Self-repetitions in a case of foreign accent syndrome

Natalie Hoste

Promotor: Prof. Dr. P. Mariën
Copromotoren: Prof. Dr. J. Van Borsel, Dr. J. Verhoeven

Masterproef voorgedragen tot het behalen van de graad van master in de logopedische en audiologische wetenschappen
Index

1. Abstracts .......................................................................................................................... 3
2. Introduction ....................................................................................................................... 4
3. Case description ............................................................................................................... 10
4. Methods .......................................................................................................................... 11
   4.1 Speech samples ......................................................................................................... 11
   4.2 Apparature ............................................................................................................... 11
   4.3 Procedure .................................................................................................................. 12
   4.4 Statistics .................................................................................................................... 16
5. Results ............................................................................................................................. 16
   5.1 Presence and frequency of the dysfluencies: counting and timing ......................... 16
   5.2 Comparison of final-, initial-, medial part-word repetitions and whole-word repetitions .................................................................................................................. 19
      5.2.1 Monosyllabic words versus multisyllabic words (Fig. 2) .................................. 19
      5.2.2 Content words versus function words (Fig. 3.) ............................................... 20
      5.2.3 Locus of the repetitions within sentences (Fig. 4) .......................................... 21
   5.3 Nature of the final repetitions .................................................................................... 22
      5.3.1 Number of iterations ....................................................................................... 22
      5.3.2 Repeated units ............................................................................................... 22
      5.3.3 Distribution of the final repetitions .................................................................. 23
6. Discussion ........................................................................................................................ 25
   6.1 Timing versus counting ............................................................................................ 25
   6.2 1995 vs. 2003 .......................................................................................................... 25
      6.1 Comparison of the distribution of final part-word repetitions, whole-word repetitions with the distribution of initial-, and medial part-word repetitions ............... 25
         6.1.1 Monosyllabic words versus multisyllabic words ........................................... 25
         6.1.2 Content words versus function words ......................................................... 26
         6.1.3 Locus of the repetitions within sentences ................................................... 26
   6.2 Number of iterations ............................................................................................... 26
   6.3 Repeated units ......................................................................................................... 27
   6.4 Distribution of the final repetitions ......................................................................... 27
   6.5 Origin of the dysfluencies ......................................................................................... 27
7. Conclusion ....................................................................................................................... 30
8. Bibliography .................................................................................................................... 31
1. Abstracts

**Inleiding:** Woordfinale onvloeien komen zelden voor. Wanneer ze toch voorkomen is dit meestal bij kinderen of ten gevolge van een neurogene stoornis. **Methodologie:** In deze studie worden de onvloeien besproken van een vrouw die lijdt aan het ‘Foreign Accent Syndrome’ ten gevolge van een conversiestoornis. Twee spraakstalen van 10 minuten, respectievelijk daterend van 1995 en 2003, werden orthografisch getranscribeerd en geannoteerd in Praat waarna de onvloeien geteld en getimed werden. Verder werden alle finale herhalingen uit een spraakstaal van 50 minuten gehaald en in detail bestudeerd. **Resultaten:** Naast vele andere onvloeien (vooral interjecties), vertoonde deze patiënt zowel woordinitieel, -mediaal als -finaal herhalingen. In 2003 stotterde ze meer dan in 1995. Ook waren er duidelijke verschillen tussen herhalingen van hele woorden en herhalingen van initiële, mediale en finale woorddelen. **Discussie:** Finale stottermomenten werden vergeleken met initiële en mediale stottermomenten. Verder werd de evolutie tussen 1995 en 2003 en de mogelijke oorsprong van het stotteren besproken. **Conclusie:** Voor zover geweten is dit de eerste patiënt die wordt gedocumenteerd met woordfinale onvloeien met een vermoeden van een psychogene oorsprong. In tegenstelling tot andere patiënten die psychogeen stotteren, is het stotteren ondanks logopedische therapie toegenomen in de periode tussen de spraakstalen. Dit is waarschijnlijk te wijten aan een ‘training effect’.

**Introduction:** Word-final dysfluencies are rare and have mostly been documented in children or as a consequence of a neurogenic disorder. **Methodology:** In this case study, the dysfluencies of a woman who suffers from foreign accent syndrome caused by a conversion disorder are reported. Two 10-minute speech samples, dating from 1995 and 2003 respectively, were orthographically transcribed and annotated in Praat. Subsequently, the dysfluencies were counted and timed. Next to that, there was a detailed investigation into the word-final repetitions that were extracted from a 50-minute speech sample. **Results:** Among many other dysfluencies (mainly interjections), this patient presents with word-initial repetitions as well as word-medial and word-final repetitions. In 2003, she stutters even more often than in 1995. There were clear differences between whole-word repetitions and initial-, medial- and final part-word repetitions. **Discussion:** Besides discussing the evolution between 1995 and 2003 and the possible origin of the dysfluencies, a comparison is made between final, initial and medial repetitions. **Conclusion:** To our knowledge, this is the first documented case of word-final dysfluencies with a suspicion of a psychogenic origin. In contrast to other psychogenic stutterers, this patient began to stutter even more from 1995 to 2003, despite speech therapy. This might be due to a ‘training effect’.


2. Introduction

In this study, the stutter-like behaviour of a Dutch woman suffering from Foreign Accent Syndrome due to a conversion disorder is described. She developed a French foreign accent and started to stutter a few hours after she had almost been involved in a traffic incident. She stuttered word-initially, as well as word-medially and word-finally. Moreover, consonants as well as syllables and whole words were involved. Besides stuttering, a variety of other dysfluencies occurred.

**Acquired stuttering (AS)** is a disorder characterised by dysfluencies. These dysfluencies appear gradually or suddenly, and most often during or after adolescence (Theys, Van Wieringen, Tuyts, & De Nil, 2009). Developmental stuttering (DS), in contrast, usually has its onset between the age of two and six (Bloodstein, 1995). AS usually occurs in patients without a history of stuttering (Theys et al., 2009), although Van Riper (1982) claimed that in some cases AS is actually the emergence of stuttering that began in childhood. AS can be divided into a neurogenic, a psychogenic, and a drug-induced type. The differential diagnosis can be complex and uncertain. Moreover, the possibility that it involves a malingeringer should always be taken into account (Van Borsel, 2011).

**Neurogenic stuttering (NS)** is by far the most common type of AS. This disorder typically occurs following a stroke, a traumatic brain injury or a degenerative disease of the central nervous system (De Nil, Rochon, & Jokel, 2007; Theys, 2008). However, other neurological events that damage the brain can also cause NS (Byrne, Byrne, & Zibin, 1993; Movsessian, 2005; Perino, Famularo, & Tarroni, 2000; Tsao, Shad, & Faillace, 2004). The incidence of NS is unknown, yet it should always be taken into account that other severe communication problems (e.g. aphasia, apraxia) can obscure the recognition of NS (De Nil et al., 2007). Some criteria for neurogenic stuttering have been proposed (Helm-Estabrooks, 1999):

- The stuttering occurs nearly as often on function words as on content words
- The stuttering can annoy the patient, but it does not make him anxious
- The stuttering does not only involve initial syllables of words and utterances in repetitions, blocks and prolongations
- Absence of secondary symptoms (e.g. facial grimacing, eye blinking) during the stuttering moments
- Lack of an adaptation effect
The stuttering occurs relatively consistent across various types of speech tasks

Van Borsel (2011) added the following criteria:

- Final consonants may also be affected by repetitions and prolongations
- Stuttering mainly occurs on /r/, /l/ and /h/
- Choral speech and repeating should be more difficult than reading aloud and spontaneous speech

Furthermore, NS seems to be unresponsive to delayed auditory feedback and frequency altered feedback (Balasubramanian, Max, Van Borsel, Rayca, & Richardson, 2003).

