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Tongue Twisters in English: Examining the Dynamics of Language Production and Working Memory in Pakistani English Learners

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Abstract: *Analyzing speech errors can deepen our understanding of speech production processes, as these errors exhibit non-random patterns. (Traxler, 2012). By analyzing errors in the recall of previously listed tongue twisters, the study interprets errors occurring at different levels, providing valuable insights into individuals' performance. Focusing on undergraduate students enrolled in a Functional English course at a Pakistani university, the research investigates the relationship between mental processes and the production of tongue twisters, both in formal and informal contexts. The findings suggest that a higher occurrence of phonological errors in the formal tongue twister articulation indicates the influence of language production awareness. This observation supports the idea that the acquisition of English as a second language may involve an unconscious process, emphasizing mimicry over comprehension.*

Key Words: Speech Errors, Tongue Twisters, Phonological Errors, Working Memory

Introduction

Humans use spoken language to convey their thoughts and interpret meaningful sounds to articulate ideas. Effective communication involves the speaker who is aiming to convey information and also a listener who aims to comprehend the speaker's message. The smoothness and clarity of conversations are impacted by various factors (Hanafiah et al., 2021). Steering effectively through the different stages of speech production, speakers are required to manage some kind of control. This control refers to a mechanism that adjusts or controls speakers' mental thoughts as well as actions (Gilbert & Burgess, 2008). This control mechanism comprises three essential components: inhibitory control, cognitive switching, and working memory updating. Inhibitory control refers to the ability to suppress the activation of irrelevant information to resolve conflicts, and cognitive switching involves the efficient transition between different mental tasks. Lastly, working memory updating pertains to the ability to refresh and modify the contents of working memory, particularly when processing new information (Miyake et al., 2001).

Speakers occasionally make errors during speech production, which can reduce the effectiveness of communication. These errors, known as speech errors or slips of the tongue, are unintended deviations from the intended message and can occur in verbal communication by any speaker (Sariasih et al., 2023; Yahya, 2022; El-Zawawy, 2021; Tampubolon & Lubis, 2021; Utami & Malihah, 2018; Vahlevi et al., 2020; Zhu & Liu, 2018). Essentially, speech errors highlight the gap between a speaker's intended message and what is actually articulated.

In psycholinguistics, speech errors are examined not because they are interesting or have some significance but rather because they are considered to unveil the mechanics of producing accurate speech. Moreover, it is also noteworthy that these speech errors don't provide much insight into how the encoding of phonological aspects is planned. They also don't reveal details about the timing coordination of various processes or their specific functions. Sound errors are basically the verbal or spoken expressions that change or deviate from the actual intent of the speakers in terms of where or which phonological segments are used, and these deviations are not similar to a full morpheme of the intended utterance (Dell, 1986).

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Additionally, transient storage in verbal working memory, which handles the processing of verbal information, is seen as essential in psycholinguistic research related to word learning and language comprehension (Baddeley, 1986). Research exploring the link between speech production and working memory (Acheson & MacDonald, 2009) indicates that the mechanisms for preserving the serial order of verbal information likely stem from the structures involved in speech production.

Research studies on people with brain damage indicate that when we intend to speak and what words to use, our ability to recall or focus on the meaning of words (lexical-semantic level) is more crucial in comparison to focusing on how they sound (phonological level), particularly when planning to utter phrases. On the other hand, some evidence from people without brain damage suggests that planning multiple words at the sound level (phonological) might also be important. This could involve a sort of phonological output buffer to help us talk smoothly. Overall, we need more research to put together what we know about how we plan what to say and how our memory, especially working memory, plays a role in this process. This involves understanding how we organize our thoughts, put words together, and manage different levels of memory while speaking.

This study delves into finding the connection or relation between speech production and working memory, focusing on the production of tongue twisters by undergraduate students of Pakistani universities taking courses in functional English. Analyzing errors in the recall of a previously listed tongue twister, the study will interpret errors occurring at various levels. The use of speech error analyses with reference to tasks pertaining to verbal working memory, like tongue twisters, will offer valuable insights into people's performance. Additionally, it will explore whether there is any connection between the production of tongue twisters and mental processes or strategies, particularly concerning the formal and informal production of tongue twisters.

Analyzing speech errors in relation to tasks involving verbal working memory, such as tongue twisters, will provide valuable insights into individual performance. Furthermore, it will investigate whether there is a link between the production process of tongue twisters and mental processes, with a focus on both formal and informal contexts.

Research Objectives

1. To explore the relationship between tongue twister production and underlying mental processes.
2. To examine the influence of verbal working memory on the precision of formal and informal tongue twister production among Pakistani English language speakers.

