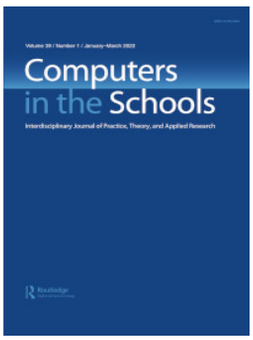

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The Effect of Computer-Mediated Feedback on L2 Accuracy. Does the Difference in Learners' Perceptual Style Moderate the Effectiveness of the Feedback?

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ABSTRACT

Computer-mediated feedback (CMF) has recently gained attention in L2 (second language) classes because it offers numerous advantages, such as flexibility and timesaving. However, not much is known about how it affects the accuracy of L2 learners and how the mediating variables, such as learners' preferred perceptual style, influences the efficacy of CMF. Therefore, the present study was conducted to examine how two types of CMF (audio-based and text-based) affect the accuracy of L2 learners on the past perfect tense and whether aligning CMF types with the learners' preferred perceptual style (auditory/read/write) mediates its efficacy. One hundred and twenty first semester students with English as a second language (ESL), with a mean age of 20 were recruited for the current study. These students were divided into two treatment groups (audio-based and text-based) and a control group based on their preferred perceptual style (auditory/read/write). The learners in the treatment groups were given three treatment sessions, one each week, where they received CMF either in the audio-based form or text-based form on their narrative writing texts. Subsequently, the effectiveness of the CMF was tested employing two testing instruments: writing task and oral production task. The writing task was a narrative text reconstruction that required the participants to use past perfect tense. Similarly, the oral production task was a dialogue activity that required the use of past perfect tense. The results indicated that both CMF types improved the accuracy of the past perfect tense, with the audio-based CMF found to be more effective. The study also demonstrated that CMF was more effective when aligned with the learners' preferred perceptual style.

KEYWORDS

Audio-based feedback; computer-mediated feedback; L2 accuracy; learners' perceptual style; text-based feedback

Introduction

There is a growing interest amongst L2 scholars in providing corrective feedback (CF) with the help of technology (Bahari, 2021). Although

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research on CF has mushroomed with studies providing evidence about its efficacy (see Kang & Han, 2015 for meta-analysis), there are still a few loose ends that warrant further investigation. For instance, using computers to give CF (Bahari, 2021). This mode of CF is different from conventional oral feedback (OF). For instance, a teacher can provide CF when the error occurs, while CMF can be provided synchronously or asynchronously (after the class). CMF can be delivered instantly and is not confined to the classroom's boundaries, making it more important during the current COVID-19 pandemic. More importantly, asynchronous CMF gives learners more time to reflect and ponder over the errors they have made (Rassaei, 2019a).

CMF can be given synchronously or asynchronously in audio-based, text-based, and video-based forms (Bahari, 2021). While a significant strand of research has examined the efficacy of text-based synchronous CMF on L2 development (Rassaei, 2019a; Sauro, 2009; Shintani & Aubrey, 2016; Yilmaz, 2012), little is known about the effectiveness of other forms of CMF, such as audio-based CMF and text-based CMF. This comparison is critical because previous CF research has demonstrated that different CF types affect L2 writing differently (Suzuki et al., 2019). For instance, interacting asynchronously (text-based and audio-based) have different instructional values (Hew & Cheung, 2012; Ice et al., 2007). However, not much is known about how the different types of CMF (audio-based and text-based) differentially affect the grammatical accuracy of L2 learners in writing. In addition to this, individual differences, including learning styles, influence the efficacy of CF (Hyland & Hyland, 2019; Rahimi, 2015; Rassaei, 2019a). Learning styles are believed to strongly influence the efficacy of CF because they "represent learners' general approaches to and preferred ways of learning" (Cohen, 2012, p. 142). In this regard, Hyland and Hyland (2019) argue that CF studies lack in consideration of varying learners' factors and stress the need to conduct more studies considering individual differences. Therefore, the current study aims to investigate and compare how two different types of CMF (audio-based and text-based) affect the grammatical accuracy of L2 learners and whether the effectiveness of CMF increases when there is an alignment between learners' preferred perceptual style (read/write vs. auditory) and CMF types (audio-based vs. text-based).

Literature review

CF and L2 development

Second language (L2) learning is challenging with many ups and downs. To help L2 learners overcome these challenges, L2 teachers provide CF.

CF can be defined as teachers' written and spoken responses to learners' errors (Bitchener & Storch, 2016). Some research scholars believe that CF can help L2 learners in writing (Bitchener & Storch, 2016), while others cast doubt (Gad et al., 2016). Similarly, from a theoretical perspective, the contribution of CF in language development is questionable. Through his Input Hypothesis, Krashen (1982) posited that CF is ineffective and harmful for language learning as it disrupts the flow of learning that may provide comprehensible input (Kim, 2004). Echoing the same notion, Chomsky (1975) suggested that CF had little impact on L2 learning in his Universal Grammar theory. On the contrary, several SLA (second-language acquisition) theories advocate in favor of CF. For instance, Bitchener (2012) argues that skill acquisition theory advocates for CF. The proponents of skill acquisition theory argue that CF provides explicit knowledge to the learners, which can later be transformed into implicit and procedural knowledge.

