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TYPHANIE PRINCE[1]

On the Jakobson's Postulate: the notion of markedness. A Case study of French Phonology of Aphasia and Acquisition

In this paper, we will suggest that the Jakobson postulate ([1941] 1968) concerning the mirror-image between language acquisition and speech language impairment is still relevant. This study presents the results of an investigation into the acquisition of phonology of 20 French children and the speech pathology of 20 French aphasic speakers. On the basis of French data, our claim is that markedness, which played a central role in Jakobson's work, is essential for the treatment of the production of children and aphasic speakers. We will show that similar strategies, such as deletions, epenthesis and substitutions are applied during acquisition but also during aphasia. These strategies correspond to the application of repair strategies made by aphasics and children to solve a conflict between their own constraints and the constraints applied in standard language.

1. *Introduction*

The starting point of this study is Jakobson's proposal ([1941] 1968) that a parallel can be drawn between the phonological system in acquisition and aphasia. In the famous *Child Language, Aphasia and Phonological Universals* (*Kindersprache, Aphasie und allgemeine Lautgesetz (1941))*, Jakobson suggests that universal laws govern the sound systems of all the language. These laws attest the strata development of the language system, they show that the system is not acquired randomly. Thus, "Jakobson put forward the thesis that the distinctive sounds of a language (i.e., phonemes) are acquired in an order that reflects their structural complexity, in terms of feature composition and basic syllabic structure" (Durand, Prince, 2015: 15). In the same way, this phonological system can be lost in aphasia, in the reverse order. Jakobson also claimed that we can observe similar strategies both in child speech and in the impairment of aphasic speakers. Finally, he proposes that these strategies respect a hierarchy of complexity.

> The dissolution of the linguistic sound system in aphasics provides an exact mirror-image of the phonological development in child language... The order in which

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> speech sounds are restored in the aphasic during the process of recovery corresponds directly to the development of child language[2].

In order to validate or amend this postulate, the purpose of this study is to explore the different strategies used by normally-developed children during acquisition and by French aphasic speakers during the production of consonantal clusters /fricative+stop/, especially sC[3] and ʁC. The question we address in this paper is: do French aphasic speakers really have the same strategies as normally-developed children during acquisition?

Another claim in this article is to investigate to what extent syllabic complexity, segmental complexity or both of them play a role in phonological acquisition and phonological disorders. We will show that transformations applied to clusters also involve segments and we propose that the complexity observed results from the interface between constraints on segmental content and syllabic representation.

Most studies on phonological disorders in aphasia make a direct reference to acquisition data (Caramazza, 1994; Den Ouden, 2011; 2002; Den Ouden, Baastianse, 2003) but many studies focus on either the acquisition of phonology (Fikkert, 1994; Rose, Wauquier, 2007; Kirk, 2008; Rose, 2009) or the phonology of aphasic speakers (Nespoulous et al., 1987; Béland, Favreau, 1991; Den Ouden, 2002; Baqué et al., 2012). In our knowledge, there is no study that has explored the consequences of this phonological link between acquisition and aphasia, or has provided any information about the phonological complexity on the basis of empirical data.

Then, Den Ouden and Bastiaanse (2003: 83) also affirm that:

> [...] the logic of the general idea behind Jakobson's statement cannot be simply dismissed, especially if we are able to argue for an distinguish specific functional modules and can study patients with deficits in specific and well-defined language functions.

Furthermore, studies in the Theory of Constraints and Repair Strategies (TCRS), such as Blumstein (1973), Nespoulous et al. (1987), Béland, Favreau (1991), Valdois (1987), Moreau (1993) and Béland, Paradis (1997), have shown that phonological disorders correspond to a surface manifestation of the application of repair strategies made by aphasics to solve a conflict between their own constraints

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[2] Jakobson (1968: 60-62).

[3] Phonology demonstrates that sC clusters have a special status for many reasons _ sC behave different from complex onsets in terms of sonority for example, data in typology and acquisition show that sC behave inconsistently, sometimes as a heterosyllabic sequence and other times as a tautosyllabic sequence (Goad, 2011). Many accounts have been proposed to address its particular behaviour (appendix, complex segment, extrasyllabicity, coda+onset, *inter alia*). However and because this is not the debate here, this point can not be treat here, but for a complete review, see Goad (2011) and Scheer (2015). In this paper, we will consider that sC is a kind of coda+onset sequence, as we will show in the analysis.

(they became too restrictive) and the constraints applied in standard language[4]. For example, in:

(1) *snail* 'lumaca' escargot /ɛskaʁgo/ → [tsɛtsaʁdo]

Generally, the aphasic speaker seems to have some difficulties to produce a complex word starting with a vowel and composed by two coda+onset clusters. Each complex element is simplified, i.e. the aphasic speakers use a repair strategy for the clusters and change them in a branching onset (or affricate). He also changes each velar into a coronal and reduplicates the branching onset in initial position. But, as suggested by Moreau (1993: 62) if an aphasic speaker applies a repair strategy, it may account for a less complex structure locally but it could generate a larger degree of complexity on the pattern (Béland, Paradis & Bois, 1993; Moreau, 1993). Besides, in acquisition, similar strategies are applied during the setting of parameters of the grammar. When the parameters are set, good productions occur. We prefer using the term of *transformations* rather than *errors*, because aphasic speakers or children apply different strategies to avoid something they cannot produce. These strategies lead to transformations in production.

