NEUROSCIENCE RESEARCH NOTES

OPEN ACCESS | MINI-REVIEW ISSN: 2576-828X

The types of repairs, categories of repairs, repairs in doctor-patient communication, and repair strategies from the perspective of psycholinguistics

Cuixia Wu [1], Hui Ying Jong [2]* and Norsofiah Abu Bakar [2]

[1] School of Humanities, Universiti Sains Malaysia, Pulau Pinang, Malaysia.
[2] Malay Linguistics Section, School of Humanities, Universiti Sains Malaysia, Pulau Pinang, Malaysia.
* Correspondence: jonghuiying@usm.my; Tel.: +60164996464

Received: 24 January 2024; **Accepted:** 18 May 2024; **Published:** 26 August 2024
Edited by: King Hwa Ling (Universiti Putra Malaysia, Malaysia)
Reviewed by: Mohammad Jahanaray (Islamic Azad University of Mashhad, Iran); Yashaswini Channabasavegowda (University of Mysore, India)
https://doi.org/10.31117/neuroscirn.v7i3.331

ABSTRACT: The nature of human spontaneous speech brings about speech errors and typical disfluencies such as hesitation, pause, silence, repetition, and repair. Recent studies in spoken dialects across many countries reported that speakers produce speech errors or unclear expressions in daily verbal communication. When speakers realize their utterances are erroneous or inappropriate, they frequently make pervasive, highly systematic, and measurable repairs in conversation. Some researchers claim that the repairs in conversation are ubiquitous. This occurrence reflects that individuals make great efforts to ensure their utterances are understandable and acceptable to the listeners. This also triggered the question of what role do speech repairs play in building mutual understanding and enhancing therapeutic relationships between doctors and patients during clinical interactions. Most of these studies have predominantly focused on first (L1) and second language (L2) acquisition, while limited studies have investigated repairs in clinical settings. Repair is a key mechanism for building mutual understanding in clinical interactions and contributes to better therapeutic relationships and treatment adherence. Doctors and patients attempt to make their utterances understandable and acceptable to attain their purposes in the clinical encounter. Nevertheless, some studies do not describe the categories of repair strategies and the trouble source, while only limited research mentioned the types of repair. This gives no insights into the specific strategies and trouble sources in the communication. This study, therefore, sets out to review the types of repairs, categories of repairs, repairs in doctor-patient communication, and repair strategies in attempting to explain the repair mechanism that works in the communication setting between doctor-patient interactions from the perspective of epistemic, pragmatics, conversation analysis, and psycholinguistics.

Keywords: Speech error; Disfluencies; Repair; Psycholinguistics; Pragmatics

1.0 INTRODUCTION

The nature of human spontaneous speech brings about speech errors and typical disfluencies such as hesitation, pause, silence, repetition, and repair (Arslan & Göksun, 2022; Dinkar et al., 2023; Shohiby & Fauziati, 2023; Susanto, 2022). The first serious discussion of disfluencies emerged during the 1990s, with 6 out of every 100 words found to be disfluencies in human natural speech (Fox Tree, 1995). Recent studies in spoken dialects across many countries reported that speakers produce speech errors or unclear expressions in daily verbal communication (Boughariou et al., 2019, 2021; Johnson & Mills, 2023; Starling, 2021; Wu, 2016; Zhang, 2022). When speakers realize their utterances are erroneous or inappropriate, they frequently make pervasive, highly systematic, and measurable repairs in conversation (Healey et al., 2005). Repair is pivotal in nurturing comprehension between participants in therapeutic interactions and enhances adherence to treatment protocols. This is in line with Postma (2000), who stated, "To err is human. To self-repair fortunately is also." Furthermore, some researchers claim that the repairs in conversation are ubiquitous. This occurrence reflects that individuals make a great effort to ensure their utterances are understandable and acceptable to the listeners (Brennan & Schober, 2001). Several studies have attempted to explain this phenomenon (Broos et al., 2016; Gilabert, 2007; Kormos, 1999; Levelt, 1989, 1992).

Doctor-patient communication is vital for effective healthcare delivery. Understanding how individuals repair speech errors during these interactions can shed light on the dynamics of communication in medical settings. Researchers have examined various aspects of doctor-patient communication, including speech accommodation theory, literacy levels affecting comprehension of medical instructions, question design, and the role of nonverbal cues. Studies have shown that factors such as the doctor's communication style, patient literacy levels, and the design of medical information presentations can significantly impact the quality of communication and patient outcomes (Davis et al., 2006; Street et al., 2007). The Levelt model provides a framework for understanding speech production processes, including how individuals monitor and repair speech errors in real time. Integrating this model into the study of doctor-patient communication can offer insights into how linguistic and cognitive factors influence communication effectiveness. By exploring speech repairs from the perspective of psycholinguistics, researchers can gain a deeper understanding of how individuals navigate communication challenges in medical encounters, ultimately contributing to improved doctor-patient communication and healthcare outcomes (Teutsch, 2003).

Speech production involves several stages, from generating thoughts to vocalizing messages. The Levelt model, proposed by Levelt (1983, 1989), outlines these stages comprehensively. The model comprises three main stages: conceptualization, formulation, and articulation. In the conceptualization stage, individuals develop thoughts and ideas for communication. These are then translated into linguistic structures during formulation, where words are selected, sentences organized, and grammatical features assigned. Finally, in articulation, motor commands are executed to vocalize the message. Central to the Levelt model is the idea of continuous monitoring and self-correction. Individuals monitor their speech output, identifying errors and initiating repairs for clearer communication. By integrating the Levelt model, insights can be gained into the intricate processes of speech production, providing a theoretical foundation for understanding and exploring speech repairs.

According to Kormos (1999), repairs are an exterior representation of a speech monitoring mechanism. In studies of repairs, Broos et al. (2016), Gilabert (2007), and Levelt (1989, 1992) proposed that addressers employ their speech comprehension system to monitor and process their speech. In other words, when disruption occurs in an ongoing speech, speakers may initiate repair to resume the normal flow (Kormos, 1999, 2006; Levelt, 1989). Therefore, Levelt (1983, 1989) suggested that most overt speech repairs are composed of three processes. When a listener has trouble hearing or understanding utterances or part of the previous speakers' utterances, they may take the initiative to repair or clarify their prior utterances (Schegloff et al., 1977). People monitor their utterances when speaking or interacting with others, and repairs can ensure interlocutors express themselves more clearly and understand speakers' utterances more easily.

What is known about disfluencies and repairs comes from research undertaken in psycholinguistics (Brennan & Schober, 2001; Diettes & Plug, 2023; Pillai, 2002, 2003; Yanti, 2022), second language acquisition (Alharbi, 2023; Harumi, 2023; Kormos, 2000; Liao, 2023; Zuniga & Simard, 2022), clinical linguistics (Barnes, 2020; Monzoni et al., 2011), applied linguistics (Zheng & Zhang, 2019), and computational linguistics (Ferreira et al., 2004; Purver et al., 2018). Psycholinguistics delves into

understanding and elucidating the psychological mechanisms underlying humans' acquisition and utilization of language (Rartner et al., 2004). Most of these studies have predominantly focused on first (L1) and second language (L2) acquisition, while limited studies have investigated repairs in clinical settings. According to McCabe and Healey (2018), repair is a key mechanism for building mutual understanding in clinical interactions and contributes to better therapeutic relationships and treatment adherence. Doctors and patients attempt to make their utterances understandable and acceptable to attain their purposes in the clinical encounter. This study, therefore, proposes the types of repairs, functions of repairs, and repair strategies in attempting to explain the repair mechanism that works in the communication setting between doctor-patient interactions.

