269
MSA-only vs. MSA-int	0.08622	(-0.024, 0.196)	1.986	2.529
MSA-only vs. ECA-int	0.04884	(-0.067, 0.165)	1.064	2.529
MSA-int vs. ECA-int	-0.03739	(-0.125, 0.05)	-1.083	2.529
PT2 Log RT (omnibus)			0.699	3.506
MSA-only vs. MSA-int	-0.12672	(-0.127, -0.307)	-1.884	2.684
MSA-only vs. ECA-int	-0.06549	(-0.41, 0.279)	-0.51	2.684
MSA-int vs. ECA-int	0.06123	(0.061, -0.25)	0.528	2.684

* Significant at $p < .05$

Discussion

The current study compared the initial stages of vocabulary acquisition in two conditions: exposure to MSA only, and exposure to an integrated combination of MSA and ECA. Learning was assessed through receptive tests of form and meaning knowledge. Both accuracy and reaction time (RT) were analyzed to determine if there were statistically significant differences in lexical representation and processing speed between the two conditions. For accuracy in both form (PT1) and meaning (PT2) recognition, no significant differences were detected between the three exposure groups (MSA-only, MSA-integrated, and ECA-integrated). This finding suggests that the learning outcomes were potentially equal, regardless of whether participants studied in one register or two. However, a significant difference was detected between exposure group log RTs on the form recognition test. Words learned in the ECA-integrated exposure were correctly identified more quickly than in either of the MSA exposures, and responses to MSA-only words were faster than those to MSA-integrated words. This finding was not repeated in the meaning recognition test: regardless of which exposure the words were learned in, answers were supplied equally quickly.

The significant results within PT1 log RT were surprising. It was hypothesized that differences would be obtained between conditions (MSA-only versus integrated exposures), and that MSA-only outcomes would be superior. Why words learned in the ECA-integrated exposure were correctly answered so much more quickly than in either of the MSA exposures is unclear. Perhaps factors unexplored in the current study, such as phonetic salience, affected acquisition and processing speed (Goldschneider & DeKeyser, 2005). That this significant log RT difference was *not* found in PT2 may be due to the fact that knowledge of meaning is considered to be less difficult than that of form (Laufer & Goldstein, 2004; Schmitt, 2010). In keeping with the processing predictions of the RHM, it was originally hypothesized that differences between conditions would be mitigated by test type (form recall versus meaning recall). Therefore, the lack of a significant finding in PT2, compared to in PT1, is not surprising. The nature of the task in PT2, choosing from 24 different options within a 10-second window with corrective feedback provided, may also have added unintentional noise to the data. However, given the within-subject nature of the study design where each subject serves as her own control, this noise would still be manifested equally across results for both conditions.

The overall absence of significant results (except for PT1 log RT) goes against what would be predicted in a paired associate paradigm; namely, that increasing the number of elements to be jointly associated should make lexical acquisition more difficult. It may be that the additional theorized learning burden of mapping multiple forms to a single meaning is ameliorated by the exposure to multiple variants. As discussed previously, the elaborative processing hypothesis (Barcroft, 2001) posits that increased acoustic variation necessitates deeper processing of the input, resulting in greater and more varied connections between meaning and acoustic form. Likewise, the BIA+ and the (Dijkstra & Van Heuven, 2002) predicts that phonological, semantic, and orthographic knowledge is coactivated during processing, and that this coactivation strengthens form-meaning mappings in the bilingual mental lexicon. Thus, interlingual cognates such as those found in sociolinguistic variation may not necessarily be as difficult to acquire as previously thought. Furthermore, the vocabulary items assessed here were intra-language lexical cognates, which, it has been suggested, characterize the majority of words across Arabic registers (Cadora, 1976). Translation equivalent items with completely different forms were not included in this study.

Overall, the findings suggest that initial learning outcomes may not be significantly different when studying two variants versus one. If this is indeed the case (in line with the null hypothesis), then the implication is that learning vocabulary in an integrated curriculum (i.e. learning intralanguage lexical cognates) leads to equally robust outcomes as in a traditional, MSA-only curriculum. Exposure to sociolinguistic variation, in the form of studying cross-varietal cognates, does not appear to negatively impact learning outcomes as compared to studying only one register.

Conclusion, Limitations, and Future Directions

Results from the current study suggest that there may not be any significant differences between learning Arabic vocabulary in an integrated setting (with half of the exposures in a spoken colloquial variety and half in MSA) as opposed to a traditional setting (exposure to MSA only). Although there was potential processing speed advantage for words learned in the Egyptian variety, accuracy scores across the two conditions were not statistically different. The results suggest that there may not be any noticeable costs to learning outcomes when studying multiple varieties of a language (i.e. an L2 curriculum which captures sociolinguistic variation) as compared to studying only one (usually the standard or prestigious register). Not only were noticeable costs not detected, but furthermore participants benefitted by gaining two varieties in the integrated condition rather than one.

