The MonPaGe_HA Database for the Documentation of Spoken French Throughout Adulthood

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Abstract

Our knowledge of life-span changes in the speech of adults is quite sparse. Existing reports are mainly based on English speakers and few studies have compared more than two extreme age groups. The present paper describes the recently constituted MonPaGe_HealthyAdults database of spoken French including 405 male and female speakers aged from 20 to 93 years old. This database aims at documenting speech throughout adulthood and at building a set of reference values for healthy speakers to be used in clinical assessment of speech. The database is built on five age groups ([20-39], [40-49], [50-59], [60-74], [75+]) and includes 4 regiolects. Speakers have been recorded on a variety of linguistic material and speech tasks in order to cover multiple speech dimensions for each speaker. These cross-sectional data form one of the largest French database available for observing typical changes in the speech of adults as a function of age, and especially in older adults.

Keywords: French, speech corpus, aging, lifespan changes

1. Introduction

Understanding potential changes in voice and speech throughout adulthood is critical for clinical research and practice, especially when dealing with neurodegenerative disorders. Data have to be age-standardized in order to tease apart speech characteristics due to age from characteristics due to the speech disorders. It is also crucial for our general understanding of the complexity of the speech production system since age-related changes can as well originate from structural changes at the peripheral level (anatomical and physiological changes in the speech apparatus affecting pulmonary function, laryngeal structure and/or vocal tract length), or from neurological changes affecting speech motor control or cognitive functions (e.g. Linville, 2001; Torre & Barlow, 2009; Seidler et al. 2010, Bilodeau-Mercure et al. 2016).

To date, our knowledge of life-span changes in the speech of adults is quite sparse. Documented in a variety of studies, age-related changes in the production of voice and speech have been reported for (a) voice quality parameters (Ramig & Ringel, 1983; Linville 2001 ; Ferrand, 2002; Shötz 2007) ; (b) pitch/speaking f0, with an increase in mean f0 for older males and a decrease for older females and a greater within-subject variability for both (Benjamin 1986, Morris & Brown 1994 ; Russell et al., 1995 Harnsberger et al., 2008) ; (c) formant frequencies, with a global formant lowering, at least on F1 (Xue & Hao, 2003, Torre & Barlow, 2009), or a trend toward a centralization of formant values (Rastatter et al. 1997) ; (d) speech rate and segment duration, showing the most robust (and documented) age-related differences, with older speakers speaking more slowly, with longer segments, and sometimes longer VOTs, and greater within-subject temporal variability, than younger adults (Ramig 1983, Morris & Brown 1994, Bilodeau-Mecure & Tremblay 2016; Verhoeven et al., 2004; Jacewicz et al., 2009; Staiger et al. 2017).

However, these results are not uncontroversial. For instance, a lack of age effect on vowel space size is found in Fletcher et al. (2015), or on speech rate in Pierce et al. (2013), or on VOT in Smith et al. (1987).

A comparison of these studies is difficult for several reasons. First, if most studies compare only two 'extreme' age groups (usually a group of young adults and a group of old adults) these groups are rarely defined on the same age intervals. Second, the speech material on which the speech dimensions are measured vary from spontaneous speech, read sentences or text, to maximum performance tasks such as diadochokinesic tests. Third, at most two speech dimensions are reported per study, which give a quite minimalist overview of the overall speech characteristics of the speakers included in each group. These methodological differences across studies limit our understanding of the age-related changes in speech, all the more that between-speakers heterogeneity is well known to increase with age.

Furthermore, most of these previous studies are based on the examination of English speakers. Only a few investigations are based on Canadian French speakers (e.g. Bilodeau-Mecure & Tremblay 2016 and other papers from this group) and to our knowledge, no cross-linguistic comparison is available. Knowing that the phonetic implementation of linguistic contrasts and prosodic features are language-dependent, it is conceivable that salient aspects of aging in speech may vary from one language to the other, or from one regional variety (regiolect) to the other. For instance, while both Northern and Southern American English older speakers read more slowly than younger adults, an age-related difference in speech rate is found only for the Northern ones when looking at spontaneous speech (Jacewicz et al. 2009).