Language learning includes providing learners with two types of input (evidence): positive and negative (Long, 1996). According to Long (1996), positive evidence includes the acceptable linguistic models in L2, while negative evidence includes the unacceptable linguistic models in L2. Through the positive evidence, learners learn what linguistic features to use, while the negative evidence emphasizes CF's role and helps learners be aware of their mistakes in linguistic production (Ellis & Sheen, 2006). Based on the negative evidence, CF can be given both implicitly and explicitly. The teacher does not highlight the error in an implicit mode, but instead implicitly suggests the correct form. While in an explicit mode, the error is highlighted, an explanation is provided, and finally, the correct form is demonstrated (Lyster & Ranta, 1997). Several studies have highlighted the pivotal role written CF plays in language learning (Ellis et al., 2008; Mujtaba et al., 2021). While these studies have demonstrated the efficacy of CF, they have also suggested that a number of different factors can moderate the efficacy of CF, such as learners' perception (Rassaei, 2013), working memory (Li & Roshan, 2019), foreign language anxiety (Rassaei, 2015b), individual differences, such as learning style (Guo & Yang, 2018; Rahimi, 2015; Rassaei, 2019a) and type of grammar structure (Suzuki et al., 2019).

Computer-mediated CF

Technological advancement has played an essential role in language learning and testing. Therefore, research on mobile-assisted language learning (MALL) and computer-assisted language learning (CALL) has received significant attention in SLA research. In the area of CF research, some

scholars have examined the efficacy of CMF on L2 development (AbuSeileek, 2013; Sauro, 2009). However, a plethora of CMF studies (e.g., Sauro, 2009; Shintani & Aubrey, 2016; Yilmaz, 2012) have focused only on audio-based CMF and other forms of CMF, such as video-based or audio-based, have not received much attention. A few studies have compared the efficacy of different forms of CMF. Ghazi and Zamanian (2016) studied the effect of asynchronous CMF versus conventional CF on Iranian students' writings. The results indicated that the students who received CF via e-mail outperformed those who received red pen conventional CF. Similarly, Tafazoli et al. (2014) studied the difference between paper feedback effectiveness instead of electronic feedback. They studied Iranian ESP students' writings and discovered that the CMF was more effective in helping students improve the grammatical accuracy. Yilmaz (2012) investigated the effects of negative feedback, target structure salience, and communication mode (face-to-face vs. synchronous computer-mediated communication) on Turkish learners and affirmed that explicit CMF was more effective than face-to-face CF. However, in a study using video-based CF, Rassaei (2017) compared the effect of recasts using face-to-face and Skype-based video conferencing on L2 development and found that both modalities had the same effect on L2 development. In a recent study, Tabrizi and Ranjbaran (2021) investigated the effects of two types of CMF: audio-based and text-based on L2 learners' writing accuracy. The study concluded that audio-based and text-based CMF outperformed the control group participants who did not receive and CF. The study further highlighted the superiority of audio-based CF over text-based CF.

Text-based vs. audio-based CF

While conventional CF modes mainly involved teachers' written or computer-mediated text-based feedback, new technological enhancements encouraged new CF modes in language learning, namely, audio-based and visual-based feedback. These offer more personal CF and, therefore, motivate the learners to participate more and increase their willingness to learn (Bueno Alastuey, 2011). In addition to this, audio-based and text-based CMF may hold different instructional values. For instance, through text-based CMF, learners' attention can be directed toward spelling and grammar errors. In contrast, audio-based CMF can be used to help learners understand suprasegmental features of the language (Rassaei, 2019a). Similarly, the involvement of an interlocutor's voice in audio-based CMF "adds to the social aspect of asynchronous computer-mediated feedback (Rassaei, 2019b, p. 99). Ice et al. (2007) argue that text-based CMF is devoid of sound and that this overshadows the social aspect of

computer-mediated interaction, resulting in learners' dissatisfaction. Rice (1992) stressed "media richness" as significant in CM (audio-based) feedback in adding to the learning experience of the learners. The elements of media richness are "the number of cues and senses involved, personalization and language variety (Rice, 1992, p. 477).

Based on the above-discussed literature, it can be argued that media richness is more robust in audio-based CMF than text-based. Anderson et al. (2001) posit that the absence of media richness and social presence in text-based CMF impedes learners' performance. A number of studies have demonstrated that learners are more inclined to receive content through multimedia than through text-based materials (Ice et al., 2007; Oomen-Early et al., 2008). Concerning L2 development, it may seem plausible to believe that the involvement of voice in audio-based CMF promotes more of a feeling of social presence than its counterpart– text-based CMF, which eventually helps learners improve the accuracy of linguistic forms. Despite these arguments, there seems to be a paucity of empirical evidence substantiating the efficacy of audio-based CMF on L2 development (Rassaei, 2019a). Recently, Rassaei (2019a) conducted a study to examine the effects of two forms of CF: audio-based and text-based. The study demonstrated that both forms of CF helped learners improve the grammatical accuracy of English articles. In a recent study, Tabrizi and Ranjbaran (2021) investigated the effects of two types of CMF: audio-based and text-based on L2 learners' writing accuracy. The study concluded that audio-based and text-based CMF outperformed the control group participants who received no CF. The study further highlighted the superiority of audio-based CMF over text-based CMF.

