

Compilation of a preliminary checklist for the differential diagnosis of neurogenic stuttering

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Background: Neurogenic stuttering (NS) is the most frequently occurring acquired form of stuttering in children and adults. This form of stuttering is primarily caused by neurological incidents. Owing to controversies with regard to similarities between developmental stuttering (DS) and NS symptomatology, differential diagnosis is problematic. Differential diagnosis will guide the appropriate management of persons who stutter (PWS).

Objectives: The aim of this study was to describe and highlight the characteristics of NS in order to compile a preliminary checklist for accurate diagnosis and intervention.

Method: An explorative, applied mixed method, multiple case study research design was followed. Purposive sampling was used to select four participants. A comprehensive assessment battery was compiled for data collection.

Results: The results revealed a distinct pattern of core stuttering behaviours in NS, although discrepancies existed regarding stuttering severity and frequency. It was also found that DS and NS can co-occur. The case history and the core stuttering pattern are important considerations during differential diagnosis, as these are the only consistent characteristics in people with NS.

Conclusion: It is unlikely that all the symptoms of NS are present in an individual. The researchers scrutinised the findings of this study and the findings of previous literature to compile a potentially workable checklist.

Introduction

Interest in the sudden onset of 'stuttering-like' behaviour is not novel. This phenomenon has been both discussed and obliquely alluded to in stuttering literature (Shapiro, 2011). Cases of acquired stuttering are nevertheless generally considered to be rare. For this reason stuttering and stutter-like behaviours have often been categorised together and treated as if all dysfluencies were indications of developmental stuttering (Shapiro, 2011). There is currently still a lack of information regarding the evidence for and the prevalence of neurogenic stuttering, but it is becoming increasingly apparent that speech-language pathologists (SLPs) often have a higher caseload of clients with neurogenic stuttering than they are aware of (Theys, Van Wierengin & De Nil, 2008). Despite the fact that neurogenic stuttering (NS) shares several symptoms and perceptual characteristics with developmental and psychogenic stuttering (Van Borsel & Taillieu, 2001), these three forms of stuttering should not be confused. Failure to distinguish between them could lead to ineffective assessments and generally inappropriate stuttering intervention, which in turn would prevent adequate progress in stuttering therapy (Balasubramanian, Cronin & Max, 2010). A holistic approach during assessment of and intervention with people who stutter or manifest dysfluencies will ensure accurate diagnosis and an appropriate and individualised therapy plan.

A therapy plan ideally reflects a thorough evaluation of all possible symptoms and etiologies. A checklist providing the distinctive features of NS will guide therapists to make a differential diagnosis between NS, developmental stuttering (DS), and acquired psychogenic stuttering (De Nil, 1999). A differential diagnosis remains challenging as similar symptoms may manifest, especially in the case of NS and psychogenic stuttering. A client with NS is often not aware of the dysfluencies but can be annoyed with his or her speech; similarly, in the case of psychogenic stuttering the client may be indifferent to his or her speech (Guitar, 2014). In both NS and psychogenic stuttering onset is sudden and dysfluencies are fairly consistent (Guitar, 2014).

Any form of stuttering and especially neurogenic stuttering (NS) can be viewed as a multidimensional speech disorder since it has an impact on the individual's physical ability,

emotions and mental health, environment, and psycho-social functioning (Yaruss, 2007). NS is classified as an acquired speech disorder (Theys *et al.*, 2008). This form of stuttering is the most frequently occurring acquired form in both adults and children (Van Borsel & Tallieu, 2001). It is most often the result of a neurological incident, be it a stroke, a traumatic brain injury (TBI) or any other event that could damage brain functionality (Theys *et al.*, 2008). For this reason it is imperative to manage NS according to the International Classification of Function (ICF). According to the model, the following need to be addressed: (1) *impairments*, which are the characteristics that can be observed; (2) *disability*, which refers to the speaker's functional communication difficulties, and (3) the *handicap*, which refers to the negative influence on the speaker's quality of life (Yaruss & Quesal, 2004).

Like any other form of stuttering, NS causes serious communication difficulties, possibly resulting in a perceived disability (Helm-Estabrooks, 1999). Communication difficulties can include social ineptitude and a negative self-perception as well as a negative perception of communication, which leads to social isolation, thus having a negative impact on the quality of life. Accurate and expeditious identification of NS can reduce or even prevent such communication difficulties (Manning, 2010). Currently the field of NS does not seem to be receiving much academic and clinical attention; but those professionals who have recognised this condition deem it crucial that SLPs are made aware of the characteristic features (Manning, 2010; Tani & Sakai, 2011; Theys *et al.*, 2008; Shipiro, 2011).

In many cases, the reason why NS is not identified or diagnosed is that the individual displays no serious symptoms. It is also difficult to associate stuttering with fleeting neurological incidents that were not perceived as critical (Manning, 2010). These clients are often not even hospitalised, so no record of a TBI presents on their medical history. The clients with more severe TBIs are admitted to hospital with survival as the main goal and no attention can be given to speech evaluations at that time. These clients are then discharged without any warning of possible communication difficulties, such as NS, that can arise. The diagnosis can be further complicated when the onset of the NS occurs only months after the TBI.

Canter (1971) compiled a set of seven characteristics for the purpose of facilitating the accurate identification of persons with NS. Helm-Estabrooks (1999) adapted these characteristics to formulate six common symptoms. The symptoms Helm-Estabrooks (1999) identified are as follows:

1. Dysfluencies, which are equally observed on function words and content words during an utterance.
2. The speakers do not seem to be fearful or aware of the stuttering events. They do seem annoyed and surprised, however, at the occurrence of these events.
3. Repetitions, blocks and prolongations appear in all positions in words and expressions.

4. During stuttering events, people do not present with the secondary behavioural symptoms, such as facial contortions, eye blinking or fist clenching associated with the moment of stuttering.
5. The clients do not demonstrate adaptation effects.
6. Stuttering occurs consistently across different speech tasks and communication contexts.

Furthermore, Tani and Sakai (2011) cautioned therapists to take cognisance of the fact that some clients manifest added symptoms of aphasia and dysarthria.

