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Linguistic behaviours in adults who clutter and adults who stutter when reading and speaking

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Abstract

The breadth of behaviours that may be considered as cluttering continues to be contentious. The current lowest common denominator (LCD) definition of cluttering excludes the possibility of high level language deficits. However, recent studies suggest that those who clutter may have linguistic deficits alongside motor control difficulties. This paper reports behavioural findings from a larger data set collected during functional MRI scans with adults who clutter (AWC), adults who stutter (AWS) and controls (CTLs). Participants were asked to read short passages aloud and describe pictures. Speech data were analysed and coded for stuttering like dysfluencies (e.g. blocks) and normal dysfluencies (e.g. revisions and fillers) by two speech and language therapists. One-way ANOVAs showed that AWC use significantly more revisions than AWS and CTLs both when reading aloud and when describing pictures. AWC showed a trend toward increased co-articulation when describing a picture compared to AWS and CTL although this failed to meet significance level, AWC speaking rates was evaluated as similar to the two other groups. Results suggest that both spontaneous speech and oral reading outputs of AWC can be differentiated from AWS and CTL by the number of revisions used. We speculate that excessive co-articulation might differentiate AWC from AWS and CTLs in spontaneous speech but this does not appear to hold true for oral reading.

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Keywords: Cluttering; normal non fluencies

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1. Introduction

1.1 Defining Cluttering

Cluttering is a multidimensional disorder and cannot be deemed to stem from one facet of communication alone (Myers & Bakker, 2013). However, a suitably constrained definition is prerequisite to ensure researchers and clinicians alike are working from a consistent viewpoint with the same disorder. With this in mind, St Louis and Schulte (2011) proposed the lowest common denominator definition (LCD) which states that cluttering is:

"…a disorder wherein segments of conversation in the speaker's native language typically are perceived as too fast, too irregular, or both. The segments of rapid and/or irregular speech rate must further be accompanied by one or more of the following: (a) excessive 'normal' disfluencies; (b) excessive collapsing or deletion of syllables; and/or abnormal pauses, syllable stress, or speech rhythm." (St. Louis & Schulte, (2011, pp 241-242).

This definition precludes the possibility that language components might be implicated as a core component, although some researchers believe this is a possibility (Bretherton-Furness & Ward , 2012; Myers & Bakker, 2013; Myers, 1992, 2011; Myers, Bakker, St Louis & Raphael, 2012, ; Van Zaalen, Wijnen, De Jonckere, 2011, 2009a, 2009b; Ward, 2006). St Louis, Raphael, Myers, and Bakker (2003) maintained that language was not included in his working definition as there appear to be PWC who do not have any difficulties with language. However, an examination of the LCD definition shows that cluttering can be characterized by a range of symptoms, not all of which need to be present at the same time to lead to a cluttering definition.

1.2 Motoric and Linguistic studies of cluttering

Bakker, Myers, Raphael and St Louis (2011) found that the diadochokinetic (DDK) rates of adults who clutter (AWC) do not differ significantly from that of fluent speakers (FS). The authors explain this by stating that DDK rates do not represent real speech as they are based on meaningless syllables. When the authors investigated speaking rate while reading it was found that AWC spoke at a significantly faster rate than FS but only when participants were asked to speak at a comfortable, self-generated rate and not when they were asked to speak quickly. Bakker et al (2011) interpret this as demonstrating a limit to how quickly people can speak regardless of diagnosis and suggests that AWC speak at an accelerated rate under all conditions due to an internal drive to do so. Alm (2004; 2011) speculates that dysfunction in the basal ganglia's ability to produce accurate timing cues for speech results in dysfluency in adults who stutter (AWS) and may also explain the dysfluency seen in AWC. Van Zaalen et al (2009) also state that the difficulties seen in cluttering stem from 'defective language automation' along with articulation errors due to an accelerated speech rate. These speculations are yet to be supported by empirical data.