Significance of the Study

This study is significant because it intersects the fields of linguistics and psychology, focusing on the relationship between verbal working memory and language production. Traditionally, linguistics and psychology were seen as separate disciplines until Noam Chomsky's work demonstrated the need for psychological insights into language structure. Since the 1960s, psycholinguists have aimed to understand how abstract language rules are processed through vocal-auditory channels.

The study's importance is underscored by its exploration of how verbal working memory affects the precision of producing tongue twisters in varying contexts among Pakistani English learners. By investigating these cognitive processes, the research contributes valuable insights into the role of memory in language proficiency. This understanding is crucial for developing more effective language learning strategies and enhancing communication skills, particularly through the use of tongue twisters as a challenging linguistic exercise.

Methodology

Two experiments are designed in this study in order to investigate the impact of cognitive processes and approaches on the production of speech. Both experiments involve the participation of twenty undergraduate students, ten in each experiment, enrolled in a Functional English course at the National University of Medical Sciences in Rawalpindi, Pakistan. To adhere to research norms, the participants are

divided into two groups, each comprising ten individuals, with an equal distribution of male and female participants in both groups. Group A was tasked with orally reciting ten formal tongue twisters (T1 –T10), whereas Group B was instructed to repetitively articulate a single tongue twister (TT1) from memory ten times. The age range of the informants spanned from 20 to 23 years, and all participants exhibited intermediate-level proficiency in English.

Two phonological stimuli in the form of lists of tongue twisters were employed in the study. The formal stimuli are comprised of tongue twisters that are ten in number and are structured according to the sequence proposed by Wilshire (1999). This list of tongue twisters was specifically designed for assessing the pronunciation of tongue twisters. The arrangement of the tongue twisters was strategically designed to elicit such errors, providing a means to evaluate speech production accuracy. The randomly selected sample of the first group of ten participants silently read each tongue twister and then gave the list of the formal tongue twisters a rapid read. The researcher recorded the loud reading for further analysis, with the aim of investigating whether language awareness influences the reduction of phonological errors. Transcriptions of the recordings utilized International Phonetic Alphabet (IPA) symbols for subsequent comparison with the target list.

The second group of ten participants was also randomly chosen for the informal stimuli. These participants were tasked with orally repeating the English tongue twister ten times. The selected tongue twister for this purpose was deliberately crafted with multiple alternations of closely resembling phonological sequences. Its length did not exceed seven words, a design choice made to mitigate potential challenges in memorization. The phonological structure of the tongue twisters was based on a compilation by Cutler (2011), with attention to varying types of errors (e.g., consonants vs. vowels) and their locations.

The objective of this exercise was to assess the working memory of memorized verbal expressions. It contrasts with the formal list, where participants articulate a given set of utterances only once, aiming to scrutinize the working memory associated with read expressions.

Table 2.1 contains both the formal and informal stimuli utilized in the experiment. The capital T with a numeric is the tongue twisters utilized as formal stimuli and the capital TT with a numeric is the tongue twister utilized for the informal stimuli.

Table 1

Formal informal stimuli of tongue twisters

S. No	Formal Stimuli	In formal Stimuli
1	T1: She sees seeds on the shelves	TT1: A big black bug bit a big black dog on a big black nose
2	T2: Teeb deer in deep tear	
3	T3: Beam peek a pier a beak	
4	T4: A venial fist of a female fest	
5	T5: Jell in cheer and chill in jeer	
6	T6: The key is geared by a geisha who does not feared	
7	T7: Shore leper with a lore shipper	
8	T8: Sheaf sawed a chair on a seed and showed there	
9	T9: The file of the vote and the vile that fought	
10	T10: The tie of a dope that sighed from a tope	

The prescribed tempo for uttering each sentence was explicitly and clearly communicated before starting the experiment. To regulate the pace, instructions were provided to each participant to either resume or accelerate if there was a cessation or deceleration in speech. In instances where the speaker encountered challenges in memorization or repetition of the tongue twisters, the researcher would reiterate them multiple times until the subject achieved a level of comfort. Noteworthy instances of clear hesitation, repetitions, or sound interjections (e.g., "uh") were documented. It is important to point out that, despite differences in repetition rates and utterance numbers, the total number of utterances produced was consistent for both formal and informal tongue twisters. The primary analytical approach employed in

data interpretation was the mathematical tool of frequency count and percentages. This involved enumerating the instances of errors and expressing them as percentages, thereby elucidating which experimental condition (i.e., formal or informal production of tongue twisters) yielded a higher frequency of errors.

