The effects of written corrective feedback on improving EFL learners' written accuracy in using the English passive structure: Do individual differences in working memory predict the effects?

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Abstract

The extent to which written CF plays a role in learners' acquiring the target language is a question that has received a lot of attention over the last 20-30 years. This paper, by drawing on a cognitive view, continued with that focus, exploring not only the efficacy of written CF on the improved accuracy of learners but also the extent to which working memory and phonological short-term memory may moderate the effects of different types of feedback.The study was undertaken with 100 university students in Iran. Firstly, a quasi-experimental study was used, with a pre-test, treatment, immediate and delayed post-tests, to investigate the effectiveness of four types of written CF (direct CF, direct CF plus revision, metalinguistic explanation, metalinguistic explanation plus revision) on a complex linguistic structure, the English passive voice. The results regarding the moderating effect of working memory and phonological short term memory revealed that (1) working memory moderated the impact of the metalinguistic explanation and combined metalinguistic explanation groups and the combined metalinguistic and direct CF groups both immediately and over time; and (2) working memory moderated the direct CF plus revisionand combined revision groups only in the long term. Furthermore, the findings suggest that more explicit types of written CF may be more effective than less explicit types of written CF.

Keywords: English passive voice, second language acquisition, individual differences, written corrective feedback

1) Introduction

The contribution of written corrective feedback to second language (L2) development has been the focusof a growing number of studies over the last 20 years. To date, written CF research has given much time to investigate whether a learner's accuracy improves after receiving written CF, and whether the effectiveness of written CF varies due to different types of written CF and differences in the error types that are targeted. Learners' improved accuracy after the provision of focused and unfocused written CF has also been stated in new writing texts immediately and over time in written CF studies (e.g., Bitchener, 2008;Rummel & Bitchener, 2015; Van Beuningen, De Jong, & Kuilken 2008, 2012).

However, the extent to which written CF plays a role in learners' acquisition of a target language is a problem that researchers and teachers of second language writing and acquisition have sought to address. For instance, questions remain as to whether focused written CF facilitates L2 development immediately and over time and whether certain types of written CF are more effective in improving accuracy than other types.

In order to address these areas where questions remain, the present study investigates the potential role of written CF within a cognitive view. Within the cognitive framework developed by Gass (1997) written CF is considered as a form of input, which may be noticed, attended to, and processed. As such, it is likely to facilitate the development of *explicit knowledge*, or the type of knowledge that learners can access through controlled and conscious processing and that they typically achieve in an instructional/educational context. Furthermore, written CF is likely to draw a learner's attention to his/her stored explicit knowledge, and through controlled processing of such knowledge, the knowledge may be consolidated. Additionally, a learner's cognitive variables may affect the efficacy of written CF. Therefore, written CF type, linguistic error type, and individual differences(e.g., working memory) may potentially moderate the effectiveness of written CF (Bitchener, 2012). Thus, by drawing on cognitive processing, this paper not only examines the efficacy of written CF on L2 development, but also investigates the potentially moderating effect of (1) text revision following feedback, (2) written CF type, (3) linguistic error type, and (4) individual differences in working memory.

2) Theoretical foundation and review of the literature

This section presents an account of skill-based theory of McLaughlin's (1987, 1990) skill

acquisition model and Anderson's (1983) adaptive control of thought model (VanPatten & Benati, 2010). These theories present the stages (from control to automatic) that learners are required to pass through to acquire any skill, including a language skill. Skill acquisition theories maintain that intentional learning (e.g., by means of written CF) can play an important role in the controlled stage and ultimately result in automatic processing. Thus, skill acquisition theories explain how learners can improve L2 development of a target structure (e.g., English passive voice) immediately and over time.

In the written CF literature, there have been theoretical arguments on the efficacy of different types of written CF on L2 development (Bitchener & Storch, 2016). Those who favour indirect written CF suggest that it is most useful because it engages learners in problem solving and guided learning (Lalande, 1982). Those supporting direct feedback suggest that it reduces learners' confusion and offers more explicit feedback on the hypotheses and it is immediate as opposed to indirect feedback. Additionally, direct CF is more useful to resolve learners' errors on more complex forms and structures. However, if learners have partially acquired a particular form and structure in their L2, there is a need for a fuller explanation regarding the error in order to hypothesize and produce the correct form and structure over time. Because direct CF only provides the correct form of an erroneous form/structure, it may not be useful for some learners (Bitchener & Ferris, 2012).

