Phonetic input, phonological categories and orthographic representations: a psycholinguistic perspective on why language education needs oral corpora. — The case of French-Japanese interphonology development —

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1. Introduction[1]

Using corpora in language education cannot be seen as a brand-new pedagogical technique any more, as far as lexicon, grammar and written corpora are concerned. In the field of Teaching English as a Foreign or a Second Language, concordancing tools have been part of the standard CALL apparatus for more than a decade (Flowerdew 1996). However, the same cannot be said of other languages, such as French, for instance, and the use of oral corpora still seems to be often limited to the use of their written transcriptions.

Since the elaboration of the *Français Fondamental* in the 1950s (Rivenc 1979/2000)[2], oral corpora have been scarce and often of very limited size, used by French teachers and applied linguists mainly for selection of linguistic forms to be taught, according to frequency of use (Biber & Reppen 2002) and other criteria. With the development of pedagogical approaches based on so-called 'authentic' documents, 'real' recordings, rather than fabricated dialogues or narratives, have been increasingly used, along with faithful transcriptions, rather than normalized transcriptions (Weber 2006). Yet, these 'real' recordings are often used as any other pedagogical document, and oral corpora are dissected to select and teach lexical and grammatical *forms* (whether the most frequent ones in French in general or those that are specific to *oral* French) through their *orthographic transcriptions*. They are not usually put into use as a source of linguistic *substance*, i.e. *phonetic input* that is specifically needed for the development of *oral* skills, in perception, production and learning tasks.

There are at least two possible explanations for this:

1- The preference accorded to written documents over oral material in traditional formal language education[3]. This is mostly due to practical reasons: lack of oral data and material, stability of written language (useful for metalinguistic analysis – which is linked to the limited capacity of our working memory), etc. Besides, for a long time,

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[1] Special thanks to Jacques Durand, Yuji Kawaguchi and David Le Gac.

[2] See also the proceedings of the symposium "Français fondamental, corpus oraux et contenus d'enseignement: 50 ans de travaux et d'enjeux'' (Lyon, France, 2005) available online at : http://colloqueff.ens-lsh.fr/franc/indexfr.htm

[3] As is exemplified in the Grammar Translation methodology, an application of the methods used in Latin and Greek to the teaching of modern languages.

there were also ideological reasons (different status for oral and written norms (Laks 2002)) and scientific motivations (following Saussure's stance, the object of linguistics should be the study of *language* ('*la langue*') and not *speech* ('*la parole*')) behind this apparent lack of interest in oral data.

2- The lack of scientifically grounded psycholinguistic perspectives on the link between input modality (oral vs. visual) and foreign language learning, which can mislead teachers and learners into thinking that modality does not really matter. However, as psycholinguists know, modality does matter in the perception and learning of language, even though language *per se* is not tied to any particular sensory modality: not only do the linguistic properties of oral and written stimuli differ, but so does their psycholinguistic processing by language learners, from low-level perceptual process (reading process *vs* listening process) to higher-level mnesic encoding in the phonological and/or orthographic lexicon (Detey 2005).

Our aim in this contribution is to show that oral corpora must be considered and used in language education not only as a source of *formal* input but also as a source of *substantial* input for foreign language (hereafter referred to as L2) teaching and learning. This input can be provided only by oral corpora and not by their written counterparts. The most obvious area of application is L2 phonology learning, but since phonology, lexicon and grammar are crucially linked in language learning, it applies to L2 oral language learning as a whole.

One of the main issues for L2 phonology learning is as follows: what input is available for the optimal development of learners' interphonology (i.e. the new phonological system developed by the learners)? This issue is particularly important when the L2 does not belong to the immediate sociolinguistic environment of the learners, as is the case for Japanese learners of French in Japan, for instance. In this case, there is often an imbalance between orthographic and phonetic input, due to limited linguistic exposure. Given the gap between oral and written French (especially on the morphophonological level (Battye, Hintze & Rowlett 2000)) on the one hand, and between the French and the Japanese writing systems (Coulmas 1989) on the other hand, it is important to examine in detail the potential role of oral corpora as a source of input for the learner.

In the following paragraphs, we examine the link between speech perception, acoustic cues and phonological learning. We take a closer look at recent studies which show that variability can play an important role in non-native phonemic discrimination training, as is exemplified in the way the English phonemes /r/ and /l/ are processed by Japanese subjects. We then consider the case of French /R/ and /l/ for Japanese learners and point out the confusing role of the orthographic factor in the learning process, which emphasizes the need for more appropriate oral resources for the learners. In the case of French, these can be drawn from the PFC corpus (*Phonologie du Français Contemporain* – Phonology of Contemporary French) (Durand, Laks, Lyche 2002, 2005): the creation of pedagogical resources out of the PFC corpus is precisely the aim of the PFC-EF (*Enseignement du Français* – French Teaching) project (Detey 2007a; Detey, Durand, Laks, Lyche & Nouveau 2007; Detey, Durand, Laks & Lyche to appear).

