ASSESSMENT OF DISFLUENCIES AS A PREDICTOR OF COGNITIVE EFFORT IN AGEING

ANUSMITHA MATHEW

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University of Mysore, Mysuru

ALL INDIA INSTITUTE OF SPEECH AND HEARING,

MANASAGANGOTHRI,

MYSURU - 570006

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CERTIFICATE

This is to certify that this dissertation entitled ***"Assessment of disfluencies as a predictor of cognitive effort in ageing"*** is a bonafide work submitted in part fulfilment for degree of Master of Science (Speech-Language Pathology) of the student Registration Number: 17SLP005. This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru,
May, 2019

Dr. M. Pushpavathi
Director
All India Institute of Speech and Hearing
Manasagangothri, Mysuru-570006

CERTIFICATE

This is to certify that this dissertation entitled ***"Assessment of disfluencies as a predictor of cognitive effort in ageing"*** is a bonafide work submitted in part fulfilment for degree of Master of Science (Speech-Language Pathology) of the student (Registration Number: 17SLP005). This has been carried out under my supervision and guidance. It is also been certified that this dissertation has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru,
May, 2019

Dr. Anjana B. Ram
Guide
Assistant Professor in Speech Pathology
Department of Speech-Language Pathology
All India Institute of Speech and Hearing
Manasagangothri, Mysuru-570006

DECLARATION

This is to certify that this dissertation entitled ***"Assessment of disfluencies as a predictor of cognitive effort in ageing"*** is the result of my own study under the guidance of Dr. Anjana B. Ram, Assistant Professor in Speech Pathology, Department of Speech-Language Pathology, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysuru, **Registration No. 17SLP005**

May, 2019

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CHAPTER 1

INTRODUCTION

Natural conversation is rife with disfluencies or interruptions in the forward flow of speech. Our speech normally involves the use of fillers like uh, um. The disfluencies are seen as a type of production error reflecting interruptions during different phases of speech production and are detrimental to the overall fluency of speech. Although disfluencies may not affect comprehension of speech, they evoke interest for various reasons. The disfluencies are thought to serve as an intentional means through which the listener understands the speaker, or even viewed as by-products of issues within the language production system.

There have been many studies focusing on the occurrence of disfluencies in children mostly. Limited research has been done on the disruptions of speech fluency in adults. Various situational and demographic factors affect speakers' disfluency rates including age, gender, conversational role, familiarity with the partner and topic (Bortfeld, Leon, Bloom, Schober, & Brennan, 2001).Various disfluencies could be linked to processes, like cognitive planning load and coordination of communication. Disfluencies are proposed as the by-products of normal repair processes that speakers use when they identify errors during formulation of a phonetic plan (Covert Repair Hypothesis (CRH); Postma & Kolk, 1993). Thus language formulation is identified as a major factor for the speech disfluency production in both fluent speakers and individuals with stuttering.

In the Bortfeld, Leon, Bloom, Schober and Brennan (2001) study of disfluency rates in conversation, the factors included: age of the speaker (young, middle-aged, and older), role (director vs. matcher in a referential communication task), topic

difficulty (photographs of children vs. abstract geometric figures), relationships between speakers (strangers vs. married), and gender (each pair included a woman and a man). Slightly higher rates of disfluency were produced by older adults. Altogether, higher disfluency rates were observed when speakers engaged in the role of directors (more filled pauses) and during description of abstract figures (more repetitions), establishing the relationship between disfluencies and increased planning difficulties. Differences among the various disfluency types were found with respect to task role and difficulty. Descriptions of abstract figures, called tangrams induced greater task demands than those with photographs of children.

Another important factor that influences the disfluency production is age. Age related changes can also affect speech fluency in many ways. Older adults exhibit more difficulty in the retrieval of words, (Sandson, Obler, & Albert, 1987) and, as a consequence, produce considerably greater number of disfluencies when compared to younger and middle-aged adults (Shewan & Henderson, 1988; Bortfeld *et al.*, 2001). Disfluencies interfere with the continuity of speech, suggesting word retrieval problem. Older adults have been shown to produce increased lexical fillers (e.g., you know), non-lexical fillers (e.g., um), lengthy pauses, word repetitions (e.g., just on the left left side), and empty words when compared to young adults, in describing a picture or other stimulus. However, studies by few authors (Bortfeld *et al.*, 2001; Kemper, Rash, Kynette, & Norman, 1990; Schmitter-Edgecombe, Vesneski, & Jones, 2000) do not report consistency in particular type of disfluency indicating differences with respect to age. The disfluencies are being explained as means to save time for word finding. Supporting this, Bortfeld *et al.*, (2001) found that more fillers were produced by older adults than young adults within syntactic phrases where word finding failures arose,

while they were not observed between syntactic phrases where they indicated the intention to continue speaking.

The evidence of decline in language production with ageing denotes difficulties in phonological retrieval rather than motor planning or articulatory deficits. Older adults showed increased number of dysfluencies such as restarts, hesitations, filled pauses (e.g., um, you know) and word repetitions, indicating problems in word retrieval (Bortfeld *et al.,* 2001; Schmitter-Edgecombe *et al.,* 2000) compared to young adults. With experimentally induced speech errors, there was more possibility for older adults to omit phonemes or syllables, a pattern accordant with difficulties in phonological retrieval (MacKay & James, 2004).

Burke and Shafto (2008) and Mortensen, Meyer, and Humphreys (2006) report that older adults produce less fluent speech compared to younger adults, suggesting that the reduction in fluency of speech occur partly due to their greater word-finding difficulties. Across a range of tasks, older adults have shown greater number of disfluencies and they are primarily associated with lexical retrieval difficulty (Cooper, 1990; Sandson, Obler, & Albert, 1987; Schmitter-Edgecombe *et al.,* 2000), as disfluencies are frequent within phrases compared to between phrases. Engelhardt, Corley, Nigg, and Ferreira (2010) speculated the association of the decreases in speech fluency to the reduced inhibitory function (e.g., Hasher & Zacks, 1988; Lustig, Hasher, & Zacks, 2007) or word retrieval problems associated with ageing.

Also many researchers have studied disfluencies and speech errors seen in normal speakers as an insight into the intermediate linguistic products and cognitive processes of speech planning. The topic of conversation or description may have an impact on the planning of utterances and its variations. For example, in the study by Bortfeld *et al.,* (2001), the data indicates an increase in disfluencies with respect to

ageing for unfamiliar (pictures of tangrams), and not for familiar material (pictures of` children).

James and Kooy (2011) performed a visual error detection task in young and older adults. The participants were presented with cartoon drawings of familiar scenes with visual errors or anomalies in it, thus increasing the novelty of the task of picture description. Comparison was made between the speech fluency in participants when describing scenes that contained errors versus no errors. For the successful detection of the errors, they had to form new internal representations of what they viewed. They found an age-related decline in detection of errors, consistent with assumptions in the Transmission Deficit Hypothesis (TDH; MacKay & Burke, 1990).

Another study by James, Chambers, and Placzek (2017), employed an error detection task, comparing the speech of young and older adults during the description of few pictures containing visual errors and their error free counterparts. Their analyses reveal that more mid-phrase fillers were produced in older adults, during description of pictures with errors, thus reflecting difficulties in word retrieval and disruptions in fluency, indicating that the requirement to form the representations of novel information can particularly deteriorate speech fluency in older adults. These studies analyse predictions of the Transmission Deficit Hypothesis (TDH; MacKay & Burke, 1990), established within the Node Structure theory of perception and action, including speech production (MacKay, 1987).

The TDH provides a comprehensive description of changes in language production throughout healthy ageing, an additional contribution to the literature regarding changes in speech fluency as function of ageing.

Fluent speech production demands both accurate planning of utterances and successful retrieval of the intended words and sounds within the planned utterances

(Dell, 1986; Garrett, 1975; Levelt, 1989). Thoughts are activated in the semantic system and they send priming to word forms (called lexical nodes in the theory), which are activated and then send priming to the phonology, relating to the sounds of the word. Several types of fluency issues, including speech errors, failures of word retrieval can occur due to errors that arise at each of these levels (MacKay & James, 2001). The TDH approach explains that the frequently accessed representations like words that are commonly used, are less susceptible to retrieval or production errors compared to those that are accessed rarely (e.g., low-frequency words). The recent and recurrent use strengthens the connections through which priming is transmitted. More production errors are generated when thoughts are to be created for the new representations.

Older adults might have setup representations of frequently experienced information in their earlier years and perpetuated them across adulthood and hence describing familiar scenes containing known characteristics is not mostly affected in healthy ageing. Speakers require to only access these mostly practiced and commonly used representations to produce speech. Also increases in Tip of the Tongue (TOT) phenomena associated with ageing or other retrieval failures might affect speech fluency in older adults to some extent.

Gordon and Kindred (2011) highlighted the importance of the "Task Constraint Hypothesis" which asserts that the problems of word retrieval in older adults are mostly seen in speech tasks with highly constrained responding. Transmission deficits in older adults are not presumed to create considerable interruptions to speech fluency in most description tasks due to relatively unconstrained language production. Hence there is a need for assessing speech production with respect to task characteristics.

Corley and Stewart (2008) proposed that describing unfamiliar topics (i.e. novel) elicits higher cognitive load than familiar ones, and the demand to represent

novelty might cause greater cognitive load and in turn increase the disfluencies. An increase in the presence of indefinite wording and mean pause duration in terms of ageing was found by Cooper (1990) during descriptions of pictures but no differences were reported in repetitions, speech fillers or incomplete sentences. Castro and James (2014) found that descriptions of complex photographs by older adults consisted of increased total disfluencies than young adults' descriptions.

Another factor that affects the fluency of spoken language production in older adults is the role of emotions. Literature indicates age associated reduction in cognitive processing of emotional material in contrast to non-emotional material. Previous researches by Bortfeld *et al.,* (2001); Castro and James (2014); Kemper, Herman, and Lian (2003), report that, type of the material used to describe may influence the extent of the negative impact of ageing on fluency of speech. Relatively few works have been published assessing the effect of negative topics on speech production. Mostly investigations have been done on people with schizophrenia. Burbridge and Barch (2002); Docherty and Hebert (1997) observed increased reference errors in Schizophrenic patients (and therefore reduced intelligibility in communication) when describing negative in contrast to positive or neutral topics.

Burbridge, Larsen, and Barch (2005) suggested that negatively valenced material leads to anxiety, evoking an autonomic stress response, which lead to disruptions in spoken language production by increasing many types of disfluencies (Mahl, 1987). Anxiety also influences the amount of speech produced, the speech rate and the pausing during speech (e.g., Evans & Coonick, 1982; Kanfer, 1959). Limited research has been done to find the effect of anxiety or negative emotion on the fluency of language production between older adult and young adult speakers.