2.0 PSYCHOLINGUISTIC FACTORS OF SPEECH REPAIR

Speech repair is a multifaceted phenomenon influenced by various psycholinguistic factors that play pivotal roles in the cognitive processes underlying language production and comprehension (Brown & Miller, 2016). Psycholinguistics, as a field, seeks to understand how these factors interact to facilitate or hinder the repair of speech errors during communication (Jones & Johnson, 2020).

One crucial psycholinguistic factor is lexical access, which refers to the mental processes of retrieving words from the mental lexicon during speech production (Levelt, 1989). Difficulties in accessing the appropriate lexical items can lead to lexical selection errors, prompting speakers to initiate repairs to correct these inaccuracies (Smith, 2018). Additionally, syntactic processing plays a crucial role in speech repair, as errors in sentence structure can impede comprehension and necessitate corrective actions.

Moreover, cognitive factors such as working memory capacity and attentional resources influence the effectiveness of speech repair mechanisms (Cowan, 2014). Individuals with greater working memory capacity may exhibit enhanced abilities to monitor their speech output and detect errors, leading to more efficient repair processes (Jones & Johnson, 2020). Attentional mechanisms also contribute to speech repair by focusing on relevant linguistic cues and facilitating error detection and correction (Levelt, 1983).

Furthermore, psycholinguistic research has highlighted the role of individual differences in speech repair strategies and outcomes (Blott et al., 2023). Language proficiency, cognitive abilities and linguistic experience can impact how individuals detect and repair speech errors during communication (Johnson et al., 2019). Understanding these differences is crucial for developing tailored interventions to improve speech repair abilities in clinical and educational settings (Jones & Johnson, 2020).

In summary, psycholinguistic factors such as lexical access, syntactic processing, working memory, attention, and individual differences play integral roles in speech repair mechanisms. By elucidating the interplay between these factors, researchers can deepen their understanding of how speech errors are detected, corrected, and managed during real-time communication, ultimately enhancing our knowledge of language processing and cognitive functioning.

3.0 REPAIRS

According to Jefferson (1972), conversational repairs originally referred to taking measures to correct errors when problems occurred during turn-takings in conversation. For instance, when the turn-takings overlapped, one of the interlocutors would give up, or both parties would compete until only one person was speaking. Afterwards, the word "correct" was further expanded by Shelogloff et al. (1977), who published a seminal paper on the preference for self-correction in the organization of repair in conversation, which opened a new chapter in the study of conversation repairs. The authors later differentiated the terms "correct" and "repair" by proposing that "correct" refers to a substitution of slips of the tongue or an error with a correct form, whereas "repair" is not a mere replacement but rather refers to various problems that can occur in conversation, including slips of the tongue, errors in utterance contents, mishearing, and misunderstanding (Shegloff et al., 1977).

Furthermore, conversational repair is not constrained to error repairs but rather includes appropriate repairs that speakers realize to explain their intentions further. Since then, researchers have attempted to make diverse repair definitions from various perspectives. For instance, Levelt (1983) and Kormos (1999) defined repair from the angle of psycholinguistics; Heeman and Allen (1994), van Hest (1996), and Postma (2000) described the concept in a narrow sense; Albert and De Ruiter (2018) and Yang (2010) viewed the idea from the perspective of conversations interaction, which is in line with Schegloff et al. (1977), while Yao's (2008) definition of repair stemmed from the perspective of cognitive linguistics.

3.1 Structure of Self-Repair

According to Schegloff (1977), the structure of conversational repair encompasses three components: trouble sources, repair initiations, and repair outcomes. Trouble sources refer to the speech that repair addresses; repair initiations describe the participants' action to initiate the repair operation; and repair outcomes include failure and successful repairs (Schegloff et al., 1977). These components are illustrated in the following example:

> N: She was givin me a:ll the people that
> → were go:ne this yea:r I mean this
> → quarter y'//know
> J: Yeah
> (Schegloff et al., 1977)

From the excerpt above, "this year" is the trouble source, after which the speaker initiates repair operation "I mean", and "this quarter" is the repair outcome. Furthermore, Levelt (1983) asserts that most overt repairs share a basic structure composed of three parts: reparandum, editing, and alteration. Nevertheless, no distinction exists between these two structures of repairs aside from the names of the components.

3.2 Categories of Repairs

Shegloff et al. (1977) distinguish repair according to the initiator of repair and the person who completes the repair with the repair sequence. Such categorization comprises four types (**Figure 1**):

- self-initiation self-repair
- other-initiation other-repair
- self-initiation other-repair
- other-initiation self-repair

While these repairs refer to successful repairs, not all can be repaired successfully (Schegloff et al., 1977). Therefore, the authors define failed repairs into two types (**Figure 1**):

- self-initiation failure
- other-initiation failure

Schegloff et al. (1977) believe that initiation failure between situations interlocutors do not initiate repairs when disfluencies occur. Initiation failure refers to the repair process that has already been initiated, yet it cannot be repaired successfully. **Figure 2** shows Levelt's categories of repairs.

Other than that, Levelt (1983) differentiates repair into five types:

1. Different Repairs: The speaker may change his mind and determine to express another message.
2. Appropriate Repairs: The speaker may realize that the way he expresses his intention needs further explanation to be more appropriate to the current situation. This repair can be further classified into four types, namely ambiguity repairs, appropriate level repairs, coherence repairs, and ALC repairs.
3. Error Repairs: The speaker detects errors and initiates repair in speech. This type of repair can be divided into three categories, namely lexical error repairs, syntactic repairs, and phonetic repairs.
4. Covert Repairs: The speaker just repeats one or more lexical items without adding or deleting the previous words.
5. Rest Repairs: Repairs that do not fall into any of the four categories mentioned above, which only account for 2.5%.

Levelt's taxonomy has been employed widely in studies of speech production for its detailed classification in repairs of first language. Based on Shegloff et al.'s (1977) taxonomy of repairs, Yang (2011) categorizes repairs in doctor-patient communication into six types according to sequential organization from conversation analysis, namely doctors' self-initiation self-repair, doctors' self-initiation patients' self-repair, patients' self-initiation self-repair, patients' self-initiation doctors' self-repair, doctors' initiation failure, and patients' initiation failure. However, he believes that it is insufficient to classify repairs based on sequential organization if one intends to determine the comprehensive characteristics of repair in doctor-patient communication. Therefore, Yang (2010) differentiates repairs into phonological, lexical, and syntactic repairs based on Levelt's (1983) error repairs. In the context of this study, the investigation of repairs in doctor-patient communication will categorize repairs based on Yang's (2010) differentiation.