2. On the role of perception and phonetic cues in phonological development

2.1. From perceptual process to phonological learning

Although some studies suggest that perception and production can develop independently, the majority of researchers support the idea that perception precedes production in the learning process (for a review, see Escudero 2007), as it was initially established by Polivanov and Trubetzkoy (1939/1949). We adopt the same stance, which Escudero (op. cit.: 110) interprets as follows: "the origin of a foreign accent is the use of language-specific perceptual strategies that are entrenched in the learner and that cannot be avoided when encountering the sounds of a second language". We will not give an overview of the main current L2 phonology learning theories here (for a state-of-the-art review, see Eckman 2004, Escudero 2007, and Hansen Edwards & Zampini in press), but we will simply mention one of the most recent ones, i.e. the Linguistic Perception model (LP), in its L2 version (L2LP) (Escudero 2005).

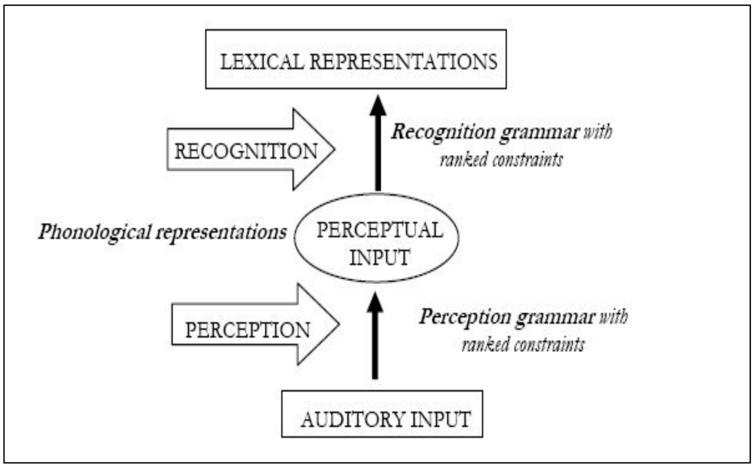

Figure 1. The Linguistic Perception model (Escudero 2005: 43)

In the L2 Linguistic Perception model, the basis for learning the L2 perceptual system is a full copy of the first language (L1) system (perception grammar and lexical representations), and the learner has full access to the L1 learning mechanism, i.e., according to Boersma's Gradual Learning Algorithm, the creation of data-driven phonetic categories, followed by lexically-driven optimization of these categories: "listeners create categories (e.g. /ɪ/ and /p/) on the basis of distributional information (Boersma, Escudero & Hayes, 2003), then use these categories to create phonological forms in their lexicon (e.g. |ʃɪp|) and mapping constraints in their perception grammar (e.g. "74 ms is not /ɪ/"), and finally optimize their constraint rankings by applying the Gradual Learning Algorithm […] to their perception grammar, driven by recognition in the lexicon" (Escudero & Boersma 2004:565). The definitions of the Full Transfer and of the Full Access that this model combines are as follows (op. cit.: 573):

- Full Transfer: "the transfer of L1 categories, L1 perceptual mappings, and L1 blank slates to the initial state of the interlanguage perception grammar";

- Full Access: "the access to an L1-like category formation device and to an L1-like constraint reranking device".

The difficulty is to establish the relative weight of one and of the other, since Full Transfer predicts phonological deafness (in Trubetzkoy's sense) and Full Access predicts the attainment of a native-like phonological competence (or Full Proficiency as Escudero (2005) names it). Escudero (2007:127) sums it up as follows: "the L2 perception is handled from the beginning by a separate perceptual system which began as a copy of the L1 system but evolves with experience with the L2. With respect to L2 development, it is proposed that L2 learners have access to the same learning mechanisms […] that were available for L1 learning". As it appears in this short summary of the L2LP model, the role of linguistic perception is crucial in L2 phonological development.

