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Cognitive and learning styles of Japanese learners and second language proficiency

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Abstract

Previous studies have suggested that individual differences might play a moderating role in second language (L2) learning. Some researchers have argued that cognitive and learning styles (individual preferences for information processing) are predictive of success in L2 learning, regardless of inconsistent results in empirical research. The present study investigates the cognitive and learning styles of L2 learners and the relationship between their style features and L2 proficiency. Participants were 34 Japanese high school students studying English as a foreign language. Their style characteristics were measured by the self-report questionnaire with eleven style dimensions. Also, they were categorized into three levels of L2 proficiency by the written and oral examinations in the school curriculum. Results showed that more than 70% of the participants were characterized as visual, concrete-sequential, deductive, and reflective learners. Overall, L2 learners' style differences were not strongly related to L2 proficiency. However, extraverted, global, sharpener/leveler, and field dependence/independence styles positively or negatively influenced the proficiency measures. The relationships between style differences and L2 proficiency levels exhibited both the linear and curvilinear patterns, suggesting that L2 learners might change their styles in order to adapt themselves to the requirements of learning contexts.

Keywords: cognitive styles; learning styles; individual differences; proficiency; second language learning

1. Introduction

The characteristics of learners are one of the possible factors to affect success in learning a foreign or second language (L2). Such learner differences, including age, gender, aptitude, cognitive and learning styles, strategies, motivation, and so forth (Cohen, 2003, 2009; Ehrman, Leaver, & Oxford, 2003; Skehan, 1991), have been found to predict the rate and success of L2 learning (Cohen, 2009). Among such learner factors, an interesting but controversial topic is cognitive and learning styles (Dörnyei & Skehan, 2003). In psychology, cognitive style refers to a specific manner of information processing related to cognitive processes (perceiving, organizing, and analyzing), a mechanism that can influence individuals' behavior and use of information processing strategies, whereas learning style is a typical preference for learning, which is influential for learners' performance, interacting with their motivation and attitudes (Armstrong, Peterson, & Rayner, 2012; see also Dörnyei & Skehan, 2003). Since the 1940s, in the field of psychology, business and education, various cognitive (learning) style models have been proposed (see Kozhevnikov, 2007; Kozhevnikov, Evans, & Kosslyn, 2014, for historical reviews), and it was hypothesized that a style is a bipolar value-free construct, such as analytic versus global processing (Goodenough, 1976; Witkin, Dyk, Faterson, Goodenough, & Karp, 1962; Witkin, Moore, Goodenough, & Cox, 1977). Specific styles should have advantages in some situations and disadvantages in others; to put it differently, one style is not always superior to other constructs (Dörnyei & Skehan, 2003; Ortega, 2009; Reid, 1995).

In second language acquisition (SLA), it has been generally believed by many researchers (e.g., Leaver, Ehrman, & Shekhtman, 2005; Oxford, 1990; Reid, 1995) that cognitive and learning styles contribute to success in SLA. Cognitive and learning styles are considered to accelerate the rate of L2 learning, interacting with learners' strategies, aptitude, and motivation (Cohen, 2003; Ehrman & Oxford, 1990; Kim & Kim, 2014; Skehan, 1991). For decades, different L2 researchers have attempted to establish the relationship between learner styles and SLA from various perspectives, but there has to be more accumulated evidence to determine the effects on SLA (Dörnyei & Ryan, 2015; Dörnyei & Skehan, 2003). Therefore, to gain more insights into this controversial issue, the present study looks at the relationship between the eleven existing cognitive and learning styles and L2 achievement.

2. Cognitive and learning styles in SLA

2.1. Style models

So far, several researchers have attempted to explain the characteristics of L2 learners with a model consisting of different styles. Reid (1987), Ehrman and

Leaver (2003), and Cohen, Oxford and Chi (2006) have developed learning style measures that consist of various style constructs proposed in the psychological literature, assuming that such style constructs might be relevant to language learning. One of the early models, which was proposed by Reid (1987, 1995), extended to sensory preferences and personality. There are three sub-styles in the model: (a) sensory learning styles (e.g., visual, auditory, and kinesthetic), (b) cognitive learning styles (e.g., field dependence/independence (FD/FI), analytic/global, and reflective/impulsive), and (c) affective/temperament learning styles (e.g., extraversion/introversion). Reid developed the *Perceptual Learning Style Preference Questionnaire* (PLSPQ) as a measure of the visual, auditory, kinesthetic, tactile, group learning, and individual learning, but the PLSPQ has not been validated in L2 empirical research (Ortega, 2009).

Ehrman and Leaver (2003) proposed a comprehensive model with a superordinate construct, synopsis-ectasis (i.e., conscious versus unconscious information processing), and they developed a self-report questionnaire, that is, the *E&L Learning Style Questionnaire*. The synopsis-ectasis model consists of ten style constructs (field sensitivity/insensitivity, FD/FI, random/sequential, global/particular processing, inductive/deductive, synthetic/analytic, analogue/digital, concrete/abstract, leveling/sharpening, and impulsivity/reflectivity). The questionnaire was carefully developed based on psychological research (Yasuda, 2019), but little research has been carried out based on the E&L model, because of the practical issue of the measurement, that is, the E&L questionnaire is difficult to analyze and interpret the obtained results (Dörnyei & Ryan, 2015).