The MonPaGe_HA database was collected with two aims. First, in order to further document life-span changes throughout adulthood, it includes speakers with a large range of ages performing various speech tasks involving multiple speech dimensions. Second, the database was built in order to constitute a set of reference values for healthy speakers that will be used for the validation of the MonPaGe speech screening protocol. This protocol was primarily designed for the assessment of French-speaking patients presenting signs of motor speech disorders. In order for the protocol to be usable in a large set of contexts (clinical practice and clinical studies), regional

variation needs to be covered. Therefore, references were seeked for speakers from four French-speaking countries, as described below.

2. The MonPaGe_HA database

The MonPaGe_HealthyAdults (MonPaGe_HA) database is made of audio recordings of 405 French-speaking adults aged from 20 to 93 years old recorded in four French-speaking countries. These data thus form one of the largest French database available for observing variation in the speech of healthy adults as a function of age, gender and regiolect, over a set of controlled speech dimensions and tasks.

2.1 Linguistic material and speech tasks

The speech material collected for each speaker is that of the MonPaGe speech screening protocol (Fougeron et al. 2016). This protocol was primarily designed for a quick (20-30 min recording) although comprehensive assessment of the speech characteristics of patients presenting signs of motor speech disorders. It is therefore conceived to cover multiple aspects of speech and voice and includes several speech tasks. Altogether, the speech protocol is organized in 8 modules, starting with an intelligibility screening (see 2.2.2), for about 6-7 minutes of recorded speech per speaker.

A detailed description of the different modules is presented in the tables at the end of the paper. In short, the speech material in the MonPaGe protocol targets different speech dimensions:

- voice, including voice quality
- articulatory precision in the articulation of both consonants and vowels
- coarticulation patterns (V-to-V, and V-to-C)
- prosodic features (expressive and linguistic prosody)
- speech (and articulation) rate and fluency

Four types of elicitation tasks are included in the material:

- Reading and/or repetition of pseudo-words containing all French consonants and vowels, tested according to their position in the pseudo-word and the level of phonetico-phonological complexity of the sequence (structural patterning, length, planning difficulty).
- Reading of sentences varying in prosody, and of a custom-made 188-word narrative text.
- Automatic production of the days of the week.
- Semi-spontaneous speech in a picture description task.

Speech-like behaviors are also tested in maximum performance tasks, such as:

- Maximum phonation time, where the speaker has to maintain voicing on a sustained vowel as long as possible in a single breath. This is a test of pneumo-phonation control.
- Diadochokinesic tasks (DDK), where the speaker is asked to repeat as fast and accurately as possible successive sequences of syllables.
- Amplitude modulation task, where the speaker is asked to modulate the amplitude of successive calls from the lowest to the highest in 4 steps.

2.2 Speakers and additional ressources

2.2.1 Sociolinguistic questionnaire

Before each recording, speakers had to respond to a questionnaire containing questions related to:

- language background and usage: 1st language(s), other language(s) used daily;
- geographical origin: region of childhood, other region(s) where the speaker had lived for 10 years or more;
- educational background: how old was the speaker when he finished his studies;
- selected medical screening: need and presence of glasses during the session ; self-assessment of hearing abilities (left and right ears on a 10-point scale) ; presence of a denture ; need of speech and language therapy in the past.

2.2.2 Intelligibity and cognitive screening

At the beginning of each recording session, the first part of the MonPaGe protocol consists of a short intelligibility test. The speaker is asked to instruct the experimenter to place some objects on a specific colored shape using a pre-set carrier sentence: “Place the [target word] on the [color] [shape]” (e.g. ‘Place the dog on the red circle’). The speaker (but not the experimenter) sees the target and associated location on the computer screen, and the experimenter needs to place the target he has heard on a sheet of paper containing empty colored shapes. For each speaker, fifteen target words are randomly extracted from a 437 words database. Each of the 437 words has 1 to 6 minimal pairs within the database, which is organized in five subsets of contrasting features (place of articulation, voice, manner, nasality/cluster and vowel). The 15 pseudo-words are extracted from these 5 subsets (3 each). Intelligibility is then scored according to the number of word correctly understood by the experimenter.