Perceptual style

Defining learning style is complex (Cassidy, 2004). However, it can be hypothesized as an amalgamation of learners' cognitive, affective, and personality traits that prompt learners to absorb and interact with information in a context differently (Krätzig & Arbuthnott, 2006). Most definitions of learning style revolve around the notion that individuals learn and process information in a particular manner. For instance, Cassidy (2004) defined learning style as "the manner in which learners choose or are inclined to approach a learning situation" (p. 420). Likewise, Dunn and Griggs (1998) defined learning style as "biologically and developmentally imposed set of characteristics that make the same teaching method wonderful for some and terrible for others" (p.3). Perceptual style is a term that is repeatedly used reciprocally with learning style (Hatami, 2018; Rassaei, 2019a). Perceptual style is an individual's chosen way of retrieving

information from the context (Hatami, 2018). In the current, the term perceptual style is used to refer to an individual's learning style. There are many merits of knowing about the learners' perceptual style as it aids them in learning. It also helps learners work productively, creatively, and analytically (Jaleel & Thomas, 2019). According to Fleming and Mills (1992) and Fleming (2006), there are four perceptual styles: visual, auditory, read/write, and kinesthetic learning style, also known as the VARK inventory. As the names suggest, visual learners mostly employ their sense of sight, auditory use hearing, read/write learners learn through printed material, and kinesthetic learners involve touch and movement. Although some learners might utilize a combination of styles while learning, most learners usually have one prominent learning style, which they prefer (Boneva & Mihova, 2011).

Given the differences in the four types of perceptual styles, one important question is whether aligning learners' perceptual style with the teacher's teaching style would yield any positive effect on learning outcomes. As the literature has articulated that learners process, retrieve, and comprehend information differently subject to their learning styles (Krätzig & Arbuthnott, 2006), it may seem plausible to hypothesize that learners prefer to learn and respond to the information in accordance with their preferred learning style. Echoing the same notion, Riding and Watts (1997) state that learners prefer teaching styles that are synchronous with their learning styles. Several scholars have reported that matching teachers' teaching styles and learners' learning styles result in improved learning (Mao & Crosthwaite, 2019; Peacock, 2001). Investigating the teachers' opinion about matching teaching style with learners' preference, Peacock (2001) demonstrated that learners were not satisfied when their learning styles were not aligned with the teaching style. The teachers also indicated that a mismatch between teaching and learning styles would lead to demotivation and apprehension among the learners. Similarly, Tight (2010) concluded that there was an increase in the rate of vocabulary learning when the teaching style was in alignment with learners' learning styles. In contrast, some L2 scholars have reported that learning is negatively affected when there is a misalignment between teaching style and learners' learning style (Littlewood et al., 1996; Mao & Crosthwaite, 2019).

Based on the above-discussed studies, it can be inferred that learners may prefer to receive CF in different forms, such as audio-based or text-based, which may have differential effects on learning outcomes. Given the difference in perceptual styles, learners with auditory and read/write perceptual styles may accrue different benefits from audio-based or text-based CF. Given the lack of computer-mediated studies involving learners'

perceptual styles, the current study aims to add to the literature by examining the following research questions:

1. Does CMF help learners improve the accuracy of the past perfect tense? If yes, is there any statistically significant difference between text-based and audio-based CMF in helping learners improve the accuracy of past-perfect tense?
2. Are the effects of CMF on the accuracy of past perfect tense moderated by learners' perceptual style?

Methods

Design

A quasi-experimental design was used to answer the questions of the study. At the outset of the study, a questionnaire designed by Fleming and Mills (1992) was filled in by the participants. Based on their answers, they were allocated to two groups: read/write styles and auditory. After this, the participants were subdivided into CMF: text-based, audio-based, and no feedback groups (see Table 1).

Learning style questionnaire

The learners' perceptual style was investigated using the VARK questionnaire adopted from Fleming and Mills (1992). The questionnaire consists of 16 different problem-solving situations and four possible responses to each. The participants read each situation and select an option that represents their best choice to solve each situation. The scoring is based on the participant's total number of specific styles in each situation. Therefore, the highest score would be 16 in a specific style, representing that the participant solely relies on that particular learning style. Then, from 150 participants who filled out the VARK questionnaire, 120 with the highest scores in the two auditory and read/write perceptual learning styles were selected and divided into the experimental groups.

Table 1. Participants.

Condition	Participants
Auditory style: Audio-based CF	20
Auditory style: Text-based CF	20
Auditory style: No CF	20
Read/write style: Audio-based CF	20
Read/write style: Text-based CF	20
Read/write style: No CF	20

Note: CF = Corrective Feedback.

