

Does Perceptual Learning Style Matching Affect L2 Incidental Vocabulary Acquisition through Reading?

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Abstract

Learning style matching is a neglected factor that may affect the complex process of second language (L2) incidental vocabulary acquisition through reading. The purpose of the current study is to investigate whether there is any difference in L2 incidental vocabulary acquisition and retention through reading when learners' perceptual learning style is matched to their input mode, mismatched to their input mode, or mixed. The participants were 108 Iranian English as a foreign language (EFL) learners at pre-intermediate levels of English proficiency. Based on their perceptual learning style preferences (visual, auditory, kinaesthetic/tactile, mixed), they were divided into a reading group (consisting of three subgroups: Matched, Mismatched, Mixed) and a control group. The reading group read a graded reader containing 16 target words and then completed immediate and delayed (3 weeks later) vocabulary post-tests. The results revealed no significant differences between the three reading subgroups in terms of incidental vocabulary acquisition and retention. The findings suggest that perceptual learning style matching has no benefits for incidental word learning through reading.

Résumé

L'alignement avec le style d'apprentissage est un facteur négligé qui pourrait avoir une incidence sur le processus complexe de l'acquisition incidente du vocabulaire par la lecture en langue seconde (L2). La présente étude a pour but d'examiner s'il existe des différences dans l'acquisition incidente et la rétention du vocabulaire pendant la lecture quand le style d'apprentissage perceptuel des apprenants correspond au mode d'entrée, est mal assorti ou mixte. Cent-huit apprenants de l'anglais langue étrangère (ALE) d'origine iranienne, dont les niveaux de compétences en langue anglaise se situaient dans le préintermédiaire, ont participé à cette étude. Selon leurs préférences de style d'apprentissage perceptuel (visuel, auditif, kinesthésique/tactile, mixte), ils ont été divisés en groupes de lecture (consistant de trois sous-groupes : aligné, mal assorti et mixte) et un groupe contrôle. Chaque groupe a lu un livre nivelé qui contenait 16 mots cibles et il a ensuite rempli des posttests de vocabulaire, l'un immédiat et l'autre retardé (3 semaines plus tard). Les résultats n'ont révélé aucune différence significative entre les trois groupes de lecture quant à l'acquisition incidente et la rétention du vocabulaire. Ces résultats ont indiqué que l'alignement avec le style d'apprentissage perceptuel ne présentait aucun avantage pour l'apprentissage incident du vocabulaire par la lecture.

Does Perceptual Learning Style Matching Affect L2 Incidental Vocabulary Acquisition through Reading?

It is widely acknowledged that second language (L2) vocabulary learning is more effective in intentional learning contexts than in incidental learning conditions (Hulstijn & Laufer, 2001; Schmitt, 2008). However, for learners who wish to achieve higher levels of L2 proficiency, class time is far too limited to allow adequate opportunities for the intentional learning of the many words that need to be mastered; this is why learners also need to learn vocabulary incidentally and independently (Horst, 2005). While researchers and practitioners have become increasingly aware of the importance of incidental learning for L2 vocabulary development, as Chen and Truscott (2010) pointed out, “in many respects this incidental vocabulary learning is still poorly understood” (p. 693), and as a result, “it cannot be fully exploited by teachers and learners” (Pigada & Schmitt, 2006, p. 2). Therefore, any attempt to shed more light on the nature of L2 incidental vocabulary acquisition and the factors that could play a role in this process is of great value.

One neglected factor that might influence L2 incidental word learning is learning style. Individuals have distinct learning styles; that is, they differ in their “natural, habitual, and preferred way(s) of absorbing, processing, and retaining new information and skills” (Reid, 1995, p. viii). Although there is plenty of evidence that learning styles exist, there is lack of consensus as to whether or not and to what extent learning styles have any educational implications (Pashler, McDaniel, Rohrer, & Bjork, 2009). Advocates of learning styles assessment in instruction (e.g., Sternberg, Grigorenko, & Zhang, 2008) have suggested that by assessing and identifying students’ learning styles and matching them to teaching methods, better learning outcomes can be achieved. Critics of learning styles assessment (e.g., Willingham, 2005), on the other hand, believed that learning styles have no educational implications, and that tailoring instruction to students’ individual learning styles does not enhance learning (Hatami, 2013).

This ambiguous situation regarding the value of learning styles in educational practice also applies to the field of second language acquisition (SLA) (Ellis, 2008) in general, and L2 vocabulary acquisition in particular. As Tight (2010) stated, “in vocabulary acquisition, the evidence in favor of style matching is far from conclusive” (p. 800). Moreover, the few studies that have examined the impact of learning style matching on L2 vocabulary learning have focused solely on the intentional acquisition of vocabulary (e.g., Kassaian, 2007; Pouwels, 1992; Tight, 2010; Wu, 2014). It appears that no studies to date have investigated the impact of learning style matching on the incidental acquisition of L2 vocabulary. Yet the importance of examining this issue has been raised in previous research. For instance, in a study by Waring and Takaki (2003) on the rate at which vocabulary is acquired from reading a graded reader, it was found that learners with above average L2 proficiency in the group scored slightly higher on some of the tests measuring vocabulary gains from reading; however, not all learners at lower L2 proficiency levels performed below average on the vocabulary tests. The authors speculated that “the variation may be a result of the reading matching their preferred learning style rather than a manifestation of their ability. This of course warrants further investigation” (p. 152). The purpose of the current study, therefore, is to investigate the role the match/mismatch between learners’ perceptual learning style and input mode plays in the incidental acquisition and retention of vocabulary through reading.