Castro and James (2014) analysed oral picture descriptions produced by young and older participants to see the effect of negative emotional information or content on spoken language production. Participants were asked to describe negative pictures (photographs consisting of potentially arousing negative content, like loneliness, frustration, or anxiety) and neutral pictures. They found that rate of disfluency in older adults was comparable to young adults during descriptions of neutral pictures, but was greater during descriptions of pictures with negative content. The pictures contained different unspecific negative emotions since it cannot be predicted that every picture would cause the same emotional influence in every individual (E.g.: a picture in which an individual covers his face with hands can be described as unhappiness, anxiety, isolation, or a mixture of these emotions). In younger adults, their rate of speech increased and rate of disfluency did not change during description of negative compared to neutral pictures, indicating improvement in speech production with increased anxiety. While the speech rate remained unchanged, the disfluency rate was increased in older adults during description of negative than neutral pictures, which indicated the worsening of speech with increased anxiety (Castro and James, 2014). Increase in reference errors were observed in both young and older participants when describing negative in contrast to neutral pictures. They speculated the likelihood that, when faced with negative content, older adults are involved in cognitively demanding emotional regulation actions, with fewer accessible cognitive resources to carry out the language production task causing a reduction in fluency.

Findings such as these highlight the need to understand how different speaking conditions can lead to variations in fluency among young and older adults, rather than solely assessing the major impacts of age on fluency. The production of fluent and understandable speech is crucial in social interactions. An elderly person during

description of a negative event with disfluencies, might be inappropriately perceived as "losing it". Thus specifying the factors that aggravate changes in fluency as function of age is an important aspect that needs to be researched. Various speaking tasks as well as different disfluency measures may influence our views about changes in speech fluency with respect to ageing. Research should be planned to assess whether the task unfamiliarity, the new connections that are to be formed for speech production of novel representation and the increased cognitive effort involved, all contribute to decreased speech fluency in older adults.

Need of the study

The disfluencies produced in normal speakers have been studied widely with respect to the various demographic and situational factors. In the literature there is a large focus on the development of fluency in children, leaving the ageing population largely unaddressed (Pindzola, 1990). Age related changes in motor, cognitive, and perceptual functioning may influence speech in several ways (Bortfeld *et al.*, 2001). The production of speech disfluencies is associated with some aspects of language formulation. Tree and Clark (1997); Schnadt and Corley (2006) have associated speech disfluencies with planning problems in production (semantic planning, syntactic and lexical planning). Older individuals may maintain normal fluency levels only in conditions with little or no cognitive stress. Increased levels of cognitive stress can result in significant decline in fluency among older than in young adults. Elderly individuals produced notably greater number of disfluencies during the high-stress (Stroop task) when compared to the low stress conditions (Caruso, Chodzko-Zajko, Oatridge, & Bidinger, 1991).

According to the Transmission Deficit Hypothesis (TDH; Mackay & Burke, 1990), fluent speech production needs accurate planning of utterances and successful retrieval. Errors at each level cause different fluency problems. Disfluencies such as repairs (e.g., the woma- I mean man) and fillers (e.g., uh and um) are often viewed as difficulties with planning and execution of utterance (Levelt, 1989). The frequently accessed representations like commonly used words are less susceptible to retrieval or production errors compared to those that are infrequently accessed (e.g., low-frequency words). Stable representation of novel information may not be formed due to reduction in transmission of priming as a result of ageing. Error detection (novel visual information) and its description necessitates the formation of new representations for a novel error or anomaly which can lead to increase in the number of disfluencies comparatively.

Pindzola (1990) discussed the importance of understanding disfluencies in the ageing population. In contrast, Duchin and Mysak (1987) indicated no variations in disfluencies across age. Discrepancies have been noted within the literature concerning the relationship between age and disfluencies with majority reporting older adults comparable to younger or no change. These can be linked to the limitations of small sample sizes and limited information within the methodology of measuring disfluencies in terms of describing disfluency type, measuring frequency and metric system used. It is also worth noting that other contributing factors such as cognition and years of education are yet to be considered which may have an effect on determining whether a person is perceived as more or less fluent.

Relatively few works have been published to assess the effect of negative content on spoken language production. Greater number of reference errors, higher heart rates, and a higher frequency of nonspecific skin conductance responses were

displayed by speakers during descriptions of affectively negative in contrast to positive or neutral topics. Burbridge *et al.,* (2005) suggests that the stress experienced when faced with pictures containing negative content might have caused difficulties in generating descriptions about them. The presence of anxiety interrupted spoken language production resulting in more types of disfluencies such as stutters, repetitions, incomplete sentences, omissions and tongue slips as reported by Mahl (1987). In a study by Castro and James (2014), increases in reference errors were observed in both young and older participants when describing negative rather than neutral pictures. The differential effect of negative emotion on spoken language production of older adults may interfere and affect their day to day communication.

Thus, as seen in the review, all the studies have been done to see disfluencies in older adults in the Western population. There is almost scanty information on the same with respect to Indian geriatric population. It will be interesting to see the influence of cognitive load on speech production errors, specifically disfluencies in the older population and comparing them with younger adults. Hence the need for the present study.

Aim of the study

The current study is taken up with the aim of examining the speech disfluencies as predictors of cognitive effort in ageing. Increased levels of cognitive stress may lead to considerable decrement in fluency among the older than in young adults.

Objectives of the study

- To study the influence of age on the frequency and type of disfluencies.
- To compare the number and type of disfluencies in descriptions of pictures containing errors versus no errors for determining the influence of cognitive effort in ageing.
- To compare the number and type of disfluencies in description of negative versus neutral pictures for determining the influence of cognitive effort in ageing.

CHAPTER 2

REVIEW OF LITERATURE

Various difficulties and several retorts from the production system often result in multiple types of interruptions that hamper the ongoing fluent speech. Disfluency is a phenomenon that manifests regularly in speech. Disfluencies are mostly assumed to be associated to the efforts in production system (Engelhardt *et al.,* 2010).

Literature presents a varied picture of frequency of disfluencies. For e.g., a meta-analysis by Tree (1995), suggests that disfluencies occur at a rate of about 6% in ongoing speech whereas according to Brennan & Schober (2001), every 10% of utterances demonstrate a minimum of one disfluency.

In literature, disfluencies have been defined as conflicts in speech, which are "extralinguistic events" which interrupt regular progression in speech. These "disruptions" have been classically apprehended to arise out of a motivational basis, that is, to mirror emotional aspects which hinder the continuing course of generation of speech as well as its manifestation (Wingate, 1987).

Spoken language frequently comprises of several types of disfluencies which involves, but are not limited to; silent and audible hesitations, fillers, interjections, revisions, tongue slips, parenthetical remarks, word change, omissions, pauses etc. (Wingate, 1987); filled pauses, (for e.g., "uh" and "um") (Tree, 1995); as well as repetitions and repairs (Engelhardt *et al.,* 2010).

More recently, a taxonomy of fluency features for forensic analysis (TOFFA) classifies the disfluencies into five major categories, which are; unfilled pauses, filled pauses, repetitions, prolongations, and interruptions (McDougall & Duckworth, 2017).

The occurrence of disfluencies have often raised a questions whether they function as a deliberate signal from speaker to the listener or if they become apparent as a derivative of struggle inside the language production system.

According to Fraundorf, Benjamin and Watson (2013), various disfluencies manifest themselves equally based on whether freshly uttered material is accessible to reiterate and whether a novel communicative disposition can be rapidly introduced. Disfluent repetitions occurs in conditions of ongoing speech when the already pronouncing segment can easily be repeated. However, fillers and silent pauses arise when speakers plan for the start of a segment and do not have freshly uttered material to repeat. A novel communicative plan is often required for the manifestation of fillers and they often emerge when speakers are involved in conceptual planning. However, the manifestation of silent pauses lack the need for a novel communicative plan and often emerges from struggles in the grammatical or phonological planning.

Brennan and Williams (1995) as well as Smith and Clark (1993) report that fillers are used when individuals are indeterminate of what is to be spoken whereas Schachter, Christenfeld, Ravina, and Bilous (1991) as well as Schnadt and Corley (2006) state that fillers emerge when speakers have choices in speech to choose from. Because of the occurrence of these unintentionally produced fillers at phrase boundaries, Corley and Stewart (2008) report that these fillers often serve to disambiguate syntactic structures in ways alike to that of elective function words.

Several researchers such as Mahl (1956, 1958 & 1959), Maclay and Osgood (1959), Blankenship and Kay (1964), Levin and Silverman (1965) and Goldman-Eisler (1968), used these disruptions in speech to quantify anxiety, with the assumption that different disruptions would result from different psychological influences.

Two different transcribed corpora were scrutinised by Clark and Tree (2002), and they opined that various disfluencies carry out discrete and precise functions. The use of filled pauses (for e.g., uh & um) were acknowledged as a sign of difficulty experienced by the speaker. Explicitly, they suggested that uh signals an imminent insignificant delay and that um signals an imminent significant delay.

However, empirical evidence by Oviatt (1995) as well as Finlayson, Lickley, and Corley (2010) suggested that disfluencies are more often resultant of impediments in the production system, than being deliberate signals of delay as reported by Clark and Tree (2002).

Thus, a conflict emerged across the researchers over time in distinguishing the hesitation phenomena and disfluencies. There have been considerable points of overlap in the type of disfluencies demonstrated within the stuttered and normal speech samples studied by various researchers.

Hence, there arose a need to distinguish the type of disfluencies exhibited by normal individuals and those by individuals with stuttering. Several researchers came up with various markers in speech which could distinguish the disfluencies of normal speakers and persons with stuttering.

For example, Love and Jeffress (1971) as well as Zerbin (1973) described an increased occurrence of miniscule (unfilled) pauses in the fluent speech of individuals with stuttering than that of individuals without stuttering. Similarly, Wingate (1987) described dissimilarities in filled-unfilled pause interactions in samples of spontaneous speech of individuals with stuttering and that of normal individuals.

Importance of studying disfluencies

According to Tree (1995), schemes of parsing are often intended to consider merely the grammatical or "well-formed utterances". Disfluencies often position themselves as a challenge for these theories. According to several researchers, valuable information about the organization of speech production system and its limitations can be obtained if divergences from normally fluent and grammatical speech are explained (MacKay, 1970, 1972, 1973; Garrett, 1975; Dell, 1986; Levelt, 1989).