Myers and Bakker (2013) used the CSI (cluttering severity instrument) to investigate the speaking characteristics of AWC. Expert clinicians were asked to rate the saliency of; speech intelligibility, rate regularity, rate, articulation precision, normal dysfluency, language disorganisation, percentage sample duration cluttered, discourse management and prosody in samples of cluttered speech. It was found that intelligibility, rate regularity; rate, articulation precision and normal dysfluency were deemed to be the most salient characteristics. This is largely consistent with data presented by St Louis (1996). Myers and Bakker (2013) found excessive dysfluencies and overly rapid and irregular rate were the most often reported features of cluttered speech, followed by abnormal handwriting, and abnormal pragmatic abilities. Reduced intelligibility was deemed as the most salient factor overall which is consistent with typical AWC self-reports that listeners struggle to understand them. Of the characteristics deemed to be most salient, four appear within the LCD; however, the most salient, intelligibility, does not. This suggests experts believe that intelligibility is core to any measure of cluttering severity, despite intelligibility not being mentioned specifically in the LCD. Myers and Bakker (2013) also found strong correlations between i) rate regularity and percentage of talking time cluttered, ii) prosody and rate regularity, iii) normal dysfluency and rate, iv) discourse management and language disorganisation. The authors expected percentage of talking time cluttered to correlate more highly with more factors as it is intended to provide a 'global measure' of the severity of cluttering

suggesting it may not be a valid measure for this purpose. Although language disorganisation did not appear in the top five in terms of saliency as rated by the experts it did appear at number six out of nine suggesting that it is considered an important factor in the identification of and severity of cluttering. This is consistent with Daly and Cantrell's (2006) Predictive Cluttering Inventory and Van Zaalen et al.'s (2009a) updated checklist.

1.3 Research questions

There is emerging evidence regarding possible association of high level language difficulties with cluttering and with the nature of the excessive normal dysfluencies seen. The present paper seeks to explore this possibility further by comparing data sets of AWS and AWC and control speakers across two tasks; the first, reading aloud and the second a spontaneous speech task in which participants describe pictures. Speech data is analysed and measures such as revisions, interjections, listener perceived excessive speed and co-articulation are examined.

We predict that AWC will present with a greater number of revisions and interjections than both other groups in both conditions and that AWC will be perceived to speak with excessive speed and be perceived as using excessive co-articulation (thus reducing their intelligibility) both when reading aloud and describing a picture. Finally, we hypothesize that AWC will have a greater number of normal dysfluencies when describing a picture compared to when reading aloud over the AWS and control groups, but these other two groups will not differ from each other in this regard.

2. Method

2.1 Participants

Speech/Language data files were collected from 14 adults who clutter (AWC: 11 males, 3 females; aged 20–55 years) 9 adults who stutter (AWS: 7 males, 2 females; aged 20-52) and 18 controls (CTL): 14 males, 4 females; aged 19–53 years). All AWC and AWS had been diagnosed as having cluttering and/or stuttering by a qualified speech and language therapist using the LCD definition of cluttering (St Louis & Schulte, 2011). Nine of the AWC group had comorbid stuttering (AWCS) ranging in severity from mild to very mild as assessed by a speech therapist using the Stuttering Severity Instrument-3 (Riley, 1994). One AWC was also dyspraxic, and another had a history of dyslexia. Of the AWC, one had dyslexia without dyspraxia and another one had a diagnosis of autism spectrum disorder. None of the CTL group or AWS had a history or diagnosis of learning or other speech and language disorders. All participants gave informed consent for their participation in the research, and the project received approval from the University of Reading's ethics committee.

Data were all taken from recordings made in Reading University's MRI scanner (where brain scan data were being collected for a separate research study; Ward et al., work in progress). Technical details of the scanning procedure are not pertinent here but while in the scanner, and in the 7 second delay between scans, participants were presented with screen images through fMRI compatible goggles of a series of emotionally neutral landscape scenes. Participants were required to respond in one of three ways: i) read aloud a descriptive sentence below a landscape picture (sentence reading condition), ii) describe a picture with a descriptive sentence and iii) to remain silent when there was a blank screen (for fMRI control purposes). Each participant was recorded reading a total of 80 sentences and describing a total of 80 picture stimuli. Sentences that were read had an average of 13.8 syllables (S.D. = 2.24).