On the basis on Jakobson's idea, we propose that markedness plays a role in acquisition and in aphasia. Children and aphasic speakers respect a hierarchy of complexity. This hierarchy is defined by markedness properties. Under this point, the goal is always to reduce the complexity adopting less marked structures. We also suggest that data from speech disorders and acquisition inform us about the complexity of clusters and segments. Complexity seems to appear on most phonological levels and much research has been devoted to understanding this notion. We propose that the complexity observed results from the interface between constraints on segmental content and syllabic representation.

First, we will start with a review of the literature on the phonology of aphasia and acquisition.

Secondly, we will present the different strategies applied in aphasia through the definition of phonological disorders called *phonemic paraphasias*. We will show that similar processes are applied in acquisition. Thirdly, we shall provide an overview of our experiment based on 20 aphasic French speakers and 20 French normally-developed children. Finally, we mainly focus on the process of reduction in clusters and provide a theoretical analysis of the data under discussion.

1.1 The Phonology of Aphasia and Acquisition

1.1.1 About Segments and Syllables in literature

If much research (Blumstein, 1978; Romani, Calabrese, 1998; Béland, Favreau, 1991) has demonstrated that deletions (consonant cluster reductions), segmental

[4] In speech language disorders, Calabrese (2005) suggested that brain damage involves a shift of parameters activation/deactivation. Repair strategies are issued to solve the violation resulting from the constraints (2005: 108).

substitutions and epenthesis (assimilation, consonantal harmony) are the most important strategies in aphasia, especially in English, French, Italian or Dutch, they are also frequent during the acquisition of phonology (Chin, Dinnsen, 1992; Fikkert, 2000; Kirk, 2008; Demuth, McCullough, 2009; Rose, 2009). The acquisition of consonant clusters is very problematic, and varies across the children and depends on the type of cluster, the position and the nature of the different consonants. Kappa (2002: 21) has shown that all the production of children tends to be unmarked in structure through different strategies such as deletion of the entire cluster, reduction and substitution (among others, Chin, Dinnsen, 1992 for English; Fikkert, 1994 for Dutch; Kappa, 2002 for Greek).

In aphasia, Blumstein, Baker & Goodglass (1977) suggest that the nature of the syllabic structure can generate transformations. For example, Blumstein (1973) has shown that deletion concerns mostly liquids in a cluster. Valdois (1987), Nespoulous and Moreau (1997) have shown that in a cluster pattern such as /obstruent+liquid/ or /fricative+liquid/, C^2 is more deleted than C^1 (Fikkert, 1994; 2000). But, in a cluster /fricative+obstruent/ as /sp/, C^1, the fricative will be deleted. In other words, deletion principally concerns the liquid or the fricative in a group in acquisition (Rose, Wauquier-Graveline, 2007) and also in aphasia. Freitas (1997) has shown that children acquired sC clusters before branching onset in Portuguese but Fikkert (1994) has shown, for Dutch, that children acquired first branching onset, as in French (Kehoe, Hilaire-Debove, Demuth & Lléo, 2008). In this way, sC clusters exhibits a different behaviour than branching onset. Dutch children also acquired onset clusters before coda clusters. Finally, in a sC clusters, children delete mostly the /s/ (Greenlee, 1974; Fikkert, 2000), like aphasics. Furthermore, the opposite strategy can be used. Valdois (1987) and Romani, Calabrese (1998) revealed that in French and Italian, the epenthesis is the most frequent repair strategy during aphasia to resolve a hiatus or if an item starts with a vowel. Another type of paraphasia in aphasia is substitution. Acquisition exposes similar transformations through consonantal harmony for example (Fikkert, 2000; Rose, 2009). At this point, Greenlee (1974) suggests three stages during acquisition of consonantal cluster; deletion of the entire cluster, deletion of one of the member of a cluster and substitution. Valdois (1987) highlights that substitution is the preferred transformation to solve a conflict between the internal parameters of the aphasic speaker and the constraints applied on language. Standard approaches to substitution in aphasia have relied on Interphonemic Distance (henceforth ID), which computes the number of feature changes. Blumstein (1973), Nespoulous et al. (1987) propose that most cases of substitutions show an ID of 1, i.e. most of the time, transformations imply only one feature value: place or manner of articulation (now PoAs and MoAs respectively). ID allows computing the degree of complexity of substitutions by comparing feature values of two matrices. The greater the distance, the more complex the substitution.

Furthermore, when segments contain the same number of features, ID is unable to reflect the complexity/the degree of markedness[5] between the different PoAs/MoAs. In this regard, we will suggest that element theory (e.g. Harris, 1994; Scheer, 1999; Cyran, 2010 or Backley, 2011) could explain the different patterns of substitution in aphasia and the asymmetrical behaviour of segmental classes, as we shall see later. We postulate that this particular scale is not universal but language-specific. According to Béland and Favreau (1991) and Béland, Paradis & Bois (1993) substitution involves particularly [coronal]. Moreau (1993) showed that [coronal] is also more deleted and used for epenthesis. [coronal], in speech disorders but also in acquisition and typology, seems to have a particular behaviour – coronals are less marked and the most frequent natural classes – as it is proposed by Jakobson, 1968; Paradis & Prunet, 1991; Scheer, 1999; Morissette & al., 2003; Kirk, 2008; Rice, 2009 for acquisition and typology.