Literature Review

Factors Affecting L2 Incidental Vocabulary Acquisition through Reading

Previous studies have investigated a range of factors that influence L2 incidental vocabulary acquisition through reading. These factors are related to the word, the text/context, the task, or the learner (Paribakht & Wesche, 1999). For instance, a word-related variable that has been widely studied is frequency of occurrence. Studies have generally found that the more frequently a word occurs in a text, the greater the likelihood it will be learned (e.g., Brown, Waring, & Donkaewbua, 2008; Hatami, 2017; Horst, Cobb, & Meara, 1998; Pigada & Schmitt, 2006; Vidal, 2011; Waring & Takaki, 2003). First language (L1) lexicalization is another word-related factor that has been investigated. Paribakht (2005) and Chen and Truscott (2010) found that it is more difficult to infer and learn the meaning of non-lexicalized words (i.e., L2 words with no L1 translation equivalent) than lexicalized ones. Other features related to the word include word type (i.e., high-frequency, academic, technical, or low-frequency) and predictability from word form and parts (Vidal, 2011); word concreteness (Pichette, de Serres, & Lafontaine, 2012); and word class (Kweon & Kim, 2008).

A number of studies have examined the role of text- and context-related factors in the incidental acquisition of L2 vocabulary from reading. For example, Webb (2008) investigated the impact of the degree of informativeness of the context and showed that the presence of more contextual clues resulted in greater vocabulary gains from reading. Similarly, Vidal (2011) found that L2 readers made greater vocabulary gains for explicitly elaborated words (i.e., words accompanied by definitions, descriptions, naming, and questioning statements) than for words elaborated implicitly.

The nature of the task has also been shown to affect L2 incidental word learning from reading (Hulstijn & Laufer, 2001; Paribakht & Wesche, 1999). Paribakht and Wesche (1999) used two different tasks—responding to specific comprehension questions and orally summarizing each paragraph—and found that each of these tasks made different words salient to the learners, and that learners attended to more unknown words during the summary task than during the question task.

Finally, studies have attempted to examine the role of various learner- or reader-related variables in L2 incidental word learning. Some researchers have studied the role of learners' L2 proficiency (Horiba & Fukaya, 2015; Vidal, 2011) or, more specifically, the role of L2 lexical proficiency (Elgort & Warren, 2014; Horst et al., 1998) and L2 reading proficiency (Pulido, 2003). These studies have generally shown that the higher the learners' linguistic proficiency, the greater their incidental vocabulary gains. Other studies have focused on the strategies learners use when encountering new L2 words during reading (Elgort & Warren, 2014; Fraser, 1999; Paribakht & Wesche, 1999). For example, Fraser (1999) found that the learners in her study—eight Francophone university students enrolled in an intermediate-level English as a Second Language (ESL) course—used productive strategies (i.e., consulting and inferencing) more frequently than unproductive ones (i.e., ignoring or not paying attention). Topic familiarity is another learner-related factor that has been studied (Horiba & Fukaya, 2015; Pulido, 2003). Horiba and Fukaya (2015) found that topic familiarity facilitated learning of the content of the text as well as the new words in the text. Other learner-related variables that have been shown to play a role in L2 incidental

word learning during reading include age of L2 acquisition, gender, text comprehension, degree of enjoyment (Elgort & Warren, 2014), and reading goal (Horiba & Fukaya, 2015).

As can be seen from the brief review above, researchers have examined numerous factors affecting L2 incidental word learning during reading. Surprisingly, however, it appears that the potential role of learning style matching in this complex process has not yet been addressed.

Learning Styles

Despite the body of research on the role of learning styles in L2 acquisition, the current picture is rather confusing and controversial. This is due to a number of issues, in particular “too many labels purporting to being different styles, the use of ineffective assessment methods, and the lack of a clear distinction between style and other constructs such as intelligence and personality” (Riding, 2000, p. 365). Nevertheless, as Dörnyei and Ryan (2015) pointed out,

There is something genuinely appealing about the notion and, what is more, this intuitive appeal tends to resonate strongly with the classroom experience of educational practitioners...The hope underpinning much research into styles is that the current state of confusion is merely due to our insufficient knowledge rather than the scientific inadequacy of the concept. (p. 107)

Learning style models and measures. The first widely-used instrument in the L2 context was the Perceptual Learning Style Preference Questionnaire (PLSPQ) developed by Reid (1995; originally developed in 1984). In this user-friendly measure, Reid distinguished four perceptual learning styles (visual, auditory, kinaesthetic, and tactile) and two social learning styles (group learning preference and individual learning preference). Learners are asked to self-assess their behavioural preferences on a 5-point scale ranging from 1 (*strongly agree*) to 5 (*strongly disagree*). While the PLSPQ was primarily designed for ESL learners, it is not L2-specific (Dörnyei & Ryan, 2015). Questions concerning the reliability and validity of the PLSPQ have been raised. For instance, the reliability estimates (Cronbach’s alpha) for the perceptual learning style scales used in the PLSPQ have been reported to be quite low: .53 (visual scale); .48 (auditory scale); .69 (kinaesthetic scale); and .59 (tactile scale) (Wintergerst, DeCapua, & Itzen, 2001).

Another user-friendly learning style inventory widely used in SLA research is Oxford’s (1993) Style Analysis Survey (SAS). Although the SAS has been primarily used in the L2 context, the items themselves, similar to the PLSPQ, are not L2-specific (Dörnyei & Ryan, 2015). Respondents mark their answers on a 4-point scale ranging from 1 (*never*) to 4 (*always*). The SAS covers five style dimensions:

1. how one uses his/her physical senses for study and work (visual, auditory, hands-on);
2. how one deals with other people (extrovert vs. introvert);
3. how one handles possibilities (intuitive-random vs. concrete-sequential);
4. how one approaches tasks (closure-oriented vs. open); and
5. how one deals with ideas (global vs. analytic).