On the other hand, research has shown that these features may not be distinguishing for neurogenic stuttering (Humphrey, 2008). Theys (2008) found that the absence of adaptation and secondary symptoms is not a reliable differential criterion. Moreover, clinicians were stated to be far from reliable in distinguishing NS from developmental stuttering (Van Borsel & Taillieu, 2001). Neurogenic stuttering has been associated with acquired neurological disorders that can occur in almost every part of the brain (Ardila & Lopez, 1986; Harrison, 2004; Van Borsel, Van Der Maede, & Santens, 2003; Yeoh, Lind & Law, 2006). Confusion between acquired stuttering in presence of neuropathology and acquired neurogenic stuttering should be avoided. Even when neuropathology is confirmed, a psychogenic origin of acquired stuttering remains possible (Baumgartner & Duffy, 1997).

The psychogenic (PS) type of acquired stuttering is rare and appears primarily as a consequence of an emotional or a psychological trauma (De Nil et al, 2007). PS is often interpreted as a type of conversion reaction (Van Borsel, 2011). “The term “conversion disorder” implies a specific psychological etiology in which intrapsychic distress is converted into somatic symptoms, thereby reducing the distress (Stone, et al., 2011).” The following criteria were suggested by Mahr and Leith (1992) to diagnose stuttering as a conversion reaction:

- A modified speech pattern that suggests stuttering
- The stuttering is associated with psychological factors and temporally related to a significant traumatic event in the patient’s life
• Absence of an organic etiology

They also mentioned some associated symptoms, of which at least one should be present:

• A history of psychological problems

• Atypical features:
  o Absence of secondary symptoms, avoidance or attempts to inhibit the stuttering
  o Little or no effect of fluency enhancing conditions (e.g. choral reading, delayed auditory feedback…)
  o Little or no variation in speech pattern among different speech tasks
  o No islands of fluency
  o Stereotyped repetition of initial or stressed syllables of words

• The patient is indifferent to the stuttering

Van Borsel (2011) added that the onset of stuttering should be sudden in cases of PS. Other proposed criteria are a lack of adaptation and a rapid recovery with speech therapy (Baumgartner et al., 1997). Psychogenic stuttering can resolve during the first evaluation or within the first therapy sessions (Baumgartner, 1999). In contrast to the criteria proposed by Van Borsel (2011), Baumgartner and Duffy (1997) reported characteristics similar to developmental stuttering (DS). For instance, struggle behaviour associated with stuttering and a speech pattern that is worse in certain speech tasks or situations has been documented. According to Baumgartner (1999) this significant traumatic event is usually associated with high levels of anxiety, stress, or both. Several factors may complicate the differential diagnosis. First of all, PS might also be caused by a physical trauma. For this reason, it may not be clear whether stuttering appears subsequently to the trauma itself, or as a reaction to it (Roth, Aronson, & Davis, 1989). Secondly, the suspicion of a neurological disease may arise as a consequence of the frequent co-occurrence of non-organic somatic symptoms (Roth et al., 1989).

In word-final dysfluencies, “the final part of a word is affected by interruptions in the flow of speech, without affecting the first sounds of a word (Humphrey & Van Borsel, 2002)”. It has generally been thought that word-final dysfluencies do not occur. Froeschels (1961), for instance, claimed that stuttering is absent at the end of a word. Indeed, word-final dysfluencies are reported rarely, except perhaps in palilalia (Humphrey et al., 2002). This is a speech disorder sometimes observed in
neurodegenerative disorders. Important characteristics of palilalia are word-final syllable repetitions or sentence-final word repetitions (Brain, 1961). Furthermore, multiple repetitions (LaPointe & Horner, 1981), an increasing speaking rate and a decreasing loudness should be present. (Brain, 1961).

However, word-final dysfluencies have been documented in neurogenic stuttering and in patients with dysfluencies of developmental origin (Humphrey et al., 2002). Word-final repetitions seem to occur most frequently, but word-final prolongations and blocks have also been observed in two adults with learning problems (Stansfield, 1995). Word-final repetitions are part-word repetitions that follow the complete production of a word (Humphrey et al., 2002). Two different types of word-final repetitions occur. In the first type, only final sounds (usually plosives) or consonant clusters are involved (Humphrey et al., 2002). In the second type, single repetitions of larger units (e.g. ‘gehoord hoord’), a vowel and its following consonant (e.g. ‘noemt oemt’), or a vowel and its following syllable are involved (e.g. ‘trolley olley’) (Van Borsel, Van Coster, & Van Lierde, 1996; Humphrey, 1997). According to the definition of the World Health Organisation (1977), “stuttering is a disorder in the rhythm of speech in which the individual knows precisely what he/she wishes to say but at the time is unable to say it because of an involuntary repetition, prolongation, or cessation of a sound”. Since word-final dysfluencies occur after the patient has expressed what he or she wishes to say, it could be stated that word-final dysfluencies can not be classified as stuttering (Humphrey et al., 2002). Furthermore word-final dysfluencies might be underreported. Humphrey and Van Borsel (2002) stated that they might go unnoticed because there seems to be little association with secondary stuttering symptoms or tension. They also might escape notice because other, more remarkable, types of dysfluencies occur and because listeners are not in the habit of listening to word-final dysfluencies (Humphrey et al., 2002).

Canter (1971) claimed that word-final dysfluencies are characteristic of neurogenic stuttering. Several authors agreed with this view (Market, Montague, & Buffalo, 1990; Rosenfield, Viswanath, Callis-Landrum, & Nudelman, 1991; Helm-Estabrooks, 1993). However, only a small number of studies have documented final repetitions and prolongations in cases of neurogenic stuttering (Humphrey et al., 2002). Ardila and Lopez (1986), for instance, examined a 50-year-old right-handed
patient who started to stutter in all positions within words following right brain damage. In a 65-year-old, right-handed patient, word-initial repetitions, blocks, prolongations, and three final repetitions were noted following brain damage (Bijleveld, Lebrun, & Van Dongen, 1994). Lebrun & Leleux (1985) reported a right-handed 60-year-old patient who presented with repetitions of a few final sounds following right brain damage. Most of the repetitions in this case study occurred word-initially. Rosenfield et al. (1991) studied eight adults who have shown acquired dysfluencies in all positions within words, including word-final dysfluencies. Theys, Van Wieringen and De Nil (2008) examined the speech characteristics of 58 Dutch-speaking patients with neurogenic stuttering following various neurological injuries. Among these, two stroke patients stuttered on final word segments, one patient with a neurodegenerative disease stuttered on final sounds, two brain injured patients presented with dysfluencies in a final position and one patient started to produce word-final dysfluencies following brain surgery. Van Borsel, Van Coster, and Van Lierde (1996) reported final repetitions in a nine-year-old boy with a history of cerebral trauma. His symptomatology represented a form of palilalia, and was somewhat different from those reported in previous studies.