More recently Lundgren, Helm-Estabrooks and Klein (2010) argued that the six symptoms as presented by Helm-Estabrooks (1999) are of questionable reliability as indicators. They contend that a person should present with all six of the symptoms associated with NS as well as a history of a neurological incident in order to be diagnosed with NS. In a study conducted by Perino, Famularo and Tarroni (2000), on the other hand, the client did not present with all six of the symptoms mentioned. They found that NS could be diagnosed due to the presence of a neurological incident and only two of the six symptoms associated with NS (Perino *et al.*, 2000). General consensus amongst researchers has not been achieved regarding the characteristic symptoms of NS and their frequency. The frequency and type of symptom are in turn dependent on the severity of the neurological incident and the site of the lesion.

These discrepancies in the literature serve to emphasise the thorough and meticulous evaluation required if clinicians are to identify and address the specific symptoms as presented in any individual client. It also becomes apparent that professionals require information and guidance regarding the frequency of symptoms associated with NS. A checklist of symptoms associated with NS would facilitate differential diagnosis, as it would enable the SLP to consider all possible symptoms and etiologies in order to identify the presence of NS effectively, as well as to differentiate between this particular kind of stuttering and other forms of dysfluency.

When a clinician plans to assess an individual who stutters, several assessment batteries are available but none that address the unique symptomatology of NS (Manning, 2010; Shipley & McAfee, 2009). Van Borsel and Taillieu (2001) examined the feasibility of performing a differential diagnosis by using only speech sample analysis. The diagnosis was based on the opinion of the various professionals involved. These researchers had access to the recordings only. No other information, for example a case history of the client, was provided. They concluded that it is not sufficient to rely only on the speech characteristics of a client in order to diagnose and treat NS correctly. The current study, therefore, incorporated a complete case history and analysis of not only the audio recording but also a video recording, which provided the opportunity to analyse all observable behaviour associated with NS.

Although research findings on NS have been reported, there are various limitations to these studies. Single case

studies (e.g. Perino *et al.*, 2000) cannot necessarily be generalised to a larger NS population (as explained by Ringo & Dietrich, 1995). The study conducted by Theys *et al.* (2008) incorporated a larger number of clients with NS, but must be at risk for personal bias and subjectivity since the participants themselves were not included in the study; they were described by the SLPs only in terms of their speech patterns and presenting symptoms.

The current study includes multiple participants; it takes the form of a multiple case study. By using a case study approach the researchers were able to gather ample information, including a detailed account of the assessment process (Theys *et al.*, 2008). The researchers were also able to give a more comprehensive representation of the NS population with multiple participants. Theys *et al.* (2008) suggested that data should be gathered that are more reliable and representative of a group of NS clients with similar conditions of origin – in other words, as in the case of this study, TBI. The study in hand was designed to address the shortcomings of previous studies.

As a result of the controversies and limited clinical guidelines in the literature, the following research question is posed: What are the distinctive characteristics of NS to be included in a preliminary differential diagnostic checklist?

Method

Aim

The aim of the study is (1) to obtain data about the characteristics of four participants with NS and (2) to identify trends and similarities in the characteristics ascertained in the participants and from current literature that could be used to compile a preliminary checklist for differential diagnosis in NS.

Research design

An explorative, applied mixed method, multiple case study research design was selected for this study. The mixed method approach used is referred to as a dominant–less-dominant model (Creswell, 1994; De Vos, 2002), in which the quantitative data were the dominant and qualitative data the less-dominant component. The researchers made use of a cross-sectional time frame in the study as a small group of individuals were assessed at a specific moment in time (Bless & Higson-Smith, 2000). Case study approaches are most effective in fields of practice that are not well understood or that require more in-depth studies (Leedy & Ormrod, 2014). For this reason the current approach is deemed appropriate.

Participants

The population targeted for this study was people who stutter (PWS). The researchers made use of a purposive sampling method to select four participants. The participants were deliberately selected on the basis of specific characteristics

(Maxwell & Satake, 2006). All four participants have a history of neurological incidents. Three of the participants suffered diverse neurological incidents (see Table 1). In this study participants were either 3- or 4-year students or already qualified and employed. High-functioning adults were selected in order to eliminate the possibility of a language disorder and/or cognitive impairment. Furthermore, participants were selected from the stuttering clinic's database at the Department of Speech-Language Pathology and Audiology, University of Pretoria. This enabled the researchers to access and scrutinise previous records regarding the therapy progress and medical history of the participants selected.

All four participants had made minimal progress during previous stuttering therapy and had experienced frequent relapses. People who present with NS do not show the expected progress when traditional stuttering therapy techniques are used (Balasubramanian, *et al.* 2010; Lundgren *et al.*, 2010). Only adults were included in the study as they are more likely to give a detailed account of their late childhood and early adulthood experiences relating to stuttering. The participants granted the researchers permission to contact their parents and/or relevant medical practitioners in order to obtain information regarding the participants' medical history and early childhood. In the case of recent neurological incidents reports were obtained from the neurologist and general practitioners. The participants had to be proficient in either Afrikaans or English as these are the languages in which the researchers can converse with professional confidence. In order to be included in the study, the participants were required to have a history of a TBI incident. There is a correlation between NS and a TBI (Jokel, De Nil & Sharpe, 2007). Individuals who had suffered a stroke or have a neurological degenerative disorder were not included in the study, because research in a single etiology of NS is required (Theys *et al.*, 2008). All four participants (see Table 1) were diagnosed with NS; however, one participant had a history of DS (normal dysfluency) as a pre-schooler. Gender was not a criterion for participant selection.

Material used for data collection

A combination of two assessment batteries was used to ensure that the researchers could highlight the majority of distinctive characteristics associated with NS (Manning, 2010). The researchers consulted assessment guidelines (Shiple & McAfee, 2009) and 'The Assessment Battery of Acquired Stuttering in Adults', or ABASA (Manning, 2010:518), in order to compile a comprehensive assessment battery for the study. The combined assessment battery for the study is tabulated in Box 1.

The constituent components of the comprehensive stuttering assessment were carefully selected to elicit all possible response types in order to formulate a comprehensive representation of each participant's stuttering behaviour. This comprehensive representation was obtained by taking into account cognitive, affective, linguistic, motor and

TABLE 1: Description of participants.