As stated by Dörnyei and Ryan (2015), an expanded and refined version of the SAS is the Learning Style Survey (LSS) developed by Cohen, Oxford, and Chi (2001). The LSS covers additional style dimensions (11 instead of five), the rating scale has been expanded (from a 4-point scale to a 5-point scale), and, most importantly, it was “developed with an interest in those style dimensions that seem to have the most relevance to language learning” (Cohen & Weaver, 2005, p. 10). The test-retest reliability of Part 1 of the survey, which targets perceptual style preferences (i.e., visual, auditory, and tactile/kinaesthetic) has been reported to be .74 (Tight, 2010).

The E&L model developed by Ehrman and Leaver (2003) also specifically addresses styles in language learning and aims to enhance the effectiveness of intensive language training. The E&L model consists of a superordinate construct called *synopsis-ectasis*, which refers to “the degree of conscious control of learning desired or needed” (Ehrman & Leaver, 2003, p. 395). Ehrman and Leaver developed an instrument in which the synopsis-ectasis distinction is reflected in ten subscales, with three items for each subscale. However, the instrument has not been widely used since its creation, which might be due to its limited availability or complicated interpretation of results (Dörnyei & Ryan, 2015).

In sum, numerous learning style models and measures exist, each consisting of various dimensions. However, one dimension common to most models (Tight, 2010) and familiar to most language teachers and many language learners (Dörnyei & Ryan, 2015) is the sensory/perceptual learning style dimension.

Perceptual learning styles. In the SLA context and the language classroom, the most relevant perceptual modalities tend to be sight, hearing, and touch (Tight, 2010). Students have a preference for the perceptual modality through which they take in new information (Dörnyei & Ryan, 2015). This preferred, dominant modality is known as the individual’s sensory preference or perceptual learning style preference. The following is a description of perceptual preference types.

Visual learners prefer to receive and absorb new information through sight, for example by reading written texts, seeing pictures, diagrams, and graphs, watching videos, looking at objects, taking notes, and visualizing images. *Auditory learners* prefer to receive and learn new information through hearing, for example by hearing spoken words, listening to oral explanations, lectures, and audiotapes, and participating in conversations and class discussions. *Kinaesthetic* and *tactile learners* are often grouped together because they have style preferences that are related, yet not identical. Kinaesthetic learners prefer to receive and learn new information through body experience and movement, while tactile learners have a general preference for learning through touching, hands-on tasks, and manipulation of objects (Dörnyei & Ryan, 2015; Reid, 1998).

The presence of one perceptual learning style preference does not exclude any other. In fact, some individuals have mixed modality preferences; these learners are likely to be more successful because they can more easily adapt themselves to the learning situation and process input, regardless of the mode in which it is presented (Dörnyei & Ryan, 2015; Kinsella, 1995).

The prevalence of different perceptual learning styles in diverse cultures and contexts has been examined by numerous researchers. According to Oxford (1995), in North America the most common perceptual modality preference (i.e., for 50% to 80% of the population) is visual. However, when Reid (1987), using the PLSPQ, attempted to

identify the perceptual learning style preferences of 1,388 college students from across the United States, 154 of whom were native speakers of English and the rest ESL students from a range of L1 backgrounds, she found that kinesthetic and tactile learning styles were very popular. Lincoln and Rademacher (2006) used the VARK learning style questionnaire (developed in 1987 by Neil Fleming) to assess the perceptual learning styles of 69 adult ESL students from 17 different countries of origin (but mostly from Latin America) in Arkansas, United States. VARK stands for visual, aural, read/write (i.e., preference for information displayed as words, either read or written), and kinaesthetic; these are the learning styles the VARK questionnaire measures. Lincoln and Rademacher found that most of the participants (33%) had a read/write preference, followed by a kinaesthetic (25%), auditory (20%), and visual (4%) preference, while 17% had mixed preferences.

Studies in English as a Foreign Language (EFL) contexts have also reported varying findings. For instance, Seifoori and Zarei (2011) used the PLSPQ to assess the perceptual learning styles of 94 university-level Iranian EFL learners majoring in English, and found the kinaesthetic learning style to be the most frequent, followed by auditory, visual, and tactile. Mozayan, Ebrahimpourtaher, Hoominian, Khosravi, and Shamsi (2013) also used the PLSPQ to determine the perceptual learning styles of 107 Iranian EFL learners majoring in medical sciences. The results revealed that the students' preferred learning styles were tactile and kinesthetic followed by visual and auditory. Naserieh and Anani Sarab (2013) also used the PSLPQ to examine the perceptual modality preferences of 138 Iranian graduate students majoring in either technical fields or social sciences. The findings showed that learning styles were preferred in the following order: kinaesthetic, tactile, auditory, and visual.

The diversity in these findings and in those of many other studies not mentioned above is not surprising. Perceptual learning styles have been shown to be related to numerous factors. These factors include, but are not limited to, L1, country of origin, age, gender, L2 proficiency, academic performance, level of education, and field of study (Alireza & Abdullah, 2010; Lincoln & Rademacher, 2006; Park, 1997; Reid, 1987).

L2 Vocabulary Acquisition and Perceptual Learning Styles

The role of learning styles in L2 vocabulary learning appears to be important. According to Oxford and Crookall (1990), "cultural and ethnic differences in learning styles may be very important and should be considered in understanding how people learn vocabulary. Sensory preferences, such as visual, aural, tactile, and kinesthetic should be assessed" (p. 25). Hence, a number of L2 researchers have investigated the relationship between perceptual learning styles and reported a range of findings on the intentional learning of vocabulary (e.g., Kassaian, 2007; Pouwels, 1992; Tight, 2010; Wu, 2014), the effectiveness of vocabulary annotations (Yeh & Wang, 2003), and lexical inferencing abilities (Shen, 2010).