1.1.2 Phonological Disorders in Aphasia vs Phonological Transformations in Acquisition

The term *phonological disorders* refers to a large scope of "phonological transformations" called *phonemic paraphasias*. Phonemic paraphasias occur in major kinds of aphasia: Broca, Wernicke and conduction. Roch-Lecours and Lhermitte (1979), Blumstein (1978) have proposed a typology of phonological disorders in aphasic speech involving substitution, addition, epenthesis, deletion or assimilation. Furthermore, similar phonological strategies are involved during the setting of parameters in acquisition or after a stroke, owing to the loss of the parameter settings.

1.1.3 Different Strategies

For the purpose of this study and on the basis of our data, we suggest to subsume phonemic transformations into 5 classes: deletion, epenthesis, metathesis, substitution and what we call total reduction (CCv → Cv):

Table 1 - *Kinds of strategies in cluster production*

Strategies		*Item*	*Ipa target*	*Productions*
Deletion C_1	$C_aC_b \rightarrow C_b$	*pen*	/stilo/	[tilo]
Deletion C_2	$C_aC_b \rightarrow C_a$	*garden*	/paʁk/	[paʁ]
Epenthesis	$C_aC_b \rightarrow C_wC_xC_b$	*snake*	/sɛʁpɑ̃/	[sɛʁəpɑ̃]
Metathesis	$C_aC_b \rightarrow C_bC_a$	*casque*	/kask/	[kaks]
Substitution C_1	$C_aC_b \rightarrow C_zC_b$	*snail*	/ɛskaʁgo/	[ɛʃkaʁdo]
Substitution C_2	$C_aC_b \rightarrow C_aC_X$	*snail*	/ɛskaʁgo/	[ɛstaʁdo]
CCv → Cv	$C_aC_b \rightarrow C_x$	*spatula*	/spatyl/	[ʃatyl]

[5] We suggest, as Den Ouden (2002), Romani, Galluzzi (2005) that complexity is equivalent to markedness.

In a consonantal sequence, the first member – C_1, the second member – C_2, or all the cluster, C_1C_2 can be deleted, like as in the example above. In this study, C_1 corresponds to a /s/ or a /ʁ/ while C_2 always corresponds to a stop.

(2) *card* 'carta' carte /kaʁt/ → [ka]

On the contrary, epenthesis corresponds to the insertion of a vowel, a glide or a consonant. Epenthesis appears frequently in hiatuses, especially in Italian (Calabrese, Romani, 1998).

(3) *snake* 'serpente' serpent /sɛʁpɑ̃/ → [sɛʁəpɑ̃]

Metathesis corresponds to the permutation of two segments in the string, we defined two kinds of metathesis:

– IntraClusterMetathesis – permutation of both members of the cluster $C_1C_2 \rightarrow C_2C_1$

(4) *helmet* 'casco' casque /kask/ → [kaks]

– InterClusterMetathesis – permutation with one of the member of the cluster and another consonant in the pattern. $C_1v[C_2C_3v]C_4vC_5 \rightarrow C_1v[C_2\mathbf{C_5}v]C_4v\mathbf{C_3}$

(5) *mosquito* 'zanzara' moustique /mustik/ → [muskit]

We can distinguish two different types of substitutions: one involves a gain or a loss of an element/feature and the other involves a complete change of segment. Finally, the last operation corresponds to a case of reduction, when a cluster is reduced to a C+V string: CCv → Cv like in the following example: *spatula:* /spatyl/ → [ʃatyl]. In this case, two different consonants: /s/ and /p/ became another consonant /ʃ/, as if it was a deletion and a substitution or a fusion of the features of the two segments.

1.2 The French Phonological System

1.2.1 Method

Population

The data is based on a cross-sectional study on a sample of 20 French monolingual children and 20 aphasic participants. 27 children were recorded but the data of 7 were discarded: 5 because the children were too shy or not interested in the task, 1 because he was bilingual, and another because he had suffered a stroke the year before. The child participants were normally developing children, 8 girls and 12 boys, aged between 2;1 and 3;8 years (M_{age} = 2;34 years). They were recorded at a kindergarten in France. All the children selected did not suffer from speech and hearing deficits, language delay, neurological or motor control disorders. All the children produced phonological transformations.

All the aphasic patients were selected at the hospital of Nantes, in the neurovascular unit. Each patients was diagnosed and classified on the basis of MT-86 a standardized battery test (Nespoulous, Joanette & Roch Lecours, 1986) by a speech therapist. The patients were selected based on the following criteria: native French speakers, right-handed, suffered from a right CVA (cerebral vascular accident), a lesion of the left hemisphere and are selected in the acute and subacute phases of stroke. All of them suffering from phonetico-phonological disorders in production. In a set of 42 aphasic patients tested in hospital, 22 aphasic speakers were not included in the sample because their disorders did not correspond to our goal (for instance those who presented a major deficit of comprehension, an important jargonaphasia or more simply because they did not produce phonemic paraphasias). 18 of the aphasic speakers were recorded between Day+1 and Day+25 at the stroke (Neurovascular) unit of a hospital in Nantes, while the other 2 were recorded in a speech therapy practice. We have recorded 11 woman and 9 men, aged between 36 and 82 years (M_{age} = 63;10 years), 7 Broca's aphasics including 1 in therapy, 6 Wernicke's aphasics including 1 in therapy, 4 conduction aphasics and 3 Transcortical aphasics. All the aphasics suffer from a phonological disorder stemming from a lesion of the left hemisphere due to a stroke. All aphasic speakers produced phonemic paraphasias.