A reason for asking learners to revise their texts is firstly to determine whether they have learnt from the feedback provided. Secondly, it is important to determine whether learners can apply what they have learnt from the feedback when revising their texts. If learners are able to accurately revise their texts, it reveals that they have likely understood the feedback (Bitchener &Storch, 2016). It has been argued that regardless of whether there is a single opportunity to revise following written CF (Frear, 2012; Van Beuningen et al., 2008) or multiple opportunities (Chandler, 2003; Hartshorn et al., 2010), revision following feedback leads to greater accuracy in new writing. This is because revision following written CF leads to 'pushed output' (Shintani et al., 2014).

2-1 Review of the literature

Kormos (2012) pointed out that working memory might moderate how learners learn from different types of written feedback. She argued that in contrast to the oral context, learning opportunities through feedback in the writing context are less constrained by time pressure;

however, she stated that because writing learners are dependent on their working memory capacity, they may respond differently to feedback.

As Sheen (2007) suggested, the passage of time may have been a critical factor in terms of the effectiveness of delayed post-tests. In her study on 147 low intermediate EFL learners, Guo (2015) also reported that learners who were provided with more explicit types of feedback (metalinguistic explanation, direct error correction, direct error correction plus metalinguistic explanation) outperformed those who were provided with less explicit types of written CF (error code and underlining). The researcher also found no significant difference among the three most explicit types of written CF. These findings were corroborated by Shintani and Ellis (2013) who investigated the comparative effect of different types of written CF (metalinguistic explanation and direct CF) on 49 low-intermediate ESL learners' accurate use of the English indefinite article. They reported that even though the metalinguistic group outperformed the direct correction group in the immediate post- test, there was no difference between the efficacy of metalinguistic explanations and direct correction groups in improving accuracy over time (after two weeks).

The study by Shintani, Aubrey and Donnellan (2016) resulted in similar findings to those of Shintani et al. (2014). In their recently published study of 61 Japanese EFL learners, Shintani et al. (2016) investigated the comparative efficacy of pre- and post-task metalinguistic explanation on learners' improved accuracy of the hypothetical condition. Similar to Shintani et al.'s (2014) study, learners received metalinguistic explanation in the form of a handout.

However, as Bitchener and Storch (2016) argued, before generalizing and drawing any conclusion regarding the efficacy of written CF types, the effectiveness of written CF types such as ME needs to be investigated taking into account learners' individual and contextual factors and different linguistic structures. Several studies have also investigated the relationship between complex working memory and the efficacy of recasts (Li, 2013; Goo, 2012; Mackey et al., 2002; Revesz, 2012; Sagarra, 2007; Trofimovich et al., 2007). Mackey et al. (2002) conducted a study on Japanese EFL learners to investigate the relationship among noticing recasts, working memory and the efficacy of recasts in the learning of the target structure (English question formation). The researchers found that learners with low working memory achieved more gain from recasts in the short term, but learners with high working memory capacity noticed the recasts better in the long

term.

The study has two main purposes: the first aim is to examine the effect of different types of written CF (direct and metalinguistic) on learners' output (immediate and delayed) in relation to the targeted structure (passive voice). The motivation for exploring this aim is drawn from the mixed findings from several recent studies (e.g., Shintani & Ellis, 2013; Shintani, et al., 2014) on the effectiveness of written CF. For this reason, the study focuses on two different types of written CF (direct and metalinguistic) in order to show to what extent the type of corrective feedback and its explicitness can impact on learners' subsequent output (immediate and delayed).

The second purpose of this study is to determine the extent to which individual differences in working memory and phonological short-term memory may moderate different types of written CF (direct and metalinguistic), and whether these differences have an effect on learners' subsequent output (immediate and delayed). This study, therefore, has investigated the moderating effect of working memory and phonological short term memory on the efficacy of written CF types (namely, direct CF, direct plus revision, metalinguistic explanation and metalinguistic plus revision). In order to address the above purposes of the study, the following research questions were designed.

RQ1: What effect do focused direct corrective feedback (DCF) and metalinguistic explanation (ME) with and without revision have on learners' use of the English passive voice in an immediate text revision and in new texts over time?

RQ2: Does the opportunity for the revision influence in the efficacy of DC and ME?

RQ3: Is there any difference in the effect of DCF and ME regardless of whether there is an opportunity for revision?

RQ4: To what extent do working memory and phonological short-term memory moderate the effects of the different types of feedback?