2.2 *Speech analysis*

Sentences were analysed and coded for containing; revisions, repetitions, abandoned words/phrases and for whether they were perceived as being excessively fast or containing excessive co-articulation. Stuttering dysfluencies were also coded for (blocks, repetitions and prolongations). The parameters for making these distinctions can be found in Appendix A. The analysis was completed by an experienced speech and language therapist and intra and inter-rater reliability were calculated.

3. Results

3.1 Descriptive statistics

Table 1 shows the means and standard deviations for the number of stammering dysfluencies and normal dysfluencies used by each group when describing a picture. It can be seen that as expected AWS showed the highest number of stammering like dysfluencies. Repetitions, coded as any sound, word or phrase that was repeated by the participant, were seen across all three groups. We would therefore expect all three groups to exhibit some repetitions. Table1 shows that interjections were used far more by AWC and CTLs than by AWS. Fillers were used to a similar extent by all three groups and AWC produced more revisions, excessive co-articulations and abandoned utterances than AWS or CTLs. Blocks were only seen by AWS as would be expected and the CTLs used no prolongations.

Table1: total number of dysfluencies (both stuttering and non-stuttering, mean and standard deviations (SD) for dysfluencies used by CTL, AWS and AWC when describing a picture.

Dysfluencies	Group								
	Controls			AWS			AWC		
	Totals	Mean	SD	Totals	Mean	SD	Totals	Mean	SD
Interjections	173	9.61	10.59	35	3.89	3.51	132	9.43	8.72
Fillers	526	29.22	22.49	347	38.56	24.12	467	33.36	21.74
Revisions	69	3.83	2.34	29	3.22	1.81	93	6.64	3.04
Prolongations	1	0.06	0.23	10	1.11	1.85	10	0.71	1.39
Repetitions	35	1.94	3.22	53	5.89	5.45	96	6.86	6.93
Abandoned utterances	5	0.28	0.56	3	0.33	0.67	15	1.07	1.44
Excessive co-articulation	2	0.11	0.46	6	0.67	1.25	35	2.5	4.48
Excessive speed	35	1.94	8.02	0	0	0	50	3.57	4.22
Block	0	0	0	69	7.67	13.53	0	0	0

Table 2 shows the totals, means and standard deviations for the dysfluencies used when participants were asked to read a sentence. It is apparent immediately that there are far fewer non stuttering like dysfluencies during reading compared to describing pictures for all groups. Table 2 shows that the CTL group used a far larger number of interjections than the other two groups. Fillers are still evenly spread across all three groups but AWC are using a far greater number of revisions and repetitions than the other two groups.

Table2: total number of, mean and standard deviations (SD) for dysfluencies used by CTL, AWS and AWC when reading a sentence.

Dysfluencies	Group								
	Controls			AWS			AWC		
	Totals	Mean	SD	Totals	Mean	SD	Totals	Mean	SD
Interjections	84	4.67	13.89	2	0.22	0.42	32	2.29	6.88
Fillers	14	0.78	1.58	6	0.67	1.56	21	1.5	1.35
Revisions	39	2.17	2.12	3	0.33	0.94	89	6.36	3.54
Prolongations	1	0.06	0.23	41	4.56	11.84	6	0.43	1.05
Repetitions	14	0.78	2.12	21	2.33	1.89	48	3.43	4.31
Abandoned utterances	0	0	0	0	0	0	1	0.07	0.26
Excessive co-articulation	0	0	0	0	0	0	7	0.5	1.24
Excessive speed	0	0	0	0	0	0	12	0.86	2.13
Block	0	0	0	2	0.22	0.42	0	0	0

Tables 1 and 2 show that AWC use a greater number of dysfluencies in both conditions compared to the other two groups.