2.2. From phonotactic information to phonological categories

Therefore, the bridge between the phonological categories and the speech perception process that the LP model establishes strongly relies on the properties of the input, not only at the acoustic level, but also at the phonotactic one: "during the first stage, learning of language specific sound categories by infants is driven by distributional evidence in the linguistic input. This *auditory-driven learning* leads to a warping of the baby's perceptual space, to discrimination curves, to the perceptual magnet effect [("differences near ambient category centres are less well perceived than differences near ambient category boundaries")], and ultimately to the creation of phonetic categories" (Boersma, Escudero & Hayes 2003: 1013). The hypothesis that adult learners also perform a distributional analysis when learning phonemic categories has been explored by other researchers. Peperkamp, Pettinato and Dupoux (2003) investigate the role of allophonic variation in the perception and acquisition of phonemic distinctions (in their experiment the French allophonic realizations of the French /r/, the voiced [ʁ] (as in '*perde*') and the unvoiced [χ] (as in '*perte*'), are tested): their results suggest that statistical learning is sensitive to context and to complementary distribution. Chambers, Onishi & Fisher (2004) follow a similar hypothesis: they show that adults are able to keep track of phonetic distributions in different phonological contexts (onset and coda) for non-native contrasts, which would support the idea that distributional learning plays an important role in phonological learning. This is also the position taken by Peperkamp & Dupoux (2004) who consider that distributional information can help infants build sound categories prelexically. The results of a series of experiments with artificial language learning tasks and adult subjects suggest that learners can create abstract phoneme categories based on distributional information with or without lexical knowledge.

2.3. Perception and phonology in loanword adaptations

In the preceding sections, we examined the role of perception and phonetic information in L1 and L2 phonological development. There is another area from which we can gain insight into the relationship between perception and phonology: loanword phonology (Boersma & Hamann 2007). In recent years a renewed debate concerning the process at work in loanword phonological adaptations has been opposing two camps: a phonological one (LaCharité & Paradis 2005) ("loanwords are adapted according to the rules and/or constraints of the borrowing language targeting aspects of phonological representation" (Rose & Demuth 2006: 1112)) and a perceptual / phonetic one, of which Peperkamp and Dupoux (2003) are the most extreme proponents, since they propose that loanword adaptations take place at the perceptual level and are defined as "phonetically minimal transformations" (op. cit.: 367). Other researchers combine the two approaches, such as Rose & Demuth (2006), or Dohlus (2005), who examines the asymmetric adaptation of German and French mid front rounded vowels /ø/ and /œ/ in Japanese: "It was shown that the adaptation of German /œ/ and /ø/ as Japanese /e/ is a phonological approximation, but the adaptation of French /œ/ and /ø/ as Japanese /u/ a phonetic approximation. In this context I argue […] that loanword adaptations are basically phonetically grounded, but that a lack of oral input and a large influence of written media trigger phonological approximation" (op. cit.: 133)[4]. Whichever stance we decide to adopt, it seems that the perceptual factor, and more precisely the fine-grained phonetic characteristics of the input, cannot be overlooked, as it appears in the study of Vendelin & Peperkamp (2004). The focus of their study is the

[4] This last quotation is of particular relevance for us, since it mentions two facts on which our general argument relies, as far as Japanese learners of French are concerned: the lack of oral input and the influence of the written medium.

adaptation of word-final [n] in Japanese loanwords borrowed from French (F) and English (E): in (F)-words, [n] is adapted as a geminate nasal followed by an epenthetic vowel; in (E)-words, [n] is adapted as a moraic nasal consonant[5]. The results of their experiment (a forced choice task with non-words uttered by French and American English speakers) show that "French and English stimuli ending in [n] differ with respect to both the length and intensity of the nasal consonant and its release, and that these differences account for the absence versus presence of an epenthetic vowel in the response of [their] Japanese subjects. […] [T]he process of loanword adaptation is guided by perceptual assimilation which exploits the principle of minimal phonetic distance and is sensible to fine phonetic details of foreign speech" (op. cit.: 130).

Overall, these results suggest that fine phonetic details do play a role in L2 speech perception and thus in L2 phonology learning. If we consider that learners need to set up a new perception grammar and that distributional information can help, it seems all the more plausible. When we look into the phonetic input that oral corpora can provide for language learners, we have to examine its features and the effect it can have on the learning process. One of its major and inherent characteristics is its variability: whether within- or between-speakers, the variability of the phonetic input (as opposed to the stability of the written material, or to the one of the familiar voice of the teacher) that oral corpora can offer has to be taken into account. More precisely, what is the effect of phonetic variability on L2 speech perception and L2 phonology learning? To answer that question, we first need to gather some information from L1 speech perception studies.

3. On the role of phonetic variability in speech perception

3.1. Speech perception models: abstractionist versus exemplarist views

In speech perception studies, there are several classical problems (Segui 2003, Nguyen 2005), among which the gap between the absence of acoustic invariance of the signal on the one hand and the (general) invariance of linguistic categories on the other hand. As Pisoni and Luce (1987: 23) explain, the "acoustic consequences of coarticulation and other sources of contextually conditioned variability result in the failure of the acoustic signal to meet two important formal conditions, invariance and linearity [(i.e., non-linearity as an overlapping of acoustic cues vs the linearity of the phonemic string in a classical phonological view)], which in turn give rise to the problem of segmentation". When we look at the different speech perception models that have been elaborated in the past decades, we can distinguish two different ways of solving the invariance problem. They correspond to two views of speech perception process (and cognitive representations), which stand at the endpoints of a continuum on which most models can be situated: the abstractionist and the exemplarist viewpoints.