3) Methodology

The study has two main purposes. The first aim of the study is to examine the effect of different types of written Corrective Feedback (CF) (direct CF, metalinguistic explanation, direct CF plus revision, metalinguistic plus revision) on learners' output (immediate and delayed) in relation to the English passive voice. This aim was motivated by the mixed findings of some studies (e.g., Shintani & Ellis, 2013; Shintani, Ellis, & Suzuki, 2014).

The second purpose of this study is to determine the extent to which individual differences in

working memory and phonological short-term memory may moderate how learners respond to and use different types of written CF (direct CF, metalinguistic explanation, direct CF plus revision, metalinguistic plus revision), and whether these differences have an effect on learners' subsequent output (both immediate and delayed). The second aim was in response to Bitchener's (2012) and Ellis' (2010) calls for more research into the moderating effect of individual factors on how learners respond to the written CF they receive.

3-1 Design

This study employed a pre-test, treatment, post-test, and delayed post-test design, using intact English as a Foreign Language (EFL) classes.

In this study, four experimental groups (direct CF, direct CF and revision, metalinguistic explanation, metalinguistic explanation and revision) and one control group were included. The treatments were operationalized as four different written CF strategies: direct written CF, direct CF and revision, written metalinguistic CF and written metalinguistic explanation and revision. The control group did not receive any feedback on their writing texts to contrast the impact of treatment on the experimental groups; instead, they were given very brief feedback on the quality and organization of their content. One week prior to the start of the CF treatment, participants completed a writing task as the pre-test. The immediate post-tests (revision and new tests) were conducted immediately after the CF treatment session has been completed in Week 2. Participants completed a working memory test (reading span test) and a phonological short term memory test (non-word span test) in Week 3. The delayed post-test was completed in Week 4.

The participants were L1 Persian EFL learners at an intermediate level. They included both males and females who were 18-25 years old. The English proficiency of participants was at the intermediate level, which suited the study. Their proficiency level was measured through an internal (Iranian) proficiency test. The test included sections on grammar, vocabulary and reading comprehension.

They were randomly divided into five groups – one class in which direct written CF was provided, one class in which direct written CF with revision was provided, one class in which metalinguistic explanation was provided, one class in which metalinguistic explanation with revision was provided, and one class that acted as a control group.

This study is a quantitative method research, thus data analysis consists of analysing the

quantitative data (Creswell & Plano Clark, 2011). Quantitative data was collected from writing tasks, reading-span tests, and non-word-span tests.

Results

RQ1: What effect does focused DCF (direct CF) and ME (metalinguistic explanation) with and without revision have on learners' use of the English passive voice in an immediate text revision and in new texts over time?

To find answers to the first research question, descriptive statistics with raw scores for the accuracy scores of the English passive voice in the written tasks were calculated. Table 1 shows the descriptive statistics for the four treatment groups at the three different testing periods – Time 1 (pre-test), Time 2 (immediate post-test) and Time 3 (delayed post-test). The mean scores refer to the mean percentage accuracy in partial obligatory occasions.

Table 1: Descriptive statistics for the accuracy scores in the written tasks

Group	***N***	**Time 1**		**Time 2**		**Time3**	
		M	SD	M	SD	M	SD
DCF	20	29.63	23.44	78.80	19.62	70.69	25.66
ME	20	45.83	28.01	79.86	16.93	80.21	18.70
DC+R	20	51.45	24.79	85.50	11.62	84.04	13.05
ME+R	19	55.20	26.65	85.55	12.07	84.50	11.31
CN	21	54.40	31.92	58.70	29.11	41.07	33.21

Note: DCF = direct corrective feedback with no revision, ME = metalinguistic explanation with no revision, DCF+R = direct corrective feedback with revision, ME+R = metalinguistic explanation with revision, CN = control group.

Table 1 shows that from the pre-test to the immediate post-test, the accuracy of all four experimental groups increased considerably; however, from the immediate post-test to the

delayed post-test the changes in the experimental groups were slight. That is, accuracy in the metalinguistic explanation group slightly increased while accuracy in the other groups slightly decreased. Accuracy in the control group also increased slightly from the pre-test to immediate post-test but it then decreased sharply inthe delayed post-test.

RQ2: Does the opportunity for the revision influence the efficacy of DC and ME?

In order to address RQ2, that is, investigating whether requiring the participants to do revision had any efficacy on accuracy in subsequent pieces of writing, the two revision groups (i.e., metalinguistic explanation plus revision and direct CF plus revision) and thetwo groups that did not make revisions (i.e., metalinguistic explanation and direct CF) were combined and compared. Table 2 shows the descriptive statistics for the treatment groups at the three different testing periods.