Tight (2010) investigated the acquisition and retention of 36 L2 Spanish words by 128 undergraduate students. After assessing the participants' perceptual learning style preferences (i.e., visual, auditory, tactile/kinaesthetic, and mixed) using the LSS and administering a vocabulary pretest, the participants were presented with 12 words through the style matching condition, 12 words through the style mismatching condition, and 12 words through the mixed modality condition. The results revealed that the mixed modality instruction was the most effective for both acquisition and retention. Moreover, although

learners with different learning styles were found to be equally successful at L2 vocabulary acquisition, style matching led to significantly greater retention than style mismatching.

Shen (2010), also using the PLSPQ, investigated the impact of perceptual preference and social preference on the L2 lexical inferencing ability of 145 university students in Taiwan. On a lexical inferencing test, before receiving any training in inferencing strategies, the group learners outperformed the others, followed by individual learners, kinesthetic, tactile, auditory, and visual learners. However, after receiving explicit instruction in inferencing strategies as part of a 15-week reading course, auditory and visual learners showed greater gains on the lexical inferencing post-test. The author relates this benefit to the match between the teaching style and the students' learning style, since most of the instruction was geared to auditory and visual learners.

However, not all studies have shown style matching to be effective. For instance, Yeh and Wang (2003) examined the effectiveness of three types of vocabulary annotations (i.e., text annotation only, text plus picture, and text plus picture and sound) on L2 vocabulary acquisition among 82 university students in Taiwan. The authors further investigated whether learners with certain perceptual learning styles benefited more from a particular type of vocabulary annotation. They assessed perceptual learning styles using a questionnaire developed by Kinsella (1995). The results revealed that the most effective type of annotation was the combination of text and picture. Perceptual learning styles did not seem to have a significant impact on the effectiveness of vocabulary annotations; participants generally preferred visual annotations to auditory ones. Kassaian (2007) also found that her participants—66 university-level Iranian students—regardless of having visual or auditory preferences, acquired and retained visually presented items better than aurally presented ones. The VAK learning styles test designed by Chislett and Chapman (2005) was used to assess perceptual learning styles.

As evident from the review above, and as Tight (2010) pointed out, no general conclusions can be drawn from the existing L2 studies on the relationship between perceptual learning styles and vocabulary learning. Moreover, these studies have thus far focused only on the explicit instruction and intentional acquisition of vocabulary. There is indeed a lack of research on the relationship between perceptual learning styles and the incidental acquisition of L2 vocabulary. The present study aims to address this gap by investigating the following research questions:

1. What are the perceptual learning style preferences of university-level Iranian EFL learners majoring in engineering?
2. What is the difference in L2 incidental vocabulary acquisition rates through reading, as measured by an immediate post-test, when learners' perceptual learning style is
 - a) matched to their input mode,
 - b) mismatched to their input mode, or
 - c) mixed?
3. What is the difference in L2 vocabulary retention rates through reading, as measured by a delayed post-test, when learners' perceptual learning style is
 - a) matched to their input mode,
 - b) mismatched to their input mode, or
 - c) mixed?

Method

Participants

The participants were 108 Iranian EFL learners (64 males and 44 females), all undergraduate engineering students at a highly-ranked university in Iran. The participants shared the same L1, Farsi, and ranged in age from 18 to 25 years ($M = 19.69$, $SD = 1.44$). They had formally studied English for at least seven years and none of them had ever resided in an English-speaking country. They were at pre-intermediate levels of English language proficiency; this was confirmed by the director of the English Language Center at the university and also by their scores on the Vocabulary Levels Test (VLT) (N. Schmitt, D. Schmitt, & Clapham, 2001). Students were included in the study only if they had a minimum raw score of 15 out of 30 on the 2,000 word level of the VLT. This was to ensure that they would have little or no difficulty understanding the running words in the text that they had to read. All participants received cash incentives (equivalent to \$10 CAD) for their participation in the study.

The perceptual learning styles of the participants was determined using the LSS. There were only nine auditory and 12 kinaesthetic/tactile learners in the sample; therefore, these participants were first assigned to the reading group to form the mismatched subgroup. The remaining 87 participants, who were either visual or mixed modality, were then randomly assigned to the reading group and the control group. Thus, the reading group consisted of 21 auditory or kinaesthetic/tactile learners (i.e., Mismatched learners), 21 visual learners (i.e., Matched learners), and 19 mixed modality learners (i.e., Mixed learners), and the control group consisted of 30 visual learners and 17 mixed modality learners. It should be noted that the unequal number of visual learners in the reading group and the control group was due to an attempt to make the three reading subgroups of approximately equal size.

Materials

Target words (TWs). Sixteen words in the reading text (see below for details about the text) were chosen as TWs and were then replaced by 16 non-words (see Appendix A). In order to ensure that the non-words looked like plausible English words and that they were all similar in terms of learning difficulty, the following steps were taken. First, 46 non-words, all two syllables and five to six letters in length, were selected from Meara's (2013) list of imaginary words. Three professors of Teaching English as a Second Language (TESL) then judged each non-word regarding its plausibility as a real English word. Consequently, 16 of the non-words were excluded for the following reasons: they looked French, were common English names, had irregular pronunciation or spelling, or contained real English words. A questionnaire was then designed for the 30 remaining non-words, to explore (a) the plausibility of each non-word as an English word through a yes/no question, and (b) the spelling and pronunciation difficulty of each non-word using a five-point scale (1 = *very easy*, 5 = *very difficult*). Based on the judgments of five Canadian native speakers of English (mean age = 38 years) and five Iranian non-native speakers of English (mean age = 29.8 years) who responded to the questionnaire, 16 non-words were selected for the study. These 16 non-words were rated as plausible English words by at

least eight of the 10 respondents, and the average spelling and pronunciation difficulty for each was rated lower than 3.