Based on the small number of reported cases, it is stated that word-final repetitions may be less common in neurogenic stuttering than is sometimes thought (Humphrey et al., 2002). Word-final dysfluencies have also been documented in patients with dysfluencies of developmental origin (Camarata, 1989; Humphrey, 1997; Lebrun & Van Borsel, 1990; Lebrun, Van Endert, & Sziwowski, 1988; McAllister & Kingston, 2005; Mowrer, 1987; Rudmin, 1984; Stansfield, 1995). In some of these cases, word-final dysfluencies were associated with a genetic syndrome (Lebrun & Van Borsel, 1990; Defloor, Van Borsel, & Curfs, 2000; Cosyns et al., 2010; Tetnowski & Donaher, 2003). Camarata (1989), Mowrer (1987) and Rudmin (1984) studied young children with word-final dysfluencies of developmental origin. In these children, the word-final dysfluencies recovered spontaneously or following a short period of treatment. These authors have suggested that the word-final dysfluencies in these developmental cases are phonologically motivated (Van Borsel, Geirnaert, & Van Coster, 2005).
Foreign Accent Syndrome (FAS) is defined as “a rare speech disorder characterised by the appearance of a new accent, different from the speaker’s native language and perceived as foreign by the listener and, in most cases, by the speaker also (Poulin, Macoir, Paquet, Fossard, & Gagnon, 2007).” Segmental and suprasegmental speech aspects change, which leads to the perception of the speech as foreign (Kuschmann, Lowit, Miller, & Mennen, 2012). In some cases the patient has been previously exposed to the foreign accent, but this is not necessary for the occurrence of the syndrome (Poulin et al., 2007). Several characteristics are believed to contribute to the perception of a foreign accent in patients with FAS, among which abnormalities of stress, rhythm, and intonation, alterations of place and manner of articulation and of voicing of consonants, changes in the articulation of vowels, and alterations in syllable structure (Moen, 1990). In the majority of cases, FAS originates from brain damage in the language-dominant hemisphere (Poulin et al., 2007). Traumatic brain injury and stroke are the leading causes of this brain damage (Haley, Roth, Helm-Estabrooks, & Thiessen, 2010). A small lesion deep in left frontal white matter pathways, anterior and superior to the head of the caudate nucleus, is found to be the most likely clinico-anatomical correlate (Haley et al., 2010). Blumstein and Kurowski (2006) were convinced that FAS is neurogenic and not psychiatric in nature. However, in some cases of FAS, a clearly identifiable neurological cause could not be established. In these cases a psychogenic etiology of FAS is likely (Critchley, 1962; Van Borsel, Janssens, & Santens, 2005; Verhoeven, Mariën, Engelborghs, D'Haenen, & De Deyn, 2005; Poulin et al., 2007; Moonis et al., 1996; Coelho & Robb, 2001; Reeves, Burke, & Parker, 2007; Hwang et al., 2006; Ryalls & Whiteside, 2006).

The aim of this paper is to add to the literature by describing a case of word-final dysfluencies in which a psychogenic origin is suspected. Although there are few cases of word-final dysfluency reported, it is important that these cases are described and analysed to add to the small body of literature concerning word-final dysfluencies. Dysfluencies are described and compared by studying two speech samples. The following questions will be studied:

1. Is there a considerable difference between results obtained by timing and the results obtained by counting, as to the presence and frequency of dysfluencies?
2. In which way did the dysfluencies evolve from 1995 to 2003?
3. Is there a significant difference in the distribution of final part-word repetitions, whole-word repetitions, initial part-word repetitions, and medial part-word repetitions (and this in monosyllabic versus multisyllabic words, content words versus function words, and as to the locus of repetitions in a sentence) ?

4. What is the nature of the final repetitions in these speech samples (final part-word repetitions as well as whole-word repetitions) as to the number of iterations, the phonological characteristics of the repeated units and the distribution of the final repetitions ?

5. To what extent does this patient meet the criteria suggested for psychogenic stuttering? And to what extent does she meet the criteria proposed for neurogenic stuttering?

Until now, there has been poor agreement as to the distinctive features of the different types of acquired stuttering. Perhaps, a detailed description of the emerging characteristics may simplify the differentiation between various types of AS. This introduction also shows that word-final dysfluency is usually a consequence of a neurological disorder or a developmental problem. It is of great importance that it is determined how often word-final dysfluencies occur in neurologically and developmentally normal speakers, and how they manifest themselves. Finally, a detailed description of the clinical picture is desirable to come to a conclusion regarding a possible treatment.

3. Case description
The right-handed woman described in this study, was 43 years old and 51 years old when the two speech samples were recorded. She had been teaching Dutch as a foreign language to French speakers for several years. After the patient was almost involved in a cycling-accident in 1995, she started to develop some neurobehavioural symptoms. She started to stutter, developed a French accent and a tremor in both hands, and she started to behave strangely. After two months she underwent a CT-scan of her brain and an EEG. These neurological examinations did not reveal anything abnormal. Moreover, aphasia, dysarthria and apraxia of speech could be formally excluded. Intensive speech therapy, psychotherapeutic treatment and psychotherapy could not eliminate the neurobehavioural symptoms (Verhoeven et al., 2005). A personality assessment (Hathaway & McKinley, 1943) in 1995 revealed a conversion disorder (Verhoeven et al., 2005). In 2003, the
patient went to another hospital for further examination of the neurobehavioural symptoms. Her speech was still disrupted and she had become wheelchair-bound as a consequence of progressive gait disturbances since 1995. Her symptoms could not be explained by medical antecedents nor did she have a history of psychiatric/developmental disorders. A bizarre, inconsistent, wide-based and unsteady gait was found during a clinical neurological examination, whereas coordination, muscle tone and tendon reflexes were normal. Structural brain imaging (CT and MRI), a standard EEG, routine laboratory studies, and a lumbar puncture revealed no abnormalities. Furthermore she scored above average on standardised neuropsychological and neurolinguistic tests (Verhoeven et al., 2005). Verhoeven et al. (2005) studied speech samples from 1995 and 2003 and stated that her speech was very hesitant, effortful and with stretches of fluent and clear speech. The strong impression of the French accent was the consequence of pronunciation errors, word-finding difficulties and the use of French words and syntactic structures. Also they reported a great amount of pauses filled by interjections and a slow speech rate in both speech samples. The stutter-like behaviour seemed to occur both word-initially and word-finally. Furthermore they noticed inappropriate pauses in the middle of speech segments, mainly in stops. In this study, these inappropriate pauses are called ‘broken words’. She also showed a strong French accent in English, but there were few iterations and inappropriate pauses in this language. In French, notable abnormalities occurred to a lesser extent, which made it her best language (Verhoeven et al., 2005).

4. Methods

4.1 Speech samples
In 1995 as well as in 2003, a speech sample was recorded. Both speech samples concerned a spontaneous conversation. In 1995, three months after the onset of the symptoms, it concerned a conversation between the patient and a neuropsychologist. In 2003, she spoke to the same neuropsychologist and a neurolinguist. As to the topics discussed, the speech samples can be considered equivalent. She spoke about what happened to her and about the impact on her personal and professional life (Verhoeven et al., 2005).

4.2 Apparature
Sony Video Hi 8 camera
4.3 Procedure

4.3.1 Presence and frequency of the dysfluencies: counting
The two samples were orthographically transcribed. Instances of dysfluency were identified by listening to the recordings. In this study, the identification of instances of dysfluency was based on the Lidcombe Behavioural Data Language (LBDL) of Stuttering (Teesson, Packman, & Onslow, 2003; Bryant & Packman, 1999). The LBDL is a behaviorally based taxonomy of stuttering. A wide range of stuttering terminology exists, but it shows little consensus (Packman & Onslow, 1998). The function of the LBDL is to categorise stuttering behaviour. This in contrast to dysfluency taxonomies (Yairi, 1997; Conture, 1990; Gregory & Hill, 1999), which assist in categorizing people as “stuttering” or “normally fluent” for clinical and research purposes (Teesson et al., 2003). Packman and Onslow (1998) stated that the existing terminology of stuttering is unsatisfactory. To obtain a valid behavioural observation, the observation should at least reflect the actual behaviour of interest (Cordes, 1994). The current terminology of stuttering is not, in general, behavioural (Packman et al., 1998). This is reflected by the term tense pause, for instance. Indeed, a pause cannot be tense in itself. Packman et al. (1998) stated that a lack of specificity is another weakness of the current terminology of stuttering. For instance, the term part-word repetition does not indicate whether it concerns the repetition of a single sound, the repetition of a consonant and a vowel, the repetition of a complete syllable, or even the repetition of multiple syllables (Teesson et al., 2003). Definitional specificity is needed to achieve acceptable levels of observer agreement (Cordes, 2000; Onslow, Gardner, Bryant, Stuckings, & Knight, 1992). A study by Teesson et al. (2003) showed that the LBDL has a high intrajudge agreement. However, only experienced judges achieved satisfactory interjudge agreement.