Table 2 shows that from the pre-test (Time 1) to the immediate post-test (Time 2), the accuracy of two experimental groups increased sharply; however, from the immediate post-test to the delayed post-test (Time 3) the changes in theexperimental groups were slight, that is, accuracy in both DMWR (direct CF and metalinguistic explanation) and DMPR (direct CF plus revision and metalinguistic explanation plus revision) groups slightly decreased. Accuracy in the control group also increased slightly from the pre-test to immediate post-test but it then decreased sharply inthe delayed post-test.

Table 2 *Descriptive statistics for the accuracy scores in the written tasks*

Groups		**Time 1**		**Time 2**		**Time 3**	
N		**M**	**SD**	**M**	**SD**	**M**	**SD**
DMWR	40	37.59	26.82	79.33	18.09	75.45	22.68
DMPR	39	53.27	25.44	85.52	11.68	84.26	12.07
CN	21	54.40	31.92	58.70	29.11	41.07	33.21

Note: DMWR group stands for the combined DC and ME groups, DMPR group stands for the

combined direct CF plus revision and metalinguistic explanation plus revision groups and CN stands for the control group.

Overall, the findings showed that (a) the experimental groups performed better in the post-tests than in the pre-test; (b) the experimental groups showed higher scores than the control group on both post-tests; (c) in the pre-test, the mean scores for DMWR (M=37.59, SD=26.82) were low in comparison to DMPR group (direct CF plus revision and metalinguistic explanation plus revision) (M=53.27, SD=25.44) and control group (M=54.40, SD=31.92) (See Table 2). This could be a concern because if there were significant differences between groups in the pre-test, group differences in Times 2 and 3 could be partially due to differences in Time1 and not due to treatment. Thus, a one-way between groups ANOVA was employed to compare groups at Time 1.

Table 3 *Descriptive statistics of the gain scores for the accuracy scores in the written tasks*

Groups		**Gain 1**		**Gain 2**	
	N	**M**	**SD**	**M**	**SD**
DMWR	40	41.74	26.55	37.85	26.86
DMPR	39	32.25	24.37	30.99	23.43
CN	21	4.30	30.38	-13.32	32.77

Note: DMWR group stands for the combined direct CF and metalinguistic explanation groups, DMPR group stands for the combined direct CF plus revision and metalinguisticexplanation plus revision groups and CN stands for the control group.

The findings showed that (a) the experimental groups performed better in the post-tests than in the pre-test; (b) the experimental groups showed higher scores than the control group on both post-tests; (c) in the pre-test, the mean scores for DMWR (direct CF and metalinguistic explanation) (M=37.59, SD=26.82) were low in comparison to DMPR group (direct CF plus

revision and metalinguistic explanation plus revision) (M=53.27, SD=25.44) and control group (M=54.40, SD=31.92). (See table 3).

Table 4. *Effect Sizes in the Form of Cohen's d for the Accuracy Scores Overtime*

Group		**Time 1–Time 2**		**Time 2–Time 3**		**Time 1–Time3**	
	N						
***d*[1]**		***p*[2]**	***d***	***p***	***d***	***p***	
DMWR	40	1.82	.00	0.18	.53	1.52	.00
DMPR	39	1.62	.00	0.10	1.00	1.55	.00
CN	21	.14	1.00	0.56	.008	0.40	.23

Note: DMWR group stands for the combined direct CF and metalinguistic explanation groups, DMPR group stands for the combined direct CF plus revision and metalinguistic explanation plus revision groups and CN stands for the control group.

The results shown in Table 4 report the pairwise comparisons (paired t-test) and effectsizes for DMWR, DMPR and control groups. The findings showed that the DMWR and DMPR groups

significantly improved from Time 1 to Time 2 with large effect sizes, that is, 1.82 and 1.62 respectively.

RQ3: Is there any difference in the effect of DC and ME regardless of whether there is an opportunity for revision?

To find answers to the third research question, the two direct CF groups (i.e., direct CF and direct CF plus revision) and the two metalinguistic explanation groups (i.e., metalinguistic explanation and metalinguistic explanation plus revision) were combined and compared. Table 5 shows the descriptive statistics for the four treatment groups at the three different testing periods, that is, Time1 (pre-test), Time 2 (immediate post-test) and Time 3 (delayed post-test).