Analysis and Findings

This analysis is carried out on the comparative examination of the formal tongue twister T1 to T10 and informal tongue twister TT1. The approach involves presenting the overall errors from both tongue twisters. An intriguing finding is that participants exhibited greater accuracy and speed when producing tongue twisters informally compared to their performance in formal contexts. Table 3.1 presents the count and percentage of errors made by the 10 participants while reading the ten tongue twisters from Wilshire (1999) once. Notably, T10 had the highest error frequency (11%), followed by T4 and T6 (10% each). Conversely, T7 had the lowest error frequency (6%), followed by T2 (7%).

Table 2

Errors produced in informal tongue twisters

No of Tongue Twister	Formal Tongue Twister (T1–T10)	Error produced	No of Errors	Error Percentage
1	/ʃi:/ /si:z/ /si:d/ /ʃelvz/	/si:/ /ʃi:z/ /si:t/ /selvz/	2 3 1 2	8%
2	/teeb/ /deer/ /deep/ /ti:r/	/ti:p/ /ti:r/ /ti:p/ /di:r/	2 1 2 2	7%
3	/bi:m/ /peek/ /pi:r/ /bi:k/	/pi:m/ /bi:k/ /bi:r/ /bi:g	2 3 1 3	9%
4	/vi:nial/ /fest/ /fi:meil/ /fest/	/fi:nial/ /vest/ /fi:mial/ /vest/	3 3 2 2	10%
5	/ʒel/ /tʃi:r/ /tʃel/ /ʒi:r/	/tel/ /tʃi:/ /ʒel/ /ʒi:/	3 2 2 1	8%
6	/ki:/ /gi:rd/ /gi:ʃa/ /fi:rd/	/gi:/ /gi:d/ /ki:ʃa/ /gi:rd/	3 2 3 2	10%
7	/ʃD:r/ /leper/ /lD:r/ /ʃepər/	/lD:r/ /ʃepər/ /ʃD:r/ /lepər/	2 2 1 1	6%
8	/ʃi:f/ /səʊd/ /si:d/ /ʃəʊd/	/si:/ /ʃəʊd/ /ti:f/ /təʊd/	2 3 1 3	9%
9	/fail/ /vəʊt/ /vail/ /fəʊt/	/faiv/ /fəʊp/ /vaip/ /vəʊp/	2 3 1 2	8%

No of Tongue Twister	Formal Tongue Twister (T1-T10)	Error produced	No of Errors	Error Percentage
10	/tai/	/dai/	3	11%
	/dəʊp/	/dəʊ/	4	
	/said/	/dait/	3	
	/təʊp/	/dəʊp/	1	
86%				

Displayed in Table 2 below are the error counts for the 10 participants who were tasked with ten times repetition of tongue twister from Cutler (1982) following its introduction. The term "bug" resulted in the highest error rate, accounting for 25% of errors, while the term "news" followed with a rate of 16%. Conversely, the term "dog" had the lowest error rate at 1%, and "bit" had a rate of 12.5%.

Table 3

Errors produced in formal tongue twisters

Target Word	Error Produced	No of Participant										Total No of Errors	Percentage of Errors
		1	2	3	4	5	6	7	8	9	10		
/big/	/bit/	0	0	2	0	0	0	0	1	0	1	4	15%
	/pig/	1	1	0	0	1	0	0	0	0	0	1	
	/mig/	0	0	0	0	0	0	0	0	0	0	1	
	/nig/	0	0	1	0	0	0	0	0	0	0	1	
	/but/	0	0	0	0	0	0	0	0	1	0	1	
	/gʌb/	0	0	0	0	0	1	0	0	0	0	1	
	/gib/	0	0	0	2	0	0	0	0	0	0	2	
	/bid/	0	0	0	0	0	0	1	0	0	0	1	
/black/	/blæt/	0	0	0	1	0	0	0	0	0	0	1	12%
	/plæt/	0	0	0	0	0	0	1	0	1	0	2	
	/blæd/	0	2	0	0	1	0	0	0	0	0	3	
	/blæg/	1	0	0	0	0	0	1	0	0	0	2	
	/blæk/	0	0	1	0	0	0	0	0	0	0	1	
	/blig/	0	0	0	0	0	1	0	1	0	0	2	
/bʌg/	/dɒg/	1	0	0	0	0	0	0	0	1	1	3	25%
	/dʌg /	0	1	0	1	0	0	2	0	0	0	4	
	/bɒg/	1	0	0	0	1	0	0	0	0	0	2	
	/bʌt/	0	0	0	0	0	1	0	2	0	0	3	
	/mʌg/	0	0	3	0	0	0	2	0	0	0	5	
	/nʌg/	0	1	0	0	0	0	0	1	0	1	3	
	/tʌg/	1	0	0	1	0	1	0	0	0	0	3	
	/dʌk/	0	0	0	0	0	0	0	0	0	0	2	
/bit/	/bid/	0	0	1	0	0	0	1	0	2	0	4	5%
	/tib/	1	0	0	0	0	0	0	0	0	0	1	
/dɒg/	/tɒg/	0	1	0	0	1	0	0	0	0	0	2	2%
/nəʊz/	/məʊz/	0	0	0	0	0	0	0	1	0	0	1	16%
	/bəʊz/	0	0	0	0	0	0	0	1	1	0	2	
	/dəʊz/	0	1	0	0	2	0	0	0	0	0	3	
	/kəʊz/	1	0	0	0	0	0	1	0	0	1	2	
	/gəʊz/	0	0	1	0	0	0	0	1	0	0	2	
	/pəʊz/	0	0	0	0	0	0	0	0	1	0	1	
	/pləʊz/	0	0	0	0	0	1	0	0	0	0	1	
	/kləʊz/	0	0	0	1	0	0	0	0	0	0	1	
	/zəʊn/	0	1	0	0	0	0	0	0	0	0	1	
	/gləʊz/	0	0	0	0	0	1	0	0	0	1	2	
76%													