Participants

A total of 150 ESL participants enrolled in three Functional English classes in a private university in Pakistan were initially invited to participate in the study. The mean age of the participants was 18 years, and they had studied English for 12 years before taking admission to the university. First, the 150 participants filled out the learning styles questionnaire. Thirty participants who could not fulfill the criteria of being classified in to either auditory or read/write perceptual styles were excluded from the study. After excluding 30 participants, 120 were finally made a part of the study (see Table 1). These participants then completed the Oxford Quick Placement Test (OPT). This test assesses test takers' language proficiency based on their grammar and vocabulary knowledge. The test has 60 multiple-choice items, measuring various grammar structures, such as verb agreement, gender, tense, and prepositions. Similarly, the test has items that measure the vocabulary knowledge by asking test takers to fill in the blanks with the most appropriate option. The result of the OPT demonstrated that all the participants were at the B2 upper-intermediate level on the CEFR.

Operationalization of CMF

The current study used two types of CMF: audio-based and text-based. The researchers employed focused CF where the learners received CF only on the past perfect tense. The following subsections explain the operationalization of these two types of CMF.

CMF (Audio-based)

In this type, the incorrect elements were underlined and embedded in the PDF file, and an audio comment was added so that the learner could hear the correct form of the incorrect error. Every time learners clicked on the underlined incorrect; they could hear the correction in audio. For instance, after pressing the incorrect phrase 'had broke,' the learners would hear the right form as 'had broken.' It should be noted that this type of CMF is different from face-to-face CF. While face-to-face CF is spontaneous in relation to learners' oral interactions, audio-based CMF is delayed as it is provided on the written linguistic irregularities of the learners. To put this another way, audio-based CMF is provided on the errors made by the learners from the previous session.

CMF (Text-based)

Text-based CMF is similar to audio-based in that the same PDF file with the underlined incorrect elements is used; however, the difference lies in

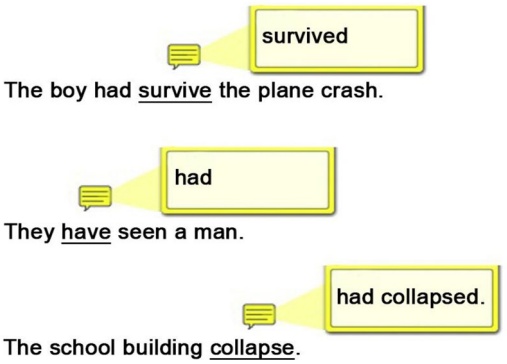

Figure 1. Text-based CMF examples.

the CMF presentation's modality. In text-based CMF, a short annotation in a comment box was used to inform the learner of the correct form of the erroneous form (see Figure 1). Upon clicking the underlined part, the error's correct form would be visible to learners.

Treatment material

The current study had three treatment sessions, designed by the researchers. The treatment was adapted from the recommended course books and newspaper articles. Three narrative text-reconstruction tasks were used in the study. A text- reconstruction task allows learners to read the text, and then teachers take the text back before asking the learners to write. This technique was employed because a text-reconstruction method can encourage learners to use the target structures instead of avoiding them. A pilot study was done on eight participants to ensure the use of target structure in writing. These participants were not included in the final study.

Testing material

To investigate CMF types' effectiveness, the current study employed two testing tasks: written and oral production tasks.

Oral production tasks

The current study employed two testing tasks: written and oral production tasks. The oral production task was a dialogue activity between two people narrating a story. A learner had to respond to a question using past perfect tense. Each activity had seven dialogues. The first and the second author were the interlocutors for this activity. In total, the researchers used three oral production tasks, each one at pretest, post-test, and delayed post-test. Care was taken to ensure that the three oral production tasks were similar

in complexity and length. The designed tasks were shown to the university's ESL teachers for their comments, and necessary changes were made to make the tasks suitable for the learners. The test re-test reliability of the instrument was computed by considering the pretest and post-test scores of the control group participants. The test re-test reliability was acceptable (ICC = .894, 95% CI = .806, .942).

Writing tasks

Three text-reconstruction tasks were used for the current study, adapted from the recommended course books and newspaper articles, such as Dawn, a leading newspaper in Pakistan. Care was taken to ensure that all the writing tasks had similar complexity and length. In this regard, the selected writing tasks were shown to the university's ESL teachers for their comments. The two ESL teachers, having more than eight years of teaching experience, agreed that the writing tasks were suitable for the study. There were eight to ten instances of the target structure (past perfect). The first text was a 'Plane Crash,' the second was 'Fire in 'School Building,' and the third was 'Earth Quake in the city' In addition to showing the writing tasks to L2 university teachers, test re-test reliability was also calculated by taking into account the pretest and post-test scores of the control group to ensure the validity of the instrument. The test re-test reliability was good (ICC=.820, 95% CI = .698, .879).

Procedure of the study

The study was conducted in a regular class of Functional English. Before collecting the data, the first author clarified the study's purpose to the participants (see Table 2 for procedure).