Table 5 Descriptive Statistics for the Accuracy Scores in the Written Tasks

Groups		**Time 1**		**Time 2**		**Time 3**	
	N	**M**	**SD**	**M**	**SD**	**M**	**SD**
DCO	40	40.40	26.31	82.15	16.27	77.36	21.20
MEO	39	50.39	27.40	82.63	14.86	82.30	15.49
CN	21	54.40	31.92	58.70	29.11	41.07	33.21

Note: DCO group stands for the combined direct CF groups (i.e., direct CF and direct CF plus revision), MEO group stands for the combined metalinguistic explanation groups (i.e., metalinguistic explanation and metalinguistic explanation plus revision) and CN stands for the control group.

Both Table 5 show that from Time 1 to Time 2, the accuracy of the two experimental groups increased sharply; however, from Time 2 to Time 3 the changes in the experimental groups were slight, that is, accuracy in both the DCO and MEO groups slightly decreased. Accuracy in the control group also increased slightly from Time 1 to Time 2 but it then decreased sharply in Time 3.

One-way ANOVA was conducted to measure whether there was significant differences in the pre-test results. The result of one-way ANOVA showed that there were no significant differences

between the three groups at Time 1 (see Table 5.9.): F (2, 97) = 2.13, P=.12, η^2=0.04. However, gain scores were employed in RQ1 and RQ2, and in orderto be consistent, for RQ3, raw scores were also changed to gain scores to measure betweengroups. Table 6 shows the descriptive statistics for the treatment and control groups for the immediate gain (gain 1) and the delayed gain (gain 2).

Table 6: Descriptive Statistics for the Accuracy Scores in the Written Tasks

Groups		***Gain 1***		***Gain 2***	
N		*M*	*SD*	*M*	*SD*
DCO	*40*	*41.75*	*25.15*	*36.96*	*27.44*
MEO	*39*	*32.24*	*25.84*	*31.90*	*22.97*
CN	*21*	*4.30*	*30.38*	*-13.32*	*32.77*

Note: DCO group stands for the combined direct CF groups (i.e., direct CF and direct CF plus revision), MEO group stands for the combined metalinguistic explanation groups (i.e., i.e., metalinguistic explanation and metalinguistic explanation plus revision) and CN stands for the control group.

In order to measure within-groups, repeated measure ANOVAs with pre- and post-test scores were conducted to compare scores on writing of the DCO and MEO feedback groups at Time 1, Time 2 and Time 3.

RQ 4: To what extent do working memory (WM) and phonological short-term memory (PSTM) moderate the effects of the different types of feedback?

To address RQ4, that is, the extent to which working memory and phonological short- term memory mediate the efficacy of different types of written CF, descriptive statistics, correlation and multiple regression were conducted. Table 7 displays the descriptive statistics of feedback type groups and working memory and phonological short-term memory scores. The direct CF group had the highest working memory and metalinguistic explanation the lowest capacity. The direct CF plus revision group had the highest phonological short-term memory and metalinguistic

explanation had the lowest capacity. One way ANOVAs showed no significant differences between the feedback groups in terms working memory: F (3, 78) = 14.09, p=.93, and phonological short-term memory:F (3, 78) = .91, p=.43.

Table 7 Descriptive Statistics of the Feedback Groups' Working Memory and Phonological Short-term Memory.

Groups		**WM**		**PSTM**	
	N	M	SD	M	SD
DC	20	.04*	.67	40.40	9.82
DC+R	20	-.07	.53	41.50	11.84
ME	20	-.007	.60	36.60	8.42
ME+R	19	.03	.59	40.63	10.27

**The scores of working memory are in terms of average z scores. Note: DCF = direct corrective feedback with no revision, ME = metalinguistic explanation with no revision, DCF+R = direct corrective feedback with revision, ME+R = metalinguistic explanation with revision, WM= working memory, PSTM= phonological short-term memory*

Table 8: Regression Results for the Effects of DCO and MEO and Contributions ofWM and PSTM

Groups		**Predictors**				
WM				**PSTM**		
B			*P*	*B*	*P*	R^2
DCO	Post-test 1	.30	.07	-.23	.14	.10
	Post-test 2	.26	.11	-.01	.93	.06

MEO	Post-test 1	.41	**.01***		-.04	.78	**.**16
	Post-test 2	.54	**.001***		.01	.89	.29

Note: DCO group stands for the combined DC groups (i.e., direct CF and direct CF plus revision), MEO group stands for the combined ME groups (i.e., metalinguistic explanation and metalinguistic explanation plus revision), WM stands for working memory and PSTM stands for phonological short-term memory.