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[5] Their study is based on Shinohara's work (1997) on French and English on-line adaptations and integrated loanwords in Japanese: a French word like *piscine* ([pisin] 'swimming pool') is adapted as [pisinːɯ] (therefore what they call "geminate" refers to [nː]; for more discussion on the nasal geminates in Japanese see for instance (Otaka 2004) and Shirai (1999)), while an English word like 'napkin' is adapted as [napɯkiN]. However, these two examples are not well chosen, since they are not prosodically symmetrical: in French, primary stress is always on the final syllable, while it is a lexical stress in English (on the first syllable, in the case of 'napkin'). Prosodic factors should be more systematically taken into account in the study of lowanword adaptations, even at the segmental level. Moreover, the adaptation of the French word [pisin] should rather be transcribed as [piʃinnɯ] or [piɕinnɯ], as the authors themselves suggest in (Peperkamp, Vendelin & Nakamura 2008: 130) with the following transliteration: "pishinnu".

In a very traditional approach, speech perception is viewed as a bottom-up process, in which the listener is filtering the input to recover abstract units and discarding all irrelevant phonetic details, which are considered to be unimportant noise. The lexicon is made up of a set of abstract lexical units, and speech recognition implies mapping together these units and the abstract sequences extracted from the signal (with top-down influences and interactive process in more recent models). However, already in the 70's, researchers like Klatt were exploring other perspectives, since in his LAFS model (Lexical Access From Spectra) (1979) the lexicon is composed of a set of spectral representations of diphone sequences, enabling direct comparison between acoustic-phonetic input and spectral representations stored in long-term memory (Pisoni & Luce 1987).

In recent years, several researchers have started to pay more attention to what has been termed "Fine Phonetic Detail" (FPD), which encompasses allophonic variation, sociophonetic variation and also important acoustic variation distinguishing male and female voices, for instance (Nguyen, Wauquier & Tuller, in press)[6]. As Nguyen, Wauquier & Tuller explain (ibid.): "FPD refers to phonetic properties that are judged non-essential in the identification of speech sounds in a theoretical framework whose limits the exemplar approach endeavors to demonstrate". They sum up the debate as follows (op. cit.: 6) (see also Smith 2004, Nguyen 2005): "Abstractionist models, on the one hand, are based on the assumption that an abstract and speaker-independent phonological representation is associated with each word in the listener's mental lexicon. In exemplar models of speech perception, on the other hand, words and frequently-used grammatical constructions are represented in memory as large sets of exemplars containing fine phonetic information. […] [W]e will argue that both phonetic details and abstract phonological categories are likely to play an important role in speech perception". The last part of the quotation echoes the most recent evolutions in the field, as is suggested by McQueen, Cutler & Norris (2006: 1113-1114, 1123): "evidence that listeners can show sensitivity to episodic detail should not be taken as evidence against abstract representations. […] However, the data on episodic effects do suggest that extreme abstractionist models are incorrect. […] Hybrid abstractionist-episodic models, therefore hold considerable promise". Given the compatibility between exemplarism and the integration of fine phonetic detail in speech perception models, it comes as no surprise that some phoneticians adopt this framework to examine the role of phonetic variation (especially sociophonetic factors) in their work, as is the case for Foulkes and Docherty (2006: 426): "Currently, the only theoretical framework that embeds indexicality centrally within phonological knowledge is the exemplar-based model of representation […]. [It] intrinsically captures the observation that no natural human utterance offers linguistic information without simultaneously indexing some social factor". Therefore, we can now concentrate on the link between variation and speech perception, first in L1, and then in L2.

3.2. Phonetic variability and perceptual learning

Factors of speech variation are well known (Meunier 2005: 360-364): coarticulation and assimilation, talker's characteristics (especially gender and age), speech situations (degree of formality, speech rate, emotions), dialectal and social variations. However, despite this variation, listeners manage to perceive speech adequately. This has been the focus of a series of studies devoted to what has been called "perceptual learning": the idea that listeners adjust their pre-existing phonemic categories through lexical knowledge, to accommodate speakers'pronunciation (Norris,

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[6] Even though the authors (ibid.) point out that allophonic and between-speakers phonetic variations might actually be processed differently by listeners. See also Kraljic, Brennan & Samuel (2008) for differences between context-independent (idiolect) and context-conditioned (dialect) variation processing by the perceptual system.