Speakers in the oldest group (75+) were also screened for cognitive deficit using MMSE in FR, BE, QC (Folstein et coll., 1975) or language deficits (with the e-GeBAS in CH (Chicherio et al. 2016)

2.3 Speakers distribution in the database

The MonPaGe_HA database includes audio recordings of 209 female and 196 male speakers, aged from 20 to 93 years old. These speakers were recorded in 4 different French-speaking locations: Paris, France (FR), Geneva, Switzerland (CH), Mons, Belgium (BE) and Montreal, Canada (QC). Table I shows the distribution of speakers per age group, sex and regiolect. Figure 1 gives the age distribution of the speakers for each group. Forty-one of these speakers have been recorded a second time with the same protocol 2 to 8 months later. This ‘Re-test’ sub-database includes 18 speakers from CH and 23 from BE, both male and female distributed over the 5 age groups.

All speakers had French as either mother tongue or predominant language. Five speakers had another language than French as first language and 89 speakers were using one or several other languages on a daily basis (English, Italian, Arabic and Spanish being the most frequent).

Speakers had no self-reported speech or voice disorders, although 18 of them reported past speech and language

therapy for a disorder that had been overcome. Seventy-two speakers (from (53 to 93 years old) reported having false teeths.

Speakers were quite representative of the standard population, i.e. the database was not constituted of academics only (or super-seniors). Speakers were recruited by students in their family circles, relatives and/or in retirement homes. An assessment of the educational level of the speaker was obtained by asking at which age the speakers finished school. Distribution was somewhat equivalent across age groups and regiolects. The mean age was 19 years old for the oldest group and 21 to 24 years old for the other groups. Quebec speakers had left school a few years later than the other speakers in average for the 40-49 group (mean: 32 y.o.).

Sex	Regiolect	20-39	40-49	50-59	60-74	75+	*total*
F	FR	12	12	10	10	10	*54*
	CH	11	11	8	9	9	*48*
	BE	11	10	10	11	11	*53*
	QC	10	8	7	18	11	*54*
	total	*44*	*41*	*35*	*48*	*41*	*209*
M	FR	10	9	10	9	9	*47*
	CH	10	10	10	10	9	*49*
	BE	11	10	9	11	10	*51*
	QC	10	6	8	16	9	*49*
	total	*41*	*35*	*37*	*46*	*37*	*196*

Table I: Distribution of the 405 speakers by age groups, sex and regiolects.

2.4 Recording conditions

Speakers were recorded at home in a quite room by trained students. A professional audio material was used for the FR and BE sets (external audiocard Foscurite Scarlet & headmounted Shure SM35-XLR microphone), while various external microphones were used for the other sets. As a consequence, recordings of different audio quality are included in the corpus. This was done on purpose in order to introduce possible noise in the reference values used for the validation of the MonPaGe protocol, which is to be used by speech pathologists in clinical practice, thus in different noise conditions and with a variety of audio equipment.

For the administration of the speech screening protocol, the computerized version of the MonPaGe was used. This application allows the prompting of the speech material/tasks in a set order, as well as the instant recordings of each production as a single audio file, indexed with the speaker's references. Speakers were seated in front of the computer and a trained experimenter administrated the protocol.

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Figure 1: Age characteristics for each age group, per regiolect and sex

4. References

Benjamin, B. J. (1982). Phonological performance in gerontological speech. Journal of Psycholinguistic Research, 11(2), 159–167.

Bilodeau-Mecure M., Tremblay P. (2016) Age Differences in Sequential Speech Production-Articulatory and Physiological Factors. J Am Geriatr Soc.;64(11):e177-e182.

Chicherio, C., Genoud-Prachex, T., Assal, F., & , Laganaro, M. (2016). Cyber-neuro-psychologie ou l'application des nouvelles technologies à l'évaluation précoce en phase aiguë des patients cérébro-lésés. Journée d'Hiver de la Société de Neuropsychologie de Langue Française, Paris.

Ferrand, C. (2002). Harmonics-to-noise ratio: an index of vocal aging. J Voice 16, 480–487.

Fletcher, A. R., McAuliffe, M. J., Lansford, K. L., & Liss, J. M. (2015). The relationship between speech segment duration and vowel centralization in a group of older speakers. Journal of the Acoustical Society of America, 138, 2132–2139.

