The Efficacy of Computer-Mediated Feedback in Improving L2 Speaking: A Systematic Review

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Abstract—**Recent trends in computer-mediated communication (CMC) have led to a proliferation of studies investigating the effect of computer-mediated feedback (CMF). The present systematic review aimed to explore the role of linguistic, contextual, and individual factors in mediating the impact of CMF on second language (L2) speaking performance. A literature search located 16 relevant empirical studies for the final analysis. Each study was coded for linguistic, contextual, and individual characteristics. First, CMF was theoretically conceptualized as an instructional input, a dialogic process, and an internal process based on theoretical underpinnings. Correspondingly, CMF was analyzed under the influence of 1) linguistic factors including feedback type, the linguistic focus of CMF, and the timing of CMF, 2) contextual factors including the feedback source and the task type, and 3) individual factors including individual differences and learners' proficiency levels. The implication of the study was twofold. Theoretically, this study not only provided a multi-dimension view towards the effect of CMF in developing L2 oral proficiency but also shed new light on the interrelations between these identified factors. Pedagogically, teachers were encouraged to take advantage of CMC technologies to enhance the effectiveness of CMF as well as considering learners' uniqueness. Suggestions for future research were also provided.**

Index Terms—**computer-mediated feedback (CMF), L2 speaking, linguistic factors, contextual factors, individual factors**

I. BACKGROUND

The COVID-19 pandemic in 2020 has triggered a huge amount of computer-mediated communication (CMC) inquiry in the field of second language acquisition (SLA). CMC refers to communication via computers between individuals (Herring, 1996). The dynamic nature of CMC is believed to be four-fold: temporality, anonymity, modality, and spatiality (Smith et al., 2003). These features highlight the effectiveness of CMC in facilitating second language (L2) development that cannot be provided by the traditional face-to-face environment. From the perspectives of contextual and linguistic factors, CMC creates and supports a flexible social context for authentic communication while drawing learners' attention to linguistic input (Heift & Rimrott, 2008;Kim, 2014;Young & Wang, 2014). From the perspectives of learners' individual differences, CMC can not only strengthen learners' motivation and self-confidence but also reduce anxiety (Kelm, 1992;Kern, 1995). Thus, the importance of CMC in L2 learning is indisputable.

Feedback is a major contributor to successful language learning (Hattie & Timperley, 2007). Broadly speaking, feedback takes the form of suggestions or comments for improvement that are provided through recognizing the quality of performance (Sadler, 1989). This kind of feedback assists learners in identifying their learning strengths and weaknesses, and improving their understanding and performance (Sadler, 1989). Narrowly speaking, in the context of L2 teaching, the feedback that learners receive mostly refers to corrective feedback (CF), i.e., the feedback on oral or written linguistic errors made by L2 learners (Sheen & Ellis, 2011). As Schmidt (1990) states in the noticing hypothesis, i.e., the intake for learning comes from learners' notice in input, CF could help learners notice the gap between their interlanguage and the target L2 form by addressing learners' erroneous utterances (Lochtman, 2002). In this study, feedback ranges from both formal and structured comments to specific CF on learners' speech (Yu et al., 2018).

Recent technological advancements have offered the opportunities of utilizing CMC technologies to provide feedback on the speaking performance of L2 learners, which can lead learners towards improved performance (Gu et al., 2021). This kind of feedback, driven by CMC technologies, is defined as computer-mediated feedback (CMF) (Bahari, 2021). Evidence from a number of experimental and meta-analyses studies has established that CMF benefits L2 learning (Sagarra & Abbuhl, 2013;Young & Wang, 2014;Ziegler, 2016). For instance, CMF is effective in enhancing achievement and engagement (Gašević et al., 2016), facilitating collaborative learning (Rassaei, 2017;Yu & Lee, 2016), creating a cosy atmosphere of learning (Cornillie et al., 2012), improving writing skills (Bitchener & Ferris, 2012), developing oral proficiency (Lyster et al., 2013;Sagarra & Abbuhl, 2013), and providing real-time error correction (Kato et al., 2016). These potential advantages of CMF emphasized the importance and need to expand studies on using CMF to facilitate L2 learning (Tabrizi, 2021).