McQueen & Cutler 2003; Kraljic & Samuels 2007). To do so, it seems that listeners use both lexical knowledge and acoustic information to tune dynamically their phonemic representations. This partly echoes what Nguyen, Wauquier & Tuller (op. cit.) call "phonetic convergence" (or imitation), i.e. the fact that speakers spontaneously tend to conform to the other speaker's pronunciation to facilitate the interaction: "[it] shows that listeners are sensitive to speaker-dependent phonetic characteristics, which have an influence on both the dynamics of conversational interaction, and across a longer time range the representations associated with words in memory when that interaction has ended". Moreover, these adjustments can also take place when native speakers are faced with non-native accented speech, as is shown by Bradlow and Bent (2008) who used Chinese-accented English speakers to test the adaptative capacity of native English listeners : after training with multiple Chinese-accented English speakers, the subjects were able to achieve talker-independent adaptation.

Now, if this capacity to adjust to different speakers' pronunciation is part of the native speaker's linguistic skills and is necessary to handle speech perception, it seems reasonable to suggest that language learners should develop a similar capacity. Moreover, if perceptual learning appears here as an *end* ("being able to adjust quickly to the other's pronunciation"), we can also wonder whether presenting learners with variable stimuli (to train them to perceptual learning) would not also be a *means* to learn the L2 phonology, if we follow Boersma and Escudero's theoretical assumptions (cf. supra about perception grammar and gradual learning). Therefore, the question is: does variable stimuli training help language learners to build up their phonological competence in L2?

4. On the role of phonetic variability in L2 phonology learning

4.1. Variation and L2 learning

As far as we know, there are only a few studies tackling precisely the effect of phonetic variability on L2 phonology learning. Eisenstein (1986) examines the intelligibility of three English dialects (Standard, New York and Black English) for learners, along with learners' attitudes and representations. Major, Fitzmaurice, Bunta & Balasubramanian (2005) test the impact of dialectal variation on learners'oral comprehension. They suggest that regional (but not ethnic or international) dialects should be inserted in language tests such as the Test of English as a Foreign Language. Sommers & Barcroft (2007) assess the effect of three sources of variability (overall amplitude, fundamental frequency and speaking rate) on L2 vocabulary learning. Interestingly, they show that L2 vocabulary learning can be improved by variable speaking rate. Finally, and more closely related to our own topic, Levy & Strange (2008) measure how linguistic experience and consonantal context can affect the perception of French vowels /y, œ, u, i/ by American listeners. Their results tend to show that consonantal context can have a strong effect on non-experienced listeners (op. cit.: 155): "Native language expectations of coarticulation affect perception of speech sounds in foreign languages. […] Naïve listeners perceive vowels in an unfamiliar language differently depending on the consonantal context in which they are presented". The importance of coarticulation effects in speech perception and lexical access has also been stressed by Nguyen (2001). This leads us to think that training L2 learners to perceive speech in L2 implies training them to handle coarticulation effects, which, in turn, would imply feeding them with a large amount of highly variable contexts of occurrence for any given (phonemic) unit under scrutiny. Oral corpora data would then be very useful, provided we have suitable data mining tools.

Yet, the question of the impact of variable phonetic input on L2 segmental categories acquisition *per se* still needs to be addressed in detail. Part of the answer lies in a series of experiments carried out in the 1990s by a team of researchers led by Lively, Pisoni, Magnuson, Yamada and their colleagues (*cf. infra*).

4.2. Training Japanese listeners to identify English /r/ and /l/: 40 years of studies

In the field of L2 speech perception and learning, one discrimination task has been the focus of several enquiries for almost 40 years now (Goto 1971, "Auditory perception by normal Japanese adults of the sounds "l" and "r"): discriminating minimal pairs such as "rice" and "lice" for instance has been a longstanding challenge for Japanese listeners, for whom the distinction /r/ vs /l/ constitutes a case of negative divergent transfer (Tarone 1987: 71) (one phonological category in L1 *vs* two in L2). In these studies, the target language usually under scrutiny is (American) English, and, among the most recent reports, a series of five articles entitled "Training Japanese listeners to identify English /r/ and /l/" (Logan, Lively & Pisoni 1991; Lively, Logan & Pisoni 1993; Lively, Pisoni, Yamada, Tohkura & Yamada 1994; Bradlow, Pisoni, Akahane-Yamada & Tohkura 1997; Bradlow, Akahane-Yamada, Pisoni & Tohkura 1999) yields a number of interesting conclusions.

First, they show that perceptual training with minimal pairs improves not only perception, but also production of the /r/-/l/ couple (Akahane-Yamada, Tohkura, Bradlow & Pisoni 1996; Bradlow, Pisoni, Akahane-Yamada & Tohkura 1997)[7]. Moreover, there is long-term retention of learning in both tasks (Bradlow, Akahane-Yamada, Pisoni & Tohkura 1999).