Week 1 (Pretest): The pretest includes written and oral production tasks. The learners were given 20 minutes to complete the written task and 02 minutes for the oral production task.

Week 2–Week 5 (Treatment Sessions): The current study had three treatment sessions. The learners completed a narrative writing task in which they had to use the target grammatical structure (past perfect tense), and in the next session, they received their draft embedded with CMF. For instance, CMF on the week 2 task was received in week 3 for review and study. Since the participants were not accustomed to this form of CMF, the first author demonstrated how to listen and see the corrections before starting the first treatment session. After completing the first writing task in week 2, the researchers collected the participants' drafts, identified the targeted grammatical structure's errors, and provided CMF on the PDF format according to the treatment conditions. The drafts were given to

Table 2. Procedure of the study.

Perceptual style	Week	Stage	Control (n = 20)	CMF Audio-base (n = 20)	CMF Text-base (n = 20)
Auditory (n = 60)	1	Pretest	Pretest Task (WT + OPT)	Pretest Task (WT + OPT)	Pretest Task (WT + OPT)
	2	Treatment session 1	Task 1	Task 1	Task 1
	3	Treatment session 2	No CF on Task 1 Task 2	CF on task 1 Task 2	CF on task 1 Task 2
	4	Treatment session 3	No CF on Task 2 Task 3	CF on Task 2 Task 3	CF on Task 2 Task 3
	5	Post-test	No CF on Task 3 Post-test Task (WT + OPT)	CF on Task 3 Post-test Task (WT + OPT)	CF on Task 3 Post-test Task (WT + OPT)
	9	Delayed Post-test	Delayed Post-test Task (WT + OPT)	Delayed Post-test Task (WT + OPT)	Delayed Post-test Task (WT + OPT)
Read/write (n = 60)	1	Pretest	Pretest Task (WT + OPT)	Pretest Task (WT + OPT)	Pretest Task (WT + OPT)
	2	Treatment session 1	Task 1	Task 1	Task 1
	3	Treatment session 2	No CF on task 1 Task 2	CF on task 1 Task 2	CF on task 1 Task 2
	4	Treatment session 3	No CF on Task 2 Task 3	CF on Task 2 Task 3	CF on Task 2 Task 3
	5	Post-test	No CF on Task 3 Post-test Task (WT + OPT)	CF on Task 3 Post-test Task (WT + OPT)	CF on Task 3 Post-test Task (WT + OPT)
	9	Delayed Post-test	Delayed Post-test Task (WT + OPT)	Delayed Post-test Task (WT + OPT)	Delayed Post-test Task (WT + OPT)

Notes: WT = Writing Task; OPT = Oral Production Task; CF = Corrective Feedback.

the participants in week 3 to study. In line with other CF studies (Li & Roshan, 2019; Rassaei, 2019a), the participants in the treatment groups were given 10 minutes to study the CF. The first author reminded the participants to click on each of the corrections provided. The first and the second author passively monitored the participants while they were studying the CF. After studying the draft, the participants were given the second writing task. The researcher then followed a similar procedure from week 2 till week 5.

Week 5 (Post-test): All the learners took the post-test in week 5. The learners were given 20 minutes to complete the written task and 02 minutes for the oral production task.

Week 9 (Delayed post-test): All the learners took the delayed post-test in week 9. The learners were given 20 minutes to complete the written task and 02 minutes for the oral production task.

Data coding and scoring

The data were coded independently by two raters. The oral production tasks for the three sessions were recorded and transcribed. Both tasks (writing and oral) were analyzed with respect to the accurate use of the target structure using the obligatory occasion formula (Shintani et al., 2014; Suzuki et al., 2019). Each occasion's accuracy was computed as a percentage of correct usage against all occasions where the target structure

was needed. The inter-rater reliability for the writing task was calculated at pretest, post-test and delayed post-test. The inter-rater reliability for writing task at pretest was (ICC = .913, 95% CI = .854, .951, $p < .001$), at post-test was (ICC = .946, 95% CI = .909, .975, $p < .001$), and at delayed post-test was (ICC = .917, 95% CI = .848, .955, $p < .001$). Similarly, the inter-rater reliability for oral production task at pretest was (ICC = .892, 95% CI = .806, .943, $p < .001$) at post-test was (ICC = .878, 95% CI = .565, .951, $p < .001$), and at delayed post-test was (ICC = .819, 95% CI = .689, .878, $p < .001$). The current study used past perfect tense marking criteria as used in previous SLA studies (Shintani et al., 2014; Suzuki et al., 2019). These marking criteria consider the past perfect tense components: the perfect aspect, the past tense, and the past participle (see Table 4). Scores were given subject to the accuracy of each component. The past perfect aspect was given a score of 1, while the other two components were given 0.5. A point score of 1 was given to the first component because it holds greater importance in understanding the English tense-aspect system (Suzuki et al., 2019). Table 3 shows the scoring criteria, and Table 4 shows the examples of learners' accuracy concerning past perfect tense. The following obligatory occasion formula was used to compute the accuracy of the past perfect tense:

$$Accuracy = \frac{Number\ of\ \ points\ scored}{Number\ of\ \ points\ possible} \times 100$$

Results

The mean and standard deviation of CMF (audio-based and text-based) during the pretest, post-test, and delayed post-test for writing and oral production tasks are displayed in Tables 5 and 6. Both CMF groups outperformed the control group in both tests (writing and oral production) in post-test and delayed post-test. Further, a one-way ANOVA applied on the pretest scores unveiled no statistically significant difference among the groups for the writing task, F (2, 57) = 0.33, $p = 0.72$, and oral production, F(2, 57) = 0.28, $p = 0.76$, ensuring that all the participants were homogenous.

