Supplementary Materials

S1: Annotation manual for disfluencies in dementia

Definitions:

Disfluency: An interruption in the smooth flow of speech, such as through a pause, a filler, or the repetition of a word, phrase or syllable.

Utterance: A syntactically independent unit of propositional information contributing new information to the discourse. Note that by this definition, utterances do not need to be clauses (e.g., in conversational speech many answers can contribute propositional information without being clauses); and clauses do not need to be utterances (e.g., clauses don't have to be syntactically independent, as when they are embedded, see also right below).

Clause: A clause refers to a phrase consisting of a verb and minimally one nominal argument (dependent). Clauses are grammatically independent when they are utterances, otherwise they are dependent and embedded of larger sentences figuring in utterances. Subclassification of clauses:

1. **independent** clauses with no embedding (i.e. simple clauses)
2. clauses carrying embedding verbs (i.e. "I said…", "I mean…", "…, you think")
3. clauses that are embedded as **arguments** (i.e. selected by an embedding verb)
4. clauses that are **adjuncts** not subcategorized/selected for by a verb but added to either an NP (relative clauses) or VP for purposes of specifying additional/optional information) (e.g. "the woman is washing dishes <u>while thinking of something else</u>.")
5. clauses that are **coordinated** with other clauses and occur as part of the same utterance (e.g. "the woman is washing dishes and thinking of something else").

Pause: A silence of 200ms or longer produced during a speaker's turn.

Filler: A linguistic element produced during a speaker's turn to indicate an expected delay in speaking, specifically "uh" and "um" (Clark & Fox Tree, 2002).

Procedure

Transcript:

6. The original transcript from the Pitt Corpus will be imported into ELAN as a single annotation on a new tier, "Participant Speech".
7. Investigator and participant speech will be separated into time-aligned annotations and investigator annotations will be moved to a separate tier, to exclude investigator speech from analysis, but retain the information of their time alignment for the later annotations of pause locations.

8. Participant speech annotations will be further divided for time-alignment in relation to the pauses identified, as outlined below.

Pauses and fillers:

9. All pauses and fillers of 200ms or longer will be marked in a time-aligned annotation, on a single tier.

10. All pause and filler annotations will be copied to another tier, where they will be later marked by syntactic position.

11. Pauses which are followed by an investigator prompt are excluded from the analysis.

Utterances

12. All utterances will be identified in a time-aligned annotation and tallied for each sample on the "Utterances" tier.

13. In immediate self-corrections or false starts, only the subsequent, corrected utterance will be annotated and counted as an utterance.