In 1993, Oxford developed the *Style Analysis Survey* (SAS) as a measure of individuals' general approach to learning and working. The SAS has been more widely used in literature (Dörnyei & Ryan, 2015), probably because of its higher practicality in terms of administration, scoring, and analysis. The SAS consists of five sub-style components: (a) visual, auditory, and hands-on (tactile); (b) extraverted/introverted; (c) intuitive/concrete-sequential (avoiding or favoring step-by-step procedures); (d) closure-/open-oriented (preferring explicit explanation or discovery learning), and (e) global/analytic (focusing on the main idea or the details). Later, the *Learning Style Survey* (LSS), an expanded and refined version of the SAS, was developed by Cohen, Oxford and Chi (2006). Their model includes the five styles used in the SAS and the other six style constructs: synthesizing/analytic (summarizing and guessing the information or analyzing and focusing on rules), sharpener/leveler (noticing differences or similarities), deductive/inductive (going from the specific to general or vice versa), FD/FI, impulsive/reflective (acting without or with thinking), and metaphoric/literal styles (deep or surface processing). As can be seen, Reid's PLSPQ only measures the perceptual style preferences, while the main focus of the E&L questionnaire is

the cognitive styles. On the contrary, the SAS and the LSS extend to the three types of style constructs: perceptual preferences, cognitive styles, and personality types. Dörnyei and Skehan (2003) list the eight style dimensions that are considered to be particularly important for L2 learning: visual/auditory/hands-on, extraverted/introverted, global/analytic, FD/FI, feeling/thinking, impulsive/reflective, intuitive-random/concrete-sequential, and closure-/open-oriented. Similarly, Ortega (2009) notes that some style dimensions, such as random/sequential, holistic/specific, gestalt/analytic, global/particular, leveling/sharpening, and impulsive/reflective, should be related to language learning, probably due to the relevance of the constructs to the cognitive processes such as noticing and some aspects of language aptitude. Therefore, the LSS is considered more valid and reliable by some researchers (Grey, Williams, & Rebuschat, 2015; Tight, 2010).

2.2. Characteristics of L2 learner styles

The purpose of the research on learner styles has been two-fold: the identification of L2 learners' styles and the relevance to SLA. The former is to identify preferred cognitive and learning styles associated with L2 learning. Motivated by the findings from the psychological research that cultural differences and social status might affect individuals' style preferences, Reid (1987) looked at the application of learning styles to SLA. In her study, the characteristics of native speakers (NSs) of English and L2 learners with different L1 were identified by the PLSPQ and other factors such as L1, age, sex, L2 proficiency, and so forth. Results showed significant differences in preferred perceptual styles between NSs and L2 learners; Korean learners were significantly more visual than NSs and Japanese learners; the Japanese were significantly less auditory than Arabic and Chinese learners and less kinesthetic than other L2 groups. The findings were corroborated by Rossi-Le (1995), indicating that learners' L1 backgrounds had an effect on their style preferences. Recent studies have reported that a visual style was the most preferred one, followed by auditory and tactile/kinesthetic styles among L2 learners whose L1 was Spanish (Tight, 2010), Korean (Kim & Kim, 2014), and Iranian (Hatami, 2018; Tabatabaei & Mashayekhi, 2013). These findings might suggest that L2 learners universally prefer learning via visual information regardless of their L1 differences. However, Lee and Kim's (2014) study showed rather mixed results; Korean L2 learners were characterized as auditory, individual, and visual learning style users with the auditory style most preferred.

Some researchers have investigated the cognitive and affective aspects of style dimensions. In a study by Psaltou-Joycey and Kantaridou (2011), Greek L2 learners' preferred styles were measured by the SAS. The results showed that the visual, intuitive-random (i.e., enjoying abstract thinking and avoiding step-by-step instruction,

Oxford, 1993), and global styles (i.e., better at getting the main ideas and guessing the meanings, Oxford, 1993) constituted the major preferences of Greek L2 learners. Kruk and Zawodniak (2019), using the LSS, reported that one Polish learner group were characterized as using more visual, introverted, FI, and literal styles, whereas the other group were associated with the global and synthesizing styles.

As can be seen, results obtained from previous research have been still inconsistent. It has been argued that a major preference for specific styles might be affected by the cultural and social contexts of learners (Nelson, 1995; Psaltou-Joycey & Kantaridou, 2011; Reid, 1987; Rossi-Le, 1995). Research by Reid (1987) and Hyland (1993) indicated that, unlike other L1 learners, Japanese learners did not exhibit such strong preference in certain perceptual styles. However, there has been little empirical evidence for the findings.