Table 3. Past perfect scoring criteria.

Criteria	Features	Components	Point
A	perfect aspect	have (aux) +verb	1
B	past tense	had	0.5
C	past participle	correct past participle form	0.5

Table 4. Scoring of the past perfect.

Criteria				
Sentence	A	B	C	Total
He work as a teacher.	0	–	–	0
He worked as a teacher.	0	–	–	0
He have work as a teacher.	1	0	0	1
He have worked as a teacher.	1	0	0.5	1.5
He has worked as a teacher.	1	0	0	1.5
He had work as a teacher.	1	0	0.5	1.5
He had worked as a teacher.	1	0.5	0.5	2.0

Table 5. Mean and standard deviation of participant's performance (WT).

Time\CF	Audio-Base (n = 20 + 20)		Text-Base (n = 20 + 20)		Control (n = 20 + 20)	
	Auditory	Read/Write	Auditory	Read/Write	Auditory	Read/Write
	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)
Pre	22.90(3.92)	22.15(5.35)	22.50(4.86)	24.30(5.05)	23.85(3.45)	22.40(6.31)
Post	48.55(8.18)	45.85(6.35)	38.35(6.38)	41.90(6.00)	23.20(5.43)	22.85(3.48)
Delayed	47.00(6.57)	46.15(5.68)	36.05(5.79)	42.45(6.56)	21.85(2.54)	21.95(2.39)

Notes: WT = Writing Task; M = Mean; SD = Standards deviation.

Table 6. Mean and standard deviation of participant's performance (OPT).

Time\CF	Audio-Base (n = 20 + 20)		Text-Base (n = 20 + 20)		Control (n = 20 + 20)	
	Auditory	Read/Write	Auditory	Read/Write	Auditory	Read/Write
	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)
Pre	12.95(4.03)	12.30(5.43)	12.70(4.88)	14.15(4.76)	13.40(3.45)	12.93(4.99)
Post	38.45(8.30)	35.85(6.31)	28.25(6.38)	32.25(6.21)	12.95(3.66)	12.20(6.07)
Delayed	39.00(8.26)	35.90(6.34)	28.30(6.64)	32.55(6.01)	12.95(3.31)	12.80(6.11)

Notes: OPT = Oral Production Task; M = Mean; SD = Standards deviation.

A two-way mixed method ANOVA with time as a within subject variable and condition (CMF) and learners' perceptual style preference as between subject variables was performed. The results of the two-way mixed ANOVA for writing task reported main effects for time F (2, 113) = 439, p <.001, $\eta p2$ =.794, CMF conditions F (2, 114) = 265, p = .000, $\eta p2$= .823 and also the interaction between time and CMF F (4, 105) = 146, p <.001, $\eta p2$= .720. No statistically significant difference was found for the learners' perceptual style difference F (1, 114) = 1.18, p = .279. The results of the ANOVA (see Table 7) reported a statistically significant interaction effect between CMF and learners' perceptual style F (2, 114) = 7.95, p < .05, $\eta p2$= .122. This result indicates that different CMF types affected

Table 7. Mixed factorial ANOVA results (WT).

Source	SS (III)	df	F	Sig.	Effect Size
Time	9972	2	439.23	.000	.794
CF	16519	2	265.56	.000	.823
Time*CF	6652	4	146.47	.000	.720
Style	37	1	1.18	.279	.010
CF * Style	495	2	7.95	.001	.122

Notes: WT = Writing Task; SS = Sum of square; CF = Corrective feedback.

Table 8. Mixed factorial ANOVA results (OPT).

Source	SS (III)	df	F	Sig.	Effect size
Time	11634	2	482.74	.000	.809
CF	17044	2	121.61	.000	.681
Time*CF	6471	4	134.26	.000	.702
Style	2.5	1	0.04	.851	.000
CF * Style	457	2	3.260	.042	.054

Notes: OPT = Oral Production Task; SS = Sum of square; CF = Corrective feedback.

learners differently who have different learning style (auditory and read/write). Similarly, for oral production task, main effects were found for time (See Table 8), F (2, 113) = 483, p <.001, ηp^2 = .809. CMF condition, F (2, 114) = 122, p <.001, ηp^2 = .681 and the interaction between time and CMF, F (4, 105) = 134, p < .001, $\eta p2$ = .702. o significant difference was found for learners' perceptual style preference F (1, 114) = 0.36, p= .851. In contrast, a statistically significant effect was observed for CMF and learners' perceptual style preference, F (2, 114) = 3.260, p < .001, ηp^2 = .054.