    a) *"Well it's a [looks like a mother washing up]."*

14. Conjoined phrases occurring within VPs or NPs will not be annotated separately:

    a) *[He climbed on the stool] [and dropped the cookie];*

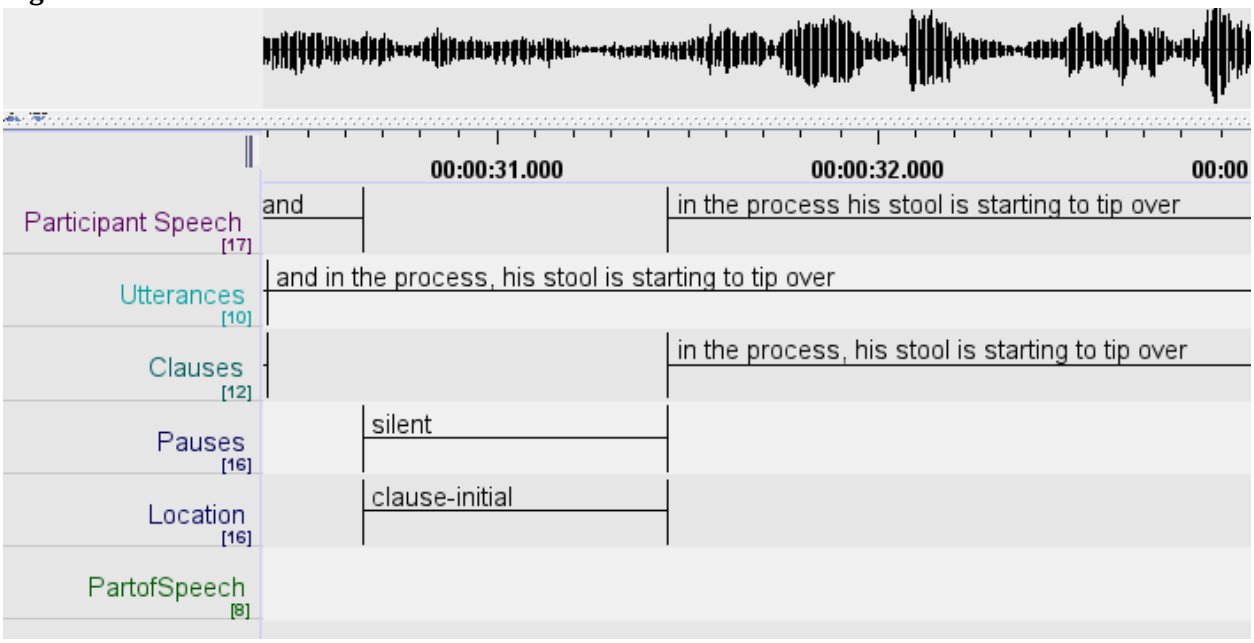
    b) *[He shouted loudly and with rage]*

Clauses

15. All clauses will be identified in a time-aligned annotation and tallied for each sample on the "Clauses" tier.

16. Conjunctions which occur outside of phrases are not considered a proper part of the clause. Such a conjunction may e.g. initiate an utterance. See an example in Fig.1 below, where "and" initiates an utterance, but not the clause, therefore resulting in a "clause-initial" pause location tag.

Figure 1



17. Revisions and repetitions of clauses WILL be counted independently at the clausal level, as clauses are not subject to the same restriction as utterances, namely contributing new propositional information to the discourse.

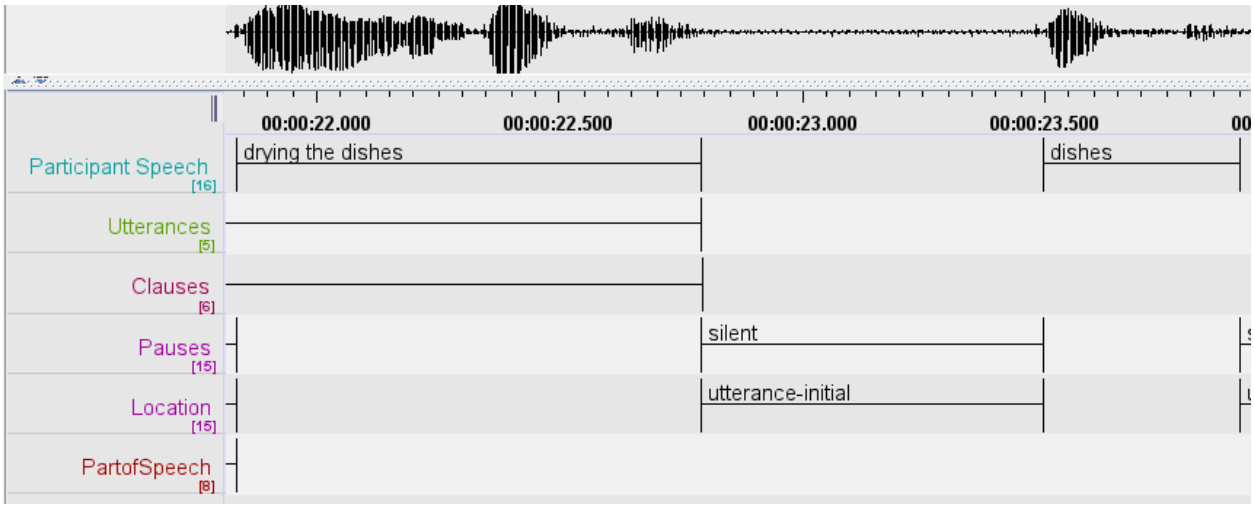
Syntactic positions of pauses and fillers