2.3. Effect on L2 proficiency

From the late 1970s to the 1990s, numerous L2 researchers' attention was directed to identifying learner factors that were predictive of successful L2 learners, such as aptitude, attitudes, motivation, and FD/FI. FD/FI reflects the degree to which individuals perceive the contexts globally or analytically (Witkin et al., 1962, 1977), and it is the most widely researched learner style in psychology and SLA (Ehrman & Leaver, 2003; Hoffman, 1997; Oxford, 1990; Skehan, 1991). FD/FI has been generally measured by the Group Embedded Figures Test, a task to identify simple figures embedded within the complex design. The FD/FI model has been repeatedly challenged by both psychologists and L2 researchers (e.g., Griffiths & Sheen, 1992; McKenna, 1990; Moran, 1985), mainly due to the ambiguity in its definition (i.e., whether a style is a synonym of intelligence or cognitive ability) because a style measured by cognitive tests represents an ability rather than a style (Brown, 2007; Cohen et al., 2006; Dörnyei & Ryan, 2015; Dörnyei & Skehan, 2003; Ehrman & Leaver, 2003; Hoffman, 1997; Kozhevnikov, 2007). However, numerous previous research has produced evidence that FD/FI is related to various aspects of SLA, such as L2 proficiency measured by the cloze test (Hansen & Stansfield, 1981), L2 writing (Violand-Sanchez, 1995), communicative aspects of L2 proficiency (Johnson, Prior, & Artuso, 2000), and the effectiveness of recasts (Rassaei, 2015). Carter (1988) found evidence that intermediate-level L2 learners of Spanish associated with FI exhibited significantly higher performance on the classroom achievement and the standardized oral proficiency test.

With regard to perceptual style dimensions, Reid (1987) and Isemonger and Sheppard (2003) showed that the relationships between perceptual styles and general standardized proficiency tests were nonsignificant. In a similar vein, Hatami (2018) demonstrated that when learners read the text for meaning,

perceptual style differences did not affect incidental learning of L2 vocabulary. On the other hand, it was found that relative to the kinesthetic style, both the visual and auditory styles were significantly related to general proficiency (Kim & Kim, 2014) and listening comprehension (Chou, 2017). Bailey, Onwuegbuzie and Daley (2000), and Tabatabaei and Mashayekhi (2013), using the Productivity Environmental Preference Survey, which includes the visual, auditory, tactile, and kinesthetic subtests, found that the kinesthetic preference was not strongly linked with L2 achievement scores. Rossi-Le (1995) reported that the visual style was found to be linked with higher proficiency. The study carried out by Chou (2017) provided evidence that the superiority of specific styles was related to the use of learning strategies. It was demonstrated that visual learners employed significantly more cognitive strategies than their auditory and kinesthetic counterparts, inferencing strategies than kinesthetic learners, and metacognitive strategies than auditory learners. Also, the particular style (i.e., focusing on the details) was significantly more associated with inferencing, socio-affective, and metacognitive strategies than the global style. On the other hand, Rassaei (2018) found that L2 learners with an auditory style outperformed those with a visual style in vocabulary learning when they were provided with annotations in an auditory mode.

With regard to cognitive and personality-related styles (except FD/FI), the relevance to SLA has not been fully elaborated in the literature. For instance, Carrell and Monroe (1995) found that L2 learners with an analytic style showed greater syntactic complexity and fluency in L2 writing. Wong and Nunan (2011) demonstrated that L2 learners' self-reported proficiency was associated with FI/FD and active/passive approaches to learning. A recent study by Kruk and Zawodniak (2019) indicated that L2 learners with FI, deductive, closure-oriented styles showed higher motivation towards grammar tasks that required the analytical ability, whereas the lower level of motivation in less communicative instruction was associated with the global and less introverted styles. Meanwhile, some other research has produced evidence that learner styles might not be a strong predictor of L2 achievement. Ehrman and Oxford (1995) examined the effects of learner styles along with a variety of learner traits (aptitude, strategies, personality, and motivation) on L2 proficiency in speaking and reading. Overall, proficiency in both speaking and reading was most strongly correlated with aptitude, but affective and temperament learning styles measured by the SAS (e.g., extraversion and introversion) were found to be non-significant. Grey et al. (2015) investigated the role of phonological working memory, personality, and learning styles in the incidental learning of semi-artificial language morphosyntax. Cognitive style differences were measured by the LSS. Results indicated that correlations of learning outcomes for learner styles were nonsignificant, but the extraverted style and the impulsive style were marginally and negatively related

to the learning outcomes, whereas the concrete-sequential style was somewhat associated with successful learning. Grey et al. (2015) argue that the concrete-sequential style might play a moderating role in learners' cognitive processes such as attentional control, which enables them to learn underlying L2 rules more effectively, whereas the extraverted and impulsive learners might be at risk.

One of the significant questions raised by Carter (1988) is as to whether the advantage of a specific learning style is limited to higher proficiency levels or whether the effect of learning styles differs in proficiency levels. In a study on FD/FI, Salmani-Nodoushan (2007) classified participants into four proficiency groups (proficient, fairly proficient, semi-proficient, and nonproficient) based on the standardized proficiency test scores. One of the significant findings was that proficiency appeared to play a moderating role in the relationship between FD/FI and performance on the task-based reading comprehension tests; nonproficient learners were not affected by their FD/FI styles, but the FD/FI styles influenced the other three proficiency groups on the various reading tasks. Recently, in a study by Lee and Kim (2014), participants were classified into four levels of L2 proficiency and their styles were measured by Reid's PLSPQ. The researchers reported that L2 learners with the highest level of proficiency significantly exhibited more dominant styles relative to the other three less proficient groups.

On the one hand, the concept of learner styles has been considered one of the important learner factors relevant to SLA. Empirical findings obtained from previous research, on the other hand, have been quite limited to specific domains (e.g., FD/FI and perceptual styles) with contradicting results. So, there needs to be further empirical support for the claim that research on cognitive and learning styles contributes to L2 research and teaching. Clearly, it remains questioned as to whether L2 learners are characterized in terms of specific style components; whether such traits are related to the success in L2 learning; and whether the effects of style differences are moderated by other learner variables. Therefore, the present study aims to answer the following research questions.