Phonemic paraphasias are the focus of this paper and involve patterns of error such as epenthesis, substitutions, deletions, metathesis and can be found across multiples tasks (spontaneous speech, repetition, picture naming, reading aloud). Furthermore, following Jakobson's postulate (1968) concerning the relation between acquisition and aphasia, we will compare all the productions to find out if children and aphasics use the same strategies.

Procedure

The experiment is composed of 40 items with clusters sC and ʁC in all positions and depending on the different classes for segments: [labial], [coronal] and [dorsal]. A naming and a repetition tasks were used to test the production of clusters. Words are monosyllabic, bisyllabic and trisyllabic (examples in table 2 below). Pictures were always black-and white drawings of common objects, vegetables and animals. Children were recorded at the kindergarten while the aphasic speakers were tested in a quiet room at the clinic. All aphasic speakers and children were recorded with a Tascam DR 100. Each session lasted approximately 20 minutes.

Table 2 - *Kinds of phonological structures*

Position	*Length*	*Syllabic structure*	*Patterns*		
# _.	1	CCVC	stage	*stade*	[stad]
	2	CCV.CV	pen	*stylo*	[stilo]
	3	CCV.CV.CV	beetle	*scarabé*	[skaʁabe]
. _ .	2	CVC.CVC	cap	*casquette*	[kaskɛk]
	3	VC.CVC.CV	snail	*escargot*	[ɛskaʁgo]
. _ #	1	CVCC	mask	*masque*	[mask]
	2	CV.CVC	dentist	*dentiste*	[dɑ̃tist]
	3	V.CVC.C	scarf	*écharpe*	[eʃaʁp]

All these data recorded were orthographically and phonetically transcribed by a French speaker using PHON software, developed by Rose, Y., MacWhinney, B., Byrne, R., Hedlund, G., Maddocks, K., O'brien, P. & Wareham, T. (2006). From the overall data, we excluded neologisms, misunderstanding productions, echolalic responses, perseverations and other paraphasias (for example lexical or semantic).

1.2.2 Data

A total of 906 phonemic transformations were explored depending on several types of transformations (table 3):

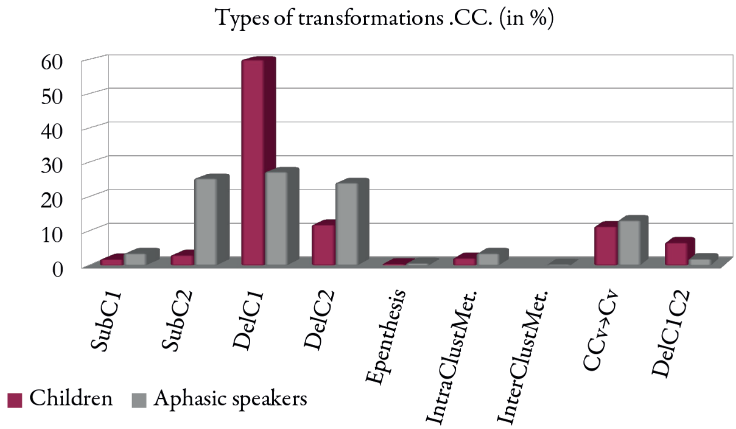
Table 3 - *Phonemic paraphasias*
Types of Transformations

	Children		*Aphasics*	
	N	*%*	*N*	*%*
Substitution C^1	11	1,85	11	3,54
Substitution C^2	18	3,03	**79**	**25,40**
Deletion C^1	**371**	**62,35**	**85**	**27,33**
Deletion C^2	**71**	**11,93**	**75**	**24,12**
Deletion C^1C^2	40	6,72	6	1,93
InterClusterMetathesis	0	0	1	0,32
IntraClusterMetathesis	13	2,18	11	3,54
Epenthesis	3	0,50	2	0,64
CCV → CV	**68**	**11,43**	41	13,18
TOTAL	595	100	311	100

The $\chi 2$ showed that there is a significant difference between the group (children *versus* aphasic speakers) and the type of transformations: $\chi 2_{[8]} = 179.6623$, p-value < 0.001.

We looked at these transformations in detail, depending on the type of the cluster, the position (initial, medial, final) and cluster's members C^1 or C^2. In figure (1) we can see the different transformations depending on the population:

Figure 1 - *Phonemic paraphasias*



The main generalizations that can be formulated on the basis of our results are: (i) the most frequent transformation observed in both groups is the deletion of C^1 or C^2 (Barlow, 2001; Greenlee, 1974; Chin, Dinnsen, 1992) (ii) children delete the initial consonant more often than C_2 (iii) other important transformations observed are s*ubstitution* of C^2 and the *reduction* – CCv → Cv (Kirk, Demuth, 2005; Barlow, 2004). Some examples are given in (6).