Participant	Chronological age (in years)	Gender	First language	Second language	Occupation	Diagnosis	Previous intervention(s)	Age at which neurological incident(s) occurred	History and nature of neurological incident(s)	Time lapsed from neurological incident(s) to assessment
P1	24	Male	English	Afrikaans	Final year BSc. Veterinary science	NS	No, only recently referred for an assessment	8 years	Severe TBI resulting from a bicycle accident	16 years
P2	22	Male	English	Afrikaans	BSc. Veterinary science 4th-year student	NS	Yes, consistent intervention from an early age with limited success and frequent relapses in stuttering behaviour	9 months 20 years 22 years	Influenza Type B Meningitis Single epileptic attack Physical assault resulting in moderate TBI	6 months
P3	22	Male	Zulu	English	Studying for a certificate to become an electrician	NS	Yes, intervention throughout high school career with limited success and frequent relapses in stuttering behaviour	3 days after birth 1 week after birth	Physical trauma resulting in severe TBI, causing fleeting hemiplegia Meningitis resulting in prolonged stay in Neonatal Intensive Care Unit	21 years
P4	31	Male	Afrikaans	English	Entrepreneur; Diploma in garden design	DS and NS	Yes, intermittent intervention from an early age with limited success and frequent relapses in stuttering behaviour	7 years 15 years	Fell off a swing at playground, but no resultant neurological implications Bicycle accident resulting in severe TBI, followed by extensive reconstructive and medical surgery	16 years

NS, neurogenic stuttering; DS, developmental stuttering; TBI, traumatic brain injury.

social functioning (Yaruss, 2007). In the case of this research study only high-functioning participants were included, and therefore the cognitive component was not evaluated formally. An information-gathering interview (Shipley & McAfee, 2009) was conducted as part of the selection process to confirm level of cognition. Cognitive awareness, however, was established utilising the same materials as with the affective and social component. The ability to have insight into one's emotional responses and experience of stuttering was evaluated with: Overall Assessment of the Speaker's Experience of Stuttering, or OASES (Yaruss & Quesal, 2010), Perceptions of Stuttering Inventory, or PSI (Woolf, 1967 as cited in Guitar, 2014), Perceptions of Self Semantic Differential Task (Kalinowski, Lerman & Watt, 1987) and Locus of control of behaviour scale, or LCB Scale (Craig, Franklin & Andrews, 1984 cited in Guitar, 2014). In addition to the Pragmatic Protocol (Prutting & Kirchner, 1987), an informal verbal and written assessment was conducted as a means of assessing the linguistic component. The speech-motor component was evaluated informally. Reading passages, stimulability probes and fluency-enhancing techniques were used to determine consistency or adaptation of dysfluency in speech. Spontaneous speech samples were collected to determine the severity and frequency of the stuttering behaviour. The instruments used to determine the abovementioned were: Stuttering Severity

BOX 1: The compiled assessment battery.**a. Case history**

- Written case history
- Information-gathering interview: specific questions guided by Shipley and McAfee (2009)
- Information from parents
- Information from other professionals (neurologist and/or medical practitioner): reports were consulted

b. Testing of general functions

- Language:
 - Language analysis of the complexity of sentences and vocabulary demonstrated in spontaneous speech
 - Pragmatic protocol (Prutting & Kirchner, 1987)
 - Analysis of written language
- Speech:
 - Oro-facial examination (Shipley & McAfee, 2009)
- Cognitive functioning:
 - Determined by means of analysis of the information-gathering interview in terms of academic background and qualifications

c. Speech fluency assessment

- Reading:
 - The Rainbow Passage (Shipley & McAfee, 2009) and 'In die wildtuin' (Pienaar & Hooper, 1968). Passages were read 3 consecutive times in order to assess consistency and adaptation
- Spontaneous Speech:
 - Conversation with researchers and an unfamiliar conversation partner, as well as an unprepared telephone conversation (400 words)
- Stimulability probes for fluency:
 - Automatic speech: counting, naming days and months of the year
 - Fluency-enhancing techniques: shadowing, light articulatory contacts and slowed speech rate
- Stuttering severity:
 - Stuttering severity instrument (SSI) (Riley, 1980)
 - Fluency charting grid, Calculating the dysfluency index, Assessment of associated motor behaviours, and Assessment of physiological factors associated with stuttering (Shipley & McAfee, 2009)

d. Self-assessment of attitudes

- Self-perception:
 - Overall assessment of the speaker's experience of stuttering (OASES) (Yaruss & Quesal, 2010)
 - Perceptions of stuttering inventory (PSI) (Woolf, 1967 as cited in Guitar, 2014)
 - Perceptions of self-semantic differential task (Kalinowski *et al.*, 1987)
 - Locus of control of behaviour scale (LCB Scale) (Craig, Franklin & Andrews, 1984 cited in Guitar, 2014)

Instrument, or SSI (Riley, 1980), Fluency Charting Grid, Calculating the Dysfluency Index, Assessment of Associated Motor Behaviours, and Assessment of Physiological Factors Associated with Stuttering (Shipley & McAfee, 2009).

Spontaneous conversations in three different communication contexts provided the researchers with the opportunity to observe each participant's communication abilities and consistency of stuttering behaviours when presented with different communication situations. An overall language assessment was deemed necessary so as to exclude the presence of a linguistic deficit. Language could not be assessed by means of formal standardised tests, as no uniform, culturally appropriate tests are available in South Africa to assess these abilities in each participant's first language. However, by means of informal verbal and written assessment in the participants' academic and/or business language (Afrikaans or English) the researchers were able to confirm the absence of any language deficits. An assessment of narrative writing was conducted to evaluate vocabulary, punctuation, spelling and story composition (Shipley & McAfee, 2009).

The study made use of inter-rater reliability since three independent interpretations of the video recordings were made by the researchers. The reliability of these interpretations was deemed high as the independent interpretations clearly correlated with one another. During the study, the researchers ensured internal validity by means of methodological triangulation by combining components of both qualitative and quantitative research (De Vos, 2002). The instruments that were used during each participant's stuttering or dysfluency assessment are standardised and are specifically compiled to assess different stuttering behaviours, therefore enhancing the content validity of the study (Delpont, 2002). Internal validity was further enhanced by making use of the purposive sampling method through which participants were selected on the basis of specific characteristics (Maxwell & Satake, 2006). By following this procedure, the researchers ensured that the most relevant data could be gathered.