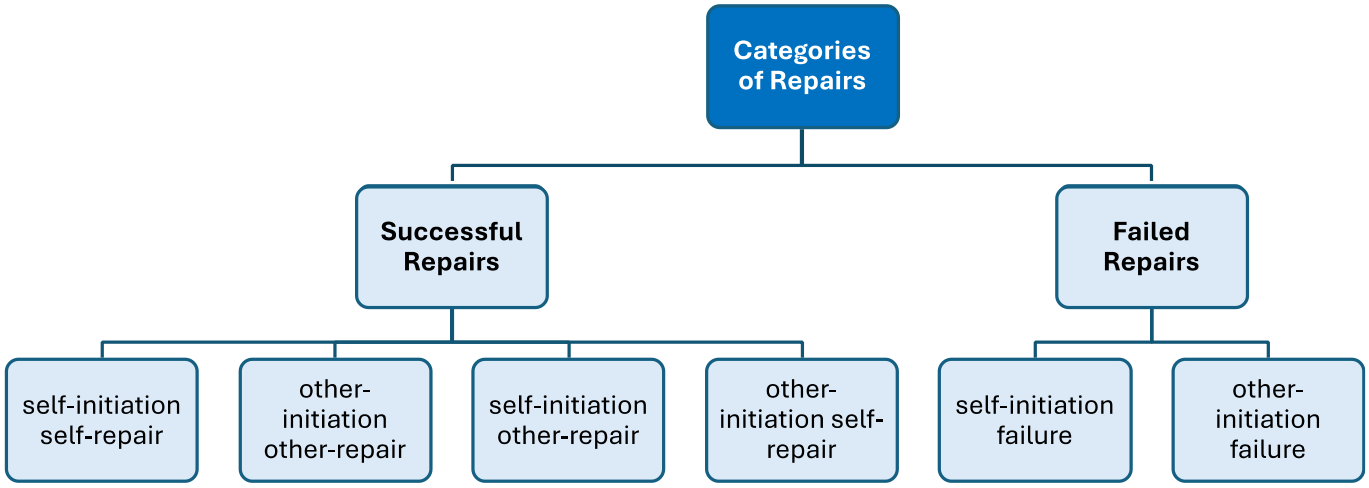

Figure 1: Categories of repairs

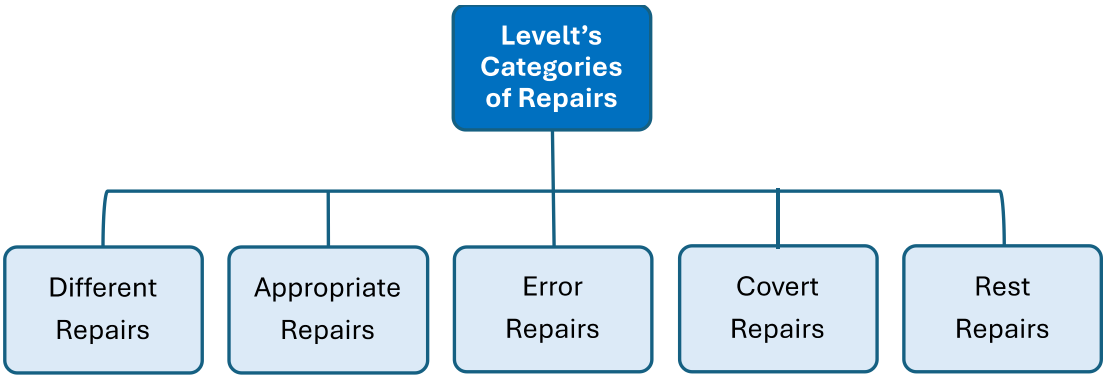

Figure 2: Levelt's categories of repairs

3.3 Repairs in Doctor-Patient Communication

Shared understanding is of great importance in doctor-patient communication since medical disputes may occur if there is a lack of understanding in doctor-patient interactions (Luo & Feng, 2018). Repairs are useful for interlocutors to make their speech understandable and acceptable in doctor-patient interactions (Delli et al., 2022; McCabe et al., 2013; Velligan et al., 2005). This is because repairs address misunderstanding, thus creating a mutual understanding of the statement between clinicians and patients, improving clinicians and patients' medical interactions, and ensuring their adherence to treatment (McCabe et al., 2013; Prusti et al., 2023). Additionally, repairs in doctor-patient communication can improve the quality and results of treatment in psychiatric therapy, increase medication safety in the healthcare setting, and enhance the efficiency of the treatment in general therapy (Delli et al., 2022; Gao, 2014; He & Zhang, 2021; Ma & Gao, 2018; McCabe et al., 2013, 2016; McCabe & Healey, 2018; Prusti et al., 2023; Themistocleous et al., 2010; Yang, 2010). It is a critical mechanism in communication, yet far too little attention has been paid to repairs in doctor-patient communication to date.

Several researchers have investigated the functions of repair in establishing and clarifying meaning in psychiatrist-patient communication and the connection between the process and the outcomes of therapy. They proposed that repair is a crucial mechanism for psychiatrists and patients to establish mutual understanding in communication and contributes to better therapeutic relationships and treatment adherence (McCabe et al., 2013, 2016; McCabe & Healey, 2018; Prusti et al., 2023; Themistocleous et al., 2010). Psychiatrists probably increase their self-repair in communication with patients to improve their relationships (McCabe & Healey, 2018). According to a study by McCabe et al. (2016), psychiatrists' use of self-repair increased by 44% after training, thus showed an improvement in the therapeutic relationship. However, Themistocleous et al. (2010) found no relation between

psychiatrists' use of repair and patients' overall view of the relationship, yet they did feel better emotionally after their interactions. The patients also felt less understood, and psychiatrists understood patients less when there were more repairs.

Past research also denoted that the use of self-repair practices by pharmacists when reviewing patients' medication can increase the clarity and accuracy of the speakers' intended message and thus improve patients' understanding, which may play a critical part in enhancing medication safety in the healthcare setting (Delli et al., 2022). In pharmacist-patient communication, pharmacists employ two main repair strategies (i.e., replacement and clarification) in self-initiated self-repair practices followed by repetition in other-initiated self-repair.

Other studies also revealed that the use of repair by doctors and patients in communication can make their speech clearer and more accurate to achieve their interaction purpose effectively (Ding, 2008; He & Zhang, 2021; Gao, 2014; Ma & Gao, 2018; Yang, 2010, 2011). Due to the distinctive communicative characteristics such as complex tasks, limited time, and interpersonal stress in doctor-patient interactions, interlocutors are inclined to make self-initiated self-repair their preference (Yang, 2010). This is aligned with Schegloff et al.'s (1977) viewpoint regarding their preference for repair in conversation. In this regard, conversation analysis provides a different approach to the study of doctor-patient communication, concentrating on how participants construct mutual understanding (Heritage, 1997). Conversation analysis prefers interlocutors' understandings and responses to utterances, which can be an advantage in exploring doctor-patient communication (McCabe & Healey, 2018). Through an analysis of editing terms of repairs based on conversation analysis, He and Zhang (2021) classified editing terms into lexical repair and non-lexical repair. The results showed that the frequency of non-lexical repair accounts for 90%, which aligns with Shegloff (1977). The results further denoted that the frequency of repair used by doctors is higher than that of patients in county-level hospitals, which differs from the study by Ma and Gao (2018) involving Grade-A tertiary hospitals.