It is important to keep in mind that this experiment represents immediate acquisition gained in a lab setting after roughly one hour of exposure. As such, it only measures the very initial form-meaning mappings of vocabulary knowledge (only two of the 18 subcategories described by Nation (2013) in his seminal guide on L2 vocabulary acquisition) in an intentional learning environment. Future research in L2 acquisition of variation should expand the scope of vocabulary knowledge measures utilized (Godfroid, 2020b; Schmitt, 2010). Furthermore, variation was operationalized as consonantal difference between registers. To gain more broader insights into the simultaneous acquisition of multiple varieties, variables such as vocalic differences, morphosyntactic differences, and appropriate pragmatic usage should also be investigated. Furthermore, this study did not look at translation-equivalent words with completely different surface forms. Follow-up studies should include these types of lexical items in proportion to their relative frequencies in standard L2 Arabic curricula.

Lastly, second language acquisition is an incredibly complex cognitive and social phenomenon. The results from this lab-based experiment can only shed light on a very small aspect of this process, which may look entirely different in classroom or digital settings. Nonetheless, it is hoped that this study will encourage not only more research into the psycholinguistic underpinnings of acquiring sociolinguistic variation, but likewise more empirically-supported discussions between language teachers and program directors as they debate curricular choices for their students.

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APPENDIX: TARGET VOCABULARY ITEMS AND MATCHED DISTRACTORS

Table A.1

Target and Distractor Words (1-12) – 24 Syllables Total

Target Words						Distractor Words			
Phonetic Difference	Location within word	Arabic Script	IPA Transliteration		Translation	Arabic Script	IPA Transliteration		Translation
			MSA	*ECA*			*MSA*	*ECA**	
	initial	1. جِسم	/d͡ʒism/	/gism/	body	25. حساب	/ħisa:b/		expense
/d͡ʒ/ → /g/	medial	2. سنجاب	/sind͡ʒa:b/	/singa:b/	squirrel	26. صنبور	/sˤunbu:r/		faucet
	final	3. مهرّج	/muhar:ad͡ʒ/	/muhar:ag/	clown	27. مقود	/ miqwad/		steering wheel
	initial	4. قمر	/qamar/	/ʔamar/	moon	28. ثمن	/θamn/	/tamn/	price
/q/ → /ʔ/	medial	5. بقرة	/baqara /	/baʔara/	cow	29. زعنفة	/zaʕnafa/		fin
	final	6. نفق	/nafaq/	/nafaʔ/	tunnel	30. دفء	/difʔ/		warmth
Interdental	initial	7. ظفر	/ðˤafar/	/dˤafar/	fingernail	31. قمل	/qaml/	/ʔaml/	lice
→	medial	8. نظّارة	/naðˤ:a:ra/	/nadˤ:a:ra/	glasses	32. حبارة	/ħib:a:ra/		squid
Alveolar**	final	9. فخذ	/faxð /	/faxd/	thigh	33. صمغ	/sˤamɣ/		glue
Interdental	initial	10. ظَرف	/ðˤarf/	/zˤarf/	envelope	34. قرش	/qirʃ/		shark
→	medial	11. تمثال	/timθa:l/	/ timsa:l /	statue	35. ذروة	/ðarwa/	/zarwa/	summit

Sibilant***	final	12.	تلوّث	/talaw:uθ/	/talaw:us/	pollution	36.	تحجّر	/taħad͡ʒ:ur/	/taħag:ur/	fossilization

* Items appear in this column only if the ECA version differs from the MSA version