Folstein MF, Folstein SE, McHugh PR. « Mini - Mental State ». A practical method for grading the cognitive state of patients for the clinician. J psychiat Res 1975 ; 12: 189 - 98

Harnsberger, J.D., Shrivastav, R., Brown, W., Rothman, H., & Hollien, H. (2008). Speaking rate and

fundamental frequency as speech cues to perceived age. J. Voice 22, 58–69.
Fougeron C., Delvaux V., Pernon M., Léveque N., Borel S., Pellet P. Bagou O., Trouville R. Ménard L., Catalano S., Lopez U., Kocjancic-Antolik T., Laganaro M. (2016) Chapitre 14. MonPaGe : un protocole informatisé d'évaluation de la parole pathologique en langue française. In Actes du colloque UNADREO « Orthophonie et technologies innovantes » (Joyeux N. & Topouzkhanian S., eds).
Jacewicz, E., Fox, R. A., O'Neill, C., & Salmons, J. (2009). Articulation rate across dialect, age, and gender. Language Variation and Change, 21(2), 233–256.
Kahane, J. (1981). Anatomic and physiologic changes in the aging peripheral speech mechanism. In: Beasley, D., Davis, G. (Eds.), Aging: Communication Processes and Disorders. Grune & Stratton, New York, 21–45.
Linville, S. E. (2001). Vocal aging. San Diego, CA: Singular.
Morris, R.J., Brown, W.S. (1994) Age-related differences in speech variability among women. Journal of Communication Disorders 27, 49–64
New, B., Pallier, C., Brysbaert, M., Ferrand, L. (2004) Lexique 2 : A New French Lexical Database. *Behavior Research Methods, Instruments, & Computers*, 36 (3), 516-524. http://www.lexique.org
Pierce, J. E., Cotton, S., & Perry, A. (2013). Alternating and sequential motion rates in older adults. International Journal of Language & Communication Disorders, 48(3), 257–264.
Quené, H. (2008). Multilevel modeling of between-speaker and within-speaker variation in spontaneous speech tempo. JASA 123, 1104–1113.
Ramig, L.A., & Ringel, R.L. (1983). Effects of physiological aging on selected acoustic characteristics of voice. J Speech Hear Res. 26, 22-30.
Ramig, L. A. (1983). Effects of physiological aging on speaking and reading rates. Journal of Communication Disorders, 16(3), 217–226.
Rastatter, M., McGuire, R., Kalinowski, J., Stuart, A. (1997) Formant frequency characteristics of elderly speakers in contextual speech. Folia Phoniatrica et Logopaedica 49, 1–8.
Russell, A., Penny, L., & Pemberton, C. (1995). Speaking fundamental frequency changes over time in women: a longitudinal study. J Speech Hear Res. 38, 101–109.
Seidler, R.D., Bernard, J.A., Burutolu, T.B., Fling, B.W., Gordon, M.T., Gwin, J.T., Kwak,Y., Lipps, D.B. (2010) Motor control and aging: links to age-related brain structural, functional, and biochemical effects. Neurosci. Biobehav. Rev. 34, 721–733.
Staiger A., Schölderle T, Brendel B. Ziegler ,W. (2016) Dissociating oral motor capabilities: Evidence from patients with movement disorders. Neuropsychologia 95 (2017) 40–53
Schötz S. (2007) Acoustic Analysis of Adult Speaker Age. In: Müller C. (eds) Speaker Classification I. Lecture Notes in Computer Science, vol 4343. Springer, Berlin, Heidelberg
Smith, B. L., Wasowicz, J., & Preston, J. (1987). Temporal Characteristics of the Speech of Normal Elderly Adults. Journal of Speech, Language, and Hearing Research, 30(4), 522–529.
Torre, P., & Barlow, J.A. (2009). Age-related changes in acoustic characteristics of adult speech. J. Commun Disord. 42, 324-33.
Verhoeven, J., De Pauw, G., & Kloots, H. (2004). Speech rate in a pluricentric language: A comparison between Dutch in Belgium and the Netherlands. Lang Speech 47, 297–308.
Xue, S., & Hao, G. (2003). Changes in the human vocal tract due to aging and the acoustic correlates of speech production: a pilot study. J Speech Lang Hear Res. 46, 689–701.

Appendix:

Detailed description of the MonPaGe modules and associated speech material. Modules are included in a computerized version of the protocol, which delivers the prompts and instructions to the speaker, then records and stores the productions.