Instrumentation for data collection

A video recording of each participant's assessment was made by means of a Samsung Digital camera, model VP-MX10A. The video recorder was placed on a SLIK tripod, model U8000 placed 1.5 m from the participant. It was positioned in such a way that a full frontal view of the participant's face, shoulders, chest, hands and arms was obtained. An audio recording of each assessment was made with an Olympus digital voice recorder, model DM-550. The audio recorder was placed on a soft surface next to the participant.

The video and audio recordings enabled the researchers to analyse not only the speech and language components of the assessment but also the behavioural aspects such as the associated motor behaviours, core stuttering behaviours and secondary behaviours associated with stuttering.

Data collection procedures

The assessment battery discussed above was implemented for a comprehensive stuttering assessment conducted on each participant individually. During each assessment the same sequence of procedures was followed. The assessment commenced with the information-gathering interview and a spontaneous conversation with the researchers. The interview was followed by the speech fluency assessment consisting of reading a passage, the introduction of stimulability probes for fluency, spontaneous conversation with an unfamiliar conversation partner and an unprepared telephone conversation, in that sequence (see Box 1). Thereafter the researchers requested that each participant write a short paragraph about any topic of interest and a complete oral-facial examination was conducted. The final task for each participant entailed the completion of the various self-perceptions checklists as identified in Box 1. Thereafter, three independent researchers interpreted the data collected and inter-rater interpretation was deemed reliable.

Data analysis procedures

The process of data analysis and interpretation of the qualitative data utilised in the current study are classified by Cresswell (1994:195) as a 'data analysis spiral', in which the researcher moves in analytical circles instead of using a static linear approach (De Vos, 2002). The data analysis spiral allows researchers to move between phases of data analysis, resulting in the adequate presentation of descriptive data that resulted in a sound understanding of the NS. The analysis spiral consists of the following phases: '[C]ollecting and recording data, managing data, reading and writing memos, describing, classifying and interpreting' and, lastly, 'representing and visualising' (De Vos, 2002:340).

The researchers viewed each participant's video recording of the stuttering assessment. The data was then organised in file folders, from where it was converted to text units as a means of simplifying analysis. After rereading the researchers to familiarise themselves with the data set by rereading the data, the spiral circled to the category formation phase. The researchers noted regularities in the subsections of the assessment conducted on participants, which led to generating categories of meaning in which internal convergence and external divergence was established. These categories or patterns were then challenged in order to search for plausible explanations. The final phase consisted of the representation and visualisation of the characteristics of NS presented in a preliminary differential diagnostic checklist.

The quantitative data was analysed by using descriptive statistics such as simple frequency distribution. Triangulation of method was utilised by mixing quantitative and qualitative approaches in order to determine an overlap between the data (quantitative and qualitative) and consequently obtain more comprehensive results.

Results

During this study, specific trends and shared characteristics amongst the four participants were identified. In order to compile a preliminary checklist, it is necessary to describe the specific trends according to the areas of the case history, cognitive functioning, affective aspects, linguistic functioning, speech motor abilities and social functioning.

Case history

Specific trends with regard to the neurological incident, family history and previous therapeutic interventions were found. With regard to the neurological incident, the participants in this study all presented with a history of a TBI. However, each TBI was different in terms of the nature, severity, age of occurrence and impact on the participant. It was noted that it is important to obtain information with regard to the client's medical history from birth to the time of the assessment. The most pertinent information with regard to early childhood and the neurological incident was obtained by consulting relevant family members rather than the participants themselves. Two participants presented with a history of meningitis during childhood in addition to the history of TBI. Previous studies have found that meningitis can affect brain functioning (Gazzolo *et al.*, 2004). Altered brain functioning has been identified as one of the various causes of NS (Helm-Estabrooks, 1999; Manning, 2010).

With regard to family history, the findings of this study concur with reports by Manning (2010) and Yairi (2007) that individuals with a family history of DS are predisposed for the occurrence of NS. Ludlow and Loucks (2003) provide an additional affirmation of the DS-NS connection, namely: the presence of DS results in increased susceptibility to NS following a neurological incident.

Cognitive awareness

Results regarding cognitive awareness were obtained by means of the OASES (Yarus & Quesal, 2010), the Perceptions of Self Semantic Differential Task (Kalinowski *et al.*, 1987), the PSI (Woolf, 1967 as cited in Guitar, 2014:168) and the LCB Scale (Craig *et al.*, 1984 cited in Guitar, 2014). The first participant (P1), who presented with a mild NS, was unaware of the presence of the stuttering behaviour. Where the onset of NS occurred in early childhood (see Table 1), as in the case of P2 and P3, awareness of and reaction to the stuttering behaviour were evident. The participants' awareness of and reaction to their stuttering are possibly due to continuous negative reaction by communication partners over a long period of time. A person can also present with a combination of stuttering behaviours when a positive history of DS and additional TBI are present, as in the case of P4. He was aware of the stuttering behaviour associated with the DS, but not of the additional NS behaviours. The onset of the DS occurred in early childhood, whereas the onset of the NS occurred in late childhood, with symptoms

of both types of stuttering behaviour continuing into adolescence and early adulthood.

All the participants in this study presented with a history of a closed TBI which resulted in diffuse brain damage. P1, P2 and P4 presented with appropriate cognitive awareness. It can therefore be deduced that cognitive awareness is not always negatively affected in all cases of NS in the presence of a history of a TBI.

Affective aspects

Similarly to cognitive awareness, the affective aspects were identified by means of the OASES (Yarus & Quesal, 2010) and the Perceptions of Self Semantic Differential Task (Kalinowski *et al.*, 1987). During this study, it was found that individuals who differ in terms of the severity of the stuttering behaviour presented with different affective responses. P1, who presented with a mild NS, exhibited only agitation and annoyance. Additional negative emotions, such as frustration, anxiety and anger, were experienced by P2, P3 and P4. Since P2 and P3 presented with severe NS from early childhood, undesirable reactions by communication partners and increased self-awareness over a long period of time resulted in negative emotions on their part. The negative emotions exhibited by P4 are related to the history of the DS. In agreement with the findings of Yaruss and Quesal (2004), PWS's awareness of their stuttering behaviour leads to anxiety and frustration and limited social interaction. The different affective responses of all the participants subsequently led to a low self-esteem and impaired self-perception. Although the participants reported that they are competent individuals in tasks that do not require social interaction or speaking, their self-esteem and self-perceptions had a negative impact on verbal interaction with communication partners. This finding contradicts reports which state that in the case of NS no or minimal awareness manifests (Manning, 2010).