18. All pauses and filler will be marked as occurring in one of three potential syntactic positions, based on the time-alignment of the utterance and clause annotations:

    a) *Utterance-initial*
    b) *Clause-initial*
    c) *Within-clause*

19. Pauses which precede disfluent speech (i.e. repetitions, truncations) will be marked for their syntactic position, although the disfluent speech itself is excluded from utterance counts. See an example in Fig. 2 below, in which the pause before the repetition, “dishes”, is tagged as utterance-initial, but the repetitious speech is not annotated on the utterance tier.

Figure 2



Part of Speech

20. Only pauses which are tagged as "within-clause" will be copied to the "Part of Speech" tier.

21. Within-clause pauses are tagged as preceding one of three possible lexical types based on the lexical content word following the pause.

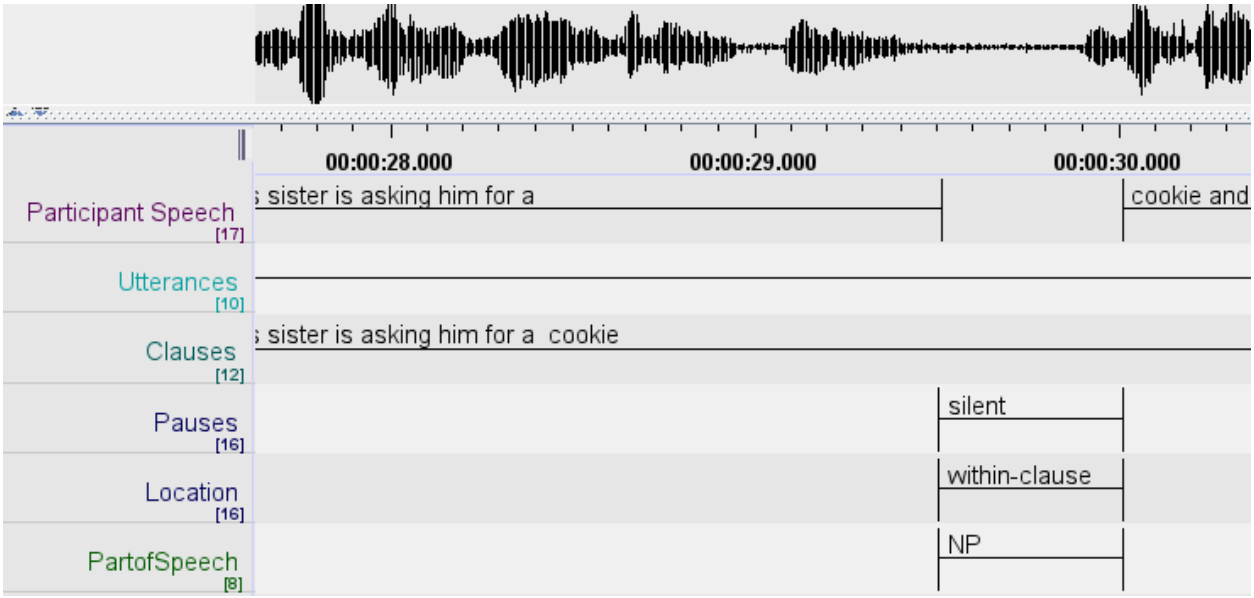
a) *Noun*

b) *Verb*

c) *Adjectives/Adverbs*

22. See an example of a simple within-clause pause tagged for part of speech in Fig. 3 below.

Figure 3



S2: *Spearman's correlation matrix of category VF scores and fluency variables*

Variables		Category VF								
		Correct Words			Mean Cluster			Switches		
		All	Mild	Mod	All	Mild	Mod	All	Mild	Mod
	n =	33	18	15	33	18	15	33	18	15
MLU	R_s	.270	-.263	.421	-.013	-.232	-.004	.261	-.045	.443
	p ≤	.129	.291	.118	.943	.353	.989	.142	.860	.098
WPM	R_s	.238	.204	.241	.132	.048	.065	.284	.261	.324
	p ≤	.183	.416	.387	.464	.851	.819	.109	.295	.238
Rate of Pauses	R_s	-.314	-.504	-.022	-.275	-.096	-.270	-.242	-.409	.015
	p ≤	.075	.033	.939	.121	.704	.330	.175	.092	.958
Pause Duration	R_s	.126	.175	.025	.037	-.190	.321	.015	.128	-.119
	p ≤	.486	.486	.929	.838	.449	.243	.935	.613	.674