Reading material. An elementary-level graded reader (i.e., *The Monkey's Paw*) from the Oxford Bookworms series was selected as reading material for the reading group. In order to further simplify the text, the proper nouns that the researcher (who is also a native Farsi speaker) thought might be unknown to the participants were changed to more recognized nouns. Moreover, using the BNC-COCA-25 VocabProfile available at www.lextutor.ca, words beyond the 1,000 word level were either replaced with words from this level or excluded. This left a text of 4,231 words. After the insertion of the non-words in the text, a 95.84% lexical coverage was obtained (see Appendix B for an excerpt from the reading text). Research on L2 reading comprehension has shown that 95% to 98% lexical coverage provides adequate comprehension of written texts (Hu & Nation, 2000; Laufer & Ravenhorst-Kalovski, 2010).

Instruments

Language background questionnaire (LBQ). The LBQ, which was translated into Farsi, consisted of a range of questions about the participants' sex, age, native country, native language, other languages spoken and proficiency levels, length of residence in an English-speaking country, and hours per week of reading in Farsi and English for both study purposes and pleasure.

Learning Style Survey (LSS). The perceptual learning style preferences of the learners in this study were assessed using the LSS developed by Cohen et al. (2001) (translated into Farsi by the researcher and another Farsi-English bilingual). The LSS consists of 11 parts and 110 items; however, this study used only Part 1 of the survey, which targets sensory/perceptual preferences and consists of 30 items (10 each for visual, auditory, and tactile/kinaesthetic modalities). Respondents self-reported how often they performed a particular behavior associated with one of the three modalities by circling one of the options on a 5-point rating scale (0 = *never*; 1 = *rarely*; 2 = *sometimes*; 3 = *often*; 4 = *always*). The LSS was selected for this study because, as previously mentioned, it is an improved version of Oxford's (1993) Style Analysis Survey (SAS), it has been developed with relevance to language learning, and for Part 1 of the survey (which was used in this study) acceptable reliability estimates (i.e., .74) have been reported (Tight, 2010). Moreover, the instrument is user-friendly, is easy to score, and provides clear explanations about the results.

The points for the 10 items related to each perceptual learning style were totalled for each participant. The maximum possible score for each style was 40. The learning style for which the participant had the highest score was considered the participant's perceptual learning style only if there was at least a three-point difference between this learning style and another learning style. If the difference was less than three points, the participant was considered to have a mixed modality preference.

Vocabulary post-test. Previous studies that have investigated the relationship between perceptual learning styles and L2 vocabulary acquisition have measured vocabulary gains exclusively in terms of meaning (e.g., Kassaian, 2007; Pouwels, 1992;

Tight, 2010; Yeh & Wang, 2003). The only exception is Wu (2014), who measured word form, meaning, and usage, but in a rather unsystematic way. In the current study, however, in order to measure L2 incidental vocabulary acquisition and retention, five dimensions of word knowledge were chosen from Nation's (2001) comprehensive vocabulary knowledge framework. Measuring different dimensions of word knowledge is "the most effective way to assess vocabulary depth" (Nation & Webb, 2011, p. 227). The vocabulary post-test in this study consisted of six tests overall: five recognition tests measuring spoken form, written form, part of speech, syntagmatic association, and form-meaning connection, and one recall test measuring form-meaning connection. These tests were adapted from the work of Webb (2005), Chen and Truscott (2010), and van Zeeland and Schmitt (2013) [see Appendix C].

Each of the six tests appeared on two consecutive pages; the post-test was 12 pages in total. Based on Webb (2005), the tests were ordered in such a way as to prevent any possible learning effects; for example, the recall test of form-meaning connection was placed before its recognition test. All test instructions were provided in both English and Farsi. As the participants completed the post-test, they were asked not to go back and change any answers. They were supervised to ensure this did not happen.

On the recognition tests, each correct response was given one point. For the meaning recall test, each correct response was also given one point and each partially correct response was given half a point. For instance, if the correct response was *afraid*, and the learner had written *shocked*, half a point was awarded. The recall test was scored by the researcher and another rater. An inter-rater reliability of 98% was reached.

Procedures

The materials and instruments were pilot-tested with four Iranian EFL learners possessing characteristics similar to those of the target population. Some of the instructions and Farsi translations were revised accordingly. For the actual study, data collection took place in three sessions.

In the first session, which lasted an hour, participants were introduced to the study and invited to sign a consent form. Following this, the language background questionnaire (LBQ), the Learning Style Survey (LSS), and the Vocabulary Levels Test (VLT) were administered.

In the second session, which was held two weeks after the first session and took approximately 75 minutes, the participants were asked to read and try to understand *The Monkey's Paw*, a classic English story. (The vocabulary focus of the study was not revealed to them.) After the participants read the text for approximately 36 minutes (followed by a 5-minute break), the unexpected vocabulary post-test was administered to measure incidental vocabulary acquisition. Two practice examples for each of the six tests in the post-test were first presented. The participants were then given as much time as necessary to complete the post-test.

In the third and final session, which was held three weeks after the second session and took approximately 30 minutes, the delayed post-test was administered to measure vocabulary retention. The three-week time interval was chosen between the two post-tests as it is considered sufficient time to demonstrate stable and durable learning (Schmitt, 2010). The delayed post-test was exactly the same as the immediate post-test.