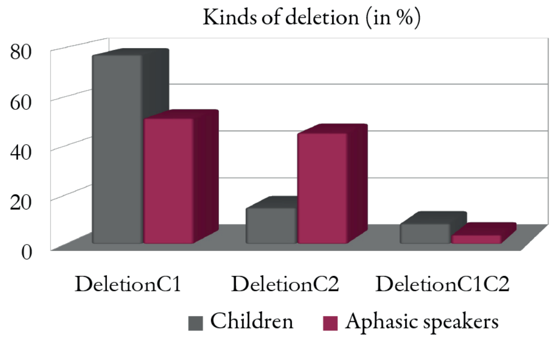
(6)	a. *snail*	'lumaca'	escargot	/ɛskaʁgo/	→	[ɛʃkaʁgo] [ɛkago] [esado]
	b. *mosquito*	'zanzara'	moustique	/mustik/	→	[muti] [musik] [muskit]
	c. *cap*	'beretto'	casquette	/kaskɛt/	→	[kakɛk] [kakɛt]
	d. *pen*	'penna'	stylo	/stilo/	→	[skilo] [tilo] [kijo]
	e. *satchel*	'cartella'	cartable	/kaʁtablə/	→	[kapat] [kaʁnat] [katab]

We propose to focus now on deletion, substitution and reduction. Despite the fact that different strategies are used, we suggest that all transformations applied by children and by aphasic speakers lead to a weakening process, a reduction of the complexity, through the syllabic structures or the internal representation of segments. To understand why children and aphasic speakers use these strategies, this study will be conducted depending on the position (initial, medial or final) and the nature of the consonants in the cluster [labial], [coronal] and [dorsal]. The listed transformations suggest that specific parameters are at play in aphasia and in acquisition. In fact, we will show that transformations involve the reduction of complexity in acquisition and also in aphasia.

1.3 Data: different paths to the weakening

1.3.1 Deletion

Figure 2 - *Kinds of deletions*



In acquisition, deletion concerns 81,00% of the total of transformations (482/595 cases). We have identified the cases of deletions depending on the position in the cluster: deletions of C^1 – 76,97%, (378/595 cases) deletions of C^2 – 14,73%, and C^1C^2 – 8,30% in the next table. Deletion of C^1 is clearly adopted. In aphasia, deletion concerns 53,38% of the total of transformations (166/311 cases). I have identified the cases of deletions depending on the position in the cluster: deletions of C^1 corresponds to 51,20%, (deletions of C^2 – 45,18%, and C^1C^2 – 3,62%).

Deletions are not random. There is a significant difference between the group and the kind of deletion: $\chi2_{[2]} = 66{,}28$, p-value < 0.001. Children delete mainly the first consonant, which is always a fricative /s/ or /ʁ/. Two main reasons account for this deletion according to Jakobson, Demuth & Kehoe (2006), Wauquier (2008), Kirk (2008): first – fricatives are more complex than stops – and acquired later – that's why they are deleted – and second, we can also consider that the first member of the cluster is in coda position (Kaye, 1992; Goad, 2011; 2012). Furthermore the coda position is more marked than the onset position, and then, in a CVCV's model (Scheer, 2004) coda is weaker and prone to the deletion. In the literature, if ʁC is always an heterosyllabic sequence, a coda+onset, the status of sC remain to be determined. If, sC is prone, like ʁC, to the deletion of the first member, we can suggest that sC behaves similarly than ʁC. This fact constitutes an argument in favor of the coda+onset representation for sC. Thus, according to these data, we propose to treat sC as a coda+onset, like ʁC, in French.

At this point, if we observed specifically the deletion of C^2, *moustique*/mustik/ →[musik], it appears that this deletion involves specifically the final position in aphasia and in acquisition. We also observed that the rate of deletion of C^2 is important in aphasia. A way to justify why they prefer to delete the second member in final position (which is always a stop), instead of the first consonant is to appeal to the CVCV model: the final position is a special position because the presence of an empty nucleus leads to the variation. In this condition, the last consonant is always weak. Moreover, we have observed that more deletion concerns [dorsal] and [coronal], in acquisition but also in aphasia. The aphasic speaker preferred to use substitution of the second consonant before deleting it. In this way, we can also consider that the nature of the consonant plays also a role in deletion process. The observation of the nature of the segments through the substitution could predict which segments are more complex than others.

In this context, the syllabic position: coda *versus* onset, and the nature of consonant seem to play an important role during acquisition and speech disorders in aphasia.