Second, they suggest that learning difficulties are linked to perceptual interferences, since Japanese listeners seem to pay more attention to F2 acoustic cues than they should. As Iverson, Kuhl, Akahane-Yamada, Diesch, Tohkura, Kettermann and Siebert (2003: B53) explain: "The perceptual space of Japanese adults are thus mistuned for acquiring the English/r/-/l/ contrast, making acoustic variation that is irrelevant to categorization more salient than the critical differences in F3. These perceptual spaces are hypothesized to interfere with acquisition in at least two ways. First, Japanese adults could be prone to form erroneous category representations for /r/ and /l/, by relying on acoustic cues, such as F2, that are perceptually salient but not reliable or robust for categorization. […] Second, high sensitivity to irrelevant acoustic differences could create problems […], requiring focused attention and longer processing times to detect the critical F3 differences, even for Japanese adults who have formed correct category representations based on F3" (see also Magnuson & Akahane-Yamada 1996).

Finally, it has been demonstrated that English /l/ is perceptually assimilated to Japanese /r/ by native Japanese listeners (even though they can have two distinct mental representations), while English /r/ is perceptually more dissimilar from Japanese /r/ (Hattori & Iverson 2007). In accordance with this, Aoyama, Flege, Guion, Akahane-Yamada & Yamada (2004) show that training native Japanese children in perception and production leads to better results for /r/ than for /l/. This lends support to the hypothesis of Flege's Speech Learning Model, which states that the more distant an L2 sound (phonetic segment) is from the closest L1 sound, the more learnable it will be.

What is remarkable for us is the integration of the variability factor in several of the experiments that have been realized. The results of replicated experiments (Logan, Lively & Pisoni 1991; Lively, Logan & Pison 1993; Pisoni, Lively, Yamada, Tohkura & Yamada, 1993) totally support the hypothesis we have been developing throughout this paper, i.e., that variable L2 phonetic input can help L2 phonology learning, as is summed up by Iverson, Kuhl, Akahane-Yamada, Diesch, Tohkura, Kettermann and

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[7] Even though it does not always yield the expected results (see for instance Takagi 2002).

Siebert (2003: B54): “It is telling that the most successful training procedures for teaching English /r/ and /l/ to Japanese adults have involved multi-talker high-variability stimulus sets (e.g. Logan, Lively & Pisoni 1991). Training procedures involving smaller stimulus sets are easier to learn but do not readily generalize to new stimuli […]. Training with larger stimulus sets may generalize better because the variability provides information about which cues are more robust and trains individuals to ignore irrelevant variation”. This has also been positively tested by Iverson, Hazan and Bannister (2005), who name this teaching method “High Variability Phonetic Training” (i.e. natural words uttered by multiple speakers), along with three other techniques, proving to be beneficial for Japanese listeners to identify English /r/ and /l/. Magnuson and his colleagues obtain similar results in experiments targeting the role of talker variability in non-native phoneme training, i.e. English /r/ and /l/ for Japanese adults (Magnuson, Yamada, Tohkura, Pisoni, Lively & Bradlow 1995; Magnuson & Yamada 1996). Their conclusion is as follows (Magnuson, Yamada, Tohkura, Pisoni, Lively & Bradlow 1995: 394): “while multiple-talker training leads to consistently good results, training with stimuli produced by only one talker may fail to promote generalization to new stimuli and talkers”. Overall, a rather clear picture emerges from all these studies, and Bradlow (2008) draws several lessons from training Japanese adults on the English /l/-/r/ contrasts. The most important one for us is the following: “Exposure to highly variable training stimuli promotes rather than interferes with non-native contrast acquisition. In particular, exposure to multiple talkers appears to be a highly effective means of ensuring that perceptual learning generalizes to novel talkers. […] This positive effect of the high variability training approach on speech category learning is consistent with exemplar-based models of speech perception […] in which item-specific acoustic-phonetic variability is encoded in the cognitive representation of experienced speech samples”. If we take into account the results of these studies, it seems that the natural multiple-talker phonetic input that oral corpora can offer could be particularly useful for L2 phonology learning. This is also compatible with the L2LP model of Escudero (2007:128) who refers to Khul’work: “Khul (2000, p. 11855) argues that […] non-native listeners simply need the “right” kind of perceptual input, i.e., exaggerated acoustic cues, multiple instances of the same sound, and a mass listening experience […]. This suggestion is compatible with the Linguistic Perception model, which proposes that the GLA [(Gradual Learning Algorithm)] will act upon auditory inputs to gradually re-rank constraints […]. Thus L2 perception accuracy would benefit from perception training to enhance L2 input, both its acoustic properties and its frequency”.