The taxonomy consists of three categories. The first category consists of repeated movements (R), including the three following descriptors: syllable repetitions (Rs) (e.g. ‘o ogen’, ‘zij zij’), incomplete syllable repetitions (Ri) (e.g. ‘klop p pen’) and multisyllable repetitions (Rm) (e.g. ‘neuro neurologe’). The example ‘zij zij’ indicates that the repetition of a monosyllabic word was also classified as a syllable repetition. In addition, a character was added to each repeated movement in order to indicate whether it concerned a reiteration of some portion of the start of the word (i), of the end of the word (f) or a reiteration of some portion in between the start
and the end of the word (m). When initial incomplete syllable repetitions (e.g. ‘st stotteren’), initial syllable repetitions (e.g. ‘o ogen’) and initial multisyllable repetitions (e.g. ‘amster amsterdam’) were added up, the number of initial part-word repetitions could be found (Van Borsel et al., 1996). Similarly, the total number of medial part-word repetitions could be found by adding medial incomplete syllable repetitions (e.g. ‘stot t t t teren’), medial syllable repetitions (e.g. ‘hypnother therapie’) and medial multisyllable repetitions (e.g. ‘neuropsycho psychologisch’). The sum of final incomplete syllable repetitions (e.g. ‘zien n n’, final syllable repetitions (e.g. ‘rijdende de de’), and final multisyllable repetitions (e.g. ‘paracetamol tamol’) was equal to the sum of final part-word repetitions and whole-word repetitions.

The second category consists of ‘fixed postures’ (F), and is divided into fixed postures with audible airflow (Fp)(e.g. ‘mmmmmmijne’) and fixed postures without audible airflow (Fb). The terms fixed postures with audible airflow and fixed postures without audible airflow are equivalent to the terms prolongations and blocks in other –not behaviorally based- taxonomies of stuttering. “Prolongations are speech segments which have greater than expected duration given their linguistic and phonetic context. They usually appear when a convulsive muscular contraction occurs during the production of a sound that can be sustained (vocal, fricative, nasal or liquid) (McAllister & Kingston, 2005)”. Blocks are defined as “inappropriate stoppages of airflow or voice” (McAllister et al., 2005). In this study, the distinction was made between inappropriate stoppages of airflow or voice within a word (Broken word/Bw) (e.g. ‘kli-niek’) and other inappropriate stoppages of airflow or voice (Fb). For this reason, the term ‘broken word’ was adopted from other stuttering taxonomies (Van Borsel et al., 1996), although this term is not included in the LBDL because it is not behavioural (a person does not break a word). In broken words, airflow or phonation stops within a word (e.g. ‘kli-niek’), but when a reiteration of a single word part occurred, it was classified as a medial incomplete syllable/syllable/multisyllable repetition. (e.g. ‘stot t t t teren’). When multiple cessations occur in one word, each airflow or phonation stop was counted as one dysfluency (e.g. one dysfluency in ‘kli-niek’, two dysfluencies in ‘neuro-logische’).

The last category consists of superfluous behaviour (S), which is divided into verbal and nonverbal superfluous behaviour. For this study, verbal superfluous behaviour
was subdivided into interjections (Si) (hesitation devices such as ‘uh’, ‘bon’, ‘enfin’,…), revisions (self-interrupted utterances containing a correction such as ‘in de wee – na de weekend’) (Sr), and incomplete phrases (self-interruptions that do not contain a correction such as ‘dat was euh…’) (Sip) (McAllister et al., 2005). Non-verbal superfluous behaviour (Sn) is equivalent to secondary stuttering symptoms like head movements, eye blinking, grimaces … (Teesson et al., 2003). In this study, the addition of a schwa at the end of a word (e.g. ‘bedeuh’), was not classified as an interjection.

The total amount of syllables as well as the total number of stuttered syllables and the number of dysfluencies per 100 syllables were counted for each recording separately. These stuttered syllables existed as a consequence of the repetitions (e.g. ‘ko’ in ‘ko komen’). While counting syllables, the strict definition of a syllable was not followed, since this may have resulted in a distorted image. Based on the definition, a syllable should at least contain a nucleus. This nucleus usually consists of a vowel, and can be followed and/or preceded by a set of consonants (called onset and coda, respectively) (McAllister et al., 2005). ‘Stot t t t eren’, for instance, contains three syllables according to the definition. However, in this example, a series of utterances, each followed by a pause, was produced. In this study, each utterance followed by a pause, was classified as a syllable.

The dysfluencies were always assigned to the most appropriate category, e.g. ‘euh euh euh’ can be seen as two repetitions of ‘euh’, but they were assigned to the category of interjections. Similar, in the utterance ‘in de wee na de weekend’ we could label ‘wee’ as an initial part-word repetition. However, it seems that this utterance was interrupted and contained a correction, which makes it a revision rather than an initial part-word repetition.

4.3.2 Timing the dysfluencies
In addition, the dysfluencies were studied from a different angle by timing them, using a technique of Corthals (2011). For this purpose, the computer program ‘Praat’ was used (Boersma & Weenink, 2009). First, the two 624-second speech samples (1995: 15 – 639; 2003: 300-924) were extracted from the entire recording. Subsequently a text tier with annotations was inserted and silences were automatically detected with a silence threshold of -30 dB (Corthals, 2011). Then a thorough analysis of the text tier content was performed, using the LBDL (Teesson et al., 2003). For the annotation of the revisions, the revised part was classified as
the revision, and not the corrected part. E.g. In ‘In de wee na de weekend’, ‘in de wee’ was annotated as a revision. Since revisions (Sr), incomplete phrases (Sip), and secondary stuttering symptoms (Sn) often contain/occur simultaneously with other dysfluencies, it should be taken into account that they might take a bigger amount of time than results show. For instance, in the incomplete phrase ‘dus i i ik’, ‘i i ik’ was annotated as an initial incomplete syllable repetition, but this is actually also a part of the incomplete phrase.

In broken words, only the time during which phonation or voice did not occur, was measured and annotated as a broken word.

When defining a repeated movement as a syllable repetition, it should concern a repetition of a syllable of the target word (e.g. ‘poli kli klinische’) rather than the repetition of a syllable based on its definition. For instance, ‘me mee’ was not classified as a syllable repetition because ‘me’ is not a whole syllable of the target word, even though ‘me’ could be a syllable, based on the definition of a syllable.

4.3.3 Nature of the final repetitions
Besides the analysis of the two 10-minute speech samples, all of the final repetitions that occurred during the 50-minute speech sample, were extracted and analyzed. As well final part-word repetitions as whole-word repetitions were assigned as final repetitions. Repetitions in the context of a revision were not included. Both the number of iterations, the repeated units and the distribution of the final repetitions were studied. With respect to the distribution of the final repetitions, the distinction between content words and function words was made as well as the distinction between monosyllabic words and multisyllabic words. Finally the locus of the final repetitions within sentences was studied. For the latter analysis, only utterances that concerned the production of a sentence were considered. In compound sentences, the different segments of the compound sentence were seen as independent clauses. Interjections at the beginning or the end of clauses were not taken into account. A distinction was made between dysfluencies in a sentence-initial position (first word of a clause), in a sentence-final position (last word of a clause) and in a sentence-medial position (everything but the initial or the final word in a sentence). In complex sentences both the conjunction and the first word of the coordinate or subordinate clause were considered as initial. Revisions were also considered as a sentence.
4.4 Statistics

SPSS (V 20) was used for statistical analysis of the data (SPSS Inc, Chicago, IL). The Pearson Chi Square Test \( (X^2) \) and the Fisher’s Exact test were used for the comparison between final part-word repetitions, whole-word repetitions, initial part-word repetitions and medial part-word repetitions. The former was used when all cells had an expected count higher than 5, and the latter was used when this was not the case. Nonparametric data were treated with the Mann-Whitney U test that was used to compare the number of iterations between groups of final repetitions. In all statistical tests, two-tailed tests of significance were based on the level of \( P < 0.05 \).