1. What are the participants' cognitive and learning styles?
2. Are the participants' cognitive and learning styles related to L2 proficiency measures?
3. Do the participants' L2 proficiency levels differentiate their style preferences?

3. Method

3.1. Participants

The participants were 37 Japanese high school students (17 females and 20 males ranging in age from 15 to 16). At the beginning of the research, they had

been learning English as a foreign language for approximately five years. Three students who failed to attend all the data collecting sessions were excluded from the following data analysis. As a result, 34 participants were selected as the final sample (15 females and 19 males). The present study classified participants with the oral and written proficiency measures below the 33.33 percentile into the S-bottom and W-bottom groups, respectively; those with the two scores above the 66.67 percentile into the S-upper and W-upper groups, and those with the scores in between into the S-middle and W-middle groups.

The present study collected the data in the 50-minute regular classes, which were held twice a week. Each lesson conducted by the researcher mainly consisted of explicit grammar explanation, practice, and communicative activities, using a grammar-based textbook. Also, a male NS of English visited the classes approximately every two weeks, as an assistant language teacher. Their school year consisted of three terms, which were separated by holidays in summer, winter, and spring. In the middle and at the end of each term, they took a paper-and-pencil test.

3.2. Measures

3.2.1. Cognitive and learning styles

To assess participants' styles, the present study used the LSS (Cohen et al., 2006), which was translated into the participants' L1 by the researcher. The LSS is a 110-item questionnaire assessing 11 learner style dimensions: visual/auditory/tactile-and-kinesthetic (30 items); extraverted/introverted (12 items); random-intuitive/concrete-sequential (12 items); closure-oriented/open (8 items); global-particular (10 items); synthesizing/analytic (10 items); sharpener/leveler (6 items); deductive/inductive (6 items); field-independent/field-dependent (6 items); impulsive/reflective (6 items); and metaphoric/literal styles (4 items). Participants were asked to self-report how often they performed a particular behavior associated with each style on a five-point Likert scale from 0 (*never*) to 4 (*always*) with no time limitation. For example, *I remember something better if I write it down* (visual). The LSS was chosen for the present study for the reasons that are briefly explained below. First, cognitive and learning styles might be measured more appropriately by a self-report rather than ability-tests, since cognitive styles refer to preferences in information processing rather than performance on cognitive tests. Second, the LSS has been widely used in L2 research as a valid and reliable measure (Hatami, 2018; Tight, 2010). Third, the LSS provides students with beneficial feedback on their learning preference, which was pedagogically important. Acceptable Cronbach's alpha was found (α = .79).

3.2.2. L2 proficiency

The present study used the scores from the three 50-minute written tests: the first-term-end exam (E1), the second-mid-term exam (E2), and the second-term-end exam (E3), along with the two speaking tests conducted during the first term (S1) and the second term (S2). Each term examination was developed by one of the high school teachers, focusing on the explicit knowledge of the targeted grammatical forms, based on the participants' textbook (the E1: sentence patterns, tenses, and modals; the E2: passives, infinitives, gerunds, and other grammatical forms; the E3: infinitives, gerunds, participles, and comparisons). Each exam consisted of a different combination of several testing formats, including the multiple-choice grammar task, the grammaticality judgment task, the completion (fill-in-the-gap) task, the rearrangement task (i.e., putting the words and phrases in the correct order; e.g., [*painted/white/by/the wall/was/Yoshiki*]), and the transformation task (i.e., rewriting the sentence following the instruction). The maximum possible score for each term exam was 100. Acceptable Cronbach's alphas were found for the E1 (.76), the E2 (.86), and the E3 (.89).

The speaking proficiency measures were developed and assessed by an assistant language teacher (a NS of English). The oral tests consisted of three components (the S1: content, voice, and style; the S2: content, style, and accuracy). The *content* was the degree to which the participants used a wide range of lexical and grammatical items; the *voice* was the degree to which their pronunciation and intonation were acceptable; the *style* was the degree to which they effectively used connectives to maintain their speech; and the *accuracy* was the degree to which their oral production was grammatically correct. Each construct was assessed on a five-point Likert scale ranging from 1 (*poor*) to 5 (*good*), and thus the maximum possible score for each speaking test was 15. The participants were asked to talk about a daily topic (e.g., favorite food) for approximately 2 minutes in dyad (S1) and to express his/her opinion on a specific topic (e.g., a recommended sightseeing place) individually (S2). Acceptable Cronbach's alpha was found for the S1 (.72), whereas the S2 had a lower alpha coefficient of .56.

Also, the present study administered the C-test taken from Gilabert (2005). The C-test comprised five short passages with 20 blanks each, in which the second half of every second word was deleted. Participants were asked to supply the missing parts within approximately 25 minutes, and each item was worth 1 point for a total of 100 points for the task. Cronbach's alpha coefficient of internal consistency was .90.

3.3. Procedure

The participants attended all procedures in their normal classes. During the first term, which started in April and ended in July, they first performed the S1 (in

mid-May or early June), followed by the E1 (in late June). Next, during the second semester (from late August to December), they performed the E2 (in mid-October), followed by the S2 (in late November) and the E3 (in early December). As regards the LSS and the C-test, they were given to the participants during the third term (in mid-January). Due to time constraints, the C-test had to be carried out for one of the two intact classes.