Phonological short-term memory did not show to be a significant predictor of variables for the DCO (direct CF and direct CF plus revision) and MEO (metalinguistic explanation and metalinguistic explanation plus revision) groups.

4) Discussion

4.1 RQ1: What effect does focused DCF and ME with and without revision have on learners' use of the English passive voice in an immediate text revision and in new texts over time?

RQ1 investigated the efficacy of direct CF and metalinguistic explanation feedback with and without revision on learners' use of the English passive voice in an immediate text and in new texts over a four-week period. The findings for RQ1 are discussed in the following order : (1) the findings for a within group comparison immediately and overtime; (2) the findings for a between group comparison immediately and over time, whichis discussed in two parts: (a) comparing the difference between the treatment groups and the control group immediately and over time; (b) comparing the difference between the individual treatment groups immediately and over time; and (3) the findings of the impact of written CF on the passive voice as a complex structure.

4.1.1 Discussion of within group comparison of findings immediately and over time

This section provides a theoretical and empirical discussion of the within group comparison of the findings immediately and over time. The results of a series of ANOVAs showed that the experimental groups (direct CF, direct CF plus revision, metalinguistic explanation, metalinguistic explanation plus revision) significantly improved their accuracy from the pre-test

to the immediate post-test. Then, from the immediate to the delayed post-test the improvement deteriorated slightly, but the decrease in accuracy was not statistically significant. This reveals that some learners retained the improvement from the immediate to the delayed post-test. Theoretically, Gass's (1997) framework identifies how a single episode of input processing (e.g., in the form of written CF) may help learners to develop their explicit knowledge. Accordingly, if noticed and comprehended, input can subsequently go through central processing (i.e., intake and integration), and result in output. Thus, the findings of the current study have shown that a single written CF treatment can help learners to improve the accuracy of a complex structure such as the English passive voice, and that accuracy is not only evident in the short term but also in the writing of a new text after a period of time.

Empirically, these results are consistent with earlier studies (e.g., Bitchener & Knoch, 2008; Bitchener & Knoch, 2010a; Rummel, 2014; Sheen 2007; Stefanou & Revesz 2015) on the effectiveness of written CF. Bitchener and Knoch's (2008) study on 144 low intermediate ESL learners reported that written CF was effective in the functional use of articles over two months. Similarly, Bitchener and Knoch (2010a), in another longitudinal study, explored the relative effectiveness of the different written CF types (direct corrective feedback; direct corrective feedback and written meta-linguistic explanation; direct corrective feedback, oral, and written meta-linguistic explanation; the control group) on two functional uses of the English article system. They found that written CF was effective after 10 months. Written CF has also been reported to be effective in the use of English articles over nine weeks (Sheen, 2007).

4.1.2 Discussion of between group comparison of findings immediately and over time

This section provides a theoretical and empirical discussion of the findings of the between group comparison in two sections, the first comparing the difference between the treatment groups and the control group immediately and over time, and the second comparing the difference between individual treatment groups immediately and over time. The effectiveness of written CF on all groups in the short term and over time is discussed below.

4.1.2.1 Discussion comparing the effectiveness of the treatment groups and the control group immediately and over time

The results of the between group analysis showed that all experimental groups (direct CF, direct CF plus revision, metalinguistic explanation, metalinguistic explanation plus revision) outperformed the control group in both the short term and over four weeks. There is a theoretical

explanation for why written CF can be considered to play a facilitative role in L2 development. Gass's framework (1997) shows that if learners are able to modify their output based on the input they have been given, they must have proceeded successfully through the cognitive processing stages (apperceived [noticed] input, comprehended input, intake, integration) to reach that modified output.

The findings are empirically supported (e.g., Bitchener & Knoch 2010a; Ellis et al., 2008). Bitchener and Knoch (2010a) investigated the relative effectiveness of written CF on two functional uses of the English article system. The findings revealed that all three groups that received treatments outperformed the control group on all post-tests. Similarly, Ellis et al.'s (2008) study on 49 intermediate EFL learners found that those who received written CF outperformed the control group both immediately and in post- tests over 10 weeks. However, the findings of the present study are in contrast to those of Guo (2015). In her study of 147 low intermediate EFL learners, Guo (2015) reported that learners who were provided with written CF outperformed the control group only in the immediate post-test, but not after four months. A possible reason for the difference in findings between the study by Guo and the current study could be the use of different study designs; that is, the delayed post-test in this study was conducted in week four and in Guo's study it was conducted after four months. Participants in Guo's study may not have been able to consolidate their knowledge of the target structures, which were the regular and irregular past tense and prepositions of place, after four months.