5. Results

5.1 Presence and frequency of the dysfluencies: counting and timing

Table 1 shows a summary of the most important results obtained by counting and timing the dysfluencies. The speech sample dating from 1995, took 624 seconds. During this spontaneous conversation a frequency of 24.95 dysfluencies per 100 syllables was found (365/1463). Out of 1463 syllables, 99 were stuttered, which equals to 6.77 % of stuttered syllables. While dysfluencies took 33.60 % of the time, 57.3 % of the total time existed of fluent speech. In this speech sample, the interlocutor was talking 9.07 % of the time. In 2003, the speech sample also consisted of 624 seconds. In this sample, a frequency of 34.19 dysfluencies per 100 syllables (399/1167) was found. The percentage of syllables stuttered amounted 17.57 % (205/1167). She spoke fluently during 53.80 % of the total time, and during 39.11 % of the time dysfluencies occurred. It should be taken into account that 6.73 % of the time, the interlocutor was talking.

Table 1: Summary of the most important results obtained by counting and timing the dysfluencies for both 1995 and 2003.

<table>
<thead>
<tr>
<th>Counting</th>
<th>Dysfluencies/syllables</th>
<th>Percentage of syllables stuttered</th>
<th># dysfl.</th>
<th># syll.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>24.95 % (365/1463)</td>
<td>6.77 % (99/1463)</td>
<td>365</td>
<td>1463</td>
</tr>
<tr>
<td>2003</td>
<td>34.19 % (399/1167)</td>
<td>17.57 % (205/1167)</td>
<td>399</td>
<td>1167</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Timing (% of time of the speech sample)</th>
<th>% of time dysfluent</th>
<th>% of time fluent</th>
<th>Int.</th>
<th>Miss.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>33.60 %</td>
<td>57.3 %</td>
<td>9.07 %</td>
<td>0.0043 %</td>
</tr>
<tr>
<td>2003</td>
<td>39.11 %</td>
<td>53.80 %</td>
<td>6.73 %</td>
<td>0.35 %</td>
</tr>
</tbody>
</table>

*Dysfl. = dysfluencies, syll. = syllables, # = number of, Int. = interlocutor, Miss. = missing*
Figure 1 shows the percentage of time of the speech sample taken by the different kinds of dysfluencies, for both 1995 and 2003. Table 2 shows the frequency of occurrence of various kinds of dysfluencies, and the percentage of time taken by these dysfluencies, for both 1995 and 2003.

Based upon the frequency of occurrence, interjections constituted the major type of dysfluency both in 1995 (201/365, 55.07 % of dysfluencies overall; 18.60 % of the total time of the speech sample) and 2003 (203/399, 50.88 %; 21.1 % of the time).

In 1995, these were followed by revisions (44/365, 12.05 %; 5.91 % of the time), initial part-word repetitions (36/365, 9.86 %; 2.96 % of the time), medial part-word repetitions (28/365, 7.67 %; 2.28 % of the time), secondary stuttering symptoms (18/365, 4.93 %; 0.71 % of the total time), broken words (15/365, 4.11 %; 0.31 % of the time), whole-word repetitions (11/365, 3.01 %), incomplete phrases (9/365, 2.47 %; 1.76 % of the time), and final part-word repetitions (3/365, 0.82 %). Whole-word repetitions and final part-word repetitions together, took 1.07 % of the time. As to the secondary stuttering symptoms (or superfluous nonverbal behaviour), this patient mainly presented with eye-blinking and head movements. Except for broken words, no other fixed postures were found. In 1995, repetitions in general took 6.31 % of the time, of which 0.29 % of the time was filled by multisyllable repetitions, 3.60 % by incomplete syllable repetitions, and 2.42 % was filled by syllable repetitions.

In 2003, interjections occurred most often (203/399, 50.88 %; 21.1 % of the time), followed by medial part-word repetitions (51/399, 12.78 %; 5.63 % of the total time), initial part-word repetitions (45/399, 11.28 %; 4.99 % of the time), secondary stuttering symptoms (32/399, 8.02 %; 1.75 % of the total time), broken words (21/399, 5.26 %; 0.44 % of the total time), revisions (17/399, 4.26 %; 2.45 % of the total time), final part-word repetitions (6/399, 1.50 %; 2.43 % of the total time), and incomplete phrases (3/399, 0.75 %; 0.49 % of the total time). Again, no blocks or prolongations occurred.

Whole-word repetitions were found 21 times (21/399, 5.26 %) and final part-word repetitions six times (6/399, 1.50 %). Together they took 2.43 % of the total time. Repetitions in general took 13.05 % of the time, of which 0.49 % was filled by multisyllable repetitions, 7.58 % by incomplete syllable repetitions, and 4.98 % was filled by syllable repetitions.
Figure 1: Percentage of the total time of each speech sample (each consisting of 624 seconds) taken by the various kinds of dysfluencies, for both 1995 and 2003.

Table 1: Frequency of occurrence and percentage of time filled up by different kinds of dysfluencies, for both 1995 and 2003.

<table>
<thead>
<tr>
<th>Counting (Frequency)</th>
<th>Timing (% of time of the speech sample)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repeated Movements</td>
<td></td>
</tr>
<tr>
<td>Initial PWR</td>
<td>36</td>
</tr>
<tr>
<td>Rii</td>
<td>22</td>
</tr>
<tr>
<td>Rsi</td>
<td>12</td>
</tr>
<tr>
<td>Rmi</td>
<td>2</td>
</tr>
<tr>
<td>Medial PWR</td>
<td>28</td>
</tr>
<tr>
<td>Rim</td>
<td>25</td>
</tr>
<tr>
<td>Rsm</td>
<td>3</td>
</tr>
<tr>
<td>Whole WR</td>
<td>11</td>
</tr>
<tr>
<td>Final PWR</td>
<td>3</td>
</tr>
<tr>
<td>Rif</td>
<td>3</td>
</tr>
<tr>
<td>Rsf</td>
<td>11</td>
</tr>
<tr>
<td>Rmf</td>
<td>0</td>
</tr>
<tr>
<td>Fixed Postures</td>
<td></td>
</tr>
<tr>
<td>Bw</td>
<td>15</td>
</tr>
<tr>
<td>Superfluos behaviour</td>
<td></td>
</tr>
<tr>
<td>Si</td>
<td>201</td>
</tr>
<tr>
<td>Sn</td>
<td>18</td>
</tr>
<tr>
<td>Sr</td>
<td>44</td>
</tr>
<tr>
<td>Sip</td>
<td>9</td>
</tr>
</tbody>
</table>

R= repeated movement => Ri: incomplete syllable/ Rs: syllable/ Rm: multisyllable/ i, m, f: Xxi: initial/ Xxm: medial/ Xxf: final; S= superfluos behaviour => Si: interjection/ Sn: nonverbal/ Sr: revision/ Sip: incomplete phrase; F= fixed posture => Fb: block/ Fp: prolongation/ Bw: broken words (Script P.Corthals UGent/HoGent)
PWR: part-word repetition, WR: word repetition
5.2 Comparison of final-, initial-, medial part-word repetitions and whole-word repetitions

In general, initial part-word repetitions were seen most frequently (81/201, 40.30 %), while medial part-word repetitions (79/201, 39.30 %) occurred slightly less. Medial part-word repetitions were followed by whole-word repetitions (32/201, 15.92 %) and final part-word repetitions (9/201, 4.48 %) were least common. Overall, repetitions occurred twice as much on multisyllabic words (136/201, 67.66 %) than in the category of monosyllabic words (65/201, 32.34 %), and repetitions occurred more than three times as much on content words (159/201, 79.10 %) than on function words (42/201, 20.90 %). Repetitions were found most often in the middle of a clause (100/201, 49.75 %), slightly less in a sentence-final position (83/201, 41.29 %) and rarely in a sentence-initial position (18/201, 8.96 %).