4. Results

Descriptive statistics for the attainment measures and the C-test are shown in Table 1. Table 2 also provides the descriptive statistics of the LSS. Kolmogorov-Smirnov tests indicated that all measures followed a normal distribution. For the data analyses, the present study used Bonferroni correction for multiple comparisons.

Table 1 Descriptive statistics of proficiency scores

	S1	S2	Total	E1	E2	E3	Total	C-test
N	34	34	34	34	34	34	34	18
M	12.44	12.44	24.88	72.62	64.21	72.91	209.74	52.44
SD	1.71	1.46	2.80	10.27	12.55	15.76	34.48	12.23

Table 2 Descriptive statistics of the LSS

Cognitive styles	*M*	*SD*	Cognitive styles	*M*	*SD*
Visual	24.8	5.0	Synthesizing	11.3	3.5
Auditory	19.9	3.9	Analytic	10.5	3.6
Tactile/Kinesthetic	18.6	3.8	Sharpener	5.9	2.4
Extraverted	13.7	4.3	Leveler	6.4	1.8
Introverted	12.3	4.1	Deductive	8.5	2.7
Random-intuitive	11.9	3.3	Inductive	6.4	1.6
Concrete-sequential	15.2	2.6	Field-independent	5.8	2.4
Closure-oriented	9.8	3.1	Field-dependent	6.7	2.3
Open-oriented	8.0	3.3	Impulsive	6.2	2.0
Global	13.1	2.2	Reflective	7.6	2.6
Particular	12.2	2.1	Metaphoric	4.2	1.9
			Literal	4.8	1.6

Note. $N = 34$.

4.1. Dominant cognitive styles

A one-way ANOVA showed that there were significant differences between the three perceptual styles (i.e., visual, auditory, and tactile/kinesthetic), $F(2, 101) = 20.097$, $p = .000$, $\eta^2 = .29$. A multiple comparison revealed that the participants' visual preference was significantly greater than the other two perceptual styles ($p < .05$), whereas the difference between auditory and tactile/kinesthetic style

was nonsignificant. Also, independent *t*-tests showed that there were significant differences between the random-intuitive and the concrete-sequential style, $t(32) = -4.640$, $p = 000$, $r = .64$; and between the deductive and the inductive style, $t(32) = 3.760$, $p = .000$, $r = .55$. On the contrary, non-significant differences at $p < .05$ were found among the other cognitive style constructs.

Next, following Kruk and Zawodniak's (2019) method, each part of the LSS on which the score was the highest was marked and the percentage values of the marked styles were calculated. When there was no difference in each part, the participants were considered as mixed styles, which represented the characteristics of both styles. As Table 3 shows, the participants of the study were characterized as users of visual (79.4%), concrete-sequential (76.5%), deductive (70.6%), and reflective styles (73.5%).

Table 3 The percentage of the styles

Styles	%	Styles	%	Styles	%	Styles	%
Visual	79.4	Closure	52.9	Sharpener	41.2	Impulsive	20.6
Auditory	8.8	Open	32.4	Leveler	47.1	Reflective	73.5
T/K	8.8	Mixed	14.7	Mixed	11.8	Mixed	5.9
Mixed	2.9						
Extraverted	52.9	Global	55.9	Deductive	70.6	Metaphoric	29.4
Introverted	35.3	Particular	32.4	Inductive	14.7	Literal	44.1
Mixed	11.8	Mixed	11.8	Mixed	14.7	Mixed	26.5
R-I	14.7	Synthesizing	47.1	FI	32.4		
C-S	76.5	Analytic	44.1	FD	52.9		
Mixed	8.8	Mixed	8.8	Mixed	14.7		

Note. T/K = Tactile/Kinesthetic; R-I = Random-intuitive; C-S = Concrete-sequential.

4.2. The relationship between learner styles and proficiency

No significant correlation was found between the LSS and the oral and written proficiency measures with alpha set at .002 (Bonferroni-adjusted). For the speaking measures, two positive correlations were marginally significant between the total speaking scores and the extraverted ($r(34) = .353$, $p = .041$), as well as the sharpener dimension ($r(34) = .373$, $p = .028$). There was also a marginally negative correlation between the speaking total scores and the FD style, $r(34) = -.388$, $p = .024$. In terms of the written measures, the LSS scores were not significantly associated with the test scores (except a marginal relationship between the inductive and the E1, $r = .362$). Similarly, the C-test scores were not significantly associated with all the learner styles at $p < .002$, but there were marginally negative correlations with the global ($r(18) = -.640$, $p = .004$) and the leveler styles ($r(18) = -.480$, $p = .044$).

Next, participants were grouped into one of the proficiency levels according to the total oral scores: the S-upper ($N = 12$), the S-middle ($N = 7$), and the

S-bottom (N = 15) (see Table 4). In order to determine whether there were significant differences in learner styles among the three groups, one-way ANOVAs were computed with alpha set at .002. Results showed a marginally significant difference in the FD style ($F(2, 31) = 3.902$, $p = .031$, $\eta^2 = .20$) with a large effect size. Although the S-upper group showed less FD than the S-middle and the S-bottom groups, *post-hoc* comparisons revealed no significant difference among the three-level proficiency groups ($p > .05$).