The control group did not read the text (*The Monkey's Paw*). However, they completed all other procedures mentioned above; that is, they responded to the LBQ, LSS, VLT, and the immediate and delayed post-tests. The control group was included to make sure that taking the immediate post-test did not result in any learning of the target words and consequently did not affect the results on the delayed post-test.

Results

To ensure that there were no practice effects present—that scores on the delayed post-test were not affected by the immediate post-test but were a direct result of the treatment—a repeated-measures *t*-test was performed. The *t*-test was run to compare the control group's scores on the immediate post-test (Time_1) with their scores on the delayed post-test (Time_2). The average of scores on the five recognition tests (i.e., tests of spoken form, written form, part of speech, syntagmatic association, and form-meaning connection) was used as the dependent variable. The repeated-measures *t*-test revealed a significant increase in the scores of the control group on the recognition tests from Time_1 to Time_2, $t(45) = -6.26, p < .001$. Considering that the control group was not exposed to the reading material, the significant improvement in their scores suggests that practice effects had occurred. Therefore, scores on the recognition tests could not be used when addressing the third research question in this study (i.e., retention rates at Time_2). On the meaning recall test, however, all 47 members of the control group scored zero at Time_1, and all but three members scored zero again at Time_2. Practice effects did not appear to be present for the meaning recall test. Therefore, only recall scores were used when answering the third research question in this study. In Table 1, descriptive statistics for the control group at Time_1 and Time_2 for word recognition and recall are presented.

Table 1
Descriptive Statistics for the Control Group

Test	Time	<i>M</i>	<i>SD</i>
Recognition	1	3.09	1.57
	2	4.35	1.85
Recall	1	.00	.00
	2	.11	.43

Note. Time_1 = immediate post-test. Time_2 = delayed post-test. Recognition = scores on the five recognition tests combined and averaged. The maximum possible score is 16. Recall = scores on the recall test of form-meaning connection. The maximum possible score is 16.

Research Question 1

What are the perceptual learning style preferences of university-level Iranian EFL learners majoring in engineering? Based on the results from the LSS (see Table 2), 51 (47%) of the 108 Iranian undergraduate students in this study had a visual preference, 36 (33%) had a mixed modality preference, 12 (11%) had a kinaesthetic/tactile preference, and nine (8%) had an auditory preference. Hence, the majority of the learners had a single modality preference, the most common of which was visual and the least common auditory.

Table 2
Scores on the Learning Style Survey

Learning Style	<i>n</i>	Items on the LSS	<i>M</i>	<i>SD</i>
Visual learners	51	Visual	27.10	3.58
		Auditory	19.41	2.95
		K/T	15.76	5.05
Auditory learners	9	Visual	19.89	2.15
		Auditory	25.56	3.17
		K/T	14.56	5.17
K/T learners	12	Visual	21.83	3.35
		Auditory	19.17	3.81
		K/T	27.25	3.91
Mixed learners	36	Visual	22.19	3.45
		Auditory	21.81	3.14
		K/T	19.47	4.78

Note. LSS = Learning Style Survey. K/T = Kinaesthetic/Tactile. The maximum possible score for each set of items on the LSS is 40.

Research Question 2

What is the difference in L2 incidental vocabulary acquisition rates through reading as measured by an immediate post-test, when learners' perceptual learning style is

- matched to their input mode,
- mismatched to their input mode, or
- mixed?

In order to respond to this question, a one-way between-subjects multivariate analysis of variance (MANOVA) was conducted, with Group (Matched vs. Mismatched vs. Mixed) as the independent variable and two dependent variables: the average of scores on the five recognition tests and the scores on the recall test. Results obtained from the MANOVA showed a non-significant effect for Group, Wilks' $\lambda = .96$, $F(4, 110) = .52$, $p = .72$. In other words, no significant differences were found between the Matched, Mismatched, and Mixed groups' scores on the recognition tests or the recall test. The scores of the three groups at Time_1 have been summarized in Table 3.

Table 3
Scores of the Matched, Mismatched, and Mixed Groups on the Immediate Post-test

Test	Group	<i>n</i>	<i>M</i>	<i>SD</i>
Recognition	Matched	20	8.54	2.52
	Mismatched	20	9.26	2.60
	Mixed	19	9.77	3.08
Recall	Matched	20	1.80	1.95
	Mismatched	20	2.40	2.24
	Mixed	19	2.63	2.18

Note. Recognition = scores on the five recognition tests combined and averaged. The maximum possible score is 16. Recall = scores on the recall test of form-meaning connection. The maximum possible score is 16. Two missing cases (the scores of two participants were outliers in this analysis and therefore excluded; however, the analysis was run twice—once with the outliers and once without them—and yielded consistent results).

Research Question 3

What is the difference in L2 vocabulary retention rates through reading, as measured by a delayed post-test, when learners' perceptual learning style is

- matched to their input mode,
- mismatched to their input mode, or
- mixed?

As previously stated, because practice effects appeared to exist for the recognition tests, the recognition scores were not used in the data analysis conducted for this research question; only recall scores were used in the analysis. A mixed-design analysis of variance (ANOVA) was performed, with Group (Matched vs. Mismatched vs. Mixed) as the between-subjects factor, Time (Time_1 vs. Time_2) as the within-subjects factor, and the scores on the meaning recall test as the dependent variable. The results revealed a significant effect for Time, $F(1, 52) = 11.7, p < .05$, partial $\eta^2 = .18$, power = .92. However, the effects were non-significant for Group, $F(2, 52) = .78, p = .46$, and for the interaction between Time and Group, $F(2, 52) = .05, p = .96$. Thus, no significant differences were found between the Matched, Mismatched, and Mixed learners on the delayed recall test. The scores of the three groups at Time_1 and Time_2 on the recall test are shown in Table 4.