5.2.1 Monosyllabic words versus multisyllabic words (Fig. 2)

In 1995 as well as in 2003 initial part-word repetitions occurred significantly (1995: Fisher’s Exact Test= 42.87, P=<0.001; 2003: 62.44, P=<0.001; in general: 106.76, P=<0.001) more often on multisyllabic words (in general (Fig. 2): 48/81, 59.26%; 1995: 21/36, 58.33 %; 2003: 27/45, 60.00 %) than on monosyllabic words (in general: 33/81, 40.74 %; 1995: 15/36, 41.67%; 2003: 18/45, 40.00 %). Medial part-word repetitions only occurred on multisyllabic words (in general: 29/79, 100.00%; 1995: 28/28, 100.00%; 2003: 51/51, 100.00%), this applies both to the results of 1995 and those of 2003. Whole-word repetitions were noticed significantly more often in the category of monosyllabic words (in general: 29/32, 90.63%; 1995:11/11, 100.00%; 2003: 18/21, 85.71%) than in the category of multisyllabic words (in general: 3/32, 9.38%; 1995: 0/11, 0.00%; 2003: 3/21, 14.29%). Opposite trends were found in 1995 and 2003 as to the distribution of final part-word repetitions in monosyllabic versus multisyllabic words. In 1995, final part-word repetitions occurred more often on monosyllabic words (2/3, 66.66 %) than on multisyllabic words (1/3, 33.33 %),
while in 2003 the final part-word repetitions were found more often in the category of multisyllabic words (5/6, 83.33 %) than in the category of monosyllabic words (1/6, 16.67 %). In general, final part-word repetitions occurred more often on multisyllabic words (6/9, 66.67 %) than on monosyllabic words (3/9, 33.33 %).

5.2.2 Content words versus function words (Fig 3.)

Initial part-word repetitions occurred significantly (Fisher’s Exact Test= In general (Fig. 3): 40.35, P=<0.001; 1995: 19.767, P=<0.001; 2003: 20.30, P=<0.001) more often on content words (in general: 64/81, 79.01 %; 1995: 28/36, 77.78 %; 2003: 36/45, 80.00 %) than on function words (in general: 17/81, 20.99 %; 1995: 8/36, 22.22 %; 2003:9/45, 20.00 %). Medial part-word repetitions were also seen considerably more often in the category of content words (in general: 74/79, 93.67 %; 1995: 27/28, 96.43 %; 2003: 47/51, 92.16 %) than in the category of function words (in general: 5/79, 6.33 %; 1995:1/28, 3.57 %; 2003: 4/51, 7.84 %). Final part-word repetitions were only found in content words (in general: 9/9, 100.00 % 1995: 3/3, 100.00 %; 2003: 6/6, 100.00 %). This was the case in 1995, as well as in 2003 and in general. Whole-word repetitions occurred more often on function words (in general: 20/32, 62.50 %; 1995: 8/11, 72.73 %; 2003: 12/21, 57.14 %) than on content words (in general: 12/32, 37.50 % 1995: 3/11, 27.27 % 2003: 9/21, 42.86 %).
5.2.3 Locus of the repetitions within sentences (Fig. 4)

Initial part-word repetitions appeared significantly (Fisher’s Exact test= in general (Fig. 4): 41.47, P=<0.001; 1995: 17.94, P=0.002; 2003: 29.496, P=<0.001) more often sentence-medially (in general: 49/81, 60.49 %; 1995: 20/36, 55.56 %; 2003: 29/45, 64.44 %), than in a sentence-final position (in general: 28/81, 34.57 %; 1995: 13/36, 36.11 %; 2003: 15/45, 33.33 %).

They occurred rarely in a sentence-initial position (in general: 4/81, 4.94 %; 1995: 3/36, 8.33 %; 2003: 1/45, 2.22 %). Medial part-word repetitions were mostly found in a sentence-final position (in general: 47/79, 59.49 %; 1995: 22/28, 78.57 %; 2003: 25/51, 49.02 %), while they were found considerably less in a sentence-medial position (in general: 30/79, 37.97 %; 1995: 6/28, 21.43 %; 2003: 24/51, 47.06 %), and they were least common in a sentence-initial position (in general: 2/79, 2.53 %; 1995: 0/28, 0.00 %; 2003: 2/51, 3.92 %). Final part-word repetitions (overall and in 2003) were mostly noticed in a sentence-medial position (in general: 5/9, 55.56 %; 2003: 4/6, 66.67 %), to a lesser extent sentence-finally (4/9, 44.44 %; 2003: 2/6, 33.33 %), and never sentence-initially. In 1995, final part-word repetitions occurred slightly more often in a sentence-final position (2/3, 66.67 %) than sentence-medially (1/3, 33.33 %). Final part-word repetitions never took place in a sentence-initial position, neither in 1995, nor in 2003. Whole-word repetitions occurred most often sentence-medially (in general: 16/32, 50.00 %; 1995: 5/11, 45.45 %; 2003: 11/21, 52.38 %), followed by repetitions in a sentence-initial position (in general: 12/32, 37.50 %; 1995:3/11, 27.27 %; 2003: 9/21, 42.86 %), and whole-word repetitions in a sentence-final position (in general:4/32, 12.50 %; 1995: 3/11, 27.27 %; 2003: 1/21, 4.76 %).
5.3 Nature of the final repetitions

In 1995, 15 final repetitions were found in a 10-minute speech sample. Whole-word repetitions (in this case only single word repetitions and no multi word repetitions occurred) constituted the major type of final repetitions (12/15, 80.00 %), while final part-word repetitions only were found in three instances (3/15, 20.00 %). In 2003, 79 final repetitions occurred in a 40 minute speech sample, including 58 whole-word repetitions (58/79, 73.42 %) (three multi word repetitions each consisting of two single word repetitions and 52 single word repetitions), and 21 final part-word repetitions (21/79, 26.58 %).

5.3.1 Number of iterations

As far as the speech sample of 1995 concerns, the number of single iterations (9/15, 60.00 %) was slightly higher compared to the number of double iterations (6/15, 40.00 %). In 2003, the majority of final repetitions consisted of single iterations (44/79, 55.70 %). Double iterations appeared 18 times (18/79, 22.78 %), triple iterations seven times (7/79, 8.86 %). In three cases, four iterations occurred in a row (3/79, 3.80 %). Furthermore, in only one instance there were five iterations (1/79, 1.27 %), in one instance seven iterations took place (1/79, 1.27 %), in one instance eight iterations (1/79, 1.27 %), and even an instance with approximately 21 iterations was found (1/79, 1.27 %). Results show, that in 2003, an increased number of iterations occurred. In 1995 only single and double iterations were found, while in 2003 the number of iterations ranged from one single iteration to 21 iterations. This difference was not significant, however (Mann-Whitney U=546.00, Z= -0.54, P= 0.592).

Overall, in final part-word repetitions a higher number of iterations occurred as in whole-word repetitions. (Mann-Whitney U=613, Z= -2.20, P=0.028). In 1995 and 2003 the same trend was found but the separate results were not statistically significant (1995: Mann-Whitney U= 12.00, Z= -1.02, P= 0.309; 2003: Mann-Whitney U= 451.50, Z= -1.94, P=0.053).

5.3.2 Repeated units

In 1995, final part-word repetitions on monosyllabic words (2/3, 66.67 %) involved the coda (e.g. 'loop p p'). In one instance the coda was a plosive, in the other instance it the nasal /n/ was involved. In the multisyllabic word (1/3, 33.33 %) only the coda of the final syllable was repeated. (e.g. 'paracetamol le'). In this case, the coda was the liquid /l/.
In 2003, the final repetitions that occurred on monosyllabic words (5/21, 23.81 %) involved the coda (e.g. het t t, 3/5, 60.00 %), or the ultimate consonant of the coda (e.g. helft t t) (2/5, 40.00 %). It concerned plosives in all instances (/t/ in four instances, in one instance /k/). In multisyllabic words (16/21, 76.19 %), final repetitions were most frequently restricted to the final syllable and involved the entire syllable (e.g. rijtende de de) (13/16, 81.25 %). However, in three instances only the coda of the final syllable was repeated (e.g. paracetamol l l) (3/16, 18.75 %). In two of these three instances the nasal /n/ was involved, in the other one the liquid /l/ was repeated.