Also, the participants were divided into the W-upper (N = 11), W-middle (N = 12), or the W-bottom groups (N = 11), based on their total exam scores (see Table 5). One-way ANOVAs (alpha set at .002) revealed marginally significant differences among three proficiency levels in the concrete-sequential ($F(2, 31) = 3.293$, $p = .050$, $\eta^2 = .18$), the global ($F(2, 31) = 3.368$, $p = .047$, $\eta^2 = .18$), and the deductive styles ($F(2, 31) = 3.922$, $p = .030$, $\eta^2 = .20$) with large effect sizes. *Post-hoc* analyses showed that the W-middle group were significantly more concrete-sequential and global than the W-bottom group and more deductive than the other two groups ($p > .05$).

Table 4 Three levels of proficiency regarding the speaking scores

Styles	S-upper (N =12)		S-middle (N = 7)		S-bottom (N = 15)		p
	M	*SD*	*M*	*SD*	*M*	*SD*	
Visual	24.8	5.3	23.6	6.3	25.4	4.2	.735
Auditory	20.8	4.6	18.7	3.2	19.7	3.6	.508
Tactile/Kinesthetic	19.3	3.3	20.0	4.8	17.5	3.5	.290
Extraverted	14.8	5.0	15.1	3.6	12.1	3.8	.157
Introverted	12.3	3.1	12.3	5.0	12.2	4.6	.997
Random-intuitive	12.1	3.8	12.9	2.3	11.2	3.4	.543
Concrete-sequential	15.0	2.6	15.4	1.8	15.3	3.0	.938
Closure-oriented	10.8	3.5	8.7	1.7	9.5	3.1	.340
Open-oriented	7.8	4.3	7.6	2.7	8.5	2.8	.799
Global	12.6	2.1	13.9	1.8	13.2	2.4	.467
Particular	12.4	2.7	11.7	1.0	12.2	2.0	.794
Synthesizing	12.5	3.4	9.6	3.5	11.2	3.5	.218
Analytic	10.0	3.0	12.0	2.2	10.3	4.5	.483
Sharpener	6.9	2.3	5.9	2.0	5.1	2.6	.167
Leveler	6.3	2.3	6.1	0.7	6.7	1.8	.703
Deductive	8.0	2.5	8.4	2.4	8.9	3.1	.725
Inductive	6.6	1.5	6.0	1.2	6.5	1.8	.719
Field-independent	6.7	2.7	5.4	2.4	5.3	2.1	.333
Field-dependent	5.4	2.6	7.9	1.9	7.3	1.7	.031*
Impulsive	6.2	2.3	6.0	2.2	6.3	1.8	.935
Reflective	7.0	3.4	8.6	2.6	7.7	1.7	.440
Metaphoric	4.1	2.2	4.4	1.5	4.2	1.9	.934
Literal	4.7	1.4	4.3	1.1	5.1	2.0	.517

Note. $p^* < .05$; $p < .002$ (Bonferroni-adjusted).

Table 5 Three levels of proficiency regarding the written scores

Styles	W-upper (*N* =11)		W-middle (*N* = 12)		W-bottom (*N* = 11)		*p*
	M	*SD*	*M*	*SD*	*M*	*SD*	
Visual	25.0	5.7	25.2	5.6	24.2	3.7	.887
Auditory	20.8	3.9	19.1	4.7	19.8	2.9	.574
Tactile/Kinesthetic	18.7	4.5	18.7	3.2	18.5	3.9	.994
Extraverted	12.8	4.0	15.6	4.1	12.5	4.5	.165
Introverted	12.7	5.1	10.4	3.8	13.8	2.5	.120
Random-intuitive	10.9	3.2	13.4	3.2	11.1	3.2	.126
Concrete-sequential	15.3	2.3	16.4	2.7	13.8	2.3	.050*
Closure-oriented	10.1	3.6	10.4	2.7	8.7	2.8	.391
Open-oriented	7.5	3.6	7.3	3.4	9.3	2.9	.329
Global	12.5	2.2	14.3	2.7	12.5	1.5	.047*
Particular	11.8	1.8	11.8	2.0	12.9	2.5	.392
Synthesizing	12.0	3.5	11.6	3.8	10.4	3.3	.540
Analytic	10.2	3.4	11.2	4.1	10.2	3.5	.759
Sharpener	6.9	2.3	5.7	2.6	5.2	2.2	.232
Leveler	6.1	1.8	6.5	1.8	6.7	1.8	.709
Deductive	7.8	2.6	10.1	1.7	7.4	3.1	.030*
Inductive	6.5	1.7	6.6	1.8	6.3	1.3	.900
Field-independent	6.9	2.2	5.4	2.7	5.2	2.1	.192
Field-dependent	6.7	2.2	6.4	2.9	7.1	1.5	.785
Impulsive	5.7	1.3	7.2	2.4	5.6	1.7	.110
Reflective	7.7	2.8	7.6	2.8	7.6	2.2	.991
Metaphoric	4.4	2.0	3.8	1.9	4.5	1.9	.709
Literal	5.0	1.8	5.3	1.5	4.1	1.6	.217

Note. $p^* < .05$; $p < .002$ (Bonferroni-adjusted).