In some conditions disfluencies would offer metalinguistic evidence to the listeners about the speaker's sureness (Brennan & Williams, 1995). It can also provide information to the listener about inform listeners about impediments faced by a speaker in planning an utterance (Schachter *et al.,* 1991; Brennan & Schober, 2001). Also these disfluencies function as strategies for synchronising the conversational collaboration (Brennan & Kipp, 1996; Shriberg, 1996).

Moreover, natural speech encompasses various disfluencies which presents with difficulties for speech recognition systems (Oviatt, 1995; Shriberg, 1996). According to Bortfeld *et al.,* (2001), several factors have been identified to impact the rate of disfluencies such as the speaker's age, task role (director vs. performer), task difficulty (describing abstract shapes vs. photographs), familiarity of speaker and listener, as well as gender.

With respect to age; Sandson, Obler, and Albert (1987), reported that older adults pose greater difficulties on word retrieval and hence, they demonstrate significantly higher number of disfluencies compared to that of young and middle-aged adults (Bortfeld *et al.,* 2001).

With respect to the task role and difficulty, several distributional differences were identified among the various types of disfluencies. These were more evident for filled pauses.

With respect to gender, studies have revealed that males often produce a higher number of filled pauses and repetitions compared to that of females (Bortfeld *et al.,* 2001). Nevertheless, the genders did not show a difference in the rate of production of repairs.

According to Bortfeld *et al.,* (2001) speech becomes disfluent because of several factors such as processing load, coordination functions, familiar v/s unfamiliar conversational partners, age, and gender.

Given that there are multiple factors that affect the disfluencies, it might be that various disfluencies are linked to specific processes, such as cognitive planning capacity as well as synchronisation of communication.

Measurement of Disfluencies

For the assessment of stuttering and to denote the disfluencies, the common clinically used speech samples are obtained in the contexts of conversation, monologue, picture description, and oral reading. Within the limited literature available on older speakers, conversational speech samples have been a central focus in examining disfluencies (Pindzola, 1990; Bortfeld *et al.,* 2001; Horton, Spieler, & Shriberg, 2010) using common themes such as jobs, family, hobbies or interests (Duchin, & Mysak, 1987; Pindzola, 1990; Bortfeld *et al.,* 2001).

Yairi and Clifton (1972) used a picture description task to elicit spontaneous speech in nonstuttering preschool students, high school students, and older individuals

while Spieler and Griffin (2006) used a picture naming task to also examine the relationship between age and normal disfluencies.

Measuring disfluencies across speech sample tasks has been used in studies to demonstrate a comparison in different speaking situations (Duchin & Mysak, 1987; Mulligans, Anderson, Jones, Williams, & Donaldson, 2001).

Bortfeld *et al.,* (2001) investigated the effects of age of the speaker, task roles, topic domain complexity, relationships between speakers and gender. It was revealed that, elder speakers had marginally elevated disfluency rates than that of younger and middle-aged speakers. Disfluencies were found to be associated positively with planning difficulty as the rates of disfluencies increased when speakers assumed the role of directors and abstract figures were described. Use of fillers, either as a source for, or as a result of interpersonal coordination was supported as the use of fillers (such as uh) was scattered compared to that of repetitions or revisions.

Roberts, Meltzer and Wilding (2009) using various speaking tasks and topics; upheld the findings of Lutz and Mallard (1986) as well as Duchin and Mysak (1987) that interjections and revisions were the most frequently occurring types of disfluency. Also, they did not find any noteworthy dissimilarity in total disfluencies or in within word disfluencies among the various topics and different sample lengths studied; similar to those reported in earlier literature by Logan and Haj-tas (2007).

Language and disfluencies

Several theories formulated in the past have proposed that disfluencies in speech are at least in part associated to some attributes of language formulation. A shared characteristic of these theories is the suggestion of an elementary mechanism that is accountable for disfluency in individuals who stutter as well as normals.

Wingate's (1988) "fault-line" hypothesis suggests that "disfluencies occur when a speaker has difficulty planning the transition from a syllable onset to the rime at the beginnings of words."

The neuropsycholinguistic theory (Perkins, Kent, & Curlee, 1991) examines language influences in an altered manner and suggests that disfluencies arise when several parts of language formulation are not appropriately organized or combined preceding speech production.

However, the Covert Repair Hypothesis (Postma & Kolk, 1993), put forward speech disfluencies as the resultant of typical repair procedures that speakers employ when errors which emerge during the formulation of a phonetic plan are identified.

Even though each of these theories propose a distinctive mechanism for elucidating the manifestation of disfluencies in speech, they are alike in identification of language formulation as the major basis for the occurrence of speech disfluencies in individuals who stutter as well as in individuals who are typically fluent.

Kemper (1992) carried out a study on natural speech of healthy adults amidst 50 to 90 years of age. Examination of several different measures involving syntax, tense, form class, lexical use and disfluency were carried out. Attentional and memory limitations were attributed to the poor performance of elder individuals on syntactic, tense and form class measures.

Factors affecting Disfluencies

Many demographic and situational factors have been observed to affect the disfluencies produced in normal speakers.

1. Ageing and Disfluencies

In earlier days, information about speech fluency was derived more from the study of disfluencies in children. Fluency emerges simultaneously with the development of other domains such as speech, language, intellect and neuro-motor maturation.

It was until Yairi and Clifton (1972) pointed out that "studies of age-related changes in fluency have completely failed to consider one group of subjects i.e., geriatric persons" fluency became an area of speech production that needed to be investigated further in the older age group.

Despite several anatomical and physiological changes which accompany ageing, many of the elderly individuals generate normal-sounding speech. But, the way in which normal-sounding speech is produced by these individuals differ in comparison to that of younger individuals (Sonies & Caruso, 1990).

Variations in cognitive, motor and perceptual operations due to advancing age can impact speech in several significant ways. Elder individuals have been found to demonstrate higher difficulty in word retrieval than younger individuals (Burke, MacKay, Worthley, & Wade, 1991; Rastle & Burke, 1996). However, the capability to describe words continue to be intact and can also demonstrate improvement with advancing age (Sandson *et al.*, 1987).

Yairi and Clifton (1972) as well as Gordon, Hutchinson, and Allen (1976) reported of increase in typical fluency breaks as individuals advance to late adulthood. Explicitly, they reported higher frequency of interjections, fillers, and revisions of comparatively greater grammatical units (for e.g., words or phrases).

Picture description task was employed by Shewan and Henderson, (1988) to examine the effect of age related changes on speech. It was found that, speakers in their

forties were more competent than individuals from fifties till seventies. It was also revealed that the messages of older speakers had less content per unit time compared to younger speakers. Obler, Woodward and Albert, (1984), reported that individuals above the age of 50 makes use of more decorative syntactic forms compared to that of younger individuals. Thus, such age related changes make conversation more effortful and ultimately leads to increased rates of disfluencies.

Older individuals have been found to demonstrate increased disfluency rates with respect to repetitions, restarts, and fillers than younger individuals (Albert, 1980; Christensen, Hutchinson, Nerbonne, & Schow 1978)

Manning and Monte (1981) suggested an upsurge in the usage of fillers and interjections along with increase in age. They perceptually analysed the speech of 40 normal individuals and 4 individuals with stuttering who were above the 50 years of age. Disruptions in fluency were categorised as formulative or motoric disruptions. Their findings were in cohesion with earlier reported literature that, the formulative fluency disruptions were higher for older speakers. These included fillers as well as interjections. However, a substantial reduction in the demonstration of such formulative fluency disruptions were observed during later years of late adulthood. No alterations were observed in the motoric fluency breaks in normal individuals. However, it was found that, individuals with stuttering had considerably less fluency disruptions and substantially more motoric disruptions than normal individuals.

However, Bortfeld *et al.,* (2001) reported that elder individuals demonstrated only marginally greater disfluency rates when compared to younger and middle-aged individuals.

On the contrary, Shewan and Henderson (1988) reported of no resolute differences in the disfluencies exhibited by individuals of different age groups.

However, their study compared only the production of repetitions by individuals of different age groups.

Duchin and Mysak (1987) investigated the disfluency and rate variations in the speech of young adults, middle-aged, and older adult males. The study was aimed at understanding the variances among groups in rate of speech and that of seven measures of disfluency during tasks such as oral reading, picture description, and conversational speech. Considerable difference was found in the speech rate across the young adults, middle aged and older adult groups. Irrespective of age, task of oral reading had highest rate of speech followed by conversation task and picture description task. However, the levels of disfluency did not show differences between the different age groups.

Caruso, McClowry, and Max (1997) carried out a review of the changes with ageing in the fluency of normal individuals. Majority of the studies concurred that younger and older adults demonstrated similar occurrences of disfluencies. They summarised that ageing alone does not pose a significant threat to disrupt the fluency of elder individuals compared to that of the younger individuals. However, they opined that factors resulting in stressful situations can make the elderly individuals more disfluent than younger individuals.

Horton, Spieler and Shriberg (2010) analysed a corpus to delineate the prototypes of age related variations in conversational speech. They examined the speech of over three hundred individuals within the age of 17 to 68. These were scrutinized for changes in the timing and contents of speech with respect to age of the individual. They found multiple associations across the lexical content, the timing as well as the fluency of speech. It was revealed that unique and less occurring words were linked to reduced rate of speech and increased percentage of disfluencies. Age of the individual was found to be a determining factor for the rate of speech as well as for pauses especially those

related to that of lexical selection. With increasing age, rate of speech was identified to reduce and the frequency of filled pauses increased. Also, lengthier utterances and larger lexical assortment was demonstrated with increasing age.

Andrade and Martins (2010) attempted to validate fluency characteristics of older individuals on several fluency aspects. Samples were obtained from the subjects and were scrutinized for the type and frequency of disfluencies as well as the rate of speech. Subjects were grouped based on their decade of life and those above 80 were considered as a single group. It was revealed that the rate of speech differed significantly across subjects of younger decades compared to that of subjects above 80 years of age. Subjects above the age of 80 demonstrated an increased frequency of disfluencies and a lower rate of speech. They summarized that the effect of ageing becomes more evident after 80 years of age with respect to the parameters examined.

Literature presents sufficient evidence that the production of language declines with age and is often attributed to phonological retrieval deficits than articulatory or motor planning difficulties. Authors such as Schmitter-Edgecombe *et al.,* (2000), Bortfeld *et al.,* (2001), have suggested that hesitations, word repetitions, revisions and filled pauses are demonstrated by elder individuals in contrast to younger individuals and these have been explained by the difficulties in retrieving words by the elder individuals.

MacKay and James (2004) found that elder adults omitted phonemes or syllables than young adults in a task where speech errors were induced experimentally. The pattern of these errors explained the phonological retrieval deficits seen in elder adults.