Linguistic functioning

Persons presenting with NS may or may not present with language impairment (Manning, 2010; Tani & Sakai, 2011). Only participants with competence in English or Afrikaans as their academic or business language were included in the study. In the case of P3, minor language difficulties, such as word retrieval, were identified in his second language (English). These difficulties were also present as reported by his family members in his first language (isiZulu). The possibility of an aphasic element should be further investigated (Tani & Sakai, 2011); however, his overall linguistic competence was not compromised. The other three participants presented with above-average language functioning. The site of the neurological lesion in persons presenting with NS is likely to have a differential impact on language functioning. Moreover, linguistic skill has been found to be genetically determined to a large degree (Di Sciullo, 2010). Language functioning, therefore, does not need to be regarded as a significant factor to consider during differential diagnosis of NS.

Results on pragmatic behaviour were obtained by means of the Pragmatic Protocol (Prutting & Kirchner, 1987). All four participants presented with pragmatic deficits associated with a neurological incident. Pragmatic behaviours characteristic of DS were also observed in P4. Depending on the nature of the neurological incident, additional pragmatic deficits may be present (Dardier *et al.*, 2011; Douglas, 2010). During differential diagnosis it is important to identify the pragmatic deficits related to the neurological incident, as well as pragmatic deficits associated with the stuttering behaviour. Pragmatic behaviours that were observed (P1–P4) to be associated with the NS included deficits in cohesion, physical proximity, topic initiation and maintenance, and conciseness. These behaviours are consistent with pragmatic breakdown found in persons with left and right hemisphere brain damage (Bloom & Opler, 1998). Pragmatic behaviours associated with DS (P4) included deficits in turn-taking ability and paralinguistic aspects in an attempt to disguise or avoid the stuttering behaviour (Guitar, 2014). Therefore, it is of importance to be vigilant in the identification of specific pragmatic deficits associated with a neurological incident. The nature of the different pragmatic deficits can guide the SLP in terms of differential diagnosis.

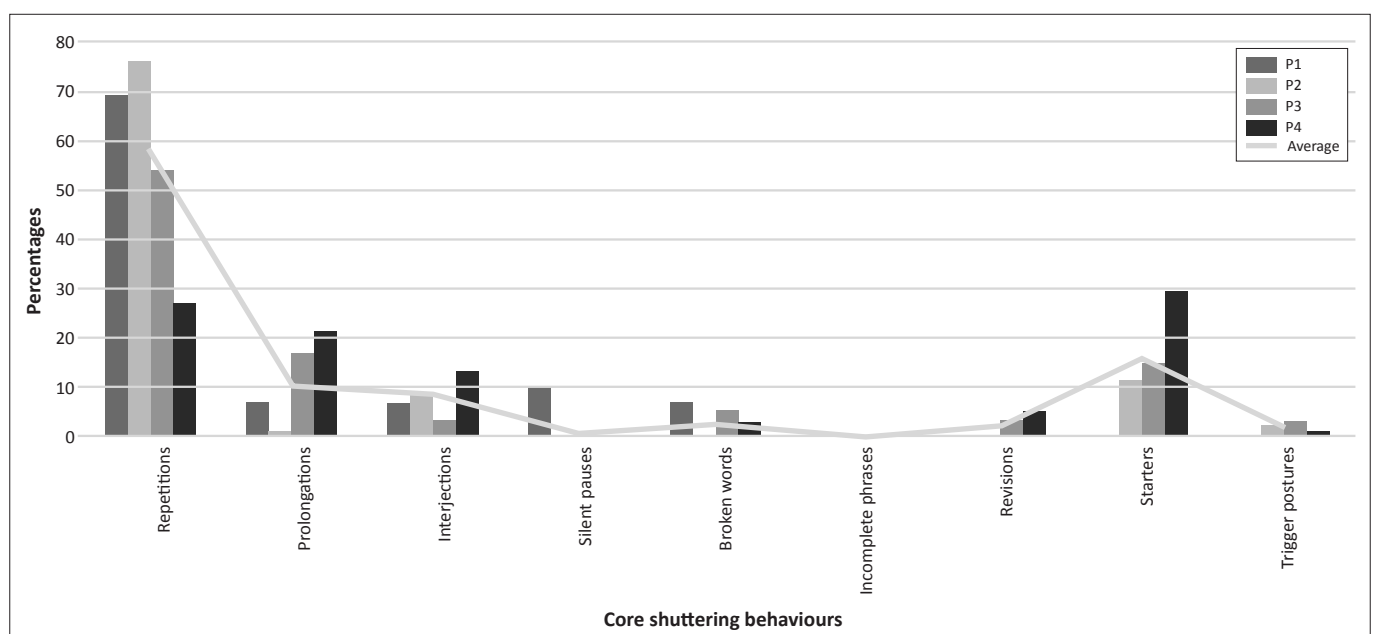
Speech motor functioning

The SSI (Riley, 1980), Fluency Charting Grid, Calculating the Dysfluency Index, Assessment of Associated Motor Behaviours, and Assessment of Physiological Factors Associated with Stuttering (Shipley & McAfee, 2009) were used to obtain results on the speech motor functioning of the participants. All the participants presented with varying degrees of stuttering severity when presented with different communication situations such as having a conversation with the researchers, talking to a complete stranger, and having a telephone conversation. Other researchers (Tani & Sakai, 2011) have also demonstrated that individuals who present

with NS do not always perform consistently throughout different communication situations. On the other hand, some researchers have found that individuals with NS present with consistent stuttering behaviours in various communication situations (Manning, 2010; Jokel, DeNil & Sharpe, 2007). Varying stuttering severity across communication situations may therefore be one of the many reasons why the SLP does not immediately identify these presenting stuttering behaviours as being related to NS.