Although studies have recognized the significance of CMF in the development of L2, there are still some research gaps that exist. On the one hand, comparing to studies investigate written competence, relatively few studies have analyzed the impact of CMF on L2 oral production (AbuSeileek & Abualsha'r, 2014;Shintani, 2016). Accordingly, the present study systematically reviews the literature published in the last decade (2012-2021) exploring the effect of CMF

on L2 speaking proficiency. On the other hand, the existing literature has predominantly concentrated on the linguistic aspects of CMF such as the feedback type (e.g., recasts, prompt, comment), the linguistic focus of L2 speaking (e.g., pronunciation, grammar, vocabulary, fluency, accuracy), and feedback timing (e.g., immediate, delayed) (Andújar-Vaca & Cruz-Martínez, 2017;Fang et al., 2021;Rassaei, 2017, 2019). However, the effect of CMF not only depends on its linguistic features (Lyster & Saito, 2010;Pawlak, 2014), but also subjects to multiple 1) contextual characteristics such as task type (Gurzynski-Weiss & Révész, 2012), feedback source (Carless, 2016), and 2) individual variables such as working memory (Sagarra & Abbuhl, 2013), proficiency level (Mackey & Philp, 1998), motivation (Uzum, 2011), anxiety (Sheen, 2008). Unfortunately, the role of contextual factors and individual differences has received scant scholarly attention (Yu et al., 2018). Therefore, to fill this gap in the CMF literature, this review takes linguistic, contextual, and individual factors into consideration. Specifically, this study aims to discover new developments and provide directions for future research in exploring the effectiveness of CMF with the following research question: How do linguistic, contextual, and individual factors impact CMF in developing L2 oral proficiency?

II. THEORETICAL FOUNDATIONS

This systematic review was underpinned by three interrelated cognitive theories of SLA: output hypothesis (Swain, 1993), interaction hypothesis (Long, 1996), and noticing hypothesis (Schmidt, 1994).

Firstly, developed by Swain (1993), the output hypothesis states that learners learn new linguistic knowledge by noticing the gap between their utterances and the target form, which enables them to be aware of it and modify their output by receiving feedback containing implicit or explicit input about the linguistic errors (Sheen & Ellis, 2011). Therefore, CMF can be conceptualized as an instructional input that intends to help learners process and repair their linguistic errors (Yu et al., 2018). The efficiency of this instructional input is largely dependent on linguistic factors, e.g., feedback type, linguistic focus, and timing (Lyster & Ranta, 1997).

Secondly, according to the interaction hypothesis, L2 proficiency is developed by interaction and communication (Long, 1996). Similarly, the sociocultural perspective views feedback as a dialogic process whereby learners develop their L2 proficiency through interacting and cooperating with an expert (e.g., an instructor, a more capable peer, and a computer system) (Sheen & Ellis, 2011). Both of the two aforementioned perspectives posit the importance of the external environment the learners are exposed to, e.g., the feedback provider and the feedback type (Ellis, 2010a). In this sense, CMF can be regarded as a dialogic process.

Thirdly, the noticing hypothesis argues that L2 learners cannot transfer input into intake unless they can consciously notice the input (Schmidt, 1994). Likewise, researchers from social constructivism perspectives have conceptualized feedback as an internal process, through which learners engage in processing, generating, and reacting to feedback (Ellis, 2010b). The ability of noticing is mediated by learner internal factors, e.g., working memory, anxiety level, and proficiency level (Pawlak, 2014). Thus, CMF can be defined as an internal process.

Taken together, CMF can be defined as an instructional input, a dialogical process and an internal process, whose efficacy is regulated by linguistic, contextual, and individual factors respectively.

III. METHOD

This systematic review qualitatively analyzed 16 selected primary studies to provide a comprehensive as well as a rigorous overview of the efficacy of CMF on L2 speaking proficiency.

A. Literature Search

Efforts were made to conduct a meticulous and thorough literature search with the goal of providing a better understanding of how CMF facilitates L2 oral proficiency development and offering a comprehensive analysis of the latest peer-reviewed studies published from 2012 to 2021. The identified major terms include: 1) computer-mediated/ computer-assisted/ technology-based feedback; 2) speaking skill/ competence, oral proficiency; 3) second/ foreign language, L2, which were keywords used by primary studies in the area of education, linguistics, information technology, e-learning, computer science interdisciplinary, and psychology. Then, combinations of the key terms with appropriate Boolean operators ("AND" or "OR) were used to search eligible studies published in electronic databases of Wiley, ERIC (Education Resources Information Center), Scopus, Sage, EBSCOhost (Academic Search Premier), Taylor and Francis (Tandf), Web of Science (WOS), and Emerald.

B. Study Selection

More than 300 studies relating to CMF and L2 oral proficiency were identified through the retrieval process. The following inclusion and exclusion criteria were applied to determine relevance to the proposed research questions.
Inclusion criteria
1. The study identified its participants as L2 learners without learning disabilities or language impairments.
2. The study provided feedback using different digital platforms: computer, mobile, website.
3. The study accessed L2 oral proficiency including accuracy, fluency, and speaking strategy.
4. The study was published in English.
Exclusion criteria

1. The duplicate studies were removed to avoid double-counting.

2. The non-empirical studies such as review articles or editorial.

3. The study did not report critical information for the present systematic review, e.g., the correlation between CMF and speaking skills.