Filler Rate	R_s	-.064	-.094	-.119	.112	.167	.035	-.247	-.344	-.176
	p ≤	.723	.711	.673	.537	.508	.902	.165	.163	.532
Filler Duration	R_s	-.035	.109	.115	.043	.190	.014	-.156	-.217	.053
	p ≤	.846	.667	.682	.810	.449	.959	.387	.388	.852
UI Rate	R_s	-.408	-.441	-.224	-.270	-.084	-.240	-.351	-.332	-.220
	p ≤	.018	.067	.422	.129	.739	.390	.045	.179	.431
CI Rate	R_s	-.055	.028	-.193	-.225	-.064	-.345	-.057	-.064	-.079
	p ≤	.762	.911	.490	.209	.801	.207	.754	.800	.781
WC Rate	R_s	-.135	-.438	.100	-.078	.068	-.039	-.038	-.261	.106
	p ≤	.454	.069	.723	.664	.789	.889	.833	.296	.707
UI Duration	R_s	.091	.162	.018	.049	-.180	.363	-.026	.100	-.165
	p ≤	.613	.521	.949	.785	.475	.183	.887	.693	.557
CI Duration	R_s	.076	.135	-.064	-.072	-.104	-.038	.048	.119	-.093
	p ≤	.674	.594	.820	.691	.680	.894	.790	.639	.742
WC Duration	R_s	.167	-.094	.115	-.041	.137	-.135	.052	-.278	.299
	p ≤	.352	.709	.683	.823	.589	.630	.775	.264	.280
NI Rate	R_s	-.160	-.515	.054	-.111	-.209	.035	-.077	-.186	.008
	p ≤	.374	.029	.848	.540	.405	.903	.669	.459	.976
VI Rate	R_s	.035	.088	.292	.015	.267	-.094	.074	-.055	.288
	p ≤	.845	.729	.292	.935	.285	.739	.681	.829	.298
AI Rate	R_s	-.077	-.161	.183	-.018	.123	.212	-.106	-.407	.226
	p ≤	.671	.522	.513	.922	.628	.448	.558	.094	.417
NI Duration	R_s	.207	-.090	-.054	.300	.426	.130	-.123	-.379	-.084
	p ≤	.247	.721	.848	.090	.078	.645	.495	.121	.767
VI Duration	R_s	.094	.191	.278	-.156	.181	-.166	.155	.014	.426
	p ≤	.604	.448	.316	.385	.473	.554	.388	.957	.113
AI Duration	R_s	-.015	-.071	.146	.040	.246	.136	-.100	-.404	.227
	p ≤	.934	.779	.605	.827	.326	.629	.580	.097	.415

MLU: Mean length of utterance (words); WPM: Words per minute; UI: Utterance-initial pause; CI: Clause-initial pause; WC: Within-clause pause; NI: Noun-initial pause VI: Verb-initial pause; AI: Adjective-initial pause