5.3.3 Distribution of the final repetitions

5.3.3.1 Content words versus function words (Fig. 5) and monosyllabic words versus multisyllabic words (Fig. 6)

In general (Fig. 5) and in 2003, final part-word repetitions occurred significantly (in general: $X^2 = 36.50, df =1, P<0.001$; 2003: $X^2= 32. 17, df=1, P<0.001$) more often on multisyllabic words (in general: 16/24, 66.67 %; 2003: 15/21, 71.43 %) than on monosyllabic words (in general: 8/24, 33.33 %; 2003: 6/21, 28.57 %). Whole-word repetitions, in contrast, were found significantly more often in the category of monosyllabic words (in general: 65/70, 92.86 %; 2003: 53/58, 91.38 %) than in the category of multisyllabic words (in general: 5/70, 7.14 %; 2003: 5/58, 8.62 %). In 1995, whole-word repetitions only occurred on monosyllabic words (12/12, 100.00 %), and final part-word repetitions occurred more often on monosyllabic words (2/3, 66.67 %) than on multisyllabic words (1/3, 33.33 %). None of the results in 1995 were statistically significant (Fisher’s Exact Test= 4.29, P= 0.200).
Final part-word repetitions were found significantly (in general: $X^2= 22.78$, df=1, $P<0.001$; 1995: Fisher’s Exact Test= 5.63, $P=0.044$; 2003: $X^2= 17.74$, df = 1, $P<0.001$) more often in the category of content words (in general (Fig. 6): 19/24, 79.17 %; 1995: 3/3, 100.00 %; 2003: 16/21,76.19 %) than in the category of function words (in general: 5/24, 20.83 %; 1995: 0/3, 0.00 %; 2003: 5/21, 23.81 %).

Whole-word repetitions, in contrast, were significantly more common in the category of function words (in general: 53/70, 75.71 %; 1995: 9/12, 75.00 %; 2003: 44/58, 75.86 %) than in the category of content words (in general: 17/70, 24.29 %; 1995: 3/12, 25.00 %; 2003: 14/58, 24.14 %).

5.3.3.2 Locus of the final repetitions within sentences (Fig. 7)

Final part-word repetitions were found most often in a sentence-final position (in general (Fig. 7): 12/24, 50.00 %; 1995: 2/3, 66.67 %; 2003: 10/21, 47.62 %), they were seen less often sentence-medially (in general: 10/24, 41.67 %; 1995: 1/3, 33.33 %; 2003: 9/21, 42.86 %), and they occurred least in a sentence-initial position (in general: 2/24, 8.33 %; 1995: 0/3, 0.00 %; 2003: 2/21, 9.52 %). Whole-word repetitions appeared most often in a sentence-medial position (in general: 40/67, 59.70 %; 1995: 5/12, 41.67 %; 2003: 35/55, 63.64 %), they were less common sentence-initially (in general: 21/67, 31.34 %; 1995: 4/12, 33.33 %; 2003: 17/55, 30.91 %), and they appeared least of all in a sentence-final position (in general: 6/67, 8.96 %; 1995: 3/12, 25.00 %; 2003: 3/55, 5.45 %). These differences were statistically significant in general and in 2003 (in general: Fisher’s Exact Test= 17.63, $P=<0.001$; 2003: Fisher’s Exact Test= 17.25, $P=<0.001$). In 1995, these results were not statistically significant (Fisher’s Exact Test= 1.962, $P=0.571$).
6. Discussion

6.1. Timing versus counting
The comparison of the results obtained by counting on the one hand, and the ones found by timing on the other hand, show that more severe results can be obtained by timing them. At least in some cases, timing the dysfluencies can provide a more realistic image, since it is more reliable to take into account the duration of the dysfluencies.

6.2. 1995 vs. 2003
Based on the comparison of the speech samples of 1995 and 2003, the following can be concluded. Over the years, a shift in symptoms has occurred. In 2003, the patient showed more dysfluencies than in 1995 and the patient’s speech became approximately 5 % less fluent. Moreover, the number of interjections – which were the most common dysfluencies in both speech samples- had increased even more in 2003. In 1995, revisions occurred more often than repetitions. In 2003, the opposite pattern was found. Thence, the percentage of syllables stuttered increased with more than 10 %. Repeated movements were most common, while revisions occurred to a lesser extent. This could be due to a training effect, which may have caused that she got better at practicing the foreign accent and the stuttering. Therefore, she simply did not have to reconstruct her sentences as much. She also presented with more secondary stuttering symptoms in 2003, perhaps because she had learned that this is a common phenomenon in people who stutter.

6.1 Comparison of the distribution of final part-word repetitions, whole-word repetitions with the distribution of initial-, and medial part-word repetitions

6.1.1 Monosyllabic words versus multisyllabic words
Initial part-word repetitions and final part-word repetitions occurred most often on multisyllabic words and to a lesser extent on monosyllabic words. Medial part-word repetitions only occurred in the category of multisyllabic words. This could possibly be attributed to the fact that it is less probable to repeat the medial part of a monosyllabic word, although this is not impossible (e.g. zie ie ie ien). Whole-word repetitions only occurred on monosyllabic words, for a reason which is not clear. Perhaps repeating a monosyllabic word takes less effort than repeating a multisyllabic word.
6.1.2 Content words versus function words
Initial and medial part-word repetitions occurred much more often on content words than on function words, while final part-word repetitions only occurred in the category of content words. Whole-word repetitions, in contrast, occurred much more often on function words than on content words. This was not totally unexpected, since most function words in Dutch are monosyllabic (McAllister et al., 2005), and in this study whole-word repetitions only occurred on monosyllabic words. Since final part-word repetitions occurred most frequently on multisyllabic words, and function words were more often monosyllabic words, it was not totally unexpected that final part-word repetitions only occurred on content words. Indeed, it seems difficult to repeat only the final part of a word when this is a monosyllabic word, although this is not impossible (e.g. een n n).

6.1.3 Locus of the repetitions within sentences
While initial part-word repetitions and final-part word repetitions occurred most often in a sentence-medial position, medial part-word repetitions occurred most often sentence-finally. Only exceptionally did they occur in a sentence-initial position. Whole-word repetitions occurred most often sentence-medially, but in contrast to the other types of repetitions, they occurred more in a sentence-initial position than in a sentence-final position. This was expected since whole-word repetitions mostly occurred on function words, and function words rarely take place in a sentence-final position (Van Borsel et al., 1996).

Based on the comparison of trends observed in 1995 and those in 2003, it can be concluded that, except for the final part-word repetitions, all other trends among different types of dysfluencies remained the same. Final part-word repetitions, in contrast, occurred most often on monosyllabic words in a sentence-final position and less often sentence-medially in 1995, while they occurred most often in the category of multisyllabic words in a sentence-medial position in 2003 and in general. These ambiguous results are probably due to the small number of final part-word repetitions in these 10-minute speech samples.

6.2 Number of iterations
In final part-word repetitions a higher number of iterations occurred than in whole-word repetitions. This might be due to the fact that it is easier to repeat a part of a word than repeating a whole word. In 2003 word parts and whole words were repeated more times in a row than in 1995. This was probably in line with the
exacerbation of the stuttering. This difference was not significant, however, and it should be taken into account that there were much more final repetitions in 2003.

6.3 Repeated units
Final part-word repetitions that occurred on monosyllabic words usually involved the coda (and in 2003 to a somewhat lesser extent the ultimate consonant of the coda). In 1995, only the coda of the final syllable was repeated in the multisyllabic word, in 2003, final repetitions were most often restricted to the entire final syllable. However, in three instances only the coda was repeated. This in contrast to the results of Van Borsel et al. (2005), who found that final part-word repetitions involving the nucleus and coda of a syllable occurred considerably more often than final part-word repetitions involving only the coda. Therefore, the authors stated that the rhyme is a genuine linguistic unit, since nucleus and coda were more tightly linked than onset and nucleus (Van Borsel et al., 2005).