Bonferroni post-hoc analysis was also applied to locate the difference among the groups. The results reported a statistically significant difference on the post-test and delayed post-test scores of writing task between CMF: audio-based vs. text-based and audio-based vs. control group (p <.001, CI 4.34–10.31), (p <.001, CI 21.69–27.65), respectively, indicating that CMF (audio-based) was significantly more effective than CMF (text-based CF) and the control group. The results were the same on the oral production task, with CMF (audio-based) outperforming the CMF (text-based) (p <.001, CI 3.52–10.50) and the control group p <.001, CI 14.07–21.02). The CMF (text-based) was statistically significantly different to the control group (p <.001, CI= 14.21–21.13).

Lastly, to clearly understand the differences in groups' scores as mentioned in Tables 5 and 6, one-way ANOVA was used on the post-test and delayed post-test scores. For writing task, the result reported statistically significant differences among the groups at post-test, F (2,117) =161, p <.001, and delayed post-test, F (2,117) = 213, p <.001. Similarly, for oral production task, the results reported statistically significant

Table 9. Multiple comparisons of CMF and learners' perceptual style conditions.

Condition	Writing Task			Oral Production Task		
	Pre	Post	Delayed	Pre	Post	Delayed
1&2	p = .62	p = .25	p =.66	p = .67	p = .27	p = .19
1&3	p = .78	p < .001	p < .001	p = .86	p < .001	p < .001
1&4	p = .33	p < .05	p < .05	p = .39	p < .05	p < .05
2&3	p = .83	p < .001	p < .001	p = .81	p < .001	p < .001
2&4	p = .20	p = .05	p = .06	p = .26	p = .08	p = .09
3&4	p = .26	p = .08	p < .001	p = .35	p = .05	p < .05

1. Audio-based CF/auditory. 2. Audio-based CF/read-write 3. Text-based CF/auditory 4. Text-based CF/read-write.

differences at post-test, F (2, 117) =158, p <.001and also the delayed post-test, F (2, 117) = 156, p <.001. Table 9 displays the results of independent t-tests for detecting the differences among the groups.

As shown in Tables 5 and 6, the audio-based CMF was significantly more effective (see Table 9) than text-based CMF (for both writing and oral tasks) when CMF is aligned with learners' perceptual style. The learners in the CMF (audio-based/auditory style) secured the highest mean score in the post-test and delayed post-test. Similarly, the learners with the read/write learning style achieved consistently high scores. In short, based on the interpretation of data, it can be established that CMF (audio-based) was more effective than CMF (text-based). There was also a statistically significant interaction found between CMF types and learners' perceptual style. The results also explained that the effect of CMF would be maximum when it is aligned with learners' preferred perceptual style.

Discussion

The current study examined how two forms of CMF (audio-based and text-based) and learners' perceptual style affect the grammatical accuracy of L2 learners. The result confirmed that both forms of CMF (audio-based and text-based) helped learners improve the accuracy of the past perfect tense, with the audio-based form of CMF proving to be more effective than the text-based. The results corroborate the findings of Rassaei (2019a), Shintani and Aubrey (2016), and Yilmaz (2012). The study further unveils that learners' perceptual style had a significant interaction with CMF, suggesting that the learners' perceptual style moderates the efficacy of CMF. The auditory learners were reported to have secured the highest marks among the other combinations of CMF and learners' perceptual styles.

The first research question asked whether there is any statistically significant difference between the two types of CMF (audio-based and text-based) and, if so, which type is most effective. While the study exhibited both CMF types' efficacy, the audio-based CMF group statistically outperformed the text-based CMF group. This is an important finding as most past studies demonstrated the effectiveness of computer-mediated asynchronous CF (Shintani & Aubrey, 2016; Yilmaz, 2012). L2 scholars have argued that CF raises learners' attention to the input they receive in the form of CF against the erroneous output they have made in writing (Bitchener & Storch, 2016). The current study affirms that both types of CMF (text-based and audio-based) raised learners' attention to erroneous output. The results also demonstrated that input provided in the form of CMF could promote grammatical accuracy, provided that the input is

salient enough to allow learners to infer negative evidence. As well, the juxtaposition of the current form and the underlining of the learners' erroneous output enables learners to get the most out of the computer-mediated CF. Leeman (2003) advocates the efficacy of recasts to the juxtaposition of the correct form provided to learners through recasts. The written form of CF is regarded as more effective than the oral form of CF because the former gives learners more time to process and plan (Sauro, 2009) and also because the written form of CF, provided through technology, enhances the saliency of the feedback (Rassaei, 2019a). The current study demonstrated that audio-based and text-based CMF promote cognitive comparison necessary for learning.