S3: *Spearman's correlation matrix of letter VF scores and fluency variables*

Variables		Letter VF								
		Correct Words			Mean Cluster			Switches		
		All	Mild	Mod	All	Mild	Mod	All	Mild	Mod
	n =	28	19	9	28	19	9	28	19	9
MLU	R_s	-.152	-.474	-.237	.020	.129	-.210	-.127	-.405	.140
	p ≤	.440	.041	.539	.919	.600	.588	.520	.085	.720
WPM	R_s	.175	.142	.580	.404	.432	.463	.213	.194	.411
	p ≤	.372	.562	.102	.033	.065	.209	.277	.427	.272
Rate of Pauses	R_s	-.377	-.507	-.237	-.458	-.632	-.358	-.318	-.450	.122
	p ≤	.048	.027	.539	.014	.004	.343	.100	.053	.754
Pause Duration	R_s	.101	.237	-.501	.048	.097	-.009	.009	.124	-.490
	p ≤	.611	.328	.170	.809	.694	.982	.962	.613	.181
Filler Rate	R_s	-.224	-.361	-.185	-.363	-.329	-.364	-.171	-.274	-.075
	p ≤	.252	.129	.633	.058	.169	.335	.384	.256	.849
Filler Duration	R_s	-.060	-.137	.397	-.299	-.303	-.356	.023	.002	.373
	p ≤	.763	.576	.290	.122	.207	.348	.906	.994	.323
UI Rate	R_s	-.536	-.605	-.395	-.406	-.592	-.306	-.487	-.554	-.061
	p ≤	.003	.006	.292	.032	.008	.423	.009	.014	.876
CI Rate	R_s	-.085	-.140	-.188	-.468	-.509	-.429	-.038	-.057	-.009
	p ≤	.669	.569	.627	.012	.026	.250	.847	.817	.982
WC Rate	R_s	-.090	-.167	-.132	-.273	-.381	-.211	-.062	-.097	.044
	p ≤	.651	.494	.734	.160	.108	.586	.752	.691	.911
UI Duration	R_s	.187	.251	-.316	-.022	.023	-.227	.077	.146	-.385
	p ≤	.342	.301	.407	.913	.926	.556	.698	.550	.307
CI Duration	R_s	-.017	-.008	.107	-.356	-.350	-.267	.111	.096	.205
	p ≤	.933	.975	.784	.063	.142	.488	.574	.696	.598
WC Duration	R_s	-.226	-.107	-.606	.003	-.010	.096	-.194	-.276	-.149
	p ≤	.247	.664	.084	.987	.968	.806	.321	.253	.703
NI Rate	R_s	-.013	-.213	-.132	-.348	-.429	-.198	-.031	-.170	.044
	p ≤	.948	.381	.734	.069	.067	.610	.875	.486	.911
VI Rate	R_s	-.097	.052	.027	-.035	-.044	-.133	-.084	.085	.009
	p ≤	.622	.832	.945	.860	.857	.732	.672	.729	.982
AI Rate	R_s	-.307	-.260	-.142	-.426	-.354	-.643	-.035	-.147	.355
	p ≤	.112	.282	.716	.024	.137	.062	.858	.548	.348
NI Duration	R_s	-.115	-.142	-.580	-.188	-.052	-.324	-.063	-.243	.017
	p ≤	.561	.561	.102	.338	.833	.396	.750	.317	.964
VI Duration	R_s	-.234	.085	-.553	.158	.079	.157	-.215	-.068	-.096
	p ≤	.231	.729	.122	.421	.747	.686	.271	.781	.806
AI Duration	R_s	-.188	-.096	-.204	-.494	-.452	-.639	.060	.001	.286
	p ≤	.337	.696	.599	.007	.052	.064	.762	.996	.456

MLU: Mean length of utterance (words); WPM: Words per minute; UI: Utterance-initial pause; CI: Clause-initial pause; WC: Within-clause pause; NI: Noun-initial pause VI: Verb-initial pause; AI: Adjective-initial pause