Module 'Intelligibility': see description in 2.2.2

Module 'Pneumophonatory control': this module includes the material for a standard assessment of voice quality on sustained vowels, with one production of a 2-3 seconds /a/. In order to assess maximum phonation time, the speaker is also asked to sustain a /a/ vowel for as long as possible at a comfortable pitch and intensity. Two trials are recorded and the speaker can try as much as he wants. For the two tasks above, audio examples are provided to the speakers.
Then, in order to test whether speakers are able to modulate the intensity of their productions and monitor their own intensity, the speaker is asked to produce the typical call 'ého' [eo] at 4 self-estimated amplitude levels from the lowest to the highest (no example provided since self-monitoring is tested).

Module 'Articulation': this module contains a set of 52 pseudowords used to assess the articulation of all French phonemes, with manipulation of complexity factors: syllable structure, syllable position and syllable frequency. These items are presented in table II. Items are presented to the speakers in orthographic form on a screen and in audio form via headphones in order to allow either reading or repetition of the forms. One production is recorded for each item.
Construction principles of the items are the following:

(a) The 'Peripheral vowels set' includes 3 exemplars of the peripheral oral vowels of French /i, e, ɛ, a, ɔ, o, u/ produced in a /pVpVpV/ frame in order to have the acoustic vowel space of the speaker

(b) The 'Bisyllabic pseudoword set' aims at testing the articulation of almost all the French consonants (/p,b,m,f,v,t,d,n,s,z,l,ʃ,ʒ,k,g,ʀ,j,w/) and vowels (/i, y, e, ø, ɛ, a, ɔ, o, u, ɔ̃ , ɛ̃, ɑ̃/) as well as the production of some clusters in various word positions.

All singleton consonants occur in word onset position followed by V1=/a/ and in word medial onset postion followed by various V2; singleton /t,d,s,z/ and /R/ also occurs in final coda position (see 'CVCVC' set); all French vowels occurs in V2 position.

Clusters of different complexity, CC (/sp, bl, kR/) and CCC (/spl, stR/) occur in both word-onset and word-medial onset positions, they are always associated with the same CV syllable (e.g. /spe.la/-/la.spe/). In order to test for syllable frequency effects, these clusters are associated with specific vowels to form pairs of syllables with high or low frequency according to the LEXIQUE3.01 database (New et al. 2004).

(c) The 'Coarticulation set' aims at testing anticipatory VtoV coarticulation on V1 /a/ according to V2 /a/ or /i/, and VtoC coarticulation on C and CC according to V2 /i/ or /y/.

(d) The 'Long pseudowords set' includes tri and quadrisyllabic words involving alternating articulatory configurations for voicing, place of articulation, mode of articulation and nasality.

(a) peripheral vowels	
Pa,pa,pa	/papapa/
Pou,pou,pou	/pupupu/
Pêp, pêp,pêp	/pɛpɛpɛ/
Pi,pi,pi	/pipipi/
Pop,pop,pop	/pɔpɔpɔ/
Pé,pé,pé	/pepepe/
Pau,pau,pau	/popopo/

(e) Coarticulation	
Laspu	/laspy/
Laspi	/laspi/
Laspa	/laspa/
tessi	/tesi/
tessu	/tesy/
maba	/maba/
mabi	/mabi/

(b) bisyllabic pseudowords		
CV.CV	Tabon	/tabɔ̃/
	Magou	/magu/
	Padan	/padɑ̃/
	Rafau	/Rafo/
	Sajau	/saʒo/
	Bayeu	/bajø/
	Ganain	/ganɛ̃/
	Zassain	/zasɛ̃/
	Yatu	/jaty/
	Ouaneu	/wanø/
CV.CVC	Nazor	/nazɔR/
	Yaouid	/jawid/
	Damette	/damɛt/
	Jaruz	/ʒaRyz/
	Faposse	/fapɔs/
CV.CCV	Laspé	/la.spe/
	Laspi	/la.spi/
	Kablan	/ka.blɑ̃/
	Kablon	/ka.blɔ̃/
CCV.CV	Spéla	/spe.la/
	Spila	/spi.la/
	Blanka	/blɑ̃.ka/
	Blonka	/blɔ̃.ka/
CV.CCCV	Vastra	/va.stRa/
	Vastré	/va.stre/
	Chaspli	/ʃa.spli/
	Chasplé	/ʃa.sple/
CCCV.CV	Stréva	/stre.va/
	Strava	/stRa.va/
	Splicha	/spli.ʃa/
	Splécha	/sple.ʃa/