3.2 Between Group Differences

A one-way ANOVA showed that there was a significant difference between groups in terms of the number of revisions used both when reading aloud ($p < 0.001$) and when describing pictures ($p = 0.004$). With bonferroni corrections it was found that when reading a description aloud AWC used significantly more revisions than CTLs ($p < 0.001$) and AWS ($p < 0.001$). This was also true for when describing a picture with AWC using significantly more revisions than AWS ($p < 0.05$) and CTLs ($p < 0.05$).There was no significant difference between the number of revisions used by AWS and CTL in either condition. A one-way ANOVA also found that there was a significant difference for the number of repetitions used by each group when describing a picture ($p < 0.05$) but not when reading a description aloud. Once bonferroni post hoc correction was applied it was found that AWC used significantly more repetitions than CTLs ($p<0.05$) but there was no significant difference between AWS and CTLs or AWC and AWS.

Further one-way ANOVAs showed no group differences between incidence of fillers (e.g. err and umm), the use of interjections or abandoned utterances between all three groups in either condition (reading or picture description). There was an approaching significant overall group difference for increased co-articulation when describing a picture ($p = 0.064$), with AWC demonstrating the highest levels of increased co-articulation when describing a picture. Interestingly, the speaking rate for AWC was not found to be significantly faster than that of the two other groups in either condition.

3.3 Within Group Differences

Paired sample t-tests were used to investigate the differences in performance between reading aloud and describing a picture within each of the three groups. It was found that AWC used significantly more interjections, fillers, repetitions, abandoned utterance and excessive speed when describing a picture compared to when reading aloud (all $p< 0.05$).

Those in the CTL group used significantly more fillers and repetitions when describing a picture compared to when reading aloud (both $p < 0.05$).

Finally, AWS used significantly more interjections, fillers and revisions when describing a picture compared to when reading aloud (all $p < 0.05$).

3.4 Comparison of the total number of normal dysfluencies used.

In order to investigate if AWC, AWS and CTLs differ in terms of the number of normal dysfluencies used overall (repetitions, revisions, interjections, fillers, abandoned utterances, excessive speed and excessive co-articulation) a one-way ANOVA was completed. No significant difference was found between all three groups when describing a picture ($p = 0.278$) but there was an approaching significant difference when reading a description aloud $p = 0.78$.

A t-test which examined the overall difference between the number of normal dysfluencies used by AWC and AWS found that there was no significant difference between the two groups when describing a picture ($p = 0.344$) but there was a significant difference when reading a description ($p < 0.01$). No significant difference between AWC and CTLs were found. The mean number of normal dysfluencies for all three groups for both describing a picture and reading a description are shown in figure 1 below.

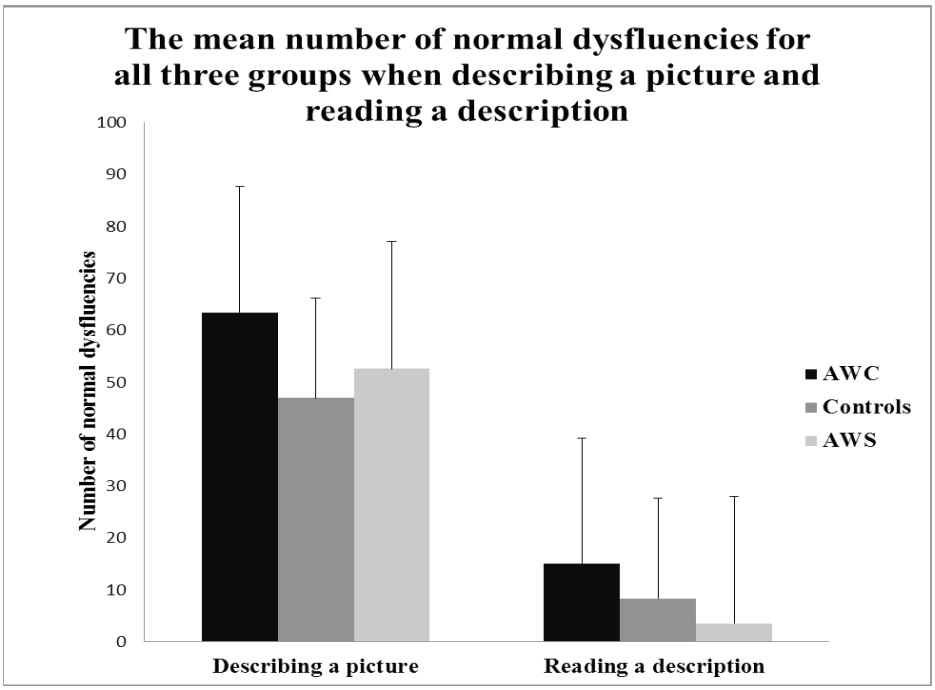

Figure 1: showing the mean number of normal dysfluencies for all three groups for both describing a picture and reading a description

Table 3: means, standard deviation, standard error and minimum and maximum of normal dysfluencies for AWC, CTLs, AWS for both tasks.