S4: *Spearman's correlation matrix of combined VF scores and fluency variables*

Variables		Combined VF								
		Correct Words			Mean Cluster			Switches		
		All	Mild	Mod	All	Mild	Mod	All	Mild	Mod
	n =	27	18	9	27	18	9	27	18	9
MLU	R_s	-.058	-.399	.226	.007	.015	.052	.000	-.227	.333
	p ≤	.775	.101	.559	.971	.953	.893	.999	.365	.381
WPM	R_s	.187	.216	.201	.474	.305	.848	.382	.424	.267
	p ≤	.350	.389	.604	.012	.218	.004	.049	.079	.488
Rate of Pauses	R_s	-.387	-.565	.059	-.319	-.286	-.297	-.439	-.663	.167
	p ≤	.046	.015	.881	.105	.250	.437	.022	.003	.668
Pause Duration	R_s	.146	.173	-.042	-.238	-.159	-.411	.018	.112	-.217
	p ≤	.466	.493	.915	.231	.529	.272	.928	.659	.576
Filler Rate	R_s	-.208	-.250	-.269	.066	.028	.211	-.352	-.452	-.134
	p ≤	.298	.317	.484	.744	.911	.586	.072	.060	.731
Filler Duration	R_s	-.154	-.030	.126	-.062	-.003	.061	-.232	-.225	.251
	p ≤	.443	.905	.747	.759	.990	.875	.244	.370	.515
UI Rate	R_s	-.545	-.582	-.268	-.141	-.037	-.096	-.549	-.594	-.133
	p ≤	.003	.011	.486	.482	.884	.806	.003	.009	.732
CI Rate	R_s	-.075	-.060	-.278	-.392	-.218	-.554	-.156	-.201	-.179
	p ≤	.709	.814	.469	.043	.385	.122	.436	.425	.645
WC Rate	R_s	-.186	-.318	.227	-.279	-.133	-.479	-.207	-.340	.134
	p ≤	.354	.198	.557	.159	.600	.193	.301	.168	.731
UI Duration	R_s	.179	.183	.017	-.339	-.213	-.717	.037	.092	-.183
	p ≤	.372	.467	.966	.084	.396	.030	.856	.716	.637
CI Duration	R_s	-.057	-.002	-.315	-.244	-.321	-.098	-.034	-.039	-.102
	p ≤	.776	.995	.409	.219	.194	.802	.866	.878	.795
WC Duration	R_s	-.031	-.130	-.109	-.079	-.113	.061	-.217	-.350	-.017
	p ≤	.876	.606	.781	.697	.655	.876	.278	.155	.966
NI Rate	R_s	-.127	-.385	.261	-.370	-.290	-.421	-.148	-.328	.159
	p ≤	.528	.115	.498	.057	.242	.259	.460	.184	.683
VI Rate	R_s	-.127	.048	.051	-.184	-.075	-.374	-.181	-.115	-.051
	p ≤	.528	.849	.896	.358	.768	.322	.366	.649	.897
AI Rate	R_s	-.208	-.218	-.070	-.001	.040	.125	-.164	-.368	.359
	p ≤	.297	.384	.858	.995	.875	.748	.414	.133	.343
NI Duration	R_s	.050	-.073	-.218	.097	.187	-.009	-.134	-.304	.050
	p ≤	.805	.775	.574	.631	.456	.982	.507	.220	.898
VI Duration	R_s	-.119	.048	-.008	-.071	-.035	.149	-.205	-.148	.083
	p ≤	.554	.850	.983	.726	.891	.703	.306	.557	.831
AI Duration	R_s	-.082	-.065	-.070	.068	.158	.057	-.099	-.268	.327
	p ≤	.685	.799	.859	.734	.532	.884	.622	.281	.391

MLU: Mean length of utterance (words); WPM: Words per minute; UI: Utterance-initial pause; CI: Clause-initial pause; WC: Within-clause pause; NI: Noun-initial pause VI: Verb-initial pause; AI: Adjective-initial pause