The current study indicates that audio-based CMF is more effective. One possible explanation of such a result could be understood from the Schmidt (2001) 'noticing' hypothesis. Schmidt argues that for CF to work, it is essential that learners notice it. In other words, grammatical rules and forms will only be learned when learners start noticing them. There is a possibility that audio-based CMF might have more efficiently raised learners' attention to the mismatches between their erroneous output and the input provided in the form of audio-based CMF than the text-based CMF, possibly because of the difference between the modality of learners' errors (text-based) and CMF (audio-based). Another possible explanation of this result could be attributed to the fact that in L2 classes, learners are generally attuned to the oral form of CF than written (Rassaei, 2019a), which makes them more comfortable with this form of CF. There is a possibility that participants of the current study found the oral form of audio-based CF more engaging, familiar, and supportive. A significant strand of research has demonstrated that learners believe asynchronous audio-based CF is more flexible and easier to understand than text-based CF (Ice et al., 2007; Rassaei, 2019a). This is probably because listening is a skill that requires instincts, while reading and writing are not (Clark & Walsh, 2004). Also, listening to a text in contrast to reading a text increases the motivation level as listening inculcates a real sense of communication between the person who has created the text and the one who is listening (Hew & Cheung, 2012). Listening to people increases listeners' perception; some scholars explain it as a social presence, meaning that another individual is involved in the conversation (Hew & Cheung, 2012; Wise et al., 2004). Hew and Cheung (2012) advocate that individuals' speech functions as a magnet that compels other individuals to be a part of the conversation–who otherwise might not be willing to become a part of the conversation. It can be inferred that the feeling of social presence infused by audio-based CF tempted learners to pay more attention to the input they received in the form of audio-based CF against the erroneous output they produced.

The effectiveness of audio-based CF can also be understood from brain imaging studies– that indicated that different forms of input stimulate different regions in the brain (Buchweitz et al., 2009). Buchweitz et al. (2009) examined brain activation employing MRI and reported links between brain cortex and audio information. The study demonstrated how audio data led to the activation of the left cortex of the brain, which is mainly associated with language learning and production. Taken this explanation together, the activation of the brain in response to audio data can help understand the efficacy of audio-based CF.

The second question that the study aimed to explore is if there is any statistically significant interaction between learners' perceptual styles and CMF modalities (audio-based and text-based). A two-way mixed method ANOVA was applied with CMF modalities: audio-based and text-based (two levels) and learners' perceptual style: auditory vs. read/write (two levels) as independent variables and learners' test score on past perfect tense a dependent variable. The result unveiled a statistically significant interaction between CMF types and learners' perceptual styles, explaining that CMF's efficacy on the learners' test scores (post and delayed) is related to their perceptual styles. The audio-based CMF was more effective than text-based CMF, as evident by the test score on the post-test and delayed post-test. Further, the results explain that when there is no alignment between CMF and learners' perceptual styles, the audio-based CMF works more effectively than the text-based CMF. Similarly, when there is an alignment between CMF and learners' perceptual style, there is a significant difference between CMF types, with audio-based outperforming the text-based CMF. Consequently, the current study's findings demonstrated that if there is an alignment between CMF types and learners' perceptual style, then the CMF works more effectively. This aligns with what other L2 researchers have demonstrated (Guo & Yang, 2018; Rassaei, 2015a; 2019a).

Conclusion and implications

The current study indicates that audio-based CMF is more effective than text-based CMF in helping L2 learners improve the grammatical accuracy of past perfect. The study also demonstrates a statistically significant interaction between CMF types and learners' perceptual style. The current study offers a number of different pedagogical implications for language teachers. First, it may not always be possible for language teachers to provide immediate feedback due to time constraints (Arroyo & Yilmaz, 2018). However, with CMF, teachers can provide asynchronous CMF beyond the classroom hours. Secondly, language teachers can use CMF during oral tasks that focus on fluency (Arroyo & Yilmaz, 2018). With

CMF, teachers can provide feedback without obstructing the oral interactions between learners and teachers (Canals et al., 2021). Lastly, research scholars assert that written CF wastes teachers' energy and inhibits them from focusing on key features of writing, such as organization and content (Gad et al., 2016). With CMF in language classes, teachers can focus on these key features of writing and provide corrections on learners' drafts after the class hours. Lastly, as this study has demonstrated that aligning learners' perceptual styles with CMF types can boost the efficacy of CMF, this is an approach that language teachers could consider adopting. The current study has a few limitations. First, the sample size is small: 120 participants; future studies could be conducted with a larger sample size. Second, the target structure of the current study was the past perfect tense. Future studies should employ different grammatical structures, such as a passive voice, as part of their study; passive voice in CF has not been explored thoroughly (Hinkel, 2004; Li & Roshan, 2019). Third, the study did not employ qualitative data collection tools, such as stimulated recall interviews or open-ended questionnaires, thus leaving the question open to discussion as to how the participants engaged with the CMF and what they thought about its use. Therefore, future studies could use a mixed-method approach to supplement the quantitative data. Lastly, the current study did not employ any screen recording software. The presence of screen recording software would ensure compliance with test design, i.e., that the participants respond to the CF they receive. Nevertheless, the current study provides evidence of potential new dimension to L2 teachers

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