Besides, a snowballing strategy was employed, i.e., references in the selected studies and meta-analyses on similar topics (Bahari, 2021;Young & Wang, 2014;Yu et al., 2018) were used to identify potentially qualified studies and further ensure a complete literature selection, resulting in 13 eligible studies. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram (Fig. 1) illustrates the selection steps.
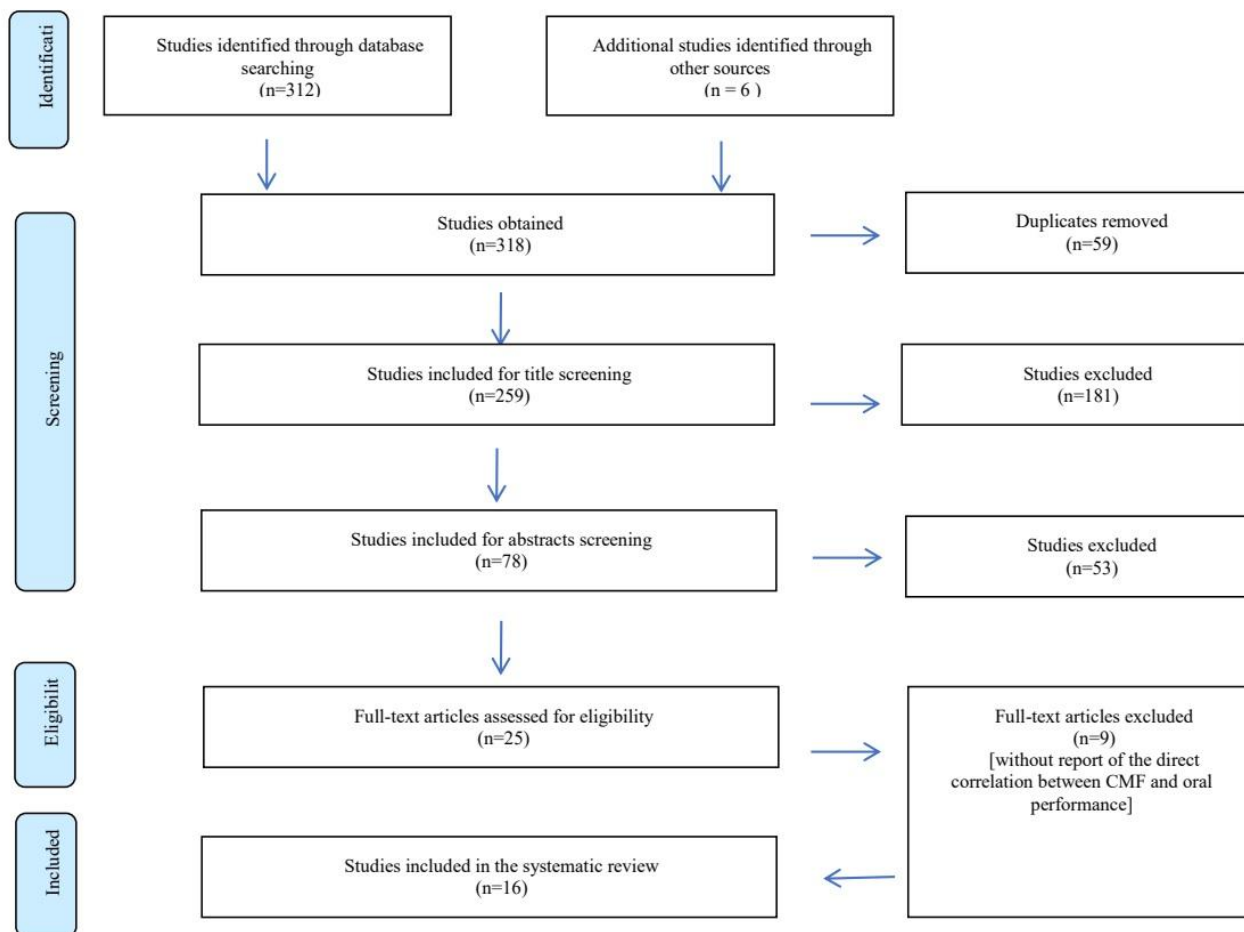

Figure 1. PRISMA Flow Diagram

C. Data Analysis

The data analysis comprised two steps. First, the basic information of reviewed studies was summarized in Appendix A accessing: 1) information about the author(s) and publication year; 2) sample size; 3) participants' portfolio including their gender, age, and L2 (Shin, 2020). Second, the characteristics of the primary studies were classified and summarized into three categories namely linguistic, contextual, and individual factors (Yu et al., 2018) (see Table 1). In total, thirteen subcategories were developed to better capture the effect of CMF on L2 oral proficiency development. Each selected study was analyzed using this coding schema.