4.1.2.2 Discussion comparing the difference between individual treatment groups immediately and over time

The findings also showed that direct CF treatment was relatively more effective than the other treatments in both the short term and over time, and also from the pre-test to the immediate and delayed post-tests**.** This can be explained theoretically in that the degree of explicitness provided to the direct CF group was higher than that of the metalinguistic explanation group. In other words, in this study, direct CF was more explicit because the direct CF group was provided with the correct form of the target structure, the English passive voice. On the other hand, metalinguistic explanation was less explicit because the feedback for the metalinguistic explanation group was in the form of a one-page handout that included when to use the English passive voice, how to construct it and some examples; however, the errors in the English passive voice were not identified in the students' written text. Thus, the metalinguistic group received no

explicit feedback on their pre-test writings.

Empirically, the findings of the current study regarding the high level of effectiveness of direct CF in comparison to other types of written CF are supported by the results of earlier studies. Bitchener (2008) reported that providing only direct CF was more effective than providing direct CF plus metalinguistic explanation over two months. He argued that the possible reason was that the limited details of written metalinguistic explanation may have been insufficient to result in a significant effect. Shintani et al. (2014) also reported that direct CF was more effective than metalinguistic explanation provided in the form of a handout in the immediate post-test. The reason was that the direct CF was more explicit and provided participants with the correct form of the target structure and thus enabled them to make a comparison between the input and their own erroneous structure.

4.1.3 The findings on the impact of written CF on the passive voice as a complex structure

The findings of the current study also showed that written CF is effective in terms of effectively targeting a complex structure, the English passive voice, immediately and after week four. The English passive voice can be categorized as a complex structure because it is formed by both rule-based and item-based structures. In the passive voice, the verb "to be" can be categorized as rule-based while the "past participle" can be categorized as item-based.

Empirically, some studies have targeted complex structure. For instance, Shintani et al. (2014) and Rummel (2014) targeted the hypothetical conditional and the present perfect tense respectively. Similar to the present study, Rummel (2014) found that written CF was effective for the present perfect tense immediately and over time (seven weeks). However, in contrast to the present study, Shintani et al. (2014) reported that learners did not sustain improved accuracy in the use of the hypothetical conditional over two weeks.

4.2 RQ2: Does the opportunity for revision influence the efficacy of DC and ME?

In order to address research question 2, that is, investigating whether requiring learners to undertake revision has any effect on the accuracy in new pieces of writing, the two revision groups (i.e., direct CF plus revision and metalinguistic plus revision) and the two groups that did not make revisions (i.e., direct CF and metalinguistic explanation) were combined and compared. Providing learners with opportunities to revise their texts may play an important role in the development process because it invites them to notice the feedback they have been provided with and to process it across the stages identified in Gass' (1997) cognitive framework (Bitchener,

2016). However, the effectiveness of revising the text while having access to written CF is arguable, because little or no cognitive processing may take place. Bitchener (2016) pointed out that when learners revise their text and have access to the corrections (e.g. direct CF) little or no cognitive processing may be needed.

However, Bruton (2009) challenged the validity of the claim becausein Truscott and Hsu's (2008) study learners made only a few errors in their pre-test writing and therefore had little room for improvement.

4.3 RQ3: Is there any difference in the effect of DC and ME regardless of whetherthere is an opportunity for revision?

Research question 3 examined the relative efficacy of metalinguistic and direct CF regardless of whether there was an opportunity for revision. Thus, the two direct CF groups (i.e., direct CF and direct plus revision) and the two metalinguistic groups (i.e., metalinguistic and metalinguistic plus revision) were combined and compared.

Theoretically, as has been explained in RQ1, the degree of explicitness and salience of input provided to the combined direct CF group was higher than that of the combined metalinguistic explanation group because the direct CF group was provided with the correct form of the target structure, the English passive voice. On the other hand, the feedback for the metalinguistic explanation group was in the form of a handout explainingthe English passive voice and the errors were not identified in their text. Thus, the directCF (a more explicit type of written CF) is likely to draw learners' attention to a greater extent than metalinguistic explanation in the form of a handout (a less explicit written CFtype).