5. Phonetic vs. orthographic input: /r/ & /l/ in French for Japanese learners

So far, we have concentrated on the discrimination between /r/ and /l/ in English, and on the distinction between highly-variable multiple-talkers phonetic input versus single-talker phonetic input in pronunciation training. Two issues still need to be tackled: the orthographic factor and the language factor.

Until recently, the orthographic factor in L2 speech perception and learning studies has been rather neglected, even though it has often been mentioned as a potential factor of influence on speech processing and linguistic development, whether in perception or in production. In the past few years, it has started to receive more attention in the fields of loanword phonology (Vendelin & Peperkamp 2006), L2 phonology (Bassetti 2006) and speech sciences (in production (Alario, Perre, Castel & Ziegler 2007) and perception (Perre & Ziegler 2008)). When we examine in detail the influence of written input (in L1 and/or L2) on oral L2 learning (Detey 2005), and more specifically on L2 phonology learning, either on a segmental (Detey, Durand & Nespoulous 2005) or syllabic level (Detey & Nespoulous 2008), we realize that using orthographic transcriptions and/or transliterations (Detey 2007b) of oral data can hinder the development of oral skills, even though written representations can, *under certain conditions*, facilitate phonemic identification (Steele 2005), help to perform other learning tasks, such as metalinguistic mental operations, and also promote multimodal encoding of lexical units or formulaic sequences. Therefore, when we examine the literature on the interactions between orthography and speech processing, as well as on the Japanese writing system (Kess & Miyamoto 1999), we find it surprising that the studies mentioned above did not pay more heed to the orthographic factor. If the Japanese /r/ (prototypically realized as a phonetic flap [ɾ], and as a lateral [l] in intervocalic position (Akamatsu 1997; Labrune 2001a)) has to be considered as the onset of moraic units (Labrune 2001b; Otake, Hatano, Cutler & Mehler 1993) rather than an autonomous segment, as it appears in the way it is represented in the two *kana* writing systems (the hiragana series ら、り、る、れ、ろ、and the katakana series ラ、リ、ル、レ、ロ), it is nonetheless transliterated with an < r > and not an < l > (respectively < ra, ri, ru, re, ro >), since the < l > is not part of the *rômaji*, i.e. the transliteration system of Japanese. If we add the fact that the ever-growing number of English loanwords in the Japanese language merge, for instance, the English < ra > and < la > into a single Japanese katakana grapheme ラ (Kamiyama 1994), we realise that the orthographic factor cannot be overlooked so easily, especially among young urban Japanese native speakers (Detey & Nespoulous, 2008). This points to the fact that the analysis of perceptual confusion between the English /r/ and /l/[8] by Japanese listeners should incorporate phonographemic representations.

A possible way of tackling this issue would be to examine the perception by Japanese listeners of the English /r/ and of its French equivalent, since their graphemic implementations are similar on a single-letter level (<r>), whereas their phonetic realizations are quite different (post-alveolar approximant, retroflex ([ɻ]) or not ([ɹ]), for English versus uvular fricative, voiced ([ʁ]) or not ([χ]), for hexagonal French (to mention only the most frequent allophones)). More importantly, we should try to answer the following question: do Japanese listeners misperceive /r/ and /l/ more easily in English than in French, given their increased phonetic dissimilarity in French in comparison with their English equivalents ? This would call for several experiments, which are yet to be realized.

As regards the impact of orthography in French for Japanese learners, we set up an experiment aimed at testing Japanese listeners'perception of the French /r/-/l/ segments (and also the labial /b/ and /v/ (see Detey, Durand & Nespoulous 2005)) in connection with their orthographic representations. Stimuli consisted of trisyllabic non-words and varied according to the segment's nature (/l, r, b, v/), position in the non-word (initial, penultimate and final) and vocalic environment (/a/, /i/, /u/, /ø/). For each auditory non-word, subjects had to select an orthographic transcription in a forced-choice task (e.g. RADEKO versus LADEKO), and 120 Japanese university students in Japan performed the test. The most interesting conclusion of this experiment is the fact

[8] To which we must add the /w/ category (see Yamada, Magnuson, Pruitt & Clarke 1994; Hardison 1999).

that the confusion rates for /l/ and /r/ were similar on average (respectively 23,7% and 23,5%), even though the vocalic environment had a differential effect on the performances (for instance with /i/, the confusion rates were 28% for /r/ and 13,6% for /l/) (cf. supra, the effects of coarticulation). According to Flege's Speech Learning Model, if we ignore the orthographic dimension of the task, we should have found more confusion for /l/ than for the French /r/ (since the latter is phonetically more different from the Japanese /r/ than /l/). This sheds light on the role that orthography can play in L2 learning, and calls for a better integration of phonetic and phonographemic training in L2 phonology learning.