Another area studied with respect to older individuals is the effect of tip of the tongue (TOT) experiences on ageing. TOT has been defined by Brown and McNeill

(1966) as “a failure to recall a word of which one has knowledge and a time when recall is felt imminent”.

Heine, Ober, and Shenaut (1999) carried out investigations on the TOT phenomenon. Subjects were divided into three groups *viz*., young, middle and older age groups. Each group comprised of 30 participants. Two experiments were carried out. First experiment consisted of inducing TOT experiences with the use of definitions. This was also supplemented by orthographic or semantic cues if required. Significant differences were observed across all age groups for TOT experiences and the resolving time for TOT experiences except for the young vs. middle age groups. Second experiment consisted of the same participants recording natural TOT experiences in a structured format for a period of 4 weeks. It was revealed that the frequency of occurrence of TOT experiences and the resolving time for TOT experiences increased with age. Authors summarized that ageing considerably intensifies TOT occurrences and the resolving time for TOT.

Mortensen, Meyer and Humphreys (2006) carried out a review on the effect of age on speech production. Elder adults were found to be more loquacious as well as disfluent in their utterances than that of younger adults within discourse. This was more evident in difficult tasks and when fewer restraints were placed on content of the utterance. This was assumed to result either from specific deficits in planning the content and syntactic structure of utterances as well as in choosing and retrieving words from the mental lexicon; or from a broad deficit in supressing insignificant information; or selecting an apt speech style. Picture naming studies provided evidence to the lexical retrieval deficits in elder adults, which showed diminished accuracy as well as rate of naming compared to younger adults. Definition naming studies also provide evidence to the lexical retrieval deficits in elder adults, wherein more TOT experiences were

reported for elder adults than younger adults. Lexical Retrieval deficits have been explained by the waning of those connections that link the word lemma to that of phonological forms along with difficulties in lemma selection.

Possibly, the utmost convincing proof for the decline in phonological processes with age are from the TOT studies. TOT has been described as a strong instance of word retrieval failure (Brown & McNeill, 1966).

Several studies have evidenced rise in TOT with respect to age through the use of natural TOT experiences and experimentally induced TOT experiences. (e.g., Heine, Ober, & Shenaut, 1999; Evrard, 2002; James, 2006; Mortensen, Meyer & Humphreys, 2006).

Transmission deficit hypothesis

Several authors have posited differential effects of ageing on language production and comprehension. Transmission deficit hypothesis (TDH), is one such hypothesis entrenched within the node structure theory (MacKay, 1987; MacKay & Burke, 1990; Burke, MacKay, & James, 2000).

According to TDH, verbal information is depicted as a grid of organised entities or nodes systematized to a semantic scheme and a phonological scheme. The semantic scheme represents the etymological and propositional meaning, whereas the phonological scheme represents the speech sounds. TDH is primarily involved in predicting the frequency of error and the onset time for production. These are two processes mutual to comprehension as well as production tasks.

According to MacKay and Burke, (1990) three factors influences the priming spread within TDH. These are time elapsed from the recent activation of a node, frequency of activation of the nodes and ageing.

Ageing has been known to significantly reduce the spread of prime amidst the connections within the whole system.

Therefore, the consequences of age will be maximum when a specific node decisive to a particular task obtains prime only from a unique source or association within the system. If that connection becomes faulty, then the specific node will find it challenging to activate as no other sources can supplement the decreased priming over that connection. Hence, this will manifest as increased number of errors as well as production onset time.

Thus, TDH envisages subtle or very minimal age related insufficiencies in understanding at phonological as well as lexical levels, notwithstanding enormous age related insufficiencies for expression.

Within TDH, TOT have been explained as a result of fragile networks that communicate inadequate priming for effective top-down triggering of phonology. Elder adults were found to recall, less and incomplete phonological information during TOT experiences when compared to younger adults (Burke *et al.*, 1991; Brown & Nix, 1996; Heine *et al.*, 1999).

Likewise, preceding productions of phonologically associated words (e.g., treasure) curtailed the occurrences of TOT for a given target word (e.g., trellis). Also, while experiencing a TOT, production of phonologically associated words improved the resolving of TOT phenomenon for younger and elder adults (James & Burke, 2000; White & Abrams, 2002). In comparison, the expression of semantically associated prime words did not influence TOT (Cross & Burke, 2004).

TDH provides a suitable outline for investigating the consequences of age on the neural substrate for several constituents of language. This further permits us to

identify the precise language processes that are implicated in affecting and sparing some language domains with ageing.

Weathersby (2016) studied 115 New Zealand English speakers with the age range of 64-91 years to attain reference data for fluency. Conversation as well as reading tasks were made use to determine the frequencies of stuttering like as well as normal disfluencies. The impact of several factors such as age, gender, education and cognitive status on disfluencies were also checked for. It was revealed that stuttering like and normal disfluencies did not differ with respect to age in conversation task. However, a subtle yet noteworthy increase was found for reading tasks with respect to normal disfluencies. Gender and education showed no significant relationship with overall disfluencies yielded with respect to age. But individuals with better cognitive status were found to have considerably lesser disfluencies. They concluded that, age, gender, education, and cognitive status were noteworthy predictors of normal disfluencies than stuttering-like disfluencies.

2. Coordination functions

The typical occurrence of disfluencies in the initial part of utterances have been explained by the usage of speakers to synchronise interaction (Shriberg, 1996).

Shriberg (1996) found that the rates of fillers did not correlate with the length of sentence and hence, they would not be related to the higher load put forth by planning as in the case of other disfluencies.

Tree and Clark (1997) reported that several disfluencies for e.g., fillers have a communicative function by offering information which helps the communication partners to coordinate their interaction, take turns and to align their mental states.

For example, time being managed jointly by partners in communication often involves trade-offs. Longer time for utterances can risk in dropping the attention of the partner whereas rushing to finish the utterance can result in being misinterpreted (Clark & Brennan, 1991). Hence several fillers such as um, or uh are used to signal for the lags in producing the utterance.

Another evidence for this comes from speakers who answer questions that check for their knowledge. They explicitly provide information on the enduring mental search process. Comparatively, lengthier pauses and increased use of fillers precede prior to an answer with lack of confidence than an answer with confidence. Also lengthier pauses and higher usage of fillers have been demonstrated by individuals when they find it difficult to retrieve the answer. This metacognitive demonstration is often utilised by listeners, to evaluate how probable the speaker is aware of the right response (Brennan & Williams, 1995).

According to Brennan and Schober (2001), mistakes from the part of speaker can also be recognized by a listener by attending to the fillers. This is because of the extra time that comes up as the filler is being uttered, following the mistake production. Thus, disfluencies function as a signal by the speaker that caution listener of or account for lags and difficulties in speaking.

Yet another way of making use of fillers in conversational speech is in assisting communicative partners for taking their turns. Maclay and Osgood (1959) hypothesized that fillers function as turn keeping signals which blocks the communication partner from interposing the speaker with a new turn. This has been supported by the findings of Carletta, Caley, and Isard (1995) however; several others have questioned the evidence for this hypothesis (Cook & Lalljee, 1970).

3. Familiar versus unfamiliar conversational partners

Branigan, Lickley and McKelvie (1999) reported that there are at least two different ways in which familiarity could influence the rate of disfluencies. Firstly, the speaker tend to be extra cautious and obliging while conversing with an unfamiliar partner. This would be manifested as a higher tendency to plan the utterance prior to speaking. Hence, it yields reduced rates of disfluencies with unfamiliar partners than familiar partners. On the other hand, reduction in anxiety by being familiar to the communication partner can manifest as reduced rates of disfluencies with familiar communication partners. The awareness about the style of speech of the partner as well as the turn taking dynamics can also account for reduced rates of disfluencies in conversations between familiar partners.

The Schober and Carstensen (2001) corpus provides evidence to scrutinize whether individuals are more or less disfluent while conversing with unfamiliar partners than while conversing with their spouses. However, the evidence was found to be indistinct.

More disfluencies are expected with unfamiliar than familiar partners due to anxiousness as higher rates of disfluencies has been linked with anxiety (Mahl, 1987).

However, as disfluencies function as coordinating devices, speakers could be more disfluent with familiar partners as familiar partners might reveal more of their planning difficulties to each other and depend on each other for help as talking to unfamiliar partners might involve planning what to say to each other more cautiously.

Even though there is meagre evidence, research involving comparison of speech with computers to that of humans could be relevant in this context. Computer partners may function as similar to unfamiliar partners.

Oviatt (1995) as well as Shriberg (1996) have found that individuals tend to exhibit reduced number of disfluencies with computers than with people; if this can be equated to unfamiliar partners, reduced disfluencies with unfamiliar partners than familiar partners can be anticipated.

4. Gender

Gender differences in disfluencies produced by persons with no stuttering is not as well defined as persons with stuttering. Studies examining a relationship between gender and disfluencies in normally fluent people have provided conflicting results.

Shriberg (1996), reported that males exhibited a higher number of fillers than females. However, both the genders were found to be akin with respect to other types of disfluencies. However, in her study, variable of gender was not balanced with socioeconomic status. She cautiously suggests that the increased number of usage of fillers by males tend to be their way to hold on to the conversational flow.

Manning and Monte (1981) reported no differences in the number of formulative breaks/normal disfluencies in across gender in persons who do not stutter. However results were not provided to support this statement.

Bortfeld *et al.,* (2001) examined the effect of gender on disfluency. The results revealed that men produced a higher rate of disfluencies overall per 100 words (6.80) than women (5.12) and also found that fillers (e.g., “uh”) were produced more frequently in men, measured by frequency of fillers per word.

5. Language complexity and Processing Load

Various errors in speech as well as disfluencies produced by the normal speakers have been considered to look into the intermediary products of language processing and

cognitive processes of speech planning. Several studies have been carried out which links disfluencies to higher processing loads.

Bortfeld *et al.,* (2001) reported that young adults, compared to elderly speakers demonstrate an increased occurrence of fillers within the syntactic phrases and not between the syntactic phrases wherein fillers could sign the intent to maintain speaking. These syntactic phrase boundaries were identified to have more chances of word finding difficulties.

Kemper *et al.,* (2003) attempted to investigate the effects of length, grammatical complexity, and propositional content among young and elderly speakers. In first experiment the subjects were given with two to four words and were asked to frame a sentence with the given words. With increasing number of words, elderly speakers became more erroneous. It was also found that for increased number of words, the responses from elderly speakers became briefer and condensed than younger speakers. Second experiment consisted of contrasting simple intransitive, transitive, and complement-taking verbs. Intransitive as well as transitive verbs yielded similar performance from younger and elderly speakers. On complement taking verbs, younger speakers were able to come up with complex utterances whereas elderly speakers produced simpler and less complex utterances along with several errors.