Group		Mean	Standard deviation	Standard error	Minimum	Maximum
AWC	Total picture description	63.43	26.12	6.98	19	105
	Total reading description	15.00	11.14	2.98	1	40
Controls	Total picture description	46.94	31.07	7.32	3	129
	Total reading description	8.39	14.49	3.42	0	56
AWS	Total picture description	52.56	26.57	8.86	11	87
	Total picture description	3.56	3.84	1.28	0	12

3.5 Reliability

Inter-and intra-rater reliability were calculated, blind on 25% of the entire data set. Intra-rater reliability revealed an agreement of 91.75% and inter-rater reliability an agreement of 82.5% for the presence or absence of each parameter (parameters shown in appendix A). Inter-rater reliability was completed by an experienced speech and language therapist.

4. Discussion

4.1 Between group differences: overall use of normal dysfluencies

An initial ANOVA found no main significant difference between numbers of normal dysfluencies for all three groups when describing a picture, but there was a significant main difference when reading a description. Finding a difference for the reading tasks is not unexpected and is consistent with the LCD and with the findings of Myers and Bakker (2013) who found that use of normal dysfluencies is a salient feature of the speech of AWC. However, this did not hold for describing a picture. This could be due to the large amount of variation in the data i.e. some CTL subjects had a large number of fillers and interjections resulting in outliers in the data. A larger sample would have helped combat this issue.

Observed t-tests revealed no significant difference between numbers of normal dysfluencies used by AWC and CTLs when describing a picture. AWC used a larger number of normal dysfluencies as can be seen in table 3 showing the means; however, due to the large variation in the CTL data (with two outliers), failed to reach significance level. However, this trend is somewhat consistent with Bretherton-Furness and Ward's (2012) finding that maze behaviours were used significantly more by AWC than by CTLs when asked to complete less structured tasks (e.g. describing a task or describing a picture) as opposed to being asked to read or recall a story.

No difference between AWS and AWC was found when describing a picture but there was a significant difference when reading a description. This is the reverse of findings with CTLs and AWC and may reflect the decreased fluency seen in AWS when tasks have less structure (e.g. when just describing a picture). It may be expected that those who stutter would do so more in the oral reading task as they cannot avoid words which they may have greater difficultly with, however, this was not the case here. There is evidence to suggest that children who stutter exhibit deficits in their linguistic skills compared to fluent peers (Anderson, Wagovich & Hall, 2006: Byrd, Conture & Ohde, 2007) however, similar results are not consistently reported with AWS. For example Prins, Main and Wampler (1997) and Hennessey, Nang and Beilby (2008) found no evidence of difficulties with linguistic encoding or lexical retrieval. Bosshardt and Fransen (1996), on the other hand, found that during sentence processing tasks AWS had slow or inefficient semantic activation. One suggestion for these inconsistencies is that there may be a linguistic 'catch up' over the course of language development into adulthood. Results here cannot shed much light on the linguistic skills of PWS; however, they do suggest that AWS exhibit normal dysfluencies to a similar extent to AWC when completing a task with greater linguistic and cognitive load as opposed to when just reading. This is a significant finding in terms of differential diagnosis.

4.2 Between group differences: use of normal dysfluencies

There was no significant difference between the incidence of fillers, interjections or abandoned utterances between all three groups in either condition, however; AWC showed increased (but not significantly more) co-articulation when describing a picture compared to AWS and CTL. This trend is in line with the findings of Myers and Bakker (2013) who found that articulatory precision was the fourth most salient feature of cluttered speech. In contrast to the findings from the spontaneous speech condition AWC showed no increase in co-articulation compared to AWS or CTL when reading aloud. This may be expected as the increased structure in the reading task may mean that fluency is improved and less salient features of cluttered speech, as posed by Myers and Bakker (2013), no longer significantly impact upon fluency.