Empirically, Shintani et al. (2014) was the only study which compared the effectiveness of the combined direct CF groups (i.e., direct CF and direct CF plus revision) and the combined metalinguistic explanation groups (i.e., metalinguistic explanation and metalinguistic explanation plus revision). They found that both the combined direct CF and the combined metalinguistic explanation treatments were effective in the short term, but only the combined direct CF was effective over time (i.e. 2 weeks).

4.4 RQ4: To what extent do working memory and phonological short-term memory moderate the effects of different types of feedback?

Research question 4 investigates the extent to which working memory and phonological short-

term memory moderate the efficacy of direct corrective feedback and metalinguistic explanation with and without revision in new writing texts immediately and over time. The findings are discussed as follows.

The possible reason for the first finding, that is, the moderating effect of working memory on the metalinguistic explanation and the combined metalinguistic explanation group and the combined metalinguistic and direct CF groups, is related to the nature of the feedback selected in the present study. In other words, there was a greater degree of explicitness in the direct corrective feedback and a lower degree of explicitness in the metalinguistic explanation feedback. The direct corrective feedback group was provided with corrected errors, which is a more explicit type of feedback, whereas the metalinguistic explanation group received feedback in the form of a handout, which is a less explicit type of feedback. In other words, the metalinguistic explanation group received only received a handout that included an explanation of the targeted structure, which was the English passive voice and the errors in the target structure were not identified on the students' writing. This may reflect two different mechanisms of noticing. The higher level of explicitness of direct corrective feedback might lead to learners noticing the target structure (i.e., the English passive voice) with less cognitive demand compared to the metalinguistic explanation that provides less explicit feedback and thus does not directly draw learners' attention to form (i.e., the English passive voice) when writing new texts immediately and over time. The noticing of less explicit types of CF (e.g., metalinguistic explanation in the form of a handout) is an attention demanding task and thus requires a domain-general, attention control mechanism considered as a critical component of working memory capacity (e.g., Goo, 2013; Engle, 2002; Kane, Conway, Hambrick, & Engle, 2007). This cognitive control mechanism is not needed for the noticing of direct CF, which has an obtrusive and explicit nature. Thus, this may be the reason that working memory is related to the effectiveness of metalinguistic explanation but not of direct CF in the acquisition of the English passive voice. In other words, it is the involvement of the executive attention process in the noticing of metalinguistic explanation that may distinguish metalinguistic explanation from direct CF in respect to the moderating role of working memory capacity on the efficacy of the two feedback conditions. Theoretically, this makes sense because working memory is a cognitive space in which an erroneous form is compared with the corrected form (Baralt, 2015). Thus, when direct CF is provided on the written text, there is no need for the processing and comparison of forms in

the working memory. Thus, these findings reveal that feedback types with different levels of explicitness may have a different impact on the moderating effect of working memory on written CF.

5) Conclusion

To summarize, the results of the present study have answered the major questions raised in written CF studies. First, a more explicit type of written CF (i.e. direst CF) enabled the Iranian EFL learners to improve their accuracy to a higher degree compared to a less explicit type of written CF (i.e., metalinguistic explanation as used in this study) in the short term and over time. This may be because more explicit types of written CF are likely to draw learners' attention to a greater extent than less explicit written CF types (e.g., the delivery of metalinguistic explanation as used in this study). Additionally, more explicit types of written CF contain more linguistic information, which may lead to the formation of a new hypothesis about the target structure (e.g., the English passive voice) and the production of output. Besides, more explicit types of feedback (e.g., direct CF) may also reduce the confusion that learners may experience if they do not understand less explicit types of CF.

Second, written CF followed by revision resulted in deeper processing of information compared to non-revision, and thus improved accuracy was longer lasting. Revision following feedback may lead to greater accuracy in new writing texts because written CF followed by revision leads to 'pushed output', especially if learners have no access to the corrections when they start writing the revision draft (as in the present study). Swain (1985, 1995) argued that that pushed output helps learners to notice grammatical forms that otherwise are likely to go unattended.

Finally, the findings showed that working memory and phonological short term memory moderate some types of written corrective feedback. Working memory seems to moderate less explicit types of feedback because the noticing of less explicit types of CF (e.g., metalinguistic explanation as used in this study) is an attention demanding task and thus requires a domain-general, attention control mechanism considered to be a critical component of working memory capacity. The findings of this study also showed that phonological short term memory negatively moderates the efficacy of direct CF plus revision, but only in the long term. In other words, the poorer one's phonological short term memory was, the more he/she benefited from the feedback.

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