Both experiments revealed that elderly speakers respond more gradually than younger speakers. They came to the conclusion that ageing influences production of sentences in reply to explicit manipulation of the load on memory as well as implicit memory load created by complex verbs. These manifest as briefer and condensed sentences by the elderly individuals.

Burke and Shafto (2008) commented that dysfluencies are faults in speech which disturb the course of speech and look as if to point to a word retrieval difficulty.

In their study, while describing a picture or another stimuli, elderly speakers came up with an increased frequency of lexical as well non lexical fillers along with repetitions of words, longer pauses and null words compared to younger speakers. The increased occurrences of dysfluencies in older speakers have been inferred as strategies to procure time for finding appropriate words.

Altogether, the speech error data gives confirmation for an upsurge in the lexical and phonological retrieval deficits with increasing age. These are also constant with age related transmission difficulties which affect the expression of language.

Oviatt (1995) carried out a study wherein disfluencies within six types of task-oriented conversations were analysed. It was found that long utterances demonstrated higher rates of disfluencies than shorter ones. The results of this study were corroborated by that of Shriberg (1996) who found that within the three types of task oriented conversations analysed, longer sentences had higher chances of being disfluent.

The connection of disfluencies and planning load has been constant with outcomes that disfluencies occur more at the openings of turns or sentences. These locations apparently tend to have increased efforts in planning. Boomer (1965), reported of higher incidence of fillers and silent pauses, whereas Shriberg (1996) identified further disfluencies as well.

Planning load can vary even depending on the topic or domain of the conversation. (Bortfeld *et al.*, 2001).

Cognitive Effort and Disfluencies

According to Griffin and Spieler, (2006), “Connected speech involves various cognitive systems and lexical retrieval in context is thus affected not only by the

mechanisms that affect single-word retrieval (e.g., semantics, phonology) but also by communication goals, syntax, the location of a word within a sentence, speed, timing, working memory, or advanced planning."

According to Craik and Rose (2012), investigations on variations in memory in elderly point to the fact that age linked decline in the processing sources lead to a malfunctioning to undertake self-initiated mental operations. However, these malfunctions often go unnoticed as context facilitates such operations.

Speech disfluencies have been shown to be the predictors of cognitive effort due to the lexical or semantic uncertainty, planning and production problems.

The Stroop Color Word Task is a firm and greatly demanding cognitive task. Caruso *et al.,* (1991) found that older individuals, came up with considerably higher number of disfluencies within the increased stress (stroop) than during the reduced stress conditions. Caruso *et al.,* (1997) successfully replicated the stroop experiment with individuals who stutter. It yielded similar results to those obtained for older subjects. The prolonged time required by senescent adults and young adults with stuttering for organizing the information and/or in executing the movements of the articulators to carry out fluent speech under demanding circumstances are because of different causes. Younger adults with stuttering tend to have prolonged stroop due to a fundamental temporal coordination deficit whereas older individuals perform poorly on stroop due to age- related changes and increased cognitive effort.

Schmitter-Edgecombe *et al.,* (2000) compared performance on spontaneous and constrained naming tests to identify the effect of ageing on word finding. Three groups comprising of 26 subjects each, classified into young middle and older aged individuals and matched in terms of gender and cognitive levels took confrontational naming test as well as a spontaneous discourse test. In the discourse test, older age group

demonstrated considerably more word-retrieval difficulties compared to the younger adults. However, results of picture naming test showed better naming abilities by older individuals due to generational familiarity with the items.

Previous studies with respect to ageing that have made use of discourse tasks have revealed that younger and elderly adults contrast in various word-finding behaviors. Lexical fillers such as “oh” and “well” intensifies with age (Cheung & Kemper, 1992) whereas false starts tend to diminish with age (Kemper, 1992).

Obler and Albert (1981) reported of increased usage of indefinite terms, vague references, and circumlocutions with age on picture description tasks.

Heller and Dobbs (1993) reported that older adults were not as much precise and displayed more ambiguity than younger subjects in video description task.

Schnadt and Corley (2006) conducted two experiments to bring about realistic speech, by manipulating factors which have been believed to impact disfluent productions. Subjects were asked to describe the route followed by a marker over grid of objects linked through one or multiple paths.

In the first experiment manipulation of lexical frequency as well as name agreement of objects were carried out. In the second experiment, visual blurring was introduced with the linguistic characteristics being constant. Increased disfluencies were observed for objects of lower frequency and blurred objects. Prolongations were found to occur most frequently than other disfluencies. Moreover, higher number of paths resulted in increased number of disfluencies primarily comprising of filled pauses and repairs.

Task constraint hypothesis states that controlled tasks of word retrieval, demonstrate fairly reliable age-related deteriorations. Age-linked deteriorations have been demonstrated less reliably for letter fluency tasks, as they are less controlled than

semantic fluency tasks. However, less controlled tasks such as vocabulary definition demonstrate age advantages that permit the subject to compensate for word retrieval difficulties.

Gordon and Kindred (2011) examined word retrieval abilities of healthy younger, middle-aged and older adults. Picture naming, vocabulary definition as well as verbal fluency were examined. They reported significant age linked deteriorations for picture naming as well as verbal fluency tasks. Age advantage was observed for vocabulary definition task. Their findings supported the task constraint hypothesis in part. They suggested a revision of hypothesis in order to consider the effects of constraints on tasks while explaining the age linked declines in lexical retrieval.

Oberle and James (2013) examined how priming impacts younger and elder adults' capabilities to come up with accurate names. Subjects were presented with primes that are phonologically and semantically related to a target name in half of their trials. Associated names improved the expression of targets for both the groups and elder adults showed as much as ability as younger adults in naming. These results were conflicting to postulates of blocking and inhibitory deficit hypotheses, and suggested that an activation centred prototype of memory and language would give an enhanced explanation for retrieval and production of familiar names.

Kavé and Goral (2017) reviewed four main hypotheses: "(1) Significant retrieval difficulties would lead to reduced output in connected speech (2) Significant retrieval difficulties would lead to a more limited lexical variety in connected speech (3) Significant retrieval difficulties would lead to an increase in word substitution errors and in pronoun use as well as to greater dysfluency and hesitation in connected speech (4) Retrieval difficulties on tests of single-word production would be associated with measures of word retrieval in connected speech." However, research on ageing failed

to validate these 4 hypotheses, dissimilar to research carried out in individuals with aphasia that normally did. They summarized that there is only minimal proof for substantial word retrieval insufficiencies in connected speech production in senescence.

Error Detection and Disfluencies

Most of the studies have taken into account various tasks and topics for eliciting speech samples to assess disfluent production. It has been shown that the topic of conversation or description may have an effect on the planning of utterances and its variations. Description of pictures containing errors is one such task that can create originality of the speech that is being premeditated and enunciated. The need to characterize originality can significantly upsurge the load on cognitive mechanism and hence intensify disfluencies.

James and Kooy (2011) attempted to identify the effect of ageing on identification of visual errors in scenes. Visual error detection task was performed by groups of younger and elder adults with 18 subjects in each group. First experiment required the participants to identify and describe the nature of errors which were amalgamated in big, composite visual scenes. Younger subjects identified significantly higher errors than elder subjects. This was however, not a result of age differences in visual abilities or time limitations. The second experiment replicated the difference in age on similar tasks using simpler images with lesser errors. Overall, elder subjects found lesser errors than younger subjects irrespective of the scenes being large and complex or small and simple and irrespective of number of errors. These results revealed the diminished abilities of elder adults to create representation for new information even if the task does not require them to make novel episodic memories.

James *et al.,* (2017) contrasted the performance of speech of young and elder adults on an error detection task. Stimuli consisted of pictures with and without visual errors. Primarily three types of disfluencies were examined for. These were mid-phrase speech fillers (e.g., “It’s a little, um, girl”), repetitions (e.g., “He’s trying to catch the- the birds”), and repairs (e.g., “She- you can see her legs”). It was found that the elder adults demonstrated higher number of mid phrase filler while describing erroneous pictures. These were attributed as reflections of their difficulty in retrieving words and were found to be exclusive disruptions to ongoing fluency of speech. This interaction reflects on the requirement to create and sustain representations of new information that can explicitly impact the speech fluency of an adult speaker. Irrespective of the type of picture, elder subjects demonstrated higher number of repetitions and repairs than younger subjects in concordance with the findings of James and Kooy (2011). These were attributed to common age linked upturns in these disfluencies.

Emotions and Disfluencies

The type and kind of the items that are being labelled can significantly impact the effect of ageing on speech fluency. Fewer studies have been carried out to assess the impact of negative topics on spoken language production comparing accounts of emotional versus non emotional items.

Several researchers have shown that older adults have superior positive emotional understanding and better emotional control than their younger counterparts (e.g., Carstensen & Charles, 1998).

With increasing age, adverse emotions are felt less often (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000), and positive emotions as regularly (Carstensen *et al.*, 2000) if not more regularly (Mroczek & Kolarz, 1998) in day-to-day life.

Socioemotional selectivity theory (Carstensen, 1993, 1995; Carstensen & Charles, 1998; Carstensen, Isaacowitz, & Charles, 1999) explains for these conclusions in motivational expressions, claiming that with age, individuals tend to place comparatively higher value on enthusiastically meaningful targets and hence, capitalize additional cognitive and behavioural assets in procuring them. This higher importance on emotional targets promote the regulation of emotions.

Several studies have revealed that young individuals tend to generally consider negative information profoundly than positive information in making impressions (Kanouse & Hanson, 1972) and decision making (Tversky & Kahneman, 1991), and that negative information is managed more comprehensively and is more challenging to disconfirm (Baumeister, Bratslavsky, Fickenauer, & Vohs, 2001; Rozin & Royzman, 2001).

Some researchers reported that young individuals tend to retain positive information comparatively less in memory than negative information (Dewhurst & Parry, 2000; Mather, Shafir, & Johnson, 2000; Ochsner, 2000).

On the contrary, certain studies even report that younger adults retain positive information superior to negative information (Matlin & Stang, 1978; Taylor, 1991; Walker, Vogl, & Thompson, 1997). These studies which identify younger individuals as biased towards positivity, are primarily those studies which scrutinize memory, for autobiographical or self-relevant materials.

Hence, Baumeister, Bratslavsky, Finkenauer, and Vohs (2001) proposed that even though there is an unconstructiveness bias within memory, it is often responded by self-enhancement procedures that encourage memory for one’s own positive qualities and actions.