Interestingly, AWC speaking rate was not found to be significantly greater than that of the two other groups in either condition. This may be due to the often noted phenomena of speech normalisation amongst AWC when placed in more formal speaking situations. It could also be due to AWC using fluency enhancing strategies and slowing their rate of speech, despite being told not to do so prior to entering the scanner.

AWC were found to use significantly more revisions than AWS and CTLs both when reading aloud and when describing pictures. Use of revisions is consistent with the LCD criteria as those who clutter are defined as using a large number of normal dysfluencies; however, the definition, at present, does not describe which normal dysfluencies are likely to predominate. AWC were also found to use significantly more repetitions than CTLs when describing a picture but not when reading a description. Consistent with other results above this also shows that

when tasks have a greater cognitive and linguist load dysfluencies increase in AWC. Our finding may suggest that only certain normal dysfluencies are used excessively e.g. revisions, results are preliminary but may suggest that we need to update the LCD with this in mind.

Our findings may also reflect difficulties with lexical retrieval amongst those who clutter. This was suggested by Bretherton-Furness and Ward (2012) who found that AWC named significantly fewer items in a 3/5 verbal fluency tasks. Similar suggestions have also been made by Daly and Cantrell (1996), Ward (2006) and Van Zaalen (2009a). Bretherton-Furness and Ward (2012) also found that AWC used significantly more maze behaviours than CTLs when describing everyday tasks such as, making a cup of coffee. Use of maze behaviours has been linked with difficulties organising verbal output and difficulties in lexical retrieval (Ward 2006).

4.3 Within group differences

Paired sample t-tests were used to investigate the differences in performance between reading aloud and describing a picture within each of the three groups as described AWC used significantly more interjections, fillers, repetitions, abandoned utterance and excessive speed when describing a picture compared to when reading aloud. This was expected as it has been seen previously that AWC have decreased fluency when performing less structured tasks (Bretherton-Furness & Ward 2012). This finding has implications for assessment of adult cluttering and confirms the need for clinicians to ensure that they use a variety of linguistic tasks in assessment; e.g. reading, describing sequences, story re-telling and general conversation (also see Scaler Scott & Ward, 2013).

Those in the CTL group used significantly more fillers and repetitions when describing a picture compared to when reading aloud. This finding is again not unexpected as when having to construct our own narrative there is greater linguistic and cognitive load so fluency levels are liable to decrease. What is noteworthy is that CTLs had far fewer types of normal dysfluencies when describing a picture compared to AWC i.e. AWC used more interjections, fillers, repetitions, abandoned utterance and excessive speed but CTLs only used more fillers and repetitions - thus demonstrating that a task with reduced structure (e.g. describing a picture) has a far greater impact upon the fluency of AWC than it does for the fluency of CTLs. The same is true for AWS who only used significantly more interjections, fillers and revisions when describing a picture compared to when reading aloud.

4.4 Limitations

The first and clearest limitation is the environment in which this data was collected. It was noted by experimenters that PWS exhibited higher levels of fluency within the scanner than they did when in conversation with the experimenters. There are a number of reasons as to why this may have been the case. Being in the scanning environment creates the illusion of being alone which often results in people who stutter becoming fluent (Ward, 2006). The rhythmic pulsing noise of the scanner have also have acted as an auditory feedback fluency enhancer. However, this pattern was not observed in AWC and their dysfluent behaviour appeared consistent regardless of whether they were outside or inside the scanner.

A further limitation is the discrepancy in numbers in each group. Not all the data was available to be analysed due to some participants not complying with instructions e.g. talking over the baseline trails, not describing pictures or blocking to the extent that there was insufficient data collected. Time constraints meant it was not possible to have equal numbers in each group. Finally there were some participants who clutter who also had co-morbidities. Ideally we would use only those with pure cluttering, however it could be argued that this would not be representative of those who clutter as there are a high number of AWC who have co-morbidities e.g. stuttering, ADHD and ASD.