On assessing adaptation and consistency of stuttering behaviour, it was noted that consistency was high and adaptability low. This is characteristic of NS (Manning, 2010) and is an important characteristic to identify during the differential diagnosis between NS and DS. By means of fluency probes P2 was able to maintain fluency for a short period of time. The other three participants achieved fluency during automatic speech tasks, but were not able to produce more fluent speech when presented with the different fluency probes. It can be deduced that some persons presenting with NS do benefit from fluency probes, but the application is limited in the sense that communication presents as deviant from what is deemed natural speech. Three out of the four participants who were included in the study did not benefit from the various stimulability probes. Balasubramanian *et al.* (2010) and Helm-Estabrooks (1999) reported similar findings. Consequently, poor adaptation of speech when the PWS is presented with fluency probes should be considered an indicator in the differential diagnosis between NS and DS.

In general, NS poses challenges with regard to differential diagnosis. Diagnosis of NS is complicated by the long-term nature of the problem, co-occurring language disorders and the additional presence of DS. The percentage of core stuttering behaviour relative to total occurrence of all behaviours across participants is presented in Figure 1.



P, participant.

FIGURE 1: Predominant core stuttering behaviours presented by P1 – P4.

Figure 1 clearly illustrates that the participants presented an array of core stuttering behaviours that exemplify the distinctive features of NS. Repetitions were the most dominant core stuttering behaviour which was present in all four participants. Repetitions consisted predominantly of sound and part-word repetitions in the initial, medial and final position of words. The presence of sound and part-word repetitions in the medial and final position of words is characteristic of NS, as described by Helm-Estabrooks (1999) and Tani and Sakai (2011). Furthermore, the findings of initial sound and part-word repetitions concur with the findings in the study conducted by Tani and Sakai (2011). Although part-word repetitions are generally accepted as core stuttering behaviours present in NS, these may also occur in DS and PS. For this reason a holistic approach is essential in order to identify other co-occurring characteristics predicting neurogenic involvement.

Associated motor behaviours in an attempt to escape the stuttering moments were present in three of the participants (P1, P3 and P4). In addition, in the case of P2 apraxia-like symptoms, such as oral searching and groping movements, were observed. This corroborates with findings by Tani and Sakai (2011), suggesting that the SLP should be aware of soft neurological signs during the differential diagnosis between DS and NS.

Social functioning

The participants' participation in social situations was evaluated by means of the OASES (Yaruss & Quesal, 2010) and the LCB Scale (Craig *et al.*, 1984 cited in Guitar, 2014). It is the experience of all the participants that their stuttering behaviours influenced their social, academic and occupational functioning negatively. For instance, P4, who presented with DS and NS, was overly aware of his limitations, thus withdrawing from social and occupational contexts. P1, P2 and P3 experienced themselves to be limited in speaking situations, due to external barriers created by different communication partners. This observation supports the findings of Yaruss (2007).

Ethical considerations

The study was cleared by the Research Committee of the Department of Speech-Language Pathology and Audiology, University of Pretoria. The participants were provided with a document containing information regarding the nature and the purpose of the study. The participants were also informed that they would be allowed to withdraw from the study at any time without any consequences. The participants were informed that all their personal information and assessment results will be kept confidential. The participants provided written consent.

Discussion

The importance of considering each individual client with his or her stuttering behaviours is highlighted in this study. The four participants presented with differences with regard to their stuttering behaviour patterns as well as the severity and frequency of the stuttering behaviour. The researchers found consistent core stuttering behaviours, however, amongst the

four participants. Core stuttering behaviours consisted mainly of repetitions of sounds in the medial and final position of a word, a lack of adaptation, high consistency and rapid firing speech. These stuttering behaviours are considered predictors of NS, as similarly described in the literature (Helm-Estabrooks, 1999; Jokel, De Nil & Sharpe, 2007; Tani & Sakai, 2011).

The case history and the core stuttering patterns are an important consideration during differential diagnosis of NS. The occurrence of a neurological incident and the core stuttering patterns are the only consistent characteristics in individuals presenting with NS and they should be considered predictors of this dysfluency disorder. Other factors that may be considered during differential diagnosis are variable, but it is important to note that the presence of one NS symptom in combination with the detailed case history guides the differential diagnosis and planning of NS intervention (Helm-Estabrooks, 1999). This study found that it is unlikely that all the symptoms of NS will be present in a single client. This finding concurs with the study conducted by Perino *et al.* (2000).

Additional findings of this study were similar to those reported in recent literature regarding the occurrence of NS in combination with DS (Manning, 2010; Yairi, 2007). It is evident that there is much yet to be discovered about the complexity of NS. It was found that DS can present simultaneously with NS, and that the onset of NS can occur in early childhood. This finding highlights the importance of making a clear differential diagnosis in early childhood in order to ensure the most effective intervention from an early age.

The Preliminary Checklist for Differential Diagnosis of Neurogenic Stuttering (see Appendix 1) takes into consideration all the relevant characteristics for differential diagnosis of NS. Besides the findings reported in current literature, additional features were identified in this study, for instance some participants presented with increased cognitive awareness, contradicting findings by Helm-Estabrooks (1999) and Guitar (2014). The characteristics identified in the participants as well as the features described in the current literature were included in the compilation of the preliminary checklist. These characteristics are categorised as either predictive or non-predictive factors. A high occurrence of predictive factors is indicative of NS, whereas non-predictive factors may be present in either NS, DS or psychogenic stuttering. The checklist has been compiled in such a manner that it should be user friendly as the SLP needs to answer only 'yes' or 'no' questions. Furthermore, guidelines for the interpretation of responses are included in the checklist. The applicability of the compiled checklist was evaluated informally by a professional speech-language pathologist with extensive experience in working with PWS. The checklist was deemed comprehensive and potentially a valuable tool.

Since the differential diagnostic applicability of this tool has not been researched in depth, the checklist should be evaluated in future research. It is recommended that the checklist should be implemented on a diverse group of individuals presenting

with fluency disorders. In addition to the application of the preliminary checklist on a diverse group, an increase in the sample size is recommended for future research. This is considered necessary since the nature of this study's explorative research design led to the inclusion of a small sample size. Although the preliminary checklist appears to be comprehensive, further research is warranted in order to determine the validity and reliability of the tool. In addition, future research is needed to determine the relationship between DS and the long-term nature of NS with regard to the level of awareness of the stuttering behaviours as well as the specific effects on overall communication.