TABLE 1
DATA ANALYSIS RESULT

Themes	Subcategories	Codes
Linguistic factor	Feedback type	CF (including recast, explicit correction, clarification request, elicitation, metalinguistic feedback, and repetition), score, comment, colour, wave-form graph
	Linguistic focus	Pronunciation, grammar, vocabulary, fluency, comprehension, accuracy, tone, coherence, speaking skills
	Feedback timing	Immediate, delayed
Contextual factor	Task type	Focused, unfocused
	Feedback source	Instructor, peer, computer system
Individual factor	Individual differences	Working memory, anxiety, motivation
	Proficiency level	Advanced, intermediate, elementary, and beginner proficiency

IV. RESULTS

The reviewed articles were discussed based on CMF's diverse conceptualizations: an instructional input, a dialogical process and an internal process, which are influenced by linguistic, contextual, and individual factors respectively.

A. CMF as an Instructional Input

Table 2 displays the reported linguistic factors that influence the effectiveness of CMF on L2 speaking performance.

TABLE 2
LINGUISTIC FACTORS

Study	Feedback type	Linguistic focus	Feedback timing
Ahn and Lee (2016)	Elicitation	Pronunciation, vocabulary	Immediate
Andújar-Vaca and Cruz-Martínez (2017)	Recast, elicitation	Pronunciation, grammar, vocabulary, fluency, comprehension	Immediate & Delayed
Bryfonski and Ma (2020)	Recast, metalinguistic feedback	Tone	Immediate
de Vries et al. (2015)	CF	Grammar	Immediate
de Vries et al. (2016)	CF	Grammar	Immediate
Ebadijalal and Yousofi (2021)	CF	Pronunciation, grammar, accuracy, fluency, coherence	Delayed
Fang et al. (2021)	CF	Vocabulary, fluency, accuracy, comprehension	Immediate & Delayed
Gleason and Suvorov (2012)	Comment	Pronunciation, fluency, speaking skills	Delayed
Gu et al. (2021)	Score, colour, wave-form graph	Fluency, pronunciation, vocabulary,	Delayed
Martin and Valdivia (2017)	CF	Oral performance in general	Immediate & Delayed
Rassaei (2017)	Recast	Accuracy of the target feature (the definite article 'the')	Immediate
Rassaei (2019)	Recast	Accuracy of the target feature (the articles 'a' and 'the')	Immediate
Sagarra and Abbuhl (2013)	Recast	Accuracy of the target feature (noun-adjective agreement)	Immediate
Wu and Miller (2020)	Score, comment	Fluency, accuracy, pronunciation,	Immediate
Yang et al. (2012)	CF	Pronunciation, fluency, comprehension, vocabulary, accuracy	Immediate & Delayed
Yu et al. (2016)	Comment	Oral performance in general	Immediate

1. Feedback Type

In the field of SLA, Lyster and Ranta (1997a) identified six types of corrective feedback, and from the most implicit one to the most explicit one they are: recasts, metalinguistic feedback, clarification requests, explicit corrections, repetitions, and elicitations. Among them, recasts (56%) have been largely investigated by the reviewed studies, followed by prompts such as and elicitation (50%) and metalinguistic feedback (44%).

As Rassaei (2019) illustrated in his study about learners' interpretations of recasts, it is worthwhile and informative to study the CF perceptions of providers and receivers in order to evaluate the effectiveness of CF. With regard to providers' views of these feedback types, Bryfonski and Ma (2020) investigated the effects of explicit versus implicit CF on Mandarin tone acquisition. The instructor initially preferred metalinguistic feedback over recasts because metalinguistic could offer more explanations on the target feature. However, after the experiment, the instructor indicated the domination of recasts due to their ease of delivery. In the follow-up semi-structured interviews, the instructor commented that her perception of feedback type was associated with the time constraints of their classes and the proficiency level of the learners. This preference largely corroborated that of learners in Andújar-Vaca and Cruz-Martínez (2017) that learners also used recasts more frequently than elicitation to help their partners in oral production when they were engaged in peer interactions. From the receivers' perspective, there was a mismatch between learners' perceived and practical preference for CF in Bryfonski and Ma (2020)'s study. Students thought they wanted to receive metalinguistic feedback with detailed explanations, whereas in reality, they preferred recasts without interruption of their speaking. This is partially consonant with previous work done by Martin and Valdivia (2017) suggesting that learners rated explicit correction as the most effective strategy. Besides the perception of CF, Gu et al. (2021) investigated learners' perceptions of the usefulness of automated feedback using the score, colour, and wave-form graph in facilitating the Speaking section of the TOEFL iBT test. The vast majority of participants acknowledged the helpfulness of these feedback types because of its construct relevance and its diagnostic nature. Another line of research has focused on L2 students' cognitive processing capacity which is closely related to the efficacy of feedback (Egi, 2010). Using stimulated recall interviews, a vast majority of the English as the foreign language (EFL) learners in the studies of Rassaei (2017, 2019) could successfully notice recasts as CF in computer-mediated instructional contexts, which guarantees the practicality of recasts.