Similarly, Yang (2010) employed conversation analysis to determine the preference structure of conversation repair in doctor-patient communication, classify the types of repairs according to their forms and functions, determine the editing terms and their distribution, and categorize the repair strategies in doctor-patient communication into seven types, namely replacement, explanation, repetition, reconstruction, accomplishment, rejection, and insertion. Nevertheless, the author did not mention the repair mechanism in the doctor-patient communication. Meanwhile, Ding (2008) classified repair strategies in the same-turn self-repair, yet he determined the five types of repair strategies: repetition, addition, explanation, rejection, and replacement. Unlike the above-mentioned studies, Ma and Gao (2018) determined seven types of repair strategies in doctor-patient communication, namely replacement, insertion, deletion, search, abortion, recycling, and reformat in the same-turn self-repair, which is in line with the findings of Gao (2014). Ma and Gao (2018) also investigated how and why doctors and patients initiate repairs in their communication from the epistemic perspective. Finally, Gao (2014) analyzed the repair phenomena in doctor-patient communication from the pragmatics perspective and found that repair adapts to the contextual correlates.

In summary, previous studies have shed light on the functions of repair in doctor-patient communication, the categories of editing terms in the repair process, the classification of repair strategies between doctors and patients, and analyzed the repair mechanism from the perspective of epistemic and pragmatics. There is a lack of published research regarding the repairs in doctor-patient communication involving Chinese dialects in rural health clinics in China. Given that different levels of hospitals have various processes in medical consultations, it is imperative to understand how doctors and patients express messages in their communication and the repair mechanism that helps increase the clarity and accuracy of the participants' intended message to improve their understanding. This will be beneficial to constructing mutual understanding, building better therapeutic relationships, increasing doctor-patient communication efficiency, and avoiding possible conflicts. Analyzing repair mechanisms from the perspective of psycholinguistics can also promote better ways for repairs to work in human speech.

4.0 EXPLANATION TOWARDS REPAIRS

Most research on repair has been conducted in diverse situations from the perspectives of pragmatics (Chen, 2010; Gao, 2014; Shao, 2014; Tang, 2011), epistemic (Ge, 2020; He, 2015, 2018; Li & Ma, 2016; Ma & Gao, 2018), conversation analysis (He & Zhang, 2021; Maharani & Suratno, 2019; Prusti et al., 2023; Yang, 2010), and psycholinguistics (Diettes & Plug, 2023; Hermawan, 2022; Levelt, 1983, 1989; Pillai, 2002, 2003) (**Figure 3**).

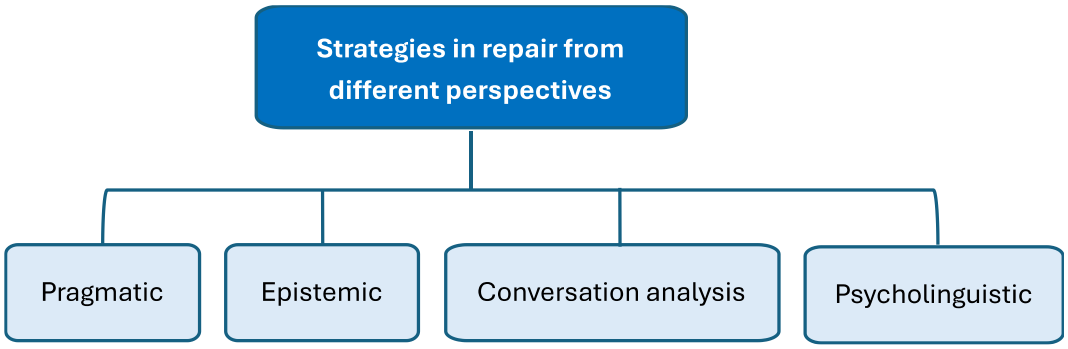

Figure 3: Strategies in repair from different perspectives

From the pragmatics perspective, repairs in doctor-patient communication are regarded as adaptations to the medical context and, in some cases, adaptations to the asymmetric power relations between doctors and patients (Gao, 2014). They both utilize repairs to smoothen the medical process and provide good treatment. Patients often employ repairs to fulfil better their responsibility of providing sufficient and appropriate information about their symptoms, while doctors occasionally utilize repairs such as abortion as an adaptation to efficiency, yet an adaptation to doctors' superior power over patients (Gao, 2014). Repairs are also initiated to improve the accuracy and clarity of the information uttered by the speakers, indicating that the speakers obey the quality maxim of the cooperative principle (Shao, 2014; Tang, 2011). Besides, repairs can be utilized to ensure the maximum of relation in courtroom interactions. For instance, prosecutors can initiate repairs to guarantee that the briefness of the defendants' statement is concerned with the maxim of manner (Shao, 2014).

Several researchers have revealed the mental mechanism of repair strategies from the perspective of epistemic (Ge, 2020; He, 2015, 2018; Li & Ma, 2016; Ma & Gao, 2018). Speakers employ different repair strategies based on their epistemic status to indicate or keep their epistemic stance, thereby attaining their expected interactive goals (He, 2015, 2018; Ma & Gao, 2018). In doctor-patient communication, doctors utilize repair strategies such as replacement, abortion, and recycling to take the "K+" stand within their professional field to make their diagnoses and suggestions more authentic and acceptable to the patients. Meanwhile, patients use repair strategies to indicate their "K+" position in delivering information about their illness and presenting accurate and integral information, prompting doctors to make better treatment recommendations (Ma & Gao, 2018). However, in courtroom interactions, speakers employ various repair strategies to improve the accuracy and credibility of their speech to keep their "K+" epistemic stance. They also utilize repair strategies such as reformatting and inserting to downgrade their epistemic stance as "K-" to decrease the certainty of their utterances, thereby skirting questions and confirming information (Ge, 2020). However, He (2018) claims that self-repairs are frequently solicited by the interlocutors' change of epistemic stance, which can be represented by two formats of "K-→K+" and "K+→ K-". Judges, prosecutors, and lawyers employ repairs using the "K-→K+" format by upgrading the epistemic stance to strengthen the constraint and attain their interactional goal. Meanwhile, defendants and witnesses utilize repairs using the format "K+ → K-" by downgrading the epistemic stance, thus skirting questions.

Past studies have also investigated repairs based on conversation analysis in different situations. Repair is one of the basic features of institutional interactions in conversation analysis (Delli et al., 2022). In doctor-patient communication, repair is pervasive (McCabe et al., 2016) and stands as a key mechanism for building a mutual understanding in clinical interactions and contributes to better therapeutic relationships and treatment adherence (McCabe & Healey, 2018; Prusti et al., 2023). Repair in clinician-patient communication reduces miscommunication between doctors and patients, thus improving both the quality and outcomes of communication. Participants employ repair strategies to make their utterances understandable and acceptable to attain their purpose in clinical encounters (He & Zhang, 2021; McCabe & Healey, 2018; Prusti et al., 2023). Repair practices also serve as the strategy pharmacists use to increase patients' understanding of their interactions, which play a crucial part in increasing medication safety in the healthcare setting (Delli et al., 2022).