Conclusion

Owing to controversies regarding similarities between DS and NS symptomatology, differential diagnosis is problematic. The study aimed to describe and highlight the characteristics of NS in order to compile a preliminary differential diagnostic checklist (see Appendix 1). The results were analysed and the literature was scrutinised in order to develop the checklist. This checklist guides SLPs in the differential diagnosis of NS and in turn should improve the appropriate management of individuals with both NS and DS. Although the trustworthiness of the checklist has not been confirmed through research, the clinical application as such proves useful as the most prevalent symptoms of NS are highlighted.

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Competing interests

The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

Authors' contributions

U.Z. (University of Pretoria) was the supervisor of the research study. J.v.d.L. (University of Pretoria) was co-supervisor. M.L. and Z.E. (University of Pretoria) conducted the research. U.Z. and J.v.d.L. compiled the article.

References

- Balabusramanian, V., Cronin, K.L., & Max, L. (2010). Dysfluency levels during repeated readings, choral readings and readings with altered auditory feedback in two cases of acquired neurogenic stuttering. *Journal of Neurolinguistics*, 23, 488–500. <http://dx.doi.org/10.1016/j.jneuroling.2009.04.004>
- Bless, C., & Higson-Smith, C. (2000). *Fundamentals of social research methods: An African perspective* (2nd edn., pp. 63–81). Cape Town: Juta.
- Bloom, R.L., & Odler, L.K. (1998). Pragmatic breakdown in patients with left and right brain damage: Clinical implications. *Journal of Neurolinguistics*, 11, 11–20. [http://dx.doi.org/10.1016/S0911-6044\(98\)00002-5](http://dx.doi.org/10.1016/S0911-6044(98)00002-5)
- Canter, G.J. (1971). Observations on neurogenic stuttering: A contribution to differential diagnosis. *British Journal of Disorders of Communication* 6, 139–143. <http://dx.doi.org/10.3109/13682827109011539>
- Craig, A., Franklin, J., & Andrews, G. (1984). A scale to measure locus of control of behaviour. *British Journal of Medical Psychology*, 57, 173–180. <http://dx.doi.org/10.1111/j.2044-8341.1984.tb01597.x>
- Creswell, J.W. (1994). *Research design: Qualitative and quantitative approaches*. Thousand Oaks, CA: Sage.
- Dardier, V., Bernicot, J., Delanoë, A., Vanberten, N., Fayada, C., Chevignard, M. et al. (2011). Severe traumatic brain injury, frontal lesions, and social aspects of language use: A study of French-speaking adults. *Journal of Communication Disorders*, 44, 359–378. <http://dx.doi.org/10.1016/j.jcomdis.2011.02.001>
- Delport, C.S.L. (2002). Quantitative data collection methods. In A.S. de Vos (Ed.), *Research at grass roots. A primer for the caring professions* (2nd edn., pp. 165–196). Pretoria: Van Schaik Publishers.
- De Nil, L.F. (1999). Stuttering: A neurophysiological perspective. In N.B. Ratner, & E.C. Healey (Eds.), *Stuttering research and practice: Bridging the gap* (pp. 85–102). Mahwah, NJ: Lawrence Erlbaum Associates, Inc., Publishers.
- De Vos, A.S. (2002). Combined quantitative and qualitative approach. In A.S. de Vos (Ed.), *Research at grass roots. A primer for the caring professions* (2nd edn., pp. 363–371). Pretoria: Van Schaik Publishers.
- De Vos, A.S. (2002). Qualitative data analysis and interpretation. In A.S. de Vos (ed.), *Research at grass roots. For the social sciences and human service professions* (2nd edn., pp. 339–354). Pretoria: Van Schaik Publishers.
- Douglas, J.M. (2010). Relation of executive functioning to pragmatic outcome following severe TBI. *Journal of Speech, Language and Hearing Research*, 53, 365–382. [http://dx.doi.org/10.1044/1092-4388\(2009\)08-0205](http://dx.doi.org/10.1044/1092-4388(2009)08-0205)
- Gazzolo, D., Grutzfeld, D., Michetti, F., Toesca, A., Lituanica, M., Bruchettini, M. et al. (2004). Increased S100B in cerebrospinal fluid of infants with bacterial meningitis: Relationship to brain damage and routine cerebrospinal fluid findings. *Clinical Chemistry*, 50, 941–944. <http://dx.doi.org/10.1373/clinchem.2003.021048>
- Guitar, B. (2014). *Stuttering an integrated approach to its nature and treatment*. (4th edn.). Baltimore, MD: Lippincott, Williams & Wilkins.
- Helm-Estabrooks, N.A. (1999). Stuttering associated with acquired neurologic disorders. In R.F. Curlee (Ed.), *Stuttering and related disorders of fluency* (2nd edn., pp. 255–268). New York, NY: Thieme Medical Publishers.
- Jokel, R., De Nil, L., & Sharpe, K. (2007). Speech disfluencies in adults with neurogenic stuttering associated with stroke and traumatic brain injury (case study). *Journal of Medical Speech-Language Pathology*, 15(3), 243–270.
- Kalinowski, L.S., Lerman, J.W., & Watt, J. (1987). A preliminary examination of self and others in stutters and non-stutters. *Journal of Fluency Disorders*, 12, 317–331. [http://dx.doi.org/10.1016/0094-730X\(87\)90030-1](http://dx.doi.org/10.1016/0094-730X(87)90030-1)
- Leedy, P.D. & Ormrod, J.E. (2014). Qualitative research. In P.D. Leedy & J.E. Ormrod (Eds.), *Practical research: Planning and design* (10th edn., pp. 141–172). Essex: Pearson Education Limited.
- Ludlow, C.L., & Loucks, T. (2003). Stuttering: A dynamic motor control disorder. *Journal of Fluency Disorders*, 28, 273–295. <http://dx.doi.org/10.1016/j.jfludis.2003.07.001>
- Lundgren, K., Helm-Estabrooks, N., & Klein, R. (2010). Stuttering following acquired brain damage: A review of literature. *Journal of Neurolinguistics* 23, 447–454. <http://dx.doi.org/10.1016/j.jneuroling.2009.08.008>
- Manning, W.H. (2010). *Clinical decision making in fluency disorders*. (3rd edn.). Clifton Park, NY: Delmar Cengage Learning.
- Maxwell, D.L., & Satake, E. (2006). *Research and statistical methods in communication sciences and disorders*. New York, NY: Thomson Delmar Learning.
- Perino, M., Famularo, G., & Tarroni, P. (2000). Acquired transient stuttering during a migraine attack. *Headache* 40, 170–172. <http://dx.doi.org/10.1046/j.1526-4610.2000.00025.x>
- Pienaar, P. de V., & Hooper, A.G. (1968). In die wildtuin [In the game reserve]. In 'n Afrikaanse fonetiese leesboek [An Afrikaans phonetic reader]. Pretoria: Van Schaik Publishers.
- Prutting, C.A., & Kirchner, D.M. (1987). A clinical appraisal of pragmatic aspects of language. *Journal of Speech and Hearing Disorders*, 52(2), 105–119.
- Riley, G.D. (1980). *Stuttering severity instrument* Tigard, OR: C.C. Publications, Inc.
- Ringo, C., & Dietrich, S. (1995). Neurogenic stuttering: An analysis and critique. *Journal of Medical Speech-Language Pathology*, 3(2), 111–122.
- Shipley, K.G., & McAfee, J.G. (2009). *Assessment in speech-language pathology. A resource manual*. (4th edn.). Clifton Park, NY: Delmar Cengage Learning.
- Shapiro, D.H. (2011). *Stuttering intervention. A collaborative journey to fluency freedom*. (2nd edn.). Austin, TX: PRO-ED, Inc.
- Di Sciullo, A.M., Piattelli-Palmarini, M., Wexler, K., Berwick, R.C., Boeckx, C., Jenkins, L., et al. (2010). The biological nature of human language. *Biolinguistics*, 4, 4–34. <http://www.biolinguistics.eu>
- Tani, T., & Sakai, Y. (2011). Analysis of five cases with neurogenic stuttering following brain injury in the basal ganglia. *Journal of Fluency Disorders*, 36, 1–16. <http://dx.doi.org/10.1016/j.jfludis.2010.12.002>
- Theys, C., Van Wieringen, A., & De Nil, L.F. (2008). A clinician survey of speech and non-speech characteristics of neurogenic stuttering. *Journal of Fluency Disorders*, 33, 1–23. <http://dx.doi.org/10.1016/j.jfludis.2007.09.001>
- Van Borsel, J., & Taillieu, C. (2001). Neurogenic versus developmental stuttering: An observer judgement study. *Journal of Communication Disorders*, 34, 385–395. [http://dx.doi.org/10.1016/S0021-9924\(01\)00057-0](http://dx.doi.org/10.1016/S0021-9924(01)00057-0)
- Woolf, G. 1967. Perceptions of stuttering inventory (PSI). *British Journal of Communication Disorders* 2, 158–177. <http://dx.doi.org/10.3109/13682826709031315>
- Yairi, E. (2007). Subtyping stuttering I: A review. *Journal of Fluency Disorders*, 32, 165–196. <http://dx.doi.org/10.1016/j.jfludis.2007.04.001>
- Yaruss, J.S. (2007). Application of the ICF in fluency disorders. *Seminars in Speech and Language*, 28(4), 312–322. <http://dx.doi.org/10.1055/s-2007-986528>
- Yaruss, J.S., & Quesal, R.W. (2004). Stuttering and the International Classification of Functioning, Disability and Health (ICF): An update. *Journal of Communication Disorders*, 37, 35–52. [http://dx.doi.org/10.1016/S0021-9924\(03\)00052-2](http://dx.doi.org/10.1016/S0021-9924(03)00052-2)
- Yaruss, J.S., & Quesal, R.W. (2010). *OASES: Overall assessment of the speaker's experience of stuttering*. Bloomington, MN: Pearson/AGS.