6.4 Distribution of the final repetitions
In the 50-minute speech sample, a greater amount of final repetitions (final part-word repetitions as well as whole-word repetitions) was available. Therefore, the results as to the distribution of these final repetitions will probably be more reliable. In general, the same trends occurred as in the two smaller speech samples. However, in the smaller speech samples, opposite trends were found in 1995 and 2003 as to locus in a sentence of the final repetitions. In this sample, however, the results were unambiguously. Final part-word repetitions were found most often sentence-finally, followed by repetitions in a sentence-medial and in a sentence-initial position.

6.5 Origin of the dysfluencies
According to the definition of stuttering of the World Health Organisation (1977), it could be stated that word-final dysfluencies can not be classified as stuttering (Humphrey et al., 2002). Since this patient presented with word-initial and word-medial dysfluencies next to the word-final repetitions, there is no doubt that it concerned stuttering.

To diagnose stuttering as a conversion reaction, the patient (and her speech) should meet the criteria suggested by Mahr et al. (1992). This patient 1) showed a modified speech pattern that suggests stuttering 2) the onset of her symptoms was temporally related to a near traffic accident 3) there was no evidence of an organic
etiology. Moreover, at least one of the associated symptoms should be present. In this patient, there was little or no variation in the speech pattern among different speech tasks. She stuttered as well during the spontaneous conversation as during reading aloud and naming. Islands of fluency did not occur while speaking Dutch, but while she spoke English and French, there were hardly any stuttered moments. In contrast to what Mahr et al. (1992) defined as an associated symptom of psychogenic stuttering, secondary symptoms did occur in this patient. Repetitions also occurred on other word parts than on the initial or stressed syllables. Furthermore, the patient reacted emotionally during the conversation and she was well aware of her symptoms, which indicates that there was no question of ‘la belle indifférence’. The effect of fluency enhancing conditions and a possible adaptation effect were not verified. Furthermore, the stuttering had a sudden onset, this in line with Van Borsel (2011). Since this patient meets the most important criteria of Mahr et al. (1992), it can be stated that her stuttering can be diagnosed as a conversion reaction.

A very remarkable phenomenon occurred, however. In psychogenic stuttering, therapy is found to be very effective (Baumgartner et al., 1997). In this patient, the problem only exacerbated after receiving speech therapy. Duffy claims that this is a possible consequence of not terminating the treatment when progress is not seen within the first few sessions (Duffy, 1989).

Another possible line of thought is that the dysfluencies were provoked by the foreign accent syndrome, which was diagnosed as a conversion reaction. The patient used syntactic structures that were consistent with mistakes made by French learners/speakers of Dutch and she substitutes words by the equivalent French word (Verhoeven et al., 2005). Possibly, these changes have led to cognitive processing difficulties at some stage in the speech production system (e.g. implementing the new syntactic structure, accessing the intended word). Similar explanations have been proposed for the occurrence of normal non-fluency and word-initial repetition in stuttering (Levelt, 1989; Kolk & Potsma, 1997).

As mentioned in the case description above, structural brain imaging as well as the standard EEG, the laboratory studies, the lumbar puncture and the standardised neuropsychological and neurolinguistic tests did not reveal any abnormalities (Verhoeven et al., 2005). Based on these results, it seems unlikely that the etiology
of the symptoms is an organic brain disease. One should never exclude, though, that the dysfluencies result from minor, undetected neurological lesions (McAllister et al., 2005). Therefore, it was examined whether the patient's symptoms met the diagnostic criteria for neurogenic stuttering proposed by Helm-Estabrooks (1999). While this author states that dysfluencies should occur nearly as often on function words as on content words, the repetitions in this patient occurred three times as much on content words as on function words. Furthermore, she was not only annoyed by the problem, but the dysfluencies made her emotional. Although Helm-Estabrooks (1999) states that there are no secondary symptoms associated with moments of dysfluency, this patient demonstrated eye-blinking and small head movements during the iterations. However, this patient met some of the criteria of Helm-Estabrooks (1999): repetitions did not only occur on initial syllables of words and utterances, but they occurred on initial syllables, as well as on medial and final syllables. On the other hand, prolongations and blocks did not occur in this patient. To diagnose the dysfluencies as neurogenic stuttering, there should be no adaptation effect and stuttering should occur relatively consistent across various types of speech tasks. Unfortunately, this could not be verified during this study. No objective data were available as to the patient's performances during reading aloud and naming, but she seemed to stutter most often when talking spontaneously. She also stuttered considerably less often when she spoke English or French. Based on the similarities between the occurring symptoms and the criteria suggested by Helm-Estabrooks (1999), it may be concluded that a neurogenic origin for the dysfluencies is unlikely in this case. As to the added criteria (Van Borsel, 2011; Balasubramanian et al., 2003), this patient met only one of them: final consonants were also affected by repetitions. She did not stutter mainly on /r/, /l/, and /h/, and the effects of fluency enhancing conditions and differences across various speech tasks were not studied.

One may wonder why this patient did not present with more characteristics of neurogenic stuttering in 2003 than in 1995, since this could be a possible consequence of the training effect. Perhaps this training effect did only include the characteristics of stuttering in general, rather than the specific characteristics of neurogenic stuttering.

It is remarkable that this patient stuttered considerably more in Dutch than in English and French. In developmental stuttering, it is exceptional for bilinguals to
stutter in one language and not in the other (Van Borsel, Maes, & Foulon, 2001). The most common pattern in DS seems to be that stuttering occurs in both languages with one language being affected more than the other. With regard to acquired stuttering, it is stated to be more pervasive than developmental stuttering. AS is claimed to occur across all speech tasks (Ringo and Dietrich, 1995) and in bilinguals both languages should be equally affected (Lebrun, Bijleveld, & Rousseau, 1990). In this case study, however, Dutch was most severely affected by the stuttering moments. In English and French, considerably less stuttering moments occurred (Verhoeven et al., 2005). One should take into account, that in the case study of Lebrun et al. (1990) as well as in this case study, formal measurements were not performed to support the clinical impressions.

This patient did not meet the criteria of palilalia, which makes a neurodegenerative disorder less probable. An increasing rate or a decreasing loudness was not observed, and in most instances only one iteration occurred. Furthermore repetitions occurred in a word-initial, as well as in a word-medial and a word-final position and they occurred both sentence-initially, sentence-medially and sentence-finally.

7. Conclusion
To our knowledge, this is the first patient reported in literature who presented with word-final dysfluencies that are most likely of psychogenic origin. Word-final dysfluencies are rare, and they usually have a developmental or a neurogenic origin (Lebrun et al., 1990). They may occur in adults, but this has only been described after brain damage (Lebrun et al., 1990). Furthermore, in contrast to other patients who presented with psychogenic stuttering, there was no or little therapy effect. From 1995 to 2003, her symptoms evolved and she started to stutter even more. This is possibly due to a training effect: over the years she has learned about the characteristics of stuttering and she has started to apply them. This patient showed initial part-word repetitions, medial part-word repetitions, final part-word repetitions and whole-word repetitions. The three first categories occurred most often on multisyllabic content words, while whole-word repetitions occurred more often on monosyllabic function words. Initial part-word repetitions, final part-word repetitions, and whole-word repetitions occurred most often in a sentence-medial position, while medial part-word repetitions mostly occurred sentence-finally. The majority of
final repetitions consisted of single iterations. Final part-word repetitions that occurred on monosyllabic words usually involved the coda of this syllable, while final part-word repetitions on multisyllabic words mostly involved the entire final syllable of the word. Weaknesses of this study are the lack of formal examinations of an adaptation effect, the effect of fluency enhancing conditions, and the different manifestations of dysfluencies across various types of speech tasks. Furthermore, it concerns a single case study and these conclusions can under no circumstances be generalised. It is desirable to add new cases of word-final dysfluencies of psychogenic origin to find out more about this rare phenomenon.

8. Bibliography