** /θ/ → /t/, /ð/ → /d/, /ðˤ/ → /dˤ/

*** /θ/ → /s/, /ð/ → /z/, /ðˤ/ → /zˤ/

Table A.2

Target and Distractor Words (13-24) – 22 Syllables Total

Target Words							Distractor Words				
Phonetic Difference	Location within word	Arabic Script		Transliterated		Translation	Arabic Script		Transliterated		Translation
				MSA	*ECA*				*MSA*		
	initial	13.	جَرو	*/d͡ʒaru/*	*/garu/*	*puppy*	*37.*	برغي	*/burɣːi/*		screw
/d͡ʒ/ → /g/	medial	14.	حاجب	/ħaːd͡ʒib/	/ħaːgib/	eyebrow	38.	نحاس	/nuħaːs/		copper
	final	15.	تاج	/taːd͡ʒ/	/taːg/	crown	39.	مشط	/miʃtˤ/		comb
	initial	16.	قنطرة	/qantˤara/	/ʔantˤara/	arch	40.	عقربة	/ʕaqraba/	/ʕaʔraba/	scorpion
/q/ → /ʔ/	medial	17.	عقد	/ʕuqd/	/ʕuʔd/	necklace	41.	نسر	/nisr/		eagle
	final	18.	برق	/barq/	/barʔ/	lightning	42.	كهف	/kahf/		cave
Interdental	initial	19.	ثعلب	/θaʕlab/	/taʕlab/	fox	43.	برغوث	/barɣuːθ/	/barɣuːt/	flea
→	medial	20.	عَظْم	/ʕaðˤm/	/ʕadˤm/	bone	44.	رُعب	/ruʕb/		fright
Alveolar**	final	21.	محراث	/miħraːθ/	/miħraːt/	plow	45.	منقار	/minqaːr/	/minʔaːr/	beak
Interdental	initial	22.	ثروة	/θarwa/	/sarwa/	wealth	46.	بجعة	/bad͡ʒʕa/	/bagʕa/	swan
→	medial	23.	محفظة	/miħfaðˤa/	/maħfazˤa/	wallet	47.	مطرقة	/mitˤraqa/	/matˤraʔa/	hammer
Sibilant***	final	24.	تلميذ	/tilmiːð/	/tilmiːz/	student	48.	خفاش	/xufaːʃ/		bat

* Items appears in this column only if the ECA version differs from the MSA version

** /θ/ → /t/, /ð/ → /d/, /ðˤ/ → /dˤ/

*** /θ/ → /s/, /ð/ → /z/, /ðˤ/ → /zˤ/

Table A.3

Target Words as Transliterated for Participants

	MSA Item	Transliteration	ECA Item	Transliteration	"Translation"
1.	/**d͡ʒ**aru/	JARU	/**g**aru/	GARU	"puppy"
2.	/**d͡ʒ**ism/	JISM	/**g**ism/	GISM	"body"
3.	/sin**d͡ʒ**aːb/	SINJAAB	/sin**g**aːb/	SINGAAB	"squirrel"
4.	/ ħaː**d͡ʒ**ib/	HAAJIB	/ħaː**g**ib/	HAAGIB	"eyebrow"
5.	/taː**d͡ʒ**/	TAAJ	/taː**g**/	TAAG	"crown"
6.	/muharːi**d͡ʒ**/	MUHARRIJ	/muharːi**g**/	MUHARRIG	"clown"
7.	/**q**amar/	QAMAR	/**ʔ**amar/	AMAR	"moon"
8.	/**q**antˤara/	QANTARA	/**ʔ**antˤara/	‘ANTARA	"arch"
9.	/ba**q**ara/	BAQARA	/ba**ʔ**ara/	BA’ ARA	"cow"
10.	/u**q**d/	ʕQD	/u**ʔ**d/	ʕ’D	"necklace"
11.	/nafa**q**/	NAFAQ	/nafa**ʔ**/	NAFA’	"tunnel"
12.	/bar**q**/	BARQ	/bar**ʔ**/	BAR’	"lightning"
13.	/**θ**aʕlab/	THAʕLAB	/**t**aʕlab/	TAʕLAB	"fox"
14.	/**ðˤ**ufr/	ĐFR	/**dˤ**ufr/	DFR	"fingernail"
15.	/na**ðˤ**ːaːra/	NAĐĐAARA	/na**dˤ**ːaːra/	NADDAARA	"glasses"
16.	/ʕa**ðˤ**m/	ʕĐM	/ʕa**dˤ**m/	ʕDM	"bone"
17.	/fax**ð**/	FAĦĐ	/fax**d**/	FAĦD	"thigh"
18.	/miħraː**θ**/	MIHRAATH	/miħraː**t**/	MIHRAAT	"plow"
19.	/**ðˤ**arf/	ĐARF	/**zˤ**arf/	ZARF	"envelope"
20.	/**θ**arwa/	THARWA	/**s**arwa/	SARWA	"wealth"

21.	/tim**θ**aːl/	TIMTHAAL	/tim**s**aːl/	TIMSAAL	"statue"
22.	/miħfa**ð**ˤa/	MIHFAĐA	/miħfa**z**ˤa/	MIHFAZA	"wallet"
23.	/talawːu**θ**/	TALAWWUTH	/talawːu**s**/	TALAWWUS	"pollution"
24.	/tilmiː**ð**/	TILMIIĐ	/tilmiː**z**/	TILMIIZ	"student"