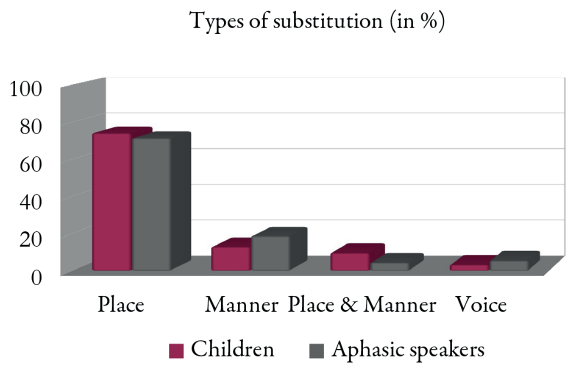
(7)	a. *mosquito*	'zanzara'	moustique	/mustik/	→	[musis]
	b. *beetle*	'scarabeo'	scarabée	/skaʁabe/	→	[saʁabe] [kaʁabe]
	c. *mask*	'maschera'	masque	/mask/	→	[mas]

If the syllabic structure is responsible for this type of transformation, we do not have an explanation for the targeting of some places of articulation. For example, when C^2 is deleted, it concerns principally [coronal] and [dorsal]. Fewer cases of [labial] were deleted. Beside deletions, another type of transformation plays an important role and can bring new elements about the complexity of place of articulations: the substitution's case.

1.3.2 Substitution

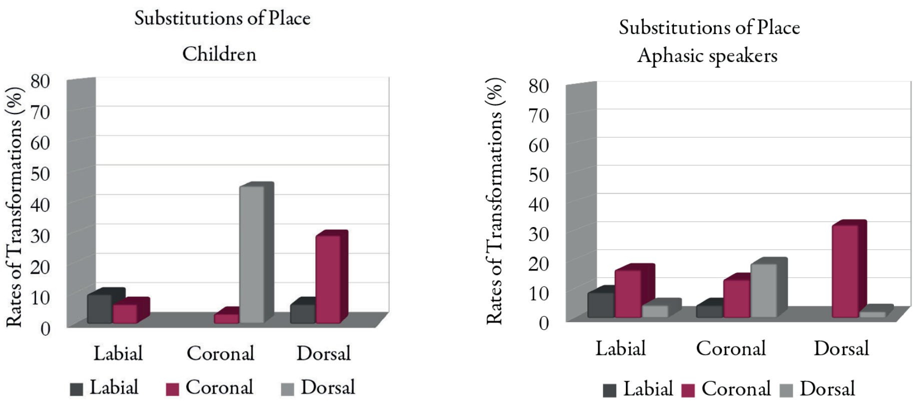
In the line of Blumstein (1973) and Nespoulous et al. (1987), we started by comparing all cases of substitutions depending on place of articulation, manner of articulation, both of them and voice.

Figure 3 - *Type of substitutions*



We can see, in the figure above that substitutions predominantly concern the place of articulations (72,13%) rather than manner or voice. Substitutions also involved mostly a single element (according to Blumstein, 1973). Data are as follows:

Figure 4 - *Substitutions' produced by children and aphasic speakers*



There is a significant difference between the kind of substitutions: for children: $\chi 2_{[4]} = 32{,}609$, p-value < 0.001 and also for aphasic speakers: $\chi 2_{[4]} = 32{,}874$, p-value < 0.001. We recall that C^1 is seldom substituted. In acquisition, substitution concerns 4,87% of the total of transformations (29/595 cases). Furthermore, an important point is that when C^2 is deleted, it concerns principally [coronal] and [dorsal]. Fewer cases of [labial] were substituted. [coronal] becomes [dorsal] and [dorsal] becomes [coronal]. Concerning this point, Jakobson (1969: 58) had shown that if a child produces /t/ earlier than the other consonants, at a particular moment, when a child start to acquire /k/, there is a phase where /k/ and /t/ are used at the same stage. He also claimed that this change is not the result of a phonetic change. Unfortunately, he did not explain why /t/ and /k/ are employed similarly, contrary to the other classes.

During aphasia, substitution concerns 28,94% of the total of transformations (90/311 cases). We recall that C^1 is also rarely substituted. [dorsal] becomes [coronal] in 93,55 % of cases, [labial] is more steady but it can also be shifted into a [coronal]. Finally [coronal] stays a coronal or also becomes [dorsal]. We have noted that [labial] appears more stable and, for these reason, less complex than [coronal] and [dorsal]. Moreover, [coronal] mostly constitutes the target of transformations and are principally affected. Why? Kean (1975: 48), Paradis and Prunet (1991), Stemberger and Stoël-Gammon (1991) or Béland and Favreau (1991) have proposed that [coronal] have a special status, they are unspecified and less marked. For this reason, [coronal] can attract other elements/features[6] from other classes, like the dorsality and this is why [coronal] is mostly the target of substitution, deletion, epenthesis (in the French liaison) or assimilation, in sum, any phonological process. Following this, as many people argue, we suggest that [coronal] is a default value in the phonological system. In fact, why does [coronal] becomes mainly [dorsal] and not [labial]? The analysis shows that these cases are always cases of assimilation/harmony – due to a context – as Stemberger and Stoel-Gammon (1991), Béland and Favreau (1991), Rose (2009) and Rice (2009) have shown. For example, aphasic speakers replace /t/ with /k/, in (8), when another dorsal (or uvular) is present in the context:

(8)	*satchel*	'cartella'	cartable	/kaʁtablə/	→	[kaʁkwab]
	card	'carta'	carte	/kaʁt/	→	[kaʁk]
	watermelon	'anguria'	pastèque	/pastɛk/	→	[paskɛk] [pakɛk]