Repair has also been investigated from the perspective of psycholinguistics (Diettes & Plug, 2023; Hermawan, 2022; Levelt, 1983, 1989; Pillai, 2002, 2003). Self-repairing of speech errors reveals that speakers possess a monitoring device with which they can test whether their speech is correct or appropriate (Postma & Kolk, 1993). A substantial amount of research indicates that speech monitoring includes an auditory component and an internal part, which can monitor speech before articulation (Levelt, 1983; Postma & Kolk, 1993; Pillai, 2002, 2003). Levelt (1983) believes that self-repair is the exterior representation of speech monitoring, which comprises three phases: monitoring one's speech and interruption of the speech, interrupting with editing terms, and making the repair proper.

4.1 Perceptual Loop Theory

Levelt (1983, 1989) proposed the Perceptual Loop Theory (**Figure 4**) for monitoring and repairing speech based on the study of repairs produced in the spontaneous speech of adult speakers of Dutch. The theory claims that speakers detect their speech just as they check the speech of others (Levelt, 1983; Levelt et al., 1999). According to Levelt (1983), self-repairs are composed of three major phases: (1) participants monitor their speech and intercept the flow of speech when trouble is detected; (2) interlocutors hesitate and pause with the use of silent or filled pauses; and (3) the speakers make repair proper. The process of self-monitoring and self-repair is shown in the following figure, which provides a concise and explicit explanation of speech production.

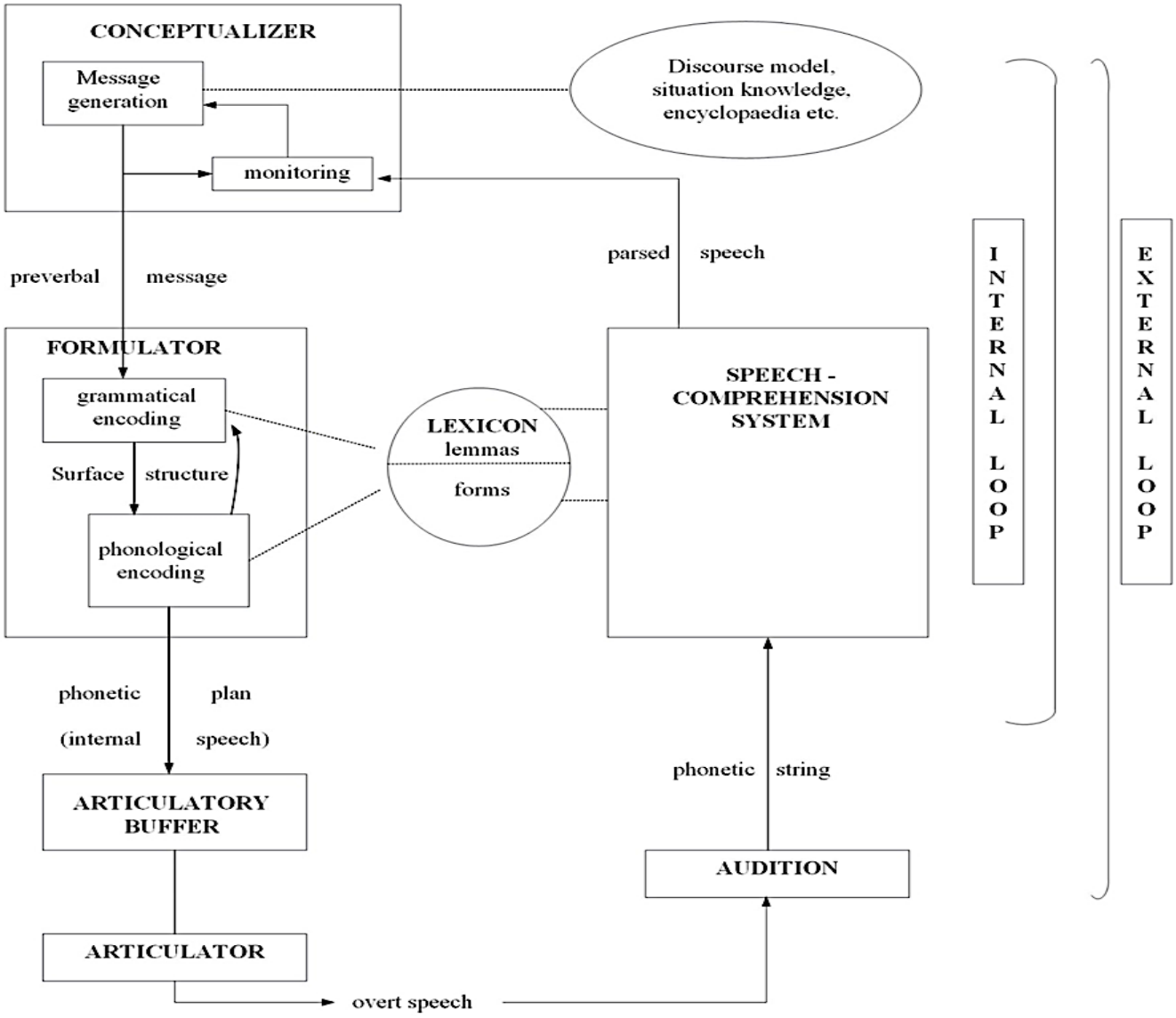

Figure 4: Levelt (1983, 1989) proposed the Perceptual Loop Theory for both monitoring and repairing in speech based on the study of repairs produced in the spontaneous speech of adult speakers of Dutch.

The Speech Production Process

Speech production is a complex process orchestrated by multiple brain regions, each playing a distinct role in generating verbal communication. The frontal, parietal, and temporal lobes of the brain are prominently involved, with specific regions such as the left superior parietal lobe, Wernicke's area, Heschl's gyri, primary auditory cortex, left posterior superior temporal gyrus (pSTG), Broca's area, and premotor cortex being key contributors. Additionally, regions within the lateral sulcus (anterior insula and posterior superior temporal sulcus), basal ganglia (putamen), and forebrain (thalamus) also participate in speech production. Notably, differences in brain activation have been observed between overt and covert speech, with distinct patterns in areas such as Broca's and Wernicke's areas. Furthermore, variations in mouth position and breathing style influence the speech mechanism. Understanding the developmental stages of speech is crucial, with the early postnatal years being particularly important. Key developmental milestones include the preverbal stage, transition to active speech, and refinement of speech, during which auditory and motor brain regions play significant roles. Overall, elucidating the intricate neural processes underlying speech production provides valuable insights into this fundamental aspect of human communication (Jahanaray et al., 2022).

The process of speech production commences from the conceptualization of a message to the articulation of the message. The Conceptualizer generates messages or ideas of an intended utterance. During this phase of conceptualizing, messages or ideas can be monitored for correctness or appropriateness. Speakers might choose suitable words to express their ideas from their knowledge stores.