5. Discussion

5.1. Cognitive and learning styles of Japanese learners

The present study looked at the characteristics of Japanese L2 learners' cognitive and learning styles. It provides evidence that Japanese L2 learners have specific style preferences. More than 70% of the participants in the study significantly exhibited more visual, concrete-sequential, and deductive styles, and they tended to be more reflective learners, which did not reach a significant level. Regarding the perceptual learning styles, the results appear to indicate that learners' L1 backgrounds might not influence their style preferences. Visual styles are likely to be cross-culturally favored by Japanese learners, as well as Spanish (Tight, 2010), Greek (Psaltou-Joycey & Kantaridou, 2011), Korean (Kim & Kim, 2014), and Iranian learners (Hatami, 2018; Tabatabaei & Mashayekhi, 2013).

Regarding the cognitive and personality-related styles, the concrete-sequential, deductive, reflective styles were favored by most of the participants. Interestingly, it was not in line with Psaltou-Joycey and Kantaridou (2011) whose

study revealed learners as mainly adopting intuitive-random and global styles, and Kruk and Zawodniak (2019) who showed that motivated learners were associated with introverted, FI, and literal styles, whereas less motivated individuals displayed the global and synthesizing styles. The concrete-sequential style reflects the tendency to appreciate logical sequence in presentation (Jonassen & Grabowski, 1993); the deductive style denotes the preference to study the rules from the teachers or references and subsequently apply the rules to examples (Leaver et al., 2005); reflective learners gather information more systematically (Jonassen & Grabowski, 1993). These characteristics appear to contribute to success in explicit learning associated with L2 instruction in Japan. Preferences in specific styles might reflect the educational contexts in Japan. From these results, it might be assumed that some aspects of learner styles are influenced by differences in cultural and educational contexts as suggested in previous literature (e.g., Nelson, 1995; Reid, 1987), but some other styles are not. Visual style preferences appeared to be dominant regardless of learners' L1, whereas cognitive and personality-related styles might be influenced by the learner factors. Of course, further empirical research is needed to test this hypothesis.

5.2. The relationship between learner styles and L2 proficiency

The present study did not report statistically significant correlations between participants' styles and the assessment scores. This finding may reflect previous studies suggesting that learner styles might not be a strong predictor of L2 achievement (e.g., Ehrman & Oxford, 1995; Grey et al., 2015; Tabatabaei & Mashayekhi, 2013). One of the possible explanations is that pedagogical intervention might help learners whose cognitive styles were considered to be disadvantageous, making it possible for them to catch up with learners with advantageous styles in the long run (Diptoadi, 1991). Another possibility is that learning outcomes might be best predicted by the interaction of learner styles and other learner factors such as cognitive ability (Alloway, Banner, & Smith, 2010; Cohen, 2003; Ehrman & Oxford, 1990; Furnham, Monsen, & Ahmetoglu, 2009; Riding & Agrell, 1997; Skehan, 1991).

First, regarding the perceptual styles, in line with Hatami (2018) and Tight (2010), the study did not show any effects of perceptive styles, which did not support Kim and Kim's (2014) prediction that the learner's visual preference increases motivation, and as a result, L2 proficiency can be facilitated. Considering that impaired eyesight does not affect L1 oral proficiency, it is assumed that cognitive mechanisms facilitating L2 development are not influenced by differences in perceptual styles. Second, the extraversion scores were relatively related to the oral interactive tests. Especially, the S-bottom group tended to be less extraverted

than the more proficient groups. It is suggested that extraverted learners are more successful in oral measures, because extraversion reflects the ability to process input and output more effectively (Dewaele & Furnham, 1999).

Third, the findings indicate that the oral proficiency tests were negatively related to FD; that is, learners with higher oral proficiency tended to be less FD and more FI than their less proficient counterparts. FI learners excel at analyzing information structurally (Jonassen & Grabowski, 1993) and conceptualizing information in a given context (Cohen et al., 2006). Thus, it is hypothesized that social-interpersonal sensitivity associated with FD contributes to communicative aspects of SLA, whereas FI learners' analytical ability benefits from formal language learning (Brown, 2007; Carter, 1988; Dörnyei & Ryan, 2015; Johnson et al., 2000), but the results showed that FI was somewhat associated with better performance on both the oral and written measures, although not in a statistically significant way. A possible explanation is that the oral measures tapped accuracy in pronunciation and lexical and grammatical forms, which required the analytical ability of FI learners. Also, the mixed results might be due to the use of the self-reporting measure rather than cognitive tests such as the group embedded figures test usually used in the literature. Further study is needed to seek the validity of self-reporting FD/FI measures.

Similarly, the sharpener style was marginally related to the oral tests, and both S- and W-upper groups tended to be more sharpening. Sharpeners excel at retrieving different linguistic stimuli from memory (Cohen et al., 2006; Jonassen & Grabowski, 1993; Oxford, 1990). Previous research indicated that FI and sharpener styles are linked with effective use of learning strategies (Cohen, 2003), such as memory, cognitive, metacognitive, affective, and social strategies (Shi, 2011). Therefore, the FI and sharpener traits might contribute to retrieving and selecting appropriate linguistic items from memory with the effective use of memory strategies. On the other hand, the opposite pole of the dimension, the leveling style, did not affect the performance on both oral and written measures, but the leveling and the global styles were negatively related to the C-test scores. The leveling and the global styles appeared to be most disadvantageous in processing the passage of the C-test, in which numerous words were erased. These styles are conceptually similar, because both represent the preferences in understanding the gist of information by eliminating or reducing differences and by attending to similarities; these styles contribute to summarizing and selecting main ideas (Cohen et al., 2006; Jonassen & Grabowski, 1993). Therefore, the macro-level of information processes entailed to perform the C-test (Babaii & Ansary, 2001) might have been hindered by the leveling and the global styles.