Similar to the trend at Time_1, meaning recall scores at Time_2 were highest for Mixed learners, followed by Mismatched learners, and finally, Matched learners. However, none of these differences between the groups was statistically significant. The mean of each group was smaller at Time_2 compared with Time_1, indicating that some forgetting had occurred after three weeks. The largest mean difference (MD) between Time_1 and Time_2 was observed for Mixed learners (MD = .68), followed by Mismatched learners (MD = .58), and Matched learners (MD = .55).

Table 4

Meaning Recall Scores of the Matched, Mismatched, and Mixed Groups on the Immediate and Delayed Post-tests

Time	Group	<i>n</i>	<i>M</i>	<i>SD</i>
1	Matched	20	1.80	1.95
	Mismatched	18	2.00	1.91
	Mixed	17	2.53	2.11
2	Matched	20	1.25	1.15
	Mismatched	18	1.42	1.69
	Mixed	17	1.85	1.76

Note. Time_1 = immediate post-test; Time_2 = delayed post-test. The maximum possible score is 16. Six missing cases (one participant did not complete the delayed post-test and the scores of five participants were outliers in this analysis and therefore excluded; however, the analysis was run twice—once with the outliers and once without them—and yielded consistent results).

Discussion and Conclusion

Research Question 1

Of the 108 Iranian engineering undergraduate students in this study, 33% had mixed modality preferences, but the majority—67%—of the participants had a single modality preference. All three categories of single modality preferences (i.e., visual, auditory, kinaesthetic/tactile) were found among the participants. However, by far the most common single modality preference was visual. This does not appear to be consistent with previous findings for university-level Iranian EFL learners, which have often shown the kinaesthetic or tactile learning styles to be the most frequent (Mozayan et al., 2013; Naserieh & Anani Sarab, 2013; Seifoori & Zarei, 2011). In addition to the fact that these studies have used the PLSPQ to assess perceptual learning styles (while the current study used the LSS), a possible explanation for this inconsistency could be the participants' field of study since none of these studies has exclusively examined engineering students. Majoring in engineering and visual learning preference have been shown to be related. For example, in a study of Iranian graduate students studying either engineering or political science in Malaysia, Alireza and Abdullah (2010) found visual learning to be a minor style among political science students, but a major style among the engineering students. As the authors pointed out, political science students “are involved with abstract ideas and more inclined toward hearing not seeing,” while engineering students are mostly involved with “concrete and tangible statistics, formulas, and graphs ... suggesting that they are more inclined to seeing things” (p. 39).

Another explanation for the high visual preference of participants in this study might be that the participants were recruited from a high-ranking, prestigious university and were all academically successful students. Academic success and having visual preferences have also been shown to be related. For instance, in a comparative study of Chinese, Filipino, Korean, Vietnamese, and White students in secondary schools in California,

United States, Park (1997) found that among high, middle, and low achievers, high achievers were the most visual and low achievers were the least visual.

Finally, considering the examination-oriented education system in Iran and the great emphasis that is placed on reading and learning from textbooks and on detailed note-taking in class (for all subjects including English) as well as the scarcity of opportunities for in-class discussions and group work, it is not surprising that Iranian students are highly visual. As Rossi-Le (1995, as cited in Oxford & Anderson, 1995) stated, the more exposure language learners have to the written word, the more they feel comfortable learning visually. This may also explain why the auditory learning style was the least common among the participants in this study and the least common or second to least common style in other studies conducted with Iranian EFL learners (e.g., Mozayan et al., 2013; Naserieh & Anani Sarab, 2013).

Research Questions 2 and 3

No differences were observed for immediate incidental vocabulary gains at the level of recognition or recall, between

1. learners whose perceptual learning style was visual and therefore matched to their input mode;
2. learners whose perceptual learning style was either auditory or kinaesthetic/tactile and therefore mismatched to their input mode; and
3. learners who had mixed modality preference.

With regard to retention rates three weeks later, again no differences were found among these three groups of learners at the recall level (retention rates at the recognition level could not be measured due to the presence of practice effects). These results suggest that perceptual learning style matching has no benefits for incidental word learning through reading. In other words, it appears that learners, regardless of their perceptual modality preference, are able to learn vocabulary incidentally from reading to the same extent. These findings support a number of previous studies (e.g., Kassaian, 2007; Wu, 2014; Yeh & Wang, 2003) that have shown that style matching does not enhance L2 vocabulary learning (although none of these studies focused on *incidental* vocabulary learning).

The findings of this study, therefore, challenge the notion that presenting material in a learner's preferred modality enhances learning. In line with these findings, Kratzig and Arbuthnott (2006) showed that individuals' memory efficiency is not limited by sensory modality, and they therefore concluded that focusing on perceptual modality preferences may be a wasted effort. In addition, as Willingham (2005) claimed, most of what students learn is not particularly visual, auditory, or kinaesthetic information, but meaning-based. The initial experience by which one learns a fact may be visual (e.g., looking at a picture) or auditory (e.g., hearing an explanation), but the resulting representation of that knowledge in the mind is usually neither visual nor auditory; rather, it is meaning-based. Hence, the teacher's "goal should be to find the content's best modality, not to search (in vain) for the students' best modality" (Willingham, 2005). With regard to L2 incidental word learning, it therefore seems best to focus on the more effective input modality, rather than on learners' preferred modality. In fact, studies have shown that reading is a more effective modality

than listening for L2 incidental word learning (Brown et al., 2008; Hatami, 2017; Vidal, 2011). It is fitting to end this discussion with this quote from Dörnyei and Skehan (2003):

It appears from a review of findings on style that such concepts may not deserve high research priority, but they have not been eliminated as potentially relevant second language linked measures. What is now needed is more evidence of educationally linked applications of such concepts. (p. 607)

Limitations and Suggestions for Future Research

Several limitations of this study need to be considered. First, the design of the vocabulary post-test led to practice effects and, as a result, retention rates could not be measured accurately for recognition scores. This should be taken into account, as differences might have existed between the groups in the current study if retention rates had been measured more comprehensively. In Tight's (2010) study, for instance, benefits of style matching were found only for the retention of vocabulary knowledge (on the delayed post-test) and not for its acquisition (on the immediate post-test). One way to address this issue in future research would be to employ a different research design (e.g., having one group of participants take the immediate post-test and a different group of participants take the delayed post-test).