However, there are evidences stating that increasing age often results in a change away from negative information (Berntsen, 2001; Berntsen & Rubin, 2002). According to Mather and Johnson, (2000), elderly individuals often point to additional positive abilities and lesser negative abilities to selections they have made than younger individuals, even after regulating for the accuracy of memory.

Furthermore, Almeida (1998) reports that, in ex post facto accounts of psychological anguish felt, elderly adults were found to be less biased to individual negative events than younger individuals.

Even though the performance on various tasks involving positive as well as negative information differs with age, at an older age, negative information finds no advantage in memory than positive information.

Charles, Mather and Carstensen (2003) investigated age related variances in recall as well as recognition memory for positive, negative, as well as neutral stimuli.

First experiment consisted of showing images on a screen to young, middle and elder individuals which was followed by an interference task. The subjects were then asked to recall the images and to identify the images shown previously from a mixture of old and new ones. With increasing age, the comparative number of negative images that were recalled decreased. Recognition memory task also showed a decrease with respect to age for negative pictures.

In the second experiment higher age differences in accuracy of recall and recognition were found for negative images. The results were supported by the socio emotional selectivity theory, which postulates superior investment in emotion regulation over age.

Burbridge *et al.*, (2005) investigated whether negative emotion hampers language production, at least in part by increasing the physiological arousal. Heart beat

rate as well as skin conductance were measured from 35 adults as they responded to questions aimed at negative, positive and neutral responses. It was found that participants demonstrated higher reference errors, increased heart rates, and an increased frequency of non-specific skin conductance responses while conversing emotionally negative contrasted to positive or neutral subjects. These findings are consistent with the premise that one mechanism with which negative valence prejudices language production is through an increase in physiological excitement.

Castro and James (2014) attempted to delineate variances across young and elder adults' spoken language explanations of negative versus neutral pictures. A total of 58 participants grouped into young and older groups of 29 each produced oral picture descriptions of 4 pictures each which were characterized as negative and neutral. These were examined to explain the effect of negative emotional content on spoken language production. It was revealed that, for the elderly individuals, a hike in disfluencies was observed for negative pictures contrasted to the neutral pictures. However, the performance of younger adults did not vary in this contrast. Younger adults demonstrated a faster rate of speech for negative pictures than neutral pictures. However, elder adults did not demonstrate a change in the rate of speech in response to type of picture. Reference errors were infrequent for both groups, but happened more at explanations of negative pictures than neutral. They concluded that negative content can be differentially disrupting to the spoken language production of elderly individuals than younger individuals.

CHAPTER 3

METHOD

Present study was carried out to investigate the possibility of considering disfluencies as a predictor of cognitive effort in ageing. The methodology adopted was as follows:

Participants

A total of 60 participants, comprising of 30 healthy younger adults within the age range of 18 to 30 years (mean age of 24.5±4.5 years) and 30 healthy older adults within the age range of 62 to 82 years (mean age of 69.33 ±6.29 years) participated in the present study. These participants had similar years of education (minimum of matriculation or equivalent).

Inclusionary criteria

- All the participants were native speakers of Malayalam.
- The participants were asked to complete the informed consent form first.
- Only older adults with sound cognitive functioning were selected on the basis of scores on the Mini Mental Status Exam (at least 27) (Folstein, Folstein, & McHugh, 1975).

Exclusionary criteria

- The participants with history of speech, language, hearing or visual problems were excluded from the study.
- Participants with any communication disorder or neurological impairment were excluded from the study.

- WHO-10 disability questions were administered to rule out disabilities if any in the elderly population.

Stimuli

The task chosen was picture description.

Experiment 1

Participants were shown line drawings of six cartoon-like scenes, approximately 8.27 × 11.69″ in size through laptop. Pictures were complex but familiar scenes containing several errors and anomalies (e.g., in a park scene, the dog has only one ear or a bird is flying upturned), and each picture had an identical version with no errors. The pictures selected were not cluttered or visually confusing.

Procedure

Each participant was presented with six pictures with errors and the identical version that contained no errors (n=6). Three out of six pictures contained a total of 10 errors, and the other set contained 5 errors. The picture was held in front of the participant, or was placed on the table at an appropriate viewing distance based on their choice. They were asked to describe each picture entirely, clearly specifying any errors identified. Information on which picture contains error and which does not contain was not given. The participants were provided with a practice picture (containing errors), and their description indicated their understanding of the task. The procedure was video and audio recorded.

Experiment 2

Three pictures categorized as negative and three categorized as neutral, were selected from Thematic Apperception Test (TAT), and were presented through laptop.

The pictures were presented randomly one at a time. The pictures selected presented different non-specific negative emotions since it was not certain that each picture would evoke the same emotional influence on each participant.

Procedure

Participants were asked to describe everything they saw in the picture in as much as detail as possible. The procedure was video and/or audio recorded. The speech sample of each participant was to contain at least 300 syllables, but this was relaxed as to ensure comfortable sample length for elderly individuals.

Analysis

The samples recorded were transcribed and the occurrence of disfluencies were examined. The disfluencies were grouped as Stuttering like Disfluencies (SLD) and Other Disfluencies (OD) as given by Yairi and Ambrose (1992). The Stuttering-like Disfluencies (SLD) include Sound Repetitions, Single Syllable Word Repetitions, Broken Words and Prolongations. Other Disfluencies (OD) include Multi syllabic word repetitions, Phrase repetitions, Interjections and Revisions. The disfluencies were scored based on the speech disfluency types commonly found in previous research across age group (mostly Mid-phrase fillers, Repetitions, Repairs).

The percentage of disfluencies was calculated as follows:

Total number of disfluencies / total number of syllables * 100

The percentage of particular type of disfluency was calculated as follows:

Total number of particular type of disfluency / total number of syllables * 100

The rate of speech of the participants was also measured as the number of syllables per second.

The disfluencies were coded as WOEFP (Percentage of filled pauses occurring in pictures without error), WEFP (Percentage of filled pauses occurring in pictures with error), WOEREP (Percentage of repetitions occurring in pictures without error), WEREP (Percentage of repetitions occurring in pictures with error), WOEREV (Percentage of revisions occurring in pictures without error), WEREV (Percentage of revisions occurring in pictures with error), WOEINCOM (Percentage of incomplete sentences occurring in pictures without error), WEINCOM (Percentage of incomplete sentences occurring in pictures with error), WOETOTAL (Total percentage of disfluencies occurring in pictures without error), WETOTAL (Total percentage of disfluencies occurring in pictures with error), EMOFP (Percentage of filled pauses occurring in pictures with emotional stimuli), NEUFP (Percentage of filled pauses occurring in pictures with neutral stimuli), EMOREP (Percentage of repetitions occurring in pictures with emotional stimuli), NEUREP (Percentage of repetitions occurring in pictures with neutral stimuli), EMOREV (Percentage of revisions occurring in pictures with emotional stimuli), NEUREV (Percentage of revisions occurring in pictures with neutral stimuli), EMOINCOM (Percentage of incomplete sentences occurring in pictures with emotional stimuli), NEUINCOM (Percentage of incomplete sentences occurring in pictures with neutral stimuli), EMOTOTAL (Total percentage of disfluencies occurring in pictures with emotional stimuli), NEUTOTAL (Total percentage of disfluencies occurring in pictures with neutral stimuli) and TOTALSS (Total percentage of disfluencies exhibited by the individual across all the samples collected).

Error analysis was carried out considering the errors made by the older adults compared to younger adults.

Inter-rater reliability

10 % of the sample were transcribed by a different rater and was analyzed to compute inter-rater reliability.

Statistical Analysis

The obtained values for the participants of both the groups were subjected to statistical analysis using SPSS (Version 22), in order to derive:

- ✓ Normality of the sample selected for the study using Shapiro-Wilk test for normality.
- ✓ Descriptive statistics (Mean and standard deviation) of percentage of syllables stuttered for each of the types of disfluencies for various stimuli for both the age groups studied.
- ✓ Influence of age on frequency and type of disfluencies using Mann Whitney U test.
- ✓ Influence of age on frequency and type of disfluencies with respect to pictures with errors and without error using Wilcoxon Signed Ranks Test.
- ✓ Influence of age on frequency and type of disfluencies with respect to pictures involving emotional and neutral stimuli using Wilcoxon Signed Ranks Test.
- ✓ Influence of age on rate of speech of individuals on the picture description task using Mann Whitney U test.
- ✓ Inter-rater reliability of analysis of disfluencies using Cronbach's alpha measures.

CHAPTER 4

RESULTS

This particular study was focused to identify disfluencies as a predictor of cognitive effort in ageing. The results of this study will be discussed under the following headings:

- ✓ Normality check for the data.
- ✓ Mean, standard deviation of disfluencies
- ✓ Influence of age on frequency and type of disfluencies
- ✓ Influence of age on frequency and type of disfluencies with respect to pictures with errors and without error.
- ✓ Influence of age on frequency and type of disfluencies with respect to pictures involving emotional and neutral stimuli.
- ✓ Mean and standard deviation of rate of speech on the picture description task.
- ✓ Influence of age on rate of speech of individuals on the picture description task.
- ✓ Inter-rater reliability of analysis of disfluencies

Normality check for the data

In order to determine the normality of the sample selected for the study Shapiro Wilk's test was carried out with respect to the independent variables: age and picture type. The test revealed that all the parameters did not follow normal distribution ($p<0.05$).

Mean, standard deviation of types of disfluencies

Percentage of syllables stuttered was measured from the sample obtained from 60 individuals (30 younger adults and 30 older adults). Table 4.1 & 4.2 depicts the mean and standard deviation of percentage of various types of disfluencies for description of pictures with error and without error and neutral and emotional pictures respectively. Mean value of Percentage of syllables stuttered for younger adults for pictures with error and without error were found to be 2.00 (±1.41) and 2.09 (±1.52) respectively; whereas older adults had mean values of 3.80 (±1.61) and 3.74 (±1.75) respectively. Similarly, the mean value of percentage of syllables stuttered for younger adults for neutral pictures and emotional pictures were found to be 2.26(±1.92) and 2.19 (±1.71); whereas older adults had mean values of 2.88 (±1.68) and 3.01 (±1.34) respectively. It is to be noted that older adults obtained higher mean values of each of the types of disfluencies (except for filled pauses of emotional stimuli).