The important question here is, do [coronal] and [dorsal] have the same complexity? Like Rice (1996) argues, we will consider the default value of a segment or the special status attributed to a segment is a parameter, which depends of the kind of language. To represent [coronal] like a default value, we propose that [coronal] don't have an element for place (Paradis, Prunet, 1991; Scheer, 1999). In turn, [labial] involves a little number of transformation, it is more stable and robust, and acquired before the [dorsal] class in acquisition. [labial] includes only one element of PoA, which is {U}, for labiality/graveness, thus their relative stability in pathology. [dorsal] becomes [coronal] because it contains more structure, two elements of place of articulation: {I} and {U}, hence their capacity of rejection. Then, [dorsal] is more marked and more complex. [dorsal] into [coronal] corresponds to a lenition,

[6] More than *feature theory*, *element theory* (e.g. Harris, 1994; Scheer, 1999; Cyran, 2010; Backley, 2011) is a way to define the internal constitution of phonemes and can provide us with a direct measure of complexity and markedness. Elements are small units which characterize the properties of a segment, they are present (marked) or absent (unmarked) of a segment, like a tool to measure the complexity. For example the labial /p/ is {Uhʔ}: {U} for labiality, {h} for noise, contrary to fricative, because /p/ is a stop and {ʔ} for occlusion, [+continuous]. /b/ share the same property plus {L} which mean is voiced. /b/ is more marked than /p/ because he received one element more.

in terms of structure. In this way, the following scale of element theory can explain most of these patterns:

[coronal]	<	[labial]	<	[dorsal]
{hʔ}		{Uʔh}		{IUʔh}

In this line, we propose that most of the substitution are cases of segmental lenition: IU > Ø or U > Ø

(9)	a. *beetle*	'scarabeo'	scarabée	/skaʁabe/	→	[staʁabe]
				IU	>	Ø

Meanwhile, the observation of the last strategy: the reduction of CC cluster into another segment may allow us to make some progress.

1.3.3 Reduction of CC clusters CCv → Cv

CCv → Cv is the result of a substitution and a deletion, what we call *reduction.* In this context, cluster is becoming a consonant but neither C^1, nor C^2. They lead to a deletion of the CC structure for a Cv structure.

In acquisition, the reduction concerns 11,43% of the cases of transformation (68/595).

(10)	*beetle*	'scarabeo'	scarabée	/**sk**aʁabe/	→	[paʁape]
	skeleton	'scheletro'	squelette	/**sk**ølɛt/	→	[pəlɛt]
	snail	'lumaca'	escargot	/ɛ**sk**aʁgo/	→	[te**t**ago] [ge**g**ago]
	cap	'casco'	casquette	/ka**sk**ɛt/	→	[ta**t**ɛt]
	watermelon	'anguria'	pastèque	/pa**st**ɛk/	→	[pa**k**ɛk]
	porcupine	'porcospino'	porc-épic	/pɔ**ʁk**epik/	→	[potepik]

In aphasia speech, the reduction concerns 13,18% of the cases of transformation (41/311)

(11)	*spatula*	'spatola'	spatule	/**sp**atyl/	→	[**t**atyd]
	beetle	'scarabeo'	scarabée	/**sk**aʁabe/	→	[**t**aʁabe]
	snake	'serpente'	serpent	/sɛʁpɑ̃/	→	[tɛtɔ̃]
	computer	'computer'	ordinateur	/ɔʁdinatœʁ/	→	[ɔtinatœʁ]

Again, the position doesn't matter but the nature of the consonant does. We have noticed that total reduction is prominent in cluster with [dorsal] and not with [labial]. And, most of the time, a [coronal] segment emerges in C^3. [coronal], again, seems to have a special status and the strategies applied during acquisition and in pathology are not random, they follow a hierarchy of complexity as suggested by Jakobson.

To conclude, the following table recapitulates the principal transformations we have seen depending on the position:

Table 4 - *Transformations depending on the position*[7]

	Clusters	
	Children	**Aphasic speakers**
#sC[7]	deletion C^1	deletion C^1
		deletion C^2
VC^1.C^{2}V	deletion C^1	substitution C^2
	CCv → Cv	deletion C^1
		deletion C^2
VC^{1}C^2#	deletion C^2	substitution C^2
	deletion C^1	deletion C^2
		CCv → Cv

We have seen that different paths coexist to lead to the weakening. Children and aphasic speakers tend to reduce the most marked structures but in a different way. They can delete the CC, delete a member to adopt a CV structure or they can also reduce the segmental content through the substitution. To resume now, what does this reduction of complexity teach us?

Theoretical points: what does reduction teach us?
Concerning the empirical research findings for the phonological theory

About the consonantal clusters. Based on the transformations observed, children have shown a preference for the CV template. They produced more transformations on the syllabic structure than on the segmental content. Regardless of the position (initial, medial or final) they always reduced the consonantal clusters through the deletion of segment. Deletion of C^1 shows clearly that the fricative is in coda position and constitutes an evidence in favor of a representation in a government phonology. sC clusters, as ʁC, are heterosyllabic (Kaye, 1992; Goad, 2011). However, if the syllabic structure is affected in the same way during aphasia, the segmental structure posed more difficulties than in acquisition. If the transformations in initial position exhibit a preference for the CV structure, aphasic speakers adopted another kind of strategy for consonantal cluster in medial and final position: the substitution of the stop. This fact has reported that segmental content is more affected in adult speech disorders than in acquisition.