(d) long pseudowords		
CV.CV.CVC	Dadada	/dadada/
CV.CV.CVC	Tatata	/tatata/
CV.CV.CV.CV	Kitoukitou	/kitukitu/
GV.GV.GV	Oui-oui-oui	/wiwiwi/
CV.GV.CV	Dayaza	/dajaza/
CV.CV.CV.CV	Takadacha	/takadaʃa/
CV.CV.CV	Fichoussu	/fiʃusy/
CV.CV.CV.CV	Ménabainban	/menabɛ̃bɑ̃/

(c) Syllable frequency (occurrence per million)	
/spli/ (234)	/sple/ (.4)
/stRa/ (128)	/stRe/ (35)
/spe/ (546)	/spi/ (70)
/blɑ̃/ (285)	/blɔ̃/ (36)

Table II: Pseudowords in the Module 'Articulation'.

Lundi, le chat, le loup et Papa vont à Bali. Les copains sont tout contents.	*Monday, the cat, the wolf and Daddy go to Bali. The friends are all happy.*
Mardi, Papy y va aussi. Il dit: "Je n'ai pas un sou! Qui va prendre soin de moi?" " Moi!" dit le chat, "moi!" dit le loup. "Vous?", Papy réfléchit.	*Tuesday, Grandpa joins them. He says: "I don't have money! Who will take care of me?" "I will!" says the cat; "I will!" says the wolf. "You two?" Grandpa wonders.*
Mercredi, Papy dit: "Toi, le chat! Tu es doux, tu es chou, tu n'as pas de poux! Mais pas ce loup: il a une cape rouge et je n'aime pas ce gars-là!"	*Wednesday, Grandpa says: "You, cat! You are kind, you are sweet, you don't have lice!" "but not this wolf, he has a red cape and I don't like him!".*
Jeudi, le chat et Papa se baladent à Bali. Papa glisse! Aïe! ouille! Son cou craque, son coude claque, c'est la débâcle!	*Thursday, the cat and Daddy wander in Bali. Daddy slips! Ouch! Ouch! His neck cracks, his elbow creaks, it's a fiasco.*
Vendredi, Papa a mal. Il pleure, il crie. "Toi, Papy, aide-moi, trouve le nain!" "Un nain? On n'en a jamais vu par ici?!"	*Friday, Daddy hurts. He weeps, he cries. "You, Grandpa, help me, find the dwarf!". "A dwarf? We never saw one around here?!".*
Samedi matin, le chat va voir son ami le loup et lui dit: "Aide-moi à soigner Papa!"	*Saturday morning, the cat goes to his friend the wolf and says "help me heal Daddy!".*
Samedi soir le loup lui donne sa recette magique: "Coupe un oignon, cache-le sous la souche, et lorsque le lilas fleurira, Papa sera guéri!" Abracadabra, ça y est, on a réussi!	*Saturday evening the wolf gives him a magic recipe: "cut an onion, hide it under the stump and when the lilac blooms, Daddy will be cured!" Abracadabra, we succeeded!".*
Dimanche, le chat tout doux, le loup magicien, Papa et Papy quittent Bali. Les copains sont tout contents.	*Sunday, the sweet cat, the wizard wolf, Daddy and Grandpa leave Bali. The friends are all happy.*

Table III: A 188-word story to be read by the speakers in the 'Text Reading' module.

Module 'Prosody': this module contains 6 sentences presented in orthographic form to the speakers with specific instructions to test the production of prosodic contrasts. All sentences are fully voiced for subsequent f0 measurements. The production of *assertive/interrogative contrast* is tested on a 4-syllable sentence 'Laurie l'a lu' (Laurie read it) and a 7-syllables sentence 'Mélanie vend du lilas' (Melanie sells lilac). Sentences are first presented on the screen as declarative (e.g. 'Laurie l'a lu.') and then whith a question mark (e.g. 'Laurie l'a lu ?') and the speaker is asked to say the same sentence asking a question.