5.3. Differential effect of proficiency

As Table 5 illustrates, the degree of FI and sharpener dimensions exhibited a linear pattern. As oral and written proficiency got higher, leaners tended to be more FI and sharpening, which supports the claim that these two characteristics contribute to L2 development (Cohen et al., 2006; Ehrman & Leaver; 2003). On the contrary, it should be noted that the concrete-sequential, global, and deductive styles show a different pattern. The W-middle group showed the highest degree of these three style preferences; the W-upper and bottom groups did not greatly differ in these dimensions. This might reflect the curvilinear development of cognitive and learning styles in L2 learning. Kozhevnikov (2007) proposes the concept of a meta-style, which reflects the flexibility to select the most beneficial style according to situational requirements. A study by Lee and Kim (2014) also indicates that learners' preferences for specific styles might be changeable depending on time and situation. In their study, 37.6% of the learners changed their dominant styles, and more than 62% of the learners maintained and modified their styles after a three-month instruction.

Thus, it is hypothesized that less proficient learners would start to exhibit the tendency to use concrete-sequential, global, and deductive styles as their proficiency increases. Learners first have to adapt themselves to requirements of L2 instruction in Japan, in which they generally receive a step-by-step explicit and deductive instruction (i.e., concrete-sequential and deductive type of learning). As they increase their understanding of the targeted L2 features, their attention might be directed to untargeted L2 input (i.e., global approach). Then, they might employ the abandoned approaches in order to further increase their L2 knowledge. They might attempt to produce learned L2 features promptly before thinking thoroughly (i.e., intuitive-random) and to identify underlying rules from exemplars (i.e., inductive). Also, increased proficiency might enable them to attend to specific aspects of L2 forms (i.e., particular), resulting in cognitive processes (e.g., noticing) that are facilitative for L2 development. This is a theoretically and pedagogically important question to be addressed in future research.

There are some limitations to be addressed in the present study. First, due to a very small sample size, it is impossible to generalize the findings obtained in the present study. Second, the study employed a self-report questionnaire for measuring styles since the construct measured by cognitive tests might represent an ability rather than a learning preference style. However, style dimensions should be measured by both cognitive tests and self-report instruments to understand the constructs more deeply. Third, the present study did not include other learner variables such as language aptitude and strategies. These variables can allow L2 researchers to investigate the phenomena of learner differences in different

perspectives because individual styles, as indicated in psychological research, might interact with the other variables such as cognitive abilities and working memory (Alloway et al., 2010; Furnham et al., 2009; Riding & Agrell, 1997), motivation (Kim & Kim, 2014), and strategies (Ehrman & Oxford, 1990). Nevertheless, the findings obtained from the present study pose several pedagogical implications. First, this line of research can contribute to improving L2 educational settings. The concept of learner styles might enable teachers and curriculum designers to develop effective instructional procedures and teaching materials. Second, specific styles (i.e., the leveling and the global styles) might be at risk in performing specific L2 tasks (e.g., the C-test) independently of their general proficiency. This is of great importance for it means that educators should be aware that certain measures might assess performance of learners with certain traits inappropriately.

6. Conclusions

The present study aimed to the investigate cognitive and learning styles of Japanese learners and the relationships between their style preferences and L2 proficiency. Learners' styles were measured by the self-reporting questionnaire with eleven style dimensions, and participants were classified into three levels of L2 proficiency based on the oral and written term tests in their normal school instruction. Results showed that the participants tended to be more visual, concrete-sequential, deductive, and reflective in their preferences. Overall, the style characteristics of L2 learners did not appear to play a major role in SLA. However, some cognitive styles were associated with learning outcomes, although these did not reach a significant level adjusted by Bonferroni correction for multiple comparisons. Extraversion was associated with communicative aspects of L2 proficiency measured by the term oral tests, whereas FD was not. On the contrary, FI and sharpening were related to better performance in both the oral and written proficiency measures. The leveling and global styles negatively influenced performance on the C-test only. It was also found that learners with the middle level of proficiency exhibited the higher degree of concrete-sequential, global, and deductive styles than higher- and lower-level learners.

Considering the limitations mentioned above, future studies should investigate the relationship between learning effects and cognitive styles assessed by both self-reported questionnaires and ability-type measures. Based on the findings from psychological research, success in L2 learning might be better interpreted by the combination of cognitive styles and other individual differences including cognitive ability, motivation, personality, and strategies. Also, it is important for L2 researchers and educators alike to test the matching hypothesis (i.e., whether instruction should be matched with the style characteristics for

better performance or not). It is one of the most controversial topics in SLA as well as educational psychology research (see Kozhevnikov et al., 2014). Recently, Tight (2010) and Rassaei (2018) provide evidence that L2 vocabulary learning might be best enhanced when instruction matches L2 learner's perceptual preferences. However, research on this matching hypothesis has not produced ample evidence (Pashler, McDaniel, Rohrer, & Bjork, 2008). Hatami (2018) reported that perceptual style matching did not facilitate incidental vocabulary learning. Thus, more thoughtful cognitive style research is needed in order to contribute to a better understanding of the role of individual differences in SLA.

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