Appendix 1

Checklist for Differential Diagnosis of Neurogenic Stuttering

Section A: Case history

Description	Present: Yes/No	Remarks
Is there a significant history of a neurological incident (from birth to the time of assessment)?		Yes=Predictive factor
Was there a sudden onset of stutter-like behaviour?		Yes=Predictive factor
Is there a family history of developmental stuttering?		Yes=Predictive factor
Is there a history of any medical complications during early childhood (as reported by the primary caregivers, such as meningitis)?		Yes=Predictive factor
Is there a history of previous/current interventions?		Yes=Predictive factor
Is there a history of relapses or limited success of previous/current interventions?		Yes=Predictive factor

Section B: Cognitive functioning

Description	Present: Yes/No	Remarks
Is the client aware of his/her stutter-like behaviours?		No=Predictive factor
Is the client somewhat aware of his/her stutter-like behaviours?		Yes=Non-predictive factor (a combination of DS and NS may show some awareness)
Is there evidence of impaired cognitive functioning?		Yes= Non-predictive factor (depending on site of lesion)

Section C: Affective aspects of functioning

Description	Present: Yes/No	Remarks
Does the client (child) show any negative emotional reaction?		No=Predictive factor
Does the client (adolescents/adults) react with minor agitation and annoyance towards the stutter-like behaviours?		Yes=Predictive factor
Is there a lack in internal locus of control during non-verbal tasks?		Yes=Predictive factor

Section D: Linguistic functioning

Description	Present: Yes/No	Remarks
Does the client present with a language deficit?		Yes=Non-predictive factor
Does the client present with a global pragmatic deficit?		Yes=Predictive factor

Section E: Speech motor functioning

Description	Present: Yes/No	Remarks
Does the client present with inconsistent frequency and severity of stutter-like behaviours in various communication situations?		No=Predictive factor
Does the client present with no adaptation and high consistency of stutter-like behaviours in the reading tasks and communication situations?		Yes=Predictive factor
Does the client show increased fluency when presented with stimulability probes?		No=Predictive factor
Does the client present with medial and/or final sound and part word repetitions?		Yes=Predictive factor
Does the client present with 'rapid fast firing' speech?		Yes=Predictive factor
Does the client present with associated motor behaviours?		Yes=Non-predictive factor

Section F: Social functioning

Description	Present: Yes/No	Remarks
Do external factors influence social, academic or occupational functioning?		Yes=Non-predictive factor

Total: Predictive factors ____/16
 Non-predictive factors ____/5
 (The presence of a majority of predictive factors is indicative of NS.)