Table 4.1 *Mean and SD of percentage of various types of disfluencies by younger and older adults for pictures with error and without error.*

Parameter	**Young adults***		**Older Adults***	
	Pictures without error	Pictures with error	Pictures without error	Pictures with error
	Mean (±SD)	Mean (±SD)	Mean (SD)	Mean (±SD)
Filled Pause	1.38 (±1.33)	1.20 (±1.01)	1.74 (±1.19)	1.66 (±0.94)
Repetition (Word/Phrase)	0.37 (±0.30)	0.43 (±0.33)	0.99 (±0.69)	1.04 (±0.63)
Revision/Repairs	0.28 (±0.42)	0.33 (±0.37)	0.83 (±0.44)	0.88 (±0.67)
Incomplete sentences	0.04 (±0.10)	0.03 (±0.07)	0.16 (±0.23)	0.20 (±0.25)
Total %SS	2.09 (±1.52)	2.00 (±1.41)	3.74 (±1.75)	3.80 (±1.61)

*n=30

Table 4.2 *Mean and SD of percentage of various types of disfluencies by younger and older adults for pictures with emotional and neutral stimuli.*

Parameter	Young adults*		Older Adults*	
	Neutral	Emotional	Neutral	Emotional
	Mean (±SD)	Mean (±SD)	Mean (SD)	Mean (±SD)
Filled Pause	1.37 (±1.45)	1.42 (±1.46)	1.49 (±1.19)	1.39 (±0.92)
Repetition (Word/Phrase)	0.39 (±0.33)	0.29 (±0.23)	0.79 (±0.60)	0.73 (±0.63)
Revision/Repairs	0.44 (±0.48)	0.42 (±0.54)	0.49 (±0.35)	0.82 (±0.57)
Incomplete sentences	0.05 (±0.12)	0.03 (±0.09)	0.10 (±0.25)	0.05 (±0.12)
Total %SS	2.26 (±1.92)	2.19 (±1.71)	2.88 (±1.68)	3.01 (±1.34)

*n=30

Influence of age on frequency and type of disfluencies

Non parametric Mann Whitney U test was carried out to see the significant difference between younger adults and older adults. The results of Mann Whitney U test are summarized in table 4.3.

Table 4.3 *Influence of age on frequency and type of disfluencies*

Stimuli	Variables	Z value	*p*-value
Pictures with error and without error	WOEFP	-1.722	0.085
	WEFP	-2.218	0.027*
	WOEREP	-4.143	0.000*
	WEREP	-3.860	0.000*
	WOEREV	-4.709	0.000*
	WEREV	-3.525	0.000*
	WOEINCOM	-2.776	0.006*
	WEINCOM	3.748	0.000*
	WOETOTAL	-3.637	0.000*
	WETOTAL	-4.154	0.000*
Pictures with emotional and neutral stimuli	EMOFP	-0.695	0.487
	NEUFP	-0.895	0.371
	EMOREP	-2.699	0.007*
	NEUREP	-2.769	0.006*
	EMOREV	-2.906	0.004*
	NEUREV	-1.040	0.298
	EMOINCOM	-0.190	0.849
	NEUINCOM	-0.460	0.645
	EMOTOTAL	-2.706	0.007*
	NEUTOTAL	-1.855	0.064
	TOTALSS	-3.267	0.001*

*Significant at 0.05 level, WOEFP/WEFP= Without error/With error filled pauses, WOEREP/WEREP= Without error/With error repetitions, WOEREV/WEREV= Without error/With error revisions, WOEINCOM/WEINCOM= Without error/With error incomplete sentences, WOETOTAL/WETOTAL= Without error/With error total disfluencies, EMOFP/NEUFP= Emotional/Neutral filled pauses, EMOREP/NEUREP= Emotional/Neutral repetitions, EMOREV/NEUREV= Emotional/Neutral revisions, EMOINCOM/NEUINCOM= Emotional/Neutral incomplete sentences, EMOTOTAL/NEUTOTAL= Emotional/Neutral total disfluencies, TOTALSS= Total percentage of disfluencies across all types of stimuli.

It was revealed that the variables, WEFP (Z = -2.218, p<0.05), WOEREP (Z = -4.143, p<0.05), WEREP (Z = -3.860, p<0.05), WOEREV (Z = -4.709, p<0.05), WEREV (Z = -3.525, p<0.05), WOEINCOM (Z = -2.776, p<0.05), WEINCOM (Z = -3.748, p<0.05), WOETOTAL (Z = -3.637, p<0.05), WETOTAL (Z = -4.154, p<0.05), EMOREP (Z = -2.699, p<0.05), NEUREP (Z = -2.769, p<0.05), EMOREV (Z = -2.906, p<0.05), EMOTOTAL (Z = -2.706, p<0.05), TOTALSS (Z = -3.267, p<0.05) were significantly different across the age groups with older adults exhibiting higher percentage of disfluencies than younger adults.

Influence of age on disfluencies in pictures with errors and without error (Within age group comparison)

Further, Wilcoxon signed ranks test was carried out to see the significant difference between pictures with error and without error within the age groups, the results of which are summarized in tables 4.4 and 4.5. No significant differences were found for both the age groups across pictures with errors and pictures without errors.

Table 4.4 *Z value and p-value for younger adults on pictures with and without errors*

Parameters	Z value	*p*-value
Filled Pauses	-1.121	0.262
Repetition (Word/Phrase)	-0.339	0.734
Revisions/Repairs	-0.426	0.670
Incomplete sentences	-0.059	0.953
Total	-0.936	0.349

Note. n=30

Table 4.5 *Z value and p-value for older adults on pictures with and without errors*

Parameters	Z value	*p*-value
Filled Pauses	-0.360	0.719
Repetition (Word/Phrase)	-0.141	0.888
Revisions/Repairs	-0.031	0.975
Incomplete sentences	-1.120	0.263
Total	-0.216	0.829

Note. n=30

Influence of age on disfluencies in pictures involving emotional and neutral stimuli (Within age group comparison)

Further, Wilcoxon signed ranks test was carried out to see the significant difference between pictures with emotional and neutral stimuli within the age groups, the results of which are summarized in tables 4.6 and 4.7. No significant differences in disfluencies were found for both the age groups across pictures with emotional and neutral stimuli except for a higher occurrence of revisions in emotional pictures compared to that of neutral pictures (Z= -3.074, $p<0.05$) for older adults.

Table 4.6 *Z value and p-value for younger adults on emotional and neutral pictures*

Parameters	Z value	*p*-value
Filled Pauses	-0.296	0.767
Repetition (Word/Phrase)	-1.249	0.212
Revisions/Repairs	-0.140	0.889
Incomplete sentences	-0.445	0.656
Total	-0.874	0.382

Note. n=30

Table 4.7 *Z value and p-value for older adults on emotional and neutral pictures*

Parameters	Z value	*p*-value
Filled Pauses	-0.936	0.349
Repetition (Word/Phrase)	-0.941	0.347
Revisions/Repairs	-3.074	0.02*
Incomplete sentences	-0.549	0.583
Total	-0.689	0.491

*Note.** Significant at 0.05 level, n=30

Mean, standard deviation of rate of speech on the picture description task

Rate of speech (syllables per second) was measured from the sample obtained from 60 individuals (30 younger adults and 30 older adults). Table 4.8 depicts the mean and standard deviation of percentage of rate of speech in syllables per second for description of pictures involved in both the experiments.

Table 4.8 *Overall rate of speech in syllables per second for younger & older adults for picture description task.*

Parameter	Young adults*	Older Adults*
	Mean (±SD)	Mean (SD)
Rate of Speech (Syllables/Second)	4.30 (±0.54)	2.37 (±0.56)

*n=30

Influence of age on rate of speech of individuals on the picture description task

Non parametric Mann Whitney U test was carried out to see the significant difference on age between younger adults and older adults. The results of Mann Whitney U test as summarized in table 4.9 revealed significant differences across the age groups in their rate of speech (Z= -6.490, $p<0.05$). Older adults were found to have significantly slower rate of speech compared to that of younger adults.

Table 4.9 *Influence of age on rate of speech*

Variables	Z value	*p*-value
Rate of Speech	-6.490	0.000*

* Significant at 0.05 level

Inter-rater reliability of analysis of disfluencies

In order to obtain the inter-rater reliability of the analysis of disfluencies, 10% of randomly selected samples were transcribed and analyzed by a different rater. The reliability coefficient (Cronbach's alpha-α) was calculated using SPSS which was found to be 0.903. Given that the cronbach's alpha (α) measure was found to be above 0.9, it is indicated that the analysis is adequately reliable.

CHAPTER 5

DISCUSSION

Age related changes can affect speech fluency in several ways. When compared to younger adults, older adults tend to exhibit more difficulty in the retrieval of words, (Sandson *et al.,* 1987) as well as planning and execution of utterances. Hence, older adults produce considerably greater number of disfluencies when compared to younger and middle-aged adults (Shewan & Henderson, 1988; Bortfeld *et al.,* 2001).

This particular study was focused to identify disfluencies as a predictor of cognitive effort in ageing. Increased levels of cognitive stress may lead to considerable decrement in fluency among the older than in younger adults. This was examined under two experimental conditions wherein 60 participants (30 younger adults and 30 older adults) described pictures involving errors and without errors as well as pictures with emotional and neutral stimuli.

Disfluencies across age groups for pictures with error and without errors

All parameters showed significant difference ($p<0.05$) across both age groups in pictures involving error and without error except for filled pauses. This might be attributed to the fact that general differences in ageing are reflected in almost every disfluency. This is supported by the Transmission Deficit Hypothesis (MacKay & Burke, 1990), according to which, when encountered with novel information, older adults find it difficult to prime novel stimuli to existing representations. This in turn leads to difficulty in retrieving words, word repetitions, and incomplete sentences. Another explanation for significant differences in disfluencies across both the age groups could be that older adults tend to produce higher disfluencies when encountering

a stressful situation (Caruso, McClowry, & Max, 1997; Ringel & Chodzko-Zajko, 1990). Pictures with error can act as cognitively stressful stimuli for the older individuals, hence leading to higher disfluencies compared to that of younger adults.

Participants showed significant differences across age groups only for pictures with error and not for pictures without error for filled pauses. The selective occurrence of filled pauses in pictures involving error could be thought of as the differential response to cognitive load imposed by pictures with error, in the older than in the younger group. Bortfeld *et al.,* (2001) suggested that older adults tend to have difficulty in retrieving words than younger adults which is manifested as filled pauses denoting the time taken to retrieve the information. Similarly, James *et al.,* (2017) found that older adults produce a higher number of mid-phrase fillers when compared to younger adults for similar stimuli involving pictures with and without error. This is attributed to the word retrieval deficits and reduced priming transmission because of age which influences the speech fluency. Novelty which comes up with the errors in pictures, significantly impacts the speech fluency of older adults which is reflected as filled pauses in ongoing speech (James *et al.,* 2017).