Table 3 provides a comparative analysis of overall errors generated in both formal and informal tongue twisters, taking into consideration the total number of utterances

Table 4

Comparative analysis of error frequencies in tongue twisters (formal & informal)

Total no. of utterances	Total no. of errors	% of errors	% of errors in T1-T10	% of errors TT1 (ten times)
200	162	81%	86%	76%

Discussion

Participants initially made errors in pronouncing words in both formal and informal tongue twisters, consistent with findings from earlier research (Allport, 1984; Baddeley et al., 1975; Corley et al., 2011; Rohman, 2016; Esselam, 2022). These studies suggest that individuals experiencing the tip-of-the-tongue phenomenon often have insights into the beginning or end of a sentence. A key feature of sound errors is their tendency to be phonetically plausible, aligning with Fromkin's (1971) observation that errors usually adapt to their context by assimilating to neighboring sounds, either regressive or progressive. However, not all sounds follow this pattern. Ill-formed sound errors, which result in sound deletion, were observed exclusively during the formal production of tongue twisters, particularly when sounds do not fit or appear later in the planning process. These errors typically involve similar segments, mainly consonants, and consistently affect the same syllable. Notably, no errors were found where the unit spanned the final segment of one syllable and the initial segment of the next, even in more complex multi-syllable units.

The analysis also reveals that initial consonant clusters often replace the phoneme /n/ in informal tongue twisters (e.g., /pləʊz/-/kləʊz/ for /nəʊz/). Additionally, the data supports the idea of syllabic structure representation, as evidenced by positional constraints on sound exchanges across different tongue twister forms. Specifically, initial segments in the original syllable replace initial segments in the target syllable, and the same applies to final segments.

The examination uncovers occurrences, where initial consonant clusters replace the phoneme /n/, notably, observed only in the informal rendition of tongue twisters (e.g., /pləʊz/-/kləʊz/ for /nəʊz/). Additionally, the data analysis offers support for the representation of syllabic structure, demonstrated by positional limitations on sound exchange in diverse tongue twister forms. In particular, initial segments in the original syllable take the place of initial segments in the target syllable, and vice versa for final segments.

This observed tendency aligns with syllable frames (MacKay, 1970), as errors primarily occur within the same frame of original items in both formal and informal tongue twisters. Additionally, ordering errors predominantly reflect phoneme substitutions rather than item substitutions, confirming predictions by Walker and Hulme (1999) that onset substitution is the most frequent type of phoneme substitution.

The analysis supports the applicability of Dell's (1986) models in describing sound errors. Dell's theory explains the activation of segments' framework, where the activation of a particular unit spreads to connected units, and the activated unit's feedback their activation. Sound errors occur when segments are activated at inappropriate times, linking them to incorrect positions. The analysis suggests that sound activation initiates and extends to the full word list in both tongue twisters, i.e. formal and informal, with a greater frequency in formal tongue twisters.

Moreover, the analysis also reveals that the working memory of memorized utterances resulted in fewer sound errors than the working memory of read utterances. This suggests that increased awareness of speech production in formal tongue twisters may lead to a higher likelihood of sound exchanges and segmental substitutions. These results are consistent with Maghrabi's (2013) findings.

Conclusion

It might be assumed that the higher occurrence of phonological errors in the articulation of formal tongue twisters, as opposed to the informal tongue twisters, may indicate that subjects' awareness of language

production contributes to a higher frequency of errors. This observation also supports the idea that acquiring English as a second language may benefit from an unconscious learning process, where mimicry takes precedence over comprehension, especially in second language acquisition. Furthermore, this could be attributed to the likelihood that informal tongue twister production stimulates mental processes more than proficiency, leading to the generation of additional cognitive processes to improve tongue twister production.

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