A new message will be generated if the monitoring process at this phase notices that the message is unsuitable. However, if yes, a preverbal message is formed and goes through this stage as input into the Formulator, which changes the concept into a linguistic structure. This process is completed through lemma selection, whereby a lemma is retrieved from the mental lexicon, where information about the lemma is stored. In this case, the lemma is grammatically encoded by accessing grammatical forms and features, including person, number, and tense, thus producing a surface structure for the message.

Subsequently, the linguistic structure is phonologically encoded, where the individual sound segments constituting the intended word, and its syllabic structure are combined. A phonetic plan is generated after the phonological word and is later phonetically encoded. It is an internal representation of articulating the planned lemma and utterance, which will then go into the Articulator to be realized as overt speech by the vocal systems. According to Levelt (1989), there is a storage device named Articulatory Buffer between the Formulator and Articulator. The next articulatory plan is temporarily stored, waiting to be retrieved and executed when the Articulator performs a phonetic plan.

Self-Monitoring Process

As shown in **Figure 3**, the audible self-produced overt speech will enter the Speech-Comprehension System, whereby participants can listen to their overt speech simultaneously as they listen to other people's speech. This system also processes inner speech (Levelt, 1989), demonstrating its capability to monitor covert and overt speech errors. According to Levelt (1983), internal and external loops enter the Speech-Comprehension System, which has access to the mental lexicon like the Formulator. This means that covert and overt speech can be monitored from the information in the lexicon. The product of the Speech-Comprehension System is parsed speech, which is the unpackaged covert or overt speech being processed.

If an error is monitored, the speaker must decide whether to intercept or to continue the speech. If the speaker decides to make a repair, then he has to reschedule his speech and start at the Conceptualizer. In this case, the monitor conducts two functions: the matching function and the awareness function. During monitoring, if an error is checked before the articulators put it into action and stop the speech, no overt error is audible. However, suppose the error is monitored as the message is stored at the Articulatory Buffer. In that case, the speaker hesitates through prolongations, is silent, and has filled pauses audible for interlocutors. Nevertheless, if the intercepted speech signal occurs following the error detection shortly or after the articulators start the error, then we will hear the error being cut off during the production, or we will hear the interruption shortly after the error, which will be followed occasionally by hesitation and a repair to the error.

5.0 CONCLUSIONS

In summary, previous studies have shed light on the functions of repair in doctor-patient communication, the categories of editing terms in the repair process, the

classification of repair strategies between doctors and patients, and analyzed the repair mechanism from the perspective of epistemic and pragmatics. There is a lack of published research regarding the repairs in doctor-patient communication involving Chinese dialects in rural health clinics in China. Given that different levels of hospitals have other processes in medical consultations, it is imperative to understand how doctors and patients express messages in their communication and the repair mechanism that helps increase the clarity and accuracy of the participants' intended message to improve their understanding. This will be beneficial to constructing mutual understanding, building better therapeutic relationships, increasing doctor-patient communication efficiency, and avoiding possible conflicts. Analyzing repair mechanisms from the perspective of psycholinguistics can also promote better ways for repairs to work in human speech.

Repair is a key mechanism for building mutual understanding in clinical interactions and contributes to better therapeutic relationships and treatment adherence. Doctors and patients attempt to make their utterances understandable and acceptable to attain their purposes in the clinical encounter. This study, therefore, sets out to investigate the types of repairs, functions of repairs, and repair strategies in attempting to explain the repair mechanism that works in the communication setting between doctor-patient interactions at clinics or hospitals.

While this study provides valuable insights, it has some limitations. These include a narrow focus that might overlook broader aspects of communication in healthcare settings, potential biases due to sample size and demographics, methodological limitations, and the study's applicability to diverse contexts. Additionally, important variables may have been omitted, highlighting the need for further research to address these gaps.

Author contributions: C.W. performed the writing idea and drafted the paper; H.Y.J. and N.A.B. contributed the manuscript materials and supervised the work.

Conflicts of interest: The authors declare no conflict of interest.

References

Albert, S., & De Ruiter, J. P. (2018). Repair: the interface between interaction and cognition. *Topics in Cognitive Science, 10*(2), 279–313. https://doi.org/10.1111/tops.12339

Alharbi, J. M. (2023). Linguistic Features Self-Repair Strategies of Arab Speakers of English Language. *Technium Social Sciences Journal, 46,* 342–354. https://doi.org/10.47577/tssj.v46i1.9337

Arslan, B., & Göksun, T. (2022). Aging, gesture production, and disfluency in speech: A comparison of younger and older adults. *Cognitive Science, 46*(2), e13098. https://doi.org/10.1111/cogs.13098

Barnes, S. (2020). Right hemisphere damage and other-initiated repair in everyday conversation. *Clinical Linguistics & Phonetics, 34*(10-11), 910-932. https://doi.org/10.1080/02699206.2019.1700309

Blott, L.M., Gowenlock, A.E., Kievit, R., Nation, K., & Rodd, J.M. (2023). Studying Individual Differences in Language Comprehension: The Challenges of Item-Level Variability and Well-Matched Control Conditions. *Journal of Cognition, 6*(1), 54. https://doi.org/10.5334/joc.317

Boughariou, E., Bahou, Y., & Belguith, L. H. (2021). *Classification Based Method for Disfluencies Detection in Spontaneous Spoken Tunisian Dialect.* In Intelligent Systems and Applications: Proceedings of the 2020 Intelligent Systems Conference (IntelliSys), 2, 182–195. https://doi.org/10.1007/978-3-030-55187-2_16

Boughariou, E., Bahou, Y., & Bleguith, L.H. (2019). Linguistic Resources Construction: Towards Disfluency Processing in Spontaneous Tunisian Dialect Speech. In: Ekštein, K. (eds) *Text, Speech, and Dialogue. Lecture Notes in Computer Science, 11697*, 316–328. https://doi.org/10.1007/978-3-030-27947-9_27

Brennan, S. E., & Schober, M. F. (2001). How listeners compensate for disfluencies in spontaneous speech. *Journal of Memory and Language, 44*(2), 274–296. https://doi.org/10.1006/jmla.2000.2753

Broos, W. P. J., Duyck. W., & Hartsuiker, R. J. (2016). Verbal self-monitoring in the second language. *Language Learning, 6*6(S2), 132–154. https://doi.org/10.1111/lang.12189

Brown, K., & Miller, J. (2016). *A Critical Account of English Syntax: Grammar, Meaning, Text. Edinburgh Textbooks on the English Language – Advanced.* Edinburgh University Press.

Chen, SL. (2010). Courtroom discourse repair study in the perspective of discourse cooperative degree model. *Journal of Chongqing Jiaotong University Social, 2010*(2), 111–117.