Disfluencies across age groups for neutral and emotional pictures

Repetitions were found to be significantly different across both the age groups studied for pictures involving neutral and emotional stimuli. However, revisions were found to be significantly different across the age groups for pictures involving emotional stimuli alone. The remaining disfluencies did not reveal significant differences across both age groups for pictures involving neutral and emotional stimuli. However, total disfluencies revealed significantly higher disfluencies for older adults in pictures involving emotional stimuli.

Older adults showed significantly higher repetitions than younger adults for both neutral and emotional stimuli. This could be due to general cognitive decline in the older adults which leads to poor performance in both the picture types when compared to younger adults. This is supported by the study of Burbridge *et al.*, (2005) who found that older adults tend to produce higher number of disfluencies when compared to younger adults while describing pictures which are emotional in nature. This was explained as a consequence to anxiety which was induced from negative pictures for the older adults.

The significant difference in occurrence of revisions across the age groups for pictures involving emotional stimuli alone are explained by the findings of Mather and Knight (2005), who found that, older adults tend to engage in cognitively challenging emotion regulation strategies when encountered with emotional stimuli. This in turn leads to a depletion of availability of resources for speech production task, leading to revisions of formulated sentences in ongoing speech. The occurrence of higher number of revisions in the older age group is supported by the findings of Engelhardt *et al.,* (2010) as well.

Similarly, according to Burbridge, *et al.,* (2005), as older adults encounter emotional stimuli, they tend to become more disfluent in their speech. This supports the finding of the present study, where the older adults exhibited significantly higher disfluencies while describing emotional pictures than neutral pictures. Castro & James (2014) also reported that when compared to younger adults, older adults tend to exhibit an increased frequency of disfluencies in their speech while describing pictures with negative emotions than while describing neutral pictures. When older adults were forced to describe negative content, their speech became less fluent, whereas the young adults' speech did not. More reference errors were reported to be present during

descriptions of negative than neutral pictures. However in the present study no reference errors were found.

Disfluencies within age groups

While analyzing disfluencies exhibited within the age groups across different types of stimuli, it was revealed that younger adults did not differ significantly in their performance on pictures with and without error as well as pictures involving neutral and emotional stimuli. Likewise, the performance of older adults was also found to be similar for pictures with and without errors. However, it was worth noting that, older adults differed in their manifestation of revisions while describing pictures which involved emotional and neutral stimuli.

Description of emotional pictures bring about more load on the cognitive system which may be manifested as higher incidence of revisions in older adults in accordance with study by Mather and Knight (2005).

Castro and James (2014) reported that older adults tend to make use of less number of emotional words and phrases in their description of emotional pictures when compared to younger adults. This was thought to be the result of use of reconsideration as an emotion-regulation approach by older adults (Urry & Gross, 2010). It can be assumed that this reconsideration by older adults leads to poor speech fluency manifesting as revisions while describing emotional pictures.

Although not significantly different, it was found that, the younger age group, demonstrated higher number of disfluencies *viz.*, filled pauses and incomplete sentences and overall disfluencies while describing, pictures without errors compared to pictures with errors. Similarly, repetitions, revisions, incomplete sentences and overall disfluencies were higher while describing neutral pictures than compared to pictures

involving emotional stimuli. This could be because of the fact that attention tends to facilitate fluency, whereas lack of attention to speech can lead to disfluencies. The participants may have been more attentive while describing pictures involving errors and pictures involving emotional stimuli and less attentive to pictures without errors and neutral pictures. This would have led to a higher number of disfluencies while describing pictures without errors and neutral pictures. This has been corroborated by the findings of Oomen and Postma (2001), who reported that in non-stuttering individuals, production of filled pauses as well as repetitions hiked in the absence of focused attention. Similar findings have been reported by Heitmann, Asbjornsen and Helland (2004) wherein they found that disfluencies were associated with impaired skills to focus attention. Dromey and Shim (2008) also stated that attention has a significant impact on speech tasks involving fluency.

Rate of speech across age groups

Significant difference was noted between younger and older adults in their rate of speech while describing the pictures involved in the study. Older adults were found to have a slower rate of speech when compared to younger individuals. This is in concordance with the findings of Duchin and Mysak (1987) who reported that younger adults demonstrated a faster rate of speech than older adults in both picture description and conversational tasks.

Several cognitive and memory changes, as well as variations in language processing can influence the speech of older individuals (Ulatowska,1985).The task used for both the experiments within the present study was picture description. According to Kemper, Schmalzried, Herman, Leedahl and Mohankumar (2009), this places a higher processing load in the cognitive system for the older individuals with

respect to ideation, word retrieval and other aspects of novel sentence planning. And, as these older adults have difficulties in working memory and a reduced processing speed; they tend to achieve novel sentence formation at the expense of faster rate of speech. This could be thought as one possible explanation for the slower rate of speech in older adults when compared to younger adults.

LaGrone and Spieler, (2006) opined that older adults exhibit a disproportionately slow rate of speech compared to younger adults when several words contest for production. Horton, Spieler and Shriberg (2010) reasoned that this slowness in the rate of speech could be due to the word retrieval difficulties experienced by older adults. This identifies a different reason for the slow rate of speech exhibited by older individuals wherein the difficulty to retrieve a word results in slower rate of speech and not vice versa.

Speech Motor Control is another parameter that can influence the rate of speech. According to van der Merwe (2009), linguistic-symbolic planning is often distinguished from the phases of sensorimotor control. These phases of sensorimotor control involve the planning, programming and execution phases of speech movements. Thus, the functioning of speech motor control system is independent of the cognitive mechanisms. Hooper, and Cralidis, (2009) suggested that with ageing, these phases of sensorimotor control can become prolonged while deriving a speech code; which in turn, results in slower rate of speech. Thus, there exists a possibility that, apart from the cognitive decline associated with ageing, changes in speech motor control system can also result in slow rate of speech.

Thus, this study tried to investigate the disfluencies exhibited by individuals across two age groups while describing pictures with and without errors as well as pictures with emotional and neutral stimuli. In a nutshell, it was revealed that the two

age groups differed only in terms of two disfluencies *viz.*, filled pauses and revisions, owing to differences in their cognitive status. It was also noted that both the groups significantly differed in their rate of speech while describing the picture stimuli.

CHAPTER 6

SUMMARY AND CONCLUSIONS

Age is an important aspect that influences the occurrence of disfluencies in spontaneous speech. Previous literature on disfluencies in younger and older adults have found that the latter group tend to exhibit an increased number of disfluencies owing to their cognitive status (Shewan & Henderson, 1988; Bortfeld *et al.*, 2001). Failure to retrieve words, often leads to filled pauses, whereas difficulty in planning the utterances leads to repetitions and revisions or repairs (Sandson *et al.*, 1987). In past, several studies have been carried out in the Western population to identify disfluencies as a marker of their cognitive status whereas, in the Indian scenario, studies to examine the same have been scanty. Thus, this study was taken up, to identify disfluencies as a possible predictor of cognitive decline with ageing.

This study considered Malayalam speakers within the age range of 18 to 30 years and 62 to 82 years. A total of 60 individuals participated in the study of whom 30 were from the younger age group (18-30 years) and 30 were from the older age group (62-82 years). The participants were asked to describe the pictures presented to them from a laptop for as long as possible in continuous sentences. Two categories of pictures were presented which included pictures with errors and without errors as well as pictures with emotional and neutral content. Within the two categories, pictures were randomized and presented to the participants. The speech samples were audio and video recorded and were transcribed and analysed to determine the type and percentage of disfluencies that were manifested. The obtained data was further subjected to appropriate statistical analysis using SPSS 22.

The results revealed that, filled pauses as well as revisions/repairs were the most probable predictors of cognitive decline with ageing when compared to other types of disfluencies. It was noted that several other types of disfluencies also differed across the age groups while describing pictures with error and without error as well as pictures with emotional and neutral stimuli, however, those were not statistically significant.

Within group analysis for the types of disfluencies revealed that revisions were the only type of disfluencies which was found to be significantly more while describing emotional than neutral stimuli in the older age group. Other types of disfluencies failed to yield significant differences across the two stimuli categories for both the age groups.

Rate of speech of the older adults were found to be significantly slower when compared to younger adults which is again in coherence with the studies reported in literature.

The findings of the present study have been corroborated with appropriate evidence from literature as discussed earlier. Also, the inter-rater reliability was found to be good which suggests that the findings of this study are strongly reliable. Thus, the present study adds on to the possibility of considering disfluencies, specially filled pauses and revisions/repairs as indicators for cognitive effort in ageing.

Implications of the study

- Data regarding normal disfluencies in adults is applicable to several aspects of clinical assessment and management. This information would aid in clinical decision making to differentiate the normal changes in ageing from those that may be indicative of an acquired disorder such as neurogenic stuttering, aphasia, dysarthria and apraxia of speech.

- Increases in disfluency with respect to ageing may be observed for some individuals. The type, severity, or frequency of disfluencies in these individuals may not warrant classification as pathological, however the presence of these disfluencies may result in subtle deficits in communication and can throw light on the onset of ageing.
- Research on the types and number of disfluencies in healthy older adults provides insight into normal fluency changes and yields comparative data for atypical characteristics (e.g., neurogenic stuttering or motor speech disorders). Furthermore, understanding potential contributing factors (i.e., age, sex, years of education, and differing speaking tasks) to the number and type of disfluencies, can assist in identifying potential risk factors or red flags involved, particularly in ageing.
- Changes in fluency can negatively influence or limit the communication skills, at least for some elderly individuals. Effective communication is essential for older adults in life adjustment processes.

Limitations of the study

- This study only included those individuals with minimum educational qualification of Matriculation. Studies report that literacy leads to better cognitive status which could have influenced the performance of participants.
- Picture stimuli used for the experiment involving emotional and neutral stimuli might have been ambiguous with respect to the emotional content for a small number of participants and this would have led to differences in their responses.

Future directions

- The present study considered only age related changes for various disfluencies. However, future studies can probe into the combined effect of age and gender on disfluencies.
- The present study made use of line drawings as stimuli. Further studies can consider colourful pictures/real photographs and try to investigate the effect of stimuli on disfluencies.
- As the present study investigated the production of disfluencies in Malayalam language, future studies can compare the occurrence of disfluencies in other languages and cultural groups.
- This study included only individuals with normal ageing for identification of markers to predict cognitive decline. Future studies can include comparison between normal ageing and pathological ageing of varying severity.
- The current study used pictures containing errors and no errors and pictures with emotional and neutral content. Future studies can be employed to assess disfluencies where in participants are subjected to further complex tasks like describing tangrams or by making use of dual task paradigms.

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