4.5 Further work

Further work is in progress to investigate the linguistic skill of those who clutter. For example data is needed regarding comprehension skills, phonological awareness and lexical access at sentence level. If we are to rule in or out the possibility of a high level language component we need more than measures of maze behaviours and perceived fluency in speaking situations.

5. Concluding Comments

The work conducted here highlights the importance of collecting data in a variety of environments when assessing people who are suspected of cluttering. AWC were found to be most easily distinguishable from AWS and fluent CTLs when tasks had less structure e.g. when asked to describe a picture, thus when they are forced to construct their own narrative. Further tasks such as relaying how they got to clinic, what they did yesterday, describing how to do tasks such as making a cup of tea would also be useful during the assessment process.

When analysing the speech of those who clutter clinicians should be aware that an excessive number of revisions in narrative appear to be a defining feature of cluttering. It was found to consistently be used to excess by AWC regardless of the task that they are asked to complete.

Appendix A.

Parameters

- Revision - the act of revising or altering (involving reconsideration and modification). Where the person speaking has stopped mid word or mid sentences and gone back and changed the content in some manner e.g. adding or removing a content or grammatical word. Revising also included changing mistakes e.g. miss articulations (rait…rabbit). A revision may be acknowledged by the speaking e.g. I mean….oh sorry….. or may not be acknowledged e.g. "that's a man….. a woman with dark hair".
- Excessive speed – has been coded for when the person speaking rate is perceived as being so fast that it requires the listener to either listen again to the recording or when the listener perceives that speed was such that they were either unsure of what they had heard or when additional effort was required to understand what was said.
- Excessive co-articulation – has been used when the person speaking is perceived to articulate two or more speech sounds together, so that one influences the other to the extent that words run together so there is a breakdown in intelligibility so the listener needs to listen for a second time, is unsure of what they have heard or when additional effort is needed to understand what was said.
- Blocks – an involuntary silent pauses or blocks in which the person who stutters is unable to produce sounds. There may be secondary behaviour seen (but not here as we are listening only).
- Prolongations – when a sound or syllable is lengthened beyond what is perceived to be reasonable/normal.
- Errr/ummm – this has been coded when a filler has been used be it umm, errr, ohhhh, hmmmm. Whenever it is felt that the speaker is filling a gap where there would be silence/pause due to thinking/forming what to say.
- Repetitions – when a sound, syllable, word or phrase is repeated.
- Interjections – when the speaker adds additional information that is not related to the task, a sudden, short utterance or exclamation an aside that is not needed and could stand alone.

References

Alm, P. A. (2004). Stuttering and the basal ganglia circuits: a critical review of possible relations. *Journal of Communication Disorders, 37*(4), 325-369.

Alm, P. A. (2011). Cluttering: a neurological perspective. In D. Ward & K. Scaler Scott (Eds.), *Cluttering: A Handbook of Research, Intervention and Education* (pp. 3-28). East Sussex: Psychology Press.

Anderson, J. D., Wagovich, S. A., & Hall, N. E. (2006). Nonword repetition skills in young children who do and do not stutter. *Journal of fluency disorders, 31*(3), 177-199.

Bakker, K., Myers, F. L., Raphael, L. J., & St Louis, K. O. (2011). A preliminary comparison of speech rate, self-evaluation, and disfluency of people who speak exceptionally fast, clutter, or speak normally. In D. Ward & K. Scaler Scott (Eds.), *Cluttering: A handbook of research intervention and education* (pp. 45-65). East Sussex: Psychology Press.

Byrd, C. T., Conture, E. G., & Ohde, R. N. (2007). Phonological Priming in Young Children Who Stutter: Holistic Versus Incremental Processing. *American Journal of Speech-Language Pathology, 16*(1), 43-53.Bosshardt and Fransen (1996)

Bosshardt, H.G., & Fransen, H. (1996). Online Sentence Processing in Adults Who Stutter and Adults Who Do Not Stutter. *Journal of Speech, Language, and Hearing Research, 39*(4), 785-797.