2. Linguistic Focus of CMF

According to the general proficiency speaking scale proposed by Hughes and Reed (2016), learners' speaking skills should be assessed in terms of comprehension, grammar, vocabulary, fluency, and pronunciation, which is also the case in the reviewed literature in this study. What stands out in Table 2 is the high rate of focus on pronunciation and accuracy (44%). The linguistic features that also attracted academic attention among the reviewed studies are fluency (31%), grammar (25%), and vocabulary (25%).

And újar-Vaca and Cruz-Mart ńez (2017) reported 80 Spanish EFL learners' views toward the linguistic focus of CMF by statistically analyzing their LREs signals in their chat on Whatsapp. The results showed that correction of phonological errors was the most abundant, which might be explained by the fact that phonology is fundamental in English interaction (Yu et al., 2018). The least favored error type to be addressed was morphosyntactic. This finding largely coincides with Mackey et al. (2000)'s belief that students were more capable of identifying and recognising the phonological errors more accurately than morphosyntactic ones.

3. Timing of CMF

Timing serves as one of the most crucial mediators of the effectiveness of CMF (Goodman et al., 2004;Smits et al., 2008). An inspection of the data in Table 2 reveals that researchers examined the immediate CMF (81%) more often than the delayed CMF (44%).

Yang et al. (2012) surveyed 90 freshmen EFL learners at an Asian university to empirically test the effectiveness of voice over instant messaging, a web-based learning application, for enhancing learners' oral proficiency. All of the participants were regarded as the advanced English learners. In this study, both immediate and delayed feedback was provided by tutors. The result indicated that learners who received delayed feedback did not improve as significantly as those who received immediate feedback. Although the delayed feedback was detailed, learners might have already forgotten the types of mistakes they had made. Thus, it was arduous for those advanced learners to take advantage of corrections supplied by the delayed feedback. Similarly, Martin and Valdivia (2017) analyzed that immediate CF may interrupt the natural flow of speech and it may also undermine both the learners' confidence and increase their anxiety. This finding is contrary to that of Guadagnoli et al. (1996) who found that the learning outcome of the lower-intermediate learners was fostered by immediate feedback, whereas delayed feedback is more effective for advanced learners. This result may reflect differences in the criteria defining learners' language proficiency. However, this finding is partially consistent with a more recent study exploring the impact of feedback timing on learning online, which has suggested that there were no remarkable correlations between language proficiency and feedback timing (Smits et al., 2008).

B. CMF as a Dialogical Process

Table 3 presents the contextual factors of CMF in terms of feedback source, task type, and assessment task.

TABLE 3
CONTEXTUAL FACTORS

Study	Feedback source	Task type
Ahn and Lee (2016)	Computer	Unfocused
And újar-Vaca and Cruz-Mart ńez (2017)	Peers	Unfocused
Bryfonski and Ma (2020)	Instructor	Focused
de Vries et al. (2015)	Computer	Focused
de Vries et al. (2016)	Computer	Focused
Ebadijalal and Yousofi (2021)	Peers	Unfocused
Fang et al. (2021)	Peers & Computer	Unfocused
Gleason and Suvorov (2012)	Peers & Instructor	Unfocused
Gu et al. (2021)	Computer	Unfocused
Martin and Valdivia (2017)	Instructor	Unfocused
Rassaei (2017)	Peers	Focused
Rassaei (2019)	Instructor	Focused
Sagarra and Abbuhl (2013)	Computer	Focused
Wu and Miller (2020)	Peers	Unfocused
Yang et al. (2012)	Instructor	Unfocused
Yu et al. (2016)	Computer	Unfocused

1. Feedback Source

Although previous research has recognized the essence of feedback provided by instructors, peers, and computer systems, research has yet to systematically investigate the effect of feedback sources on speaking skills (van Ginkel et al., 2017). It can be seen from the data in Table 3 that the rates of these three feedback sources in the selected studies are almost equivalent: 44% of feedback was generated by computers automatically, 38% and 31% came from peers and instructors respectively.