Cowan, N. (2014) Working Memory Underpins Cognitive Development, Learning, and Education. *Educational Psycholical Review, 26*(2), 197–223. https://doi.org/10.1007/s10648-013-9246-y

Davis, T. C., Wolf, M. S., Bass, P. F., Middlebrooks, M., Kennen, E., Baker, D. W., & Bennett, C. L. (2006). Low literacy impairs comprehension of prescription drug warning labels. *Journal of General Internal Medicine, 21*(8), 847–851. https://doi.org/10.1111/j.1525-1497.2006.00529.x

Delli, R. M., Kaur, J., Lai, S. M. P., & Dumanig, F. P. (2022). Self-Repair Practices in Pharmacist-Patient Interaction and their Role in Preventing Misunderstanding and Maintaining Medication Safety. *Respectus Philologicus, 41*(46), 53–66. https://doi.org/10.15388/RESPECTUS.2022.41.46.107

Diettes, K. J. V., & Plug, L. (2023). *Temporal organization in lexical self-repair in Colombian Spanish unscripted speech.* In Proceedings of the 20th International Congress of Phonetic Sciences. International Phonetic Association, 4076-4080.

Ding, H. (2008). *Repairs in Clinical Conversations between Physicians and Patients, in Chinese.* [Master's Thesis, Northeast Normal University].

Dinkar, T., Clavel, C., & Vasilescu, I. (2023). Fillers in spoken language understanding: Computational and psycholinguistic perspectives. *Traitement Automatique des Langues, 63*(3), 37–62. https://doi.org/10.48550/arXiv.2301.10761

Ferreira, F., Lau, E. F., & Bailey, K. G. (2004). Disfluencies, language comprehension, and tree adjoining grammars. *Cognitive Science, 28*(5), 721–749. https://doi.org/10.1207/s15516709cog2805_5

Fox Tree, J. E. (1995). The effects of false starts and repetitions on the processing of subsequent words in spontaneous speech. *Journal of Memory and Language, 34,* 709–738. https://doi.org/10.1006/jmla.1995.1032

Gao, Y. (2014). *A Pragmatic Study on Same-Turn Self-Repair in Chinese Medical Interaction*. [Master Thesis, Shandong University].

Ge, L. (2020). *The Same-Turn Self-Repair in Chinese Civil Courtroom Interaction—A Case Study of Changsha Civil Courtroom.* [Master's Dissertation , Hunan University].

Gilabert, R. (2007). Effects of manipulating task complexity on self-repairs during L2 oral production. *International Review of Applied Linguistics in Language Teaching, 45*(3), 215–240. https://doi.org/10.1515/iral.2007.010

Harumi, S. (2023). The mediative role of learning materials: Raising L2 learners' awareness of silence and conversational repair during L2 interaction. *Journal of Silence Studies in Education, 2*(2), 145–162. https://doi.org/10.31763/jsse.v2i2.79

He, L. & Zhang, L. (2021). Analysis of the Same-Turn Self-Repair in Doctor-Patient Communication. *Medicine and Philosophy, 42*(17), 49–52. https://doi.10.12014/j.issn.1002-0772.2021.17.11

He, X. (2015). *A Study of Repair Sequence in Chinese Courtroom Interaction.* [Doctoral Dissertation, Central China Normal University].

He, X. (2018). A Study on the Epistemic Status of Conversational Repair in Courtroom Trial Discourse. *Journal of PLA University of Foreign Languages, 41*(4), 61–68.

Healey, P., Colman, M., & Thirlwell, M. (2005). Analyzing multimodal communication. In J. C. J. Kuppevelt, L. Dybkjær, & N. O. Bernsen (Eds.), *Advances in natural multimodal dialogue systems, 30*, 113–129. Dordrecht, the Netherlands: Springer.

Heeman, P., & Allen, J. (1994). *Detecting and Correcting Speech Repairs.* In the proceedings of the 32nd annual meeting on Association for Computational Linguistics, 295–302. https://doi.org/10.3115/981732.981773

Heritage, J. (1997). Conversation analysis and institutional talk: Analyzing data. In D. Silverman (Ed.), *Qualitative research: Theory, method and practice*, 161–182. London: Sage.

Hermawan, S. (2022). Speech disfluency in Ellen degeneres talk show: A psycholinguistics study. *AMCA Journal of Education and Behavioral Change, 2*(1), 32–38. https://doi.org/10.51773/ajeb.v2i1.142

Jahanaray, M., Jahanaray, A., & Zohoorian, Z. (2022) Brain regions involved in speech production, mechanism and development. *Neuroscience Research Notes, 5*(4), 178. https://doi.org/10.31117/neuroscirn.v5i4.178

Jefferson, G. (1972). Side sequences. In D. Sudnow (ed.). *Studies in Social Interaction,* 294–338. The Free Press, London: Collier-MacMillan Limited.

Johnson, K. N., & Mills, M. T. (2023). Exploratory Examination of Speech Disfluencies in Spoken Narrative Samples of School-Age Bidialectal Children. *American Journal of Speech-Language Pathology, 32*(3), 1182–1194. https://doi.org/10.1044/2023_AJSLP-21-00158

Johnson, R. K., & Prebor, J. (2019). Update on preservice training in augmentative and alternative communication for speech-language pathologists. *American Journal of Speech-Language Pathology, 28*(2), 536–549. https://doi.org/10.1044/2018_AJSLP-18-0004