Bosshardt, H. G., Ballmer, W., & De Nil, L.F. (2002). Effects of category and rhyme decisions on sentence production. *Journal of Speech, Language, and Hearing Research, 40*, 373-384.

Bretherton-Furness, J., & Ward, D. (2012). Lexical access, story re-telling and sequencing skills in adults who clutter and those who do not. *Journal of fluency disorders, 37*(4), 214-224.

Daly, D. A., & Cantrell, R. P. (2006). *Cluttering characteristics identified as diagnostically significant by 60 fluency experts.* Paper presented at the Proceedings of the second world congress on fluency disorder. .

Hennessey, N. W., Nang, C. Y., & Beilby, J. M. (2008). Speeded verbal responding in adults who stutter: Are there deficits in linguistic encoding? *Journal of fluency disorders, 33*(3), 180-202.

Myers, F. L. (1992). Cluttering: A Synergistic Framework. In F. L. Myers & K. O. St Louis (Eds.), *Cluttering: a clinical perspective* (pp. 71-84). Leicester, UK: FAR Communications (Reissued in 1996 by Singular, San Diego CA).

Myers, F. L. (2011). Treatment of cluttering: A cognitive-behavioural approach centred on rate control. In D. Ward & K. Scaler Scott (Eds.), *Cluttering: A Handbook of Research, Intervention and Education* (pp. 152-174). East Sussex: Psychology Press.

Myers, F. L., & Bakker, K. (2013). Experts' saliency ratings of speech-language dimensions associated with cluttering. *Journal of fluency disorders*. doi: http://dx.doi.org/10.1016/j.jfludis.2013.10.004

Myers, F. L., Bakker, K., St. Louis, K. O., & Raphael, L. J. (2012). Disfluencies in cluttered speech. *Journal of fluency disorders, 37*(1), 9-19.

Prins, D., Main, V., & S.W. (1997). Lexicalisation in adults who stutter. *Journal of Speech, Language, and Hearing Research, 40*, 373-384.

Riley, G. D. (1994). *Stuttering severity instrument for children and adults* (3rd ed.). Austin: TX: Pro-Ed.

Scaler Scott, K, & Ward, D. (2013). *Managing cluttering: a comprehensive guidebook of activities*. Austin, Texas: Pro Ed inc.

St Louis, K. O. (1996). A Tabular Summary of Cluttering Subjects in the Special Edition *Journal of fluency disorders, 21*, 337-343.

St Louis, K. O., Raphael, L. J., Myers, F. L., & Bakker, K. (2003). Cluttering Updated. *Feature - the ASHA LEADER*.

St Louis, K. O., & Schulte, K. (2011). Defining Cluttering: The Lowest Common Denominator. In D. Ward & K. Scaler Scott (Eds.), *Cluttering: A Handbook of Research, Intervention and Education* (pp. 233-253). East Sussex: Psychology Press.

Van Zaalen- op 't Hof, Y. (2009). *Cluttering Identified. Differential diagnostics between cluttering, stuttering and speech impairment in learning disabilities.* (PhD thesis), Utrecht University, Netherlands.

Van Zaalen- op 't Hof, Y., Wijnen, F., & De Jonckere, P. H. (2009a). Differential diagnostic characteristics between cluttering and stuttering—Part one. *Journal of fluency disorders, 34*(3), 137-154.

Van Zaalen, Y., Wijnen, F., Dejonckere, P.H. (2009b). Differential diagnostics between cluttering and stuttering, part two. *Journal of fluency disorders, 34*(3), 137-154.

Van Zaalen- op 't Hof, Y., Wijnen, F., & Dejonckere, P. (2011). Language planning disturbances in children who clutter or have learning disabilities. *International Journal of Speech-Language Pathology, 11*(6), 496-508.

Ward, D. (2006). *Stuttering and Cluttering: Framework for understanding and treatment.* Hove: Psychology Press.

Ward, D. (2007). The bad, the good and the misunderstood: cluttering and problems of image. *Proceedings of the First World Conference on Cluttering.* Bulgaria.