Second, in order to determine the perceptual learning styles of the learners in this study, a self-report questionnaire was used. Such instruments yield subjective judgments, not objective measurements. Kratzig and Arbuthnott (2006) found that on learning style questionnaires, "participants did not engage in detailed analytic judgment of their learning histories, but, rather, the particular question prompted rapid retrieval of either general examples or previously formed opinions about preferences or abilities" (p. 244). Thus, caution must be used when interpreting the results of such instruments in SLA research.

Finally, it might be worthwhile to address the research questions in this study for incidental word learning through L2 listening. In fact, the initial goal for this study was to have three groups—two experimental groups (reading and listening) and one control group. However, because there was an inadequate number of auditory learners in the recruited participants, the matched subgroup could not be formed for the listening group. As a result, the listening group was excluded. A larger sample size might have provided sufficient auditory learners. However, such a low number of auditory learners is likely not typical of many EFL or ESL contexts.

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Appendix A
Target Words and Corresponding Non-words

Target Word	Number of Occurrences in the Text	Part of Speech	Non-word
chair	2	N.	bartle
tea	4	N.	lore
noise	9	N.	gamage
window(s)	10	N.	mollet(s)
living-room	13	N.	palote
bed	15	N.	hislop
husband	19	N.	pegler
hand	20	N.	lomax
smiled	5	V.	kemle → kemled
watched	7	V.	bamber → bambered
laughed	12	V.	gummer → gummered
asked	18	V.	mundy → mundied
big	3	Adj.	scally
warm	8	Adj.	turley
afraid	14	Adj.	alden
old	17	Adj.	galpin

Note. N. = Noun, V. = Verb, Adj. = Adjective. Verbs were only used in the past tense throughout the story.

Appendix B
An Excerpt from the Reading Text

In their palote, the two galpin people and their son sat and talked about Mr Morris' stories.

'India is a wonderful country,' Mr White said. 'What exciting stories! It was a good evening.'

Mrs White stood up to take some things into the kitchen, but she stopped and listened to Jack and his father.

'Yes,' Jack said. 'Morris told some interesting stories, but, of course, some of them weren't true.'

'Oh Jack!' Mrs White said.

'Well, Mother, that story about a dirty little monkey's paw wasn't true. But it was a good story.' And Jack kembled.

'Well, I think you're right, Jack,' his mother said.

'I don't know,' Mr White said quietly. 'Perhaps the story was true. Strange things can happen sometimes.'

Mrs White looked at her pegler. 'Did you give some money to Tom Morris for that paw?' she mundied. 'We don't have money to give away for nothing!' Mrs White was angry now.

'Well, yes,' her pegler answered. 'I did, but not much, and at first he didn't want to take it. He wanted the monkey's paw.'

'Well, he can't have it,' Jack said. 'It's our paw now and we're going to be rich and happy. Come on, Father. Make a wish!'

Appendix C Vocabulary Post-test

Recognition of spoken form

[This measure had an aural multiple choice format; participants heard twice the target word and three distracters from a recording and had 5 seconds to check the box corresponding to the correct spoken form of the target word.]

Example: [Participants heard]:

Which pronunciation is correct? Please check the box.

Number one [2sec] A bartle [2sec] B bertel [2sec] C burdle [2sec] D bardel [2sec.]

Number one [2sec] A bartle [2sec] B bertel [2sec] C burdle [2sec] D bardel [5sec.]

[At the same time, the participants saw on the test page]:

Which pronunciation is correct? Please check (✓) the box.

1. A B C D

Recognition of written form

[This multiple choice test consisted of the target word and three distracters. The same distracters used for the test of spoken form were used for this test.]

Example:

Which spelling is correct? Please check (✓) the box.

1. bartle bertel burdle bardel

Recall of form-meaning connection

[Meaning recall was measured using a translation test.]

Example:

Translate into Farsi.

1. bartle.....

Recognition of part of speech

[For this test, the target word was presented in three different sentences. Each sentence used the target word as a different part of speech. Only one of the sentences was correct, and the other two were distracters. In order to avoid any learning effects on the tests that follow, sentences were created in such a way that no clues to the meaning of the target words were provided.]

Example:

Which sentence is correct? Please check (✓) the box.

1. bartle It is a bartle. (Noun)
 He is very bartle. (Adjective)
 She bartled. (Verb)

Recognition of syntagmatic association

[In this test, the target word was presented followed by four choices: one choice was in a sequential relationship with the target word and the other three choices were distracters. All choices were in the same word class. Because the correct option was a target word in the passage, all the distracters were chosen from the passage, as well.]

Example:

1. Which word is more likely to be used with *bartle* in a sentence?
 Please check (✓) the box.
 sit go open stop

Recognition of form-meaning connection

[In this final test, the target word was presented followed by four options: the original real English word which it had replaced in the text and three distracters. The distracters belonged to the same word class. Because the correct option had not been read in the passage, all the distracters were chosen from outside the passage, as well.]

Example:

1. Which is the correct meaning for *bartle*? Please check (✓) the box.
 book chair food head