Jones, C., & Johnson, D. (2020). Exploring Psycholinguistic Factors in Speech Repair: A Review. *Language and Cognition, 23*(2), 187–201. https://doi.org/10.1017/langcog.2019.38
Kormos, J. (1999). Monitoring and self-repair in L2. *Language learning, 49*(2), 303–342. https://doi.org/10.1111/0023-8333.00090
Kormos, J. (2000). The timing of self-repairs in second language speech production. *Studies in Second Language Acquisition, 22,* 145–169. https://doi.org/10.1017/S0272263100002011
Kormos, J. (2006). *Speech production and second language acquisition.* Lawrence Erlbaum Associates Publishers.
Levelt, W. J. (1983). Monitoring and Self-repair in Speech. *Cognition, 14*(1), 41–104. https://doi.org/10.1016/0010-0277(83)90026-4
Levelt, W. J. (1989). *Speaking: From intention to articulation.* The MIT Press. https://doi.org/10.7551/mitpress/6393.001.0001
Levelt, W. J. (1992). Accessing words in speech production: Stages, processes and representations. *Cognition, 42*(1-3), 1–22. https://doi.org/10.1016/0010-0277(92)90038-J
Levelt, W. J., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences, 22*(1), 1–38. https://doi.org/10.1017/S0140525X99001776
Li, L., & Ma, W. (2016). Request sequence in Chinese public service calls. *Discourse Studies. 18*(3),269–285. https://doi.org/10.1177/1461445616634552
Liao, J. (2023). Disfluency and self-repair in presentational and interpersonal speech modalities. *Foreign Language Annals, 56*(2), 401–427. https://doi.10.1111/flan.12658
Luo, Q., & Feng, Zh. (2018). *A Study on Speech Characteristics of Chinese Doctor-Patient Conversations*. Beijing, Science Press.
Ma, W. & Gao, Y. (2018). A Study on the Same-Turn Self-Repair in Chinese Doctor-Patient Interaction. *Journal of Foreign Languages, 41*(3), 42–54.
Maharani, A., & Suratno, A. (2019). Analysis of conversational organization in Indonesian doctor–patient diagnostic talks. *Asian Englishes, 21*(1), 70–86. https://doi.org/10.1080/13488678.2018.1447307
McCabe, R., & Healey, P. G. (2018). Miscommunication in doctor–patient communication. *Topics in Cognitive Science, 10*(2), 409–424. https://doi.org/10.1111/tops.12337
McCabe, R., Healey, P. G. T., Priebe, S., Lavelle, M., Dodwell, D., Laugharne, R., Snell, A., & Bremner, S. (2013). Shared understanding in psychiatrist–patient communication: Association with treatment adherence in schizophrenia. *Patient Education and Counseling, 93*(1), 73–79. https://doi.org/10.1016/j.pec.2013.05.015
McCabe, R., John, P., Dooley, J., Healey, P., Cushing, A., Kingdon, D., Bremner, S., & Priebe, S. (2016). Training to enhance psychiatrist communication with patients with psychosis (TEMPO): Cluster randomized controlled trial. *British Journal of Psychiatry, 209*(6), 517–524. https://doi.org/10.1192/bjp.bp.115.179499
Monzoni, C. M., Duncan, R., Grünewald, R., & Reuber, M. (2011). How do neurologists discuss functional symptoms with their patients: a conversation analytic study. *Journal of Psychosomatic Research, 71*(6), 377–383. https://doi.org/10.1016/j.jpsychores.2011.09.007
Pillai, S. (2002). *Error-detection, self-monitoring and self-repair in speech production.* In Proceedings of the 9th Australian International Conference on Speech Science & Technology, Melbourne, 2, 533–537.
Pillai, S. (2003). *Speech disfluencies and self-repairs in Malaysian English*. In Proceedings of the 6th International Seminar on Speech Production, 231–236.
Postma, A. (2000). Detection of errors during speech production: A review of speech monitoring models. *Cognition, 77*(2), 97–132. https://doi.org/10.1016/S0010-0277(00)00090-1
Postma, A., & Kolk, H. (1993). The covert repair hypothesis: Prearticulatory repair processes in normal and stuttered disfluencies. *Journal of Speech, Language, and Hearing Research, 36*(3), 472–487. https://doi.org/10.1044/jshr.3603.472
Prusti, S. M., Das, M., & Singh, R. (2023). Inaccuracies in Patient-Physician Communication. *Journal of Data Acquisition and Processing, 38*(2), 2695–2707. https://doi.10.5281/zenodo.777058
Purver, M., Hough, J., & Howes, C. (2018). Computational models of miscommunication phenomena. *Topics in Cognitive Science, 10*(2), 425–451. https://doi.org/10.1111/tops.12324
Ratner, N. B., & Gleason, J. B. (2004). Psycholinguistics. In L. R. Squire (Ed.), *Encyclopedia of Neuroscience*, 1199–1204. Academic Press. https://doi.org/10.1016/B978-008045046-9.01893-3
Schegloff, E., Jefferson, G., & Sacks, H. (1977). The preference for self-correction in the organizationof repair in conversation. *Language, 53,* 361–382. https://doi.org//10.1353/lan.1977.0041

Shao, Y. (2014). *A Study of Features and Causes of Repair in Chinese Criminal Courtroom Discourse* [Master Dissertation, Central China Normal University].
Shohiby, N. N. I., & Fauziati, E. (2023). *Exploring Speech Disfluencies Found in A Talk Show Program of Metro TV (A Case Study: Reporter of Economic Sharia Talk Show Program).* [Doctoral dissertation, University of Muhammadiyah Surakarta].
Smith, G. (2018). *A theory of timing effects in a self-organizing model of sentence processing*. [Doctoral Dissertation, University of Connecticut].
Starling, E. M. (2021). *Examination of Speech Disfluencies in the Story Generation Narratives of Bidialectal Children.* [Doctoral dissertation, University of Houston].
Street, R. L., Jr., Gordon, H. S., & Haidet, P. (2007). Physicians' communication and perceptions of patients: Is it how they look, how they talk, or is it just the doctor? *Social Science & Medicine, 65*(3), 586–598. https://doi.org/10.1016/j.socscimed.2007.03.036
Susanto, F. F. (2022). An Analysis of Disfluencies for Describing Phenomena In Spontaneous Speech. *At-Ta'lim: Jurnal Pendidikan, 8*(1), 35–66. https://doi.org/10.55210/attalim.v8i1.726
Tang, C. (2011). Self-repair devices in classroom monologue discourse. *Concentric: Studies in Linguistics, 37*(1), 93–120.
Teutsch C. (2003). Patient-doctor communication. *The Medical Clinics of North America. 87*(5), 1115–1145. https://doi.org/10.1016/s0025-7125(03)00066-x
Themistocleous, M., McCabe, R., Rees, N., Hassan, I., Healey, P., & Priebe, S. (2010). Establishing mutual understanding in interaction: An analysis of conversational repair in psychiatric consultations. *Communication and Medicine, 6*(2), 165–176. https://doi.org/10.1558/cam.v6i2.165
Van Hest, G. W. C. M. (1996). *Self-repair in L1 and L2 production.* Tilburg University Press.
Velligan, D. I., Lam, Y.-W. F., Glahn, D. C., Barrett, J. A., Maples, N. J., Ereshefsky, L., & Miller, A. L. (2005). Defining and Assessing Adherence to Oral Antipsychotics: A Review of the Literature. *Schizophrenia Bulletin, 32*(4), 724–742. https://doi.org/10.1093/schbul/sbj075
Wu, Q. (2016). A Study on Conversation Repair of Family Conversation in Hengyang Dialect. *Journal of Guangxi Vocational and Technical College. 9*(1), 71–74.
Yang, Sh. (2010). *A Corpus-Based Study of Repair in Chinese Doctor-Patient Conversations*. [Doctoral dissertation, Shanghai International Studies University].
Yang, Sh. (2011). The Correction and Instruction Positions in Chinese Doctor-Patient Conversations. *Journal of Daqing Normal University, 31*(5), 91–93.
Yanti, W. D. (2022). *An Analysis of Speech Disfluency in the "Inside Out (2015)" Movie by Pete Docter: A Psycholinguistics Approach.* [Master's Thesis, Diponegoro University].
Yao, J. (2008). Self-repair in Conversation: A Survey. *Contemporary Linguistics, 10*(2), 147–157.
Zhang Y. (2022). *Research on Organization of Repair Sequence of the Uighur Interview Program "Star Is Coming".* [Master's Thesis, Xinjiang Normal University]
Zheng, W. & Zhang, Y. (2019). *Self-repair in Simultaneous interpretation*. In Proceedings of the 2nd international conference on cultures, languages and literatures, and arts (CLLA 2019), 224–229. https://doi.10.25236/clla.2019.050
Zuniga, M., & Simard, D. (2022). Exploring the intricate relationship between foreign language anxiety, attention and self-repairs during L2 speech production. *System, 105,* 102732. https://doi.org/10.1016/j.system.2022.102732