Firstly, regarding the feedback provided by peers, Gleason and Suvorov (2012) addressed learner perceptions of CMF offered by both peers and instructors in aiding their oral skills. In the semi-structured interviews, learners

expressed their desire to communicate with fellow classmates through an online platform. They believed such CMC technology to be reciprocal that allowed them to obtain peer feedback, and further promote learners to 1) reflect on their own oral performance, 2) exchange value and ideas, and 3) interact with their peers. More recently, Wu and Miller (2020) confirmed this result by collecting 25 Hong Kong learners' attitudes towards mobile-assisted peer feedback. They found that involving students in giving peer feedback not only transferred learners' identity from receivers relying on teacher feedback to producers and evaluators of knowledge but also engaged learners in a more socially equal atmosphere of speaking (Wu & Miller, 2019). The result revealed learners' appreciation to offer and receive peer feedback, which allowed them to participate in speaking tasks fully and collaboratively. In addition, Ebadijalal and Yousofi (2021) also reported participants' positive attitudes towards peer feedback, perceiving it as an ideal substitution for instructor feedback. Nonetheless, some participants failed to recognize the advantages of peer feedback due to their lack of confidence in themselves and their peers. Thus, learners' uniqueness such as their different personalities and anxiety levels should also be taken into account.

Secondly, on the subject of instructors' feedback, all the participants in Martin and Valdivia (2017)'s study valued it the most and followed it by feedback from themselves and classmates, which contradict Gleason and Suvorov (2012) showing the preference for peer feedback over instructor feedback. This result is in accord with previous research indicating that instructors were considered to be learners' prime source of knowledge, so the feedback provided by them was deemed to be more reliable (Van den Boom et al., 2007).

Thirdly, as for the feedback given by automated computer systems, it can serve as an additional learning resource that monitors learners' input and output while providing immediate and individualized feedback (Fang et al., 2021;Gu et al., 2021). Ahn and Lee (2016) analyzed the user experience of a mobile-based learning system that provides timely feedback for improving speaking proficiency. The result supports prior research that appraised this system in enhancing the spoken grammar of 29 Dutch learners (de Vries et al., 2015). They stated that the system afforded a sense of collaboration for learners which is indispensable for accessing spoken output. Moreover, the research to date has identified several virtues of using computer systems to offer feedback as follows: 1) it supplies constant and intensive feedback (de Vries et al., 2015); 2) it could be controlled by learners in terms of the amount and type (Heift, 2004); 3) it is able to focus on both holistic evaluations and specific linguistic phenomena (Gu et al., 2021).

2. Task Type

The task is defined as a meaning-oriented material that requires learners to use the target language in order to accomplish a teaching goal (Bygate et al., 2013). On the word of Long (2000), tasks were regarded as an ideal platform for L2 teaching and learning, since the CF provided at the post-task stage drives learners attention to both forms and meanings. Task-related characters were often investigated as leading relational variables that moderate the links between feedback and L2 development, which highlights the significance of exploring the role of task type (Révész, 2009). According to Ellis (2009), there are two types of tasks, i.e., unfocused (designed for learners to use language in general communicatively) and focused tasks (designed for learners to communicate using some specific linguistic features such as certain grammatical structures). It is apparent from Table 2 that more than two-thirds of the selected articles utilized unfocused tasks (69%), while 38% of the studies employed focused tasks.

On the subject of focused tasks, Sagarra and Abbuhl (2013) studied how computer-delivered recasts in the absence of meaning-focused interaction affected the accuracy of Spanish noun–adjective agreement in learners' spoken language. The results showed that recasts led to gains of the target feature. A possible explanation for is outcome may be the models of target structures provided by recasts could profit learners (Leeman, 2003). In a similar vein, de Vries et al. (2015) found prompt (without giving target structure) made no difference in learners' improvements of the target structure -- inversion of subject and verb in Dutch, which would further prove the importance of affording the target feature in CF (i.e., recasts) to facilitate L2 grammar learning. Another plausible reason for this result may be the complexity of the target structure which might benefit more from implicit feedback such as recasts (Goo & Mackey, 2013). The inversion in L2 Dutch occurs even in advanced learners due to its difficulty (Blom & de Korte, 2011). Moreover, this result reflects that of Rassaei (2019) who found that partial recast would promote target-like modified output effectually. While concerning the unfocused task, feedback mainly concentrated on general speaking proficiency, in terms of fluency, accuracy, pronunciation, and comprehension (Fang et al., 2021;Wu & Miller, 2020). In comparison, feedback given in unfocused tasks was found to address learners' oral errors more frequently than in focused tasks (Gurzynski-Weiss & Révész, 2012).

C. CMF as an Internal Process

Table 4 demonstrates the individual factors relate to CMF, i.e., individual differences, proficiency level, and L1 background.