The use of prosody to express different phrasing is then tested with the sentences 'Anne, Marie et moi allons à la mer' (Anne, Marie and I are going to the see shore) vs. 'Anne-Marie et moi allons à la mer' (here 'Anne-Marie' is a compound first name, so only 2 persons are involved). Expected phrasing are the following: (Anne), (Marie) (et moi) (allons à la mer) vs. (Anne-Marie) (et moi) (allons à la mer)

Module 'Diadochokinesia': DDK tests are often used in clinical practice to test the ability to make alternating movements in quick succession. Items have to be produced in a continuous manner in a single breath group and speakers are asked to speak as fast and as accurately as possible. Seven items, which vary in term of complexity, are used here. They include (a) repetitive CV syllables involving different places of articulation: /bababa/, /dedede/, /gogogo/ (the vowels are chosen to be close to the consonant place of articulation), (b) repetitive CCV syllables, of a more complex structure: /klaklakla/, /tRatRatRa/, (c) sequences of different syllables, either simple CV or complex CCV: /badego/, /klatRa/.

Module 'Days of the week': the speaker is asked to produce in a continuous manner the days of the week (starting from Monday) over a period of 30 seconds. This module aims at testing continuous speech production in an 'automated mode' since the speech material to produce is an overlearned series.

Module 'Text reading': continuous read speech is assessed in this module, in which the speaker has to read a custom-made short story. Successive (groups of) sentences of the text are presented one by one on the computer screen (Table III). The story includes 188 words. It has been especially written to allow the description of the phonetics and phonology of French speakers. Some of the words have been selected to allow comparison between isolated production (in the 'articulation' or 'days of the week' modules) and productions of similar words in a more continuous meaningful production mode (e.g. vowel production, V-to-V coarticulation (papa/papi), complex CC sequences, days of the week…). It also allows the assessment of expressive prosodic functions elicited, which are elicited in the text with many punctuation marks and direct speech. Part of the first sentence ('Les copains sont tout contents') is repeated in the last sentence, to allow comparison in the search for potential fatigue effects.

Module 'Picture description': more spontaneous production is elicited in this last module where speakers are asked to describe the picture presented in figure 2. The picture includes some of the items present in the text reading.

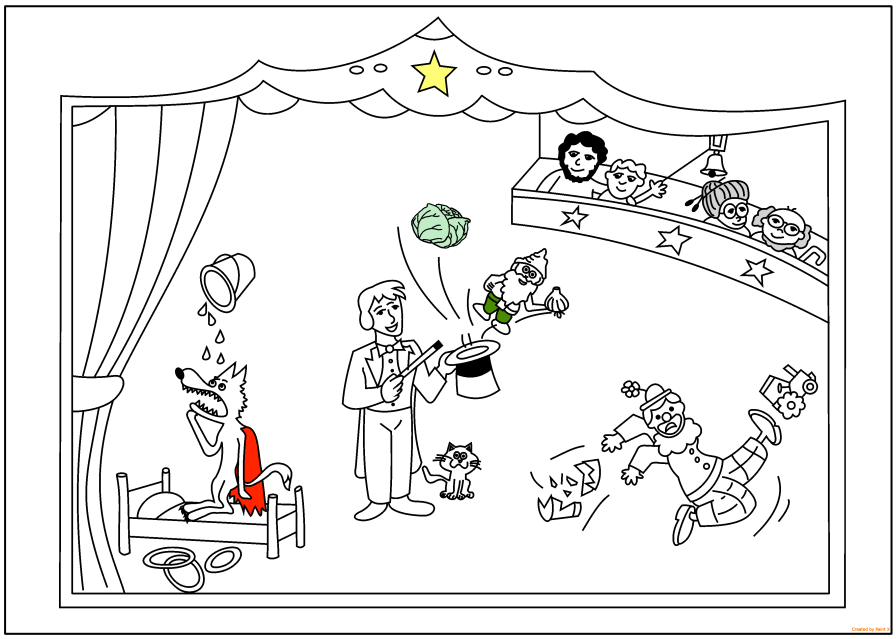

Figure 2: Picture to be described by the speakers in the 'Picture description' module.