About the complexity between the nature of segments. If the [labial] class is more steady, the contrast between [coronal] and [dorsal] has not yet been set in acquisition. This is the reason why children used harmony/assimilation between [dorsal] and [coronal]. We can conclude that [labial] is less complex. Furthermore, if the data are similar in aphasia, they clearly show a preference for the [coronal]. [labial] and also [dorsal] turn into [coronal]. For these reasons, we have been proposed that [coronal] is the less marked structure, in terms of markedness, as argued by Paradis, Prunet (1991).

[7] We precise that ʁC doesn't exist in french in initial position.

The process of substitution results from adjustments and parameter setting. They correspond to a transformation, which disrupts the internal constitution of segments.

Concerning the Jakobson's postulate

Deletions of C^1, C^2 or substitutions showed a preference to reduce the syllabic structure or the segmental content. The collapsing of the whole cluster, which combines a substitution and a deletion, also leads to a reduction of complexity of the cluster into a Cv string. Consequently, if different paths are possible, the goal is still to reduce the complexity. We have also seen that aphasic speakers and children use the same processes – depending on the context – but statistics are useful to encourage further thinking.

As far as acquisition is concerned, deletion reflects the fact that the consonantal clusters and the coda position has not yet been apprehended by the phonological system. French children, during acquisition, show a preference for the weakening of the syllabic structure. Deletion of /s/ and /ʁ/ is the consequence of this weakening. Children have a clear preference for the CV template. The consonantal clusters are not yet acquired. After the setting of consonantal clusters parameter, another type of strategy, substitution, indicates that children try to test the possible values in different positions depending on the parameters of their language.

We notice that three main stages can be considered during the acquisition of a syllabic position and acquisition of the possible values in this position – depending on the parameters on the language.

The first one corresponding to the deletion C^1C^2, the second is the deletion of one of the member C^1 or C^2, then, when the CC group is acquired, substitution can appear (Greenlee, 1974). For these cases, these substitutions mainly concern the stop. According to Fikkert (2007):

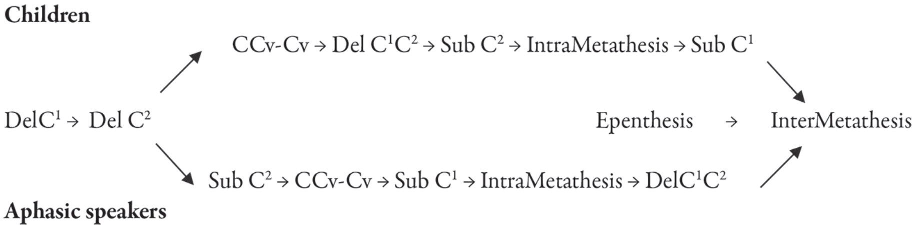
> Moreover, development was formalized as the change of one or more parameter settings from the default to the marked value, thereby assuming continuity from children's early grammars to the final state grammar. Markedness played a key role in the principles and parameter framework: in the initial state all parameters have the default or unmarked value. In the course of development, parameters are changed to their marked setting if the input data provide positive evidence for that setting[8].

We have also seen that aphasic speakers tend to reduce the complexity but in a different way. If the access to the constraints on the syllabic structure is defective, the aphasic speaker will delete the coda position, like children. They also have a preference for a CV structure. In other cases, aphasic speakers have mostly deleted or substituted the second member, which is always a stop. We suggest that the nature of the consonant, particularly the place of articulation, is more problematic than the syllabic structure. Moreover, some other data, not presented here, have shown a big tendency wherein aphasics tend to substitute. To explain this, the proposal we are making is the following: during aphasia, access to the segmental constraints is

[8] Fikkert (2007: 548).

sometimes more problematic than the access to constraints of syllabic structure in acquisition.

To summarise the different strategies they made, the following scheme represents a scale where the deletion constitutes the most important transformation for both children and aphasic speakers and where epenthesis and metathesis are less employed.



To conclude for this point, we suggest that children favor segmental structure over syllabic structure while aphasic exhibit the opposite behaviour.

However, children seem to follow a pattern where deletion precedes the substitution and the reverse in aphasia. Therefore, regarding the strategies applied by children and aphasic speakers, Jakobson's postulate concerning a mirror image is still relevant but requires a more detailed analysis.

We have seen that when a subject suffers from aphasia, their phonological constraints undergo change. The value of certain parameters doesn't correspond to the value of the parameters of the language. The aphasic speaker uses different strategies to resolve these conflicts. This observation allows us to answer fundamental questions in phonology concerning the status of consonantal sequences and the internal structure of segments in particular. We saw in this study that constraints on segmental and syllabic content can generate different transformations; which allows us to account for a number of performance errors. Finally, studying data in acquisition and in speech disorders in adult helps our understanding of what is really the functioning of the phonological system, as Goldrick (2011: 19):

> Thus, although speech errors data are clearly influenced by grammatical principles, they present a mostly unexplored empirical domain for testing the predictions of grammatical theories[9].

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[9] Goldrick (2011: 19).

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