TABLE 4
INDIVIDUAL FACTORS

Study	Individual differences	Proficiency level
Ahn and Lee (2016)	N/A	N/A
Andújar-Vaca and Cruz-Martínez (2017)	N/A	Intermediate
Bryfonski and Ma (2020)	N/A	Beginner & Upper-intermediate
de Vries et al. (2015)	N/A	Pre-intermediate & Intermediate
de Vries et al. (2016)	N/A	Beginners & Pre-intermediate
Ebadijalal and Yousofi (2021)	Anxiety	Intermediate
Fang et al. (2021)	N/A	Pre-intermediate
Gleason and Suvorov (2012)	Motivation	Pre-intermediate
Gu et al. (2021)	NA	N/A
Martin and Valdivia (2017)	Anxiety	Intermediate
Rassaei (2017)	N/A	Intermediate
Rassaei (2019)	N/A	Intermediate
Sagarra and Abbuhl (2013)	Working memory	N/A
Wu and Miller (2020)	N/A	Upper-intermediate
Yang et al. (2012)	Motivation	Advanced
Yu et al. (2016)	N/A	Beginner & Pre-intermediate

1. Individual Differences

Thus far, research has shown that CMF effectiveness is constrained by individual learner characteristics: 1) learners' abilities such as working memory (WM) capacity (Sagarra & Abbuhl, 2013), 2) learners' propensities including foreign language anxiety (Ebadijalal & Yousofi, 2021;Martin & Valdivia, 2017), and learners' motivation (Gleason & Suvorov, 2012;Yang et al., 2012). As exhibited by Table 4, anxiety and motivation particularly come to the forefront of the research agenda in the recent decade (13%) in comparison with WM (6%).

Firstly, working memory is broadly defined as the impermanent storage and manipulation of information that is essential for carrying out complex cognitive tasks (Baddeley, 2007), which can also be applied to SLA (Hasegawa et al., 2002). WM has been demonstrated to impact the noticing of interactional recasts (Egi et al., 2002;Sagarra, 2007). In line with Mackey et al. (2010), empirical evidence suggested that WM was positively associated with speaking performance in the groups that received oral computer-delivered recasts (Sagarra & Abbuhl, 2013). In particular, learners with higher WM spans produced more accurate utterances regarding the target structure than the lower WM span learners.

Secondly, anxiety was demonstrated to have a disruptive influence on L2 acquisition in general, especially for L2 speaking (Chou, 2018;Zhang, 2019) and L2 speaking in particular (Bashori et al., 2020). Online classes may serve to mitigate anxiety by providing CMF as well as enabling learners to have more time to process input and plan output (Baralt & Gurzynski-Weiss, 2011). Ebadijalal and Yousofi (2021) compared the effect of L1 CMF and L2 CMF on speaking performance and anxiety of 32 EFL learners from Iran. Although participants in both groups appreciated CMF's beneficial role in diminishing anxiety, only L1 CMF led to a statistically significant reduction of anxiety at the end of the experiment. The results verified that CMF might not exert a direct impact on lowering anxiety, the language used in CMF also matters. This finding deviates from that of Martin and Valdivia (2017), reporting support towards the provision of CF in oral tasks regardless of participants anxiety level because CF would evoke a positive recognition of the work and make learners feel more at ease, which in turn lower learners' anxiety (Tseng & Tsai, 2007).

Thirdly, motivation accounts for people's behaviour, the endeavor one makes, the last of willingness to sustain this activity (Dörnyei, 2002). Depending on the learner's attitudes towards the community of the target language, Gardner and Lambert (1959) classified motivation into two kinds: 1) integrative motivation (learning the target language for communication); 2) instrumental motivation (learning the target language for pragmatic and utilitarian benefits). Gleason and Suvorov (2012) examined the influence of CALL with CMF in fostering L2 learners' motivation. The majority of learners showed both integrative and instrumental motivation, who claimed to use English in the future for professional goals as well as personal communication purposes. Additionally, CALL where CMF was found to be efficient in improving learners' L2 confidence and affording opportunities to practice the target language. These results agree with the findings of Yang et al. (2012), in which CMF offered a sense of accomplishment. Since motivation positively correlates with achievement, the sense of accomplishment would further strengthen learners' motivation (Huang, 2004). The motivation type improved in Yang et al. (2012) was the integrative motivation with a highly-regarded communicative aim, whereas Gleason and Suvorov (2012) illustrated the increment in both integrative and instrumental motivation. This inconsistency may be due to the different linguistic focuses in these two studies: Yang et al. (2012) provided elicit correction on pronunciation and vocabulary, while Gleason and Suvorov (2012) focused more on fluency and speaking skills, which are more required in the professional field.

2. Proficiency Level

This review categorized learners' proficiency levels based on the Common European Framework of Reference for Languages (CEFR) level. In total, five proficiency levels have been identified, i.e., beginners, pre-intermediate, intermediate, upper-intermediate, and advanced. Evidence suggests that there exists an interplay between the

effectiveness of CMF and L2 proficiency (Ziegler et al., 2018). de Vries et al. (2015) analyzed the proficiency gains under two conditions: 1) learners received oral practice and immediate CF and 2) learners received only oral practice without CF. The result revealed that unlike learners with higher proficiency levels, elementary learners were unable to improve their grammatical accuracy on the target structure without CF. This is in accordance with de Vries et al. (2016), who performed a similar experiment and found that CF significantly facilitated L2 speaking for learners with little to general knowledge (0–60 %) of the target structure, and such benefit decreased as L2 proficiency increased. Taken together, these findings indicated that CMF would produce the most salient effect on lower-intermediate learners. In detail, Bryfonski and Ma (2020) demonstrated that the lower proficiency learners were better suited for more from implicit feedback (e.g., recasts) than from explicit metalinguistic feedback, which contrasts with the finding of Li (2009) that learners with little knowledge of the target structure benefited more from explicit feedback than implicit feedback. This discrepancy could be attributed to the fact that recasts present examples of target-like language form (Sagarra & Abbuhl, 2013).

V. DISCUSSION AND CONCLUSION

This systematic review has presented an overview in light of the preceding empirical studies about the effect of CMF on L2 speaking proficiency from 2012 to 2021. Rigorous and exhaustive searches found 16 studies that met the inclusion criteria. Three sets of factors that could mediate the effect were identified, i.e., linguistic, contextual, and individual factors.

The insights and implications provided by the current review are twofold. Theoretically speaking, a comprehensive framework of CMF was proposed to facilitate understanding of the factors that play a role in the CMF process from the aforementioned three theoretical perspectives. Interactions were found not only between the factors and CMF but also between the factors. For instance, on the one hand, the impact of CMF is mediated by learners' individual factors including learners' WM capacity, anxiety levels, and proficiency levels. As Yilmaz (2013) argued that prior knowledge of a target feature (proficiency level) is assumed to affect CF. On the other hand, those individual features would also interact with linguistic factors including feedback type, linguistic focus, and feedback timing. As Yoshida (2010) suggested that instructors would determine the specific type of CF based on their perceptions of learners' oral proficiency. Pedagogically speaking, instructors should take full advantage of computer or mobile devices to promote L2 oral proficiency development. They could explicitly demonstrate their feedback strategies. In this way, learners would notice the feedback more easily and learn specific features contained in those feedback strategies. After learners have a basic understanding of feedback, instructors could train them to provide peer feedback to each other, since many learners showed favourable attitudes towards peer feedback (Ebadijalal & Yousofi, 2021;Wu & Miller, 2020). Instructors should also be cautious when providing CMF considering learner differences in perceiving and responding to CMF. Especially in Asian EFL contexts, where learners are always sensitive and anxious, instructors should devote effort to create a more relaxed and harmonious atmosphere by providing positive and explicitly detailed feedback.

The present study has identified several suggestions for future studies. First, although CMF attracted considerable scholarly attention, tremendous research efforts were given to investigate the linguistic factors. Thus, more attention must be paid to contextual factors (e.g., grouping, treatment length) and individual learner factors (e.g., aptitude, learning style, learner beliefs, cultural background). Second, several studies have recognized the correlation between linguistic, contextual, and individual factors. Surprisingly, their interplay has still not yet been extensively examined. Further investigation and experimentation into this topic are strongly recommended.

APPENDIX A. SUPPLEMENTARY DATA

Study	Sample size	Participants' portfolio		
		Gender	Age	L2
Ahn and Lee (2016)	302	N/A	Middle school students	English
Andújar-Vaca and Cruz-Martínez (2017)	80	32M;48F	18-31	English
Bryfonski and Ma (2020)	41	18M; 23F	Mean=39.5years	Chinese, Mandarin
de Vries et al. (2015)	29	11M; 18F	22-48 (Mean=31 years)	Dutch
de Vries et al. (2016)	31	15M; 16F	16-62 (Mean=28 years)	Dutch
Ebadijalal and Yousofi (2021)	32	32F	19-28	English
Fang et al. (2021)	66	56M; 10F	18-20	English
Gleason and Suvorov (2012)	10	N/A	20-30 (Mean=25 years)	English
Gu et al. (2021)	154	N/A	N/A	English
Martin and Valdivia (2017)	50	17M; 33F	Two-thirds of the participants were older than 25	English
Rassaei (2017)	57	25M; 32F	18-33	English
Rassaei (2019)	70	29M; 41F	22-33	English
Sagarra and Abbuhl (2013)	218	N/A	First‐semester Spanish students	Spanish
Wu and Miller (2020)	25	10M; 15F	18-22	English
Yang et al. (2012)	90	N/A	N/A	English
Yu et al. (2016)	159	N/A	N/A	English

Note. M stands for males, F stands for females

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