6. Available resources for French: the PFC corpus

In the preceding paragraphs, we pointed out the advantages of using phonetic data from oral corpora by comparing the results yielded by single versus multiple talkers input in discrimination training. In the last paragraph we contrasted phonetic and orthographic input, and we emphasized the possible interferences of the orthographic representations in the learning process. Therefore, three types of input have been considered so far, from the most 'stable' to the most 'variable': orthography, single-talker, multiple-talker. Of course, a lot more experimental work needs to be accomplished to deepen our knowledge of the process at stake, and these three types of input have been, and will be, coexisting in language classrooms for a long time and for different reasons. However, if orthographic ('the teacher's writing') and single-speaker ('the teacher's voice') input have almost always been used in language education, the same cannot be said of multiple-speakers and oral corpora data. This is where the novelty lies, because these corpora are relatively new.

Once we are convinced that oral corpora can actually become pedagogical tools for L2 phonology learning, we need to find the available resources. As far as French language is concerned, oral corpora are relatively scarce, and it is only recently (February 2008) that the French Ministry of Culture and Communication opened an official website (www.corpusdelaparole.culture.fr) on which all main French oral corpora are connected and freely accessible. Among these, the most important one, and also more directly connected to our topic, is the PFC corpus, an achievement of the PFC project (*Phonologie du Français Contemporain: usages, variétés et structure*) coordinated by Jacques Durand (University of Toulouse), Bernard Laks (University of Paris X and Chantal Lyche (University of Oslo). The project's initial aim was to record, partially transcribe orthographically and analyze over 500 speakers from approximately 50 different locations in the francophone world, from France to Belgium, Burkina Faso, Canada, Ivory Coast, Louisiana, Switzerland, and other French speaking areas.

The project has been extensively described in other publications (Durand & Lyche 2003), but two interesting aspects of the project need to be underlined here. First, one of the distinctive qualities of the corpus is the use of the exact same protocol for all the recordings, including a wordlist (encompassing the segmental inventory of French) and a text (containing liaisons and schwas contexts) that subjects had to read aloud. Therefore, the words "*rat*" ("rat"), "*lierre*" ("ivy") and "*extraordinaire*" ("extraordinary"), for instance, were recorded by hundreds of different speakers, sometimes with noticeable allophonic variation. According to the studies we reviewed earlier, using these data for training Japanese learners to perceive and produce the French /r/ may prove to be useful, provided they are used adequately. Moreover, the PFC protocol also includes two conversations (one formal, one informal) and any user (teacher or learner) can look for a word or a structure in the corpus thanks to a freely accessible search engine on Internet (www.projet-pfc.net) that provides contextualized oral tokens of the item and corresponding standard orthographic transcriptions.

The second point we wish to mention is that such resources need *ad hoc* adaptation for language education contexts and teachers/learners' requests. The PFC-EF (Enseignement du français) sub-project, launched in 2006, aims at exploiting the PFC corpus for pedagogical purposes, mainly through a more user-friendly interface and tools on its website (www.projet-pfc.net/?pfc-ef) (for more information see Detey, Durand, Laks, Lyche & Nouveau 2007), but also through pedagogical publications (Detey, Durand, Laks & Lyche to appear). Therefore, we can hope that in a near future the PFC corpus will be used by French teachers and learners around the globe to develop oral skills in French, and more specifically master the French sound system.

7. Conclusion

In this contribution we tried to show that oral corpora could be used in foreign language education to help learners develop oral skills. More specifically, we concentrated on the role of oral corpora data as phonetic input for L2 phonology learning. After a brief presentation of the growing number of experiments devoted to what has been called 'Fine Phonetic Details' in the speech processing literature, we reviewed a number of studies which focus on the beneficial effect of high-variability stimuli training for Japanese learners of English struggling with the /r/-/l/ distinction. We pointed out the relatively neglected impact of the orthographic factor on L2 speech perception and learning, which we illustrated with Japanese learners of French and the French liquids /r/ and /l/. Finally, we briefly presented the PFC (*Phonologie du Français Contemporain*) corpus and its pedagogical exploitation in the PFC-EF (*Enseignement du Français*) sub-project. Even though we need further experimental work to test more accurately our hypotheses concerning the use of variable phonetic input with Japanese learners of French, it is thanks to the recent constitution of large-sized corpora like PFC that we will be able to set up some of the necessary tests. Meanwhile, the oral data are freely available and can be used in many different pedagogical contexts, from oral comprehension tasks to *Francophonie* awareness-raising language observation activities.

References

Akahane-Yamada, R., Tohkura, Y., Bradlow, A. R. and Pisoni, D. B. 1996. "Does training in speech perception modify speech production?". *Proceedings of the 1996 International Conference on Spoken Language Processing*, Philadelphia. 606 - 609.

Akamatsu, T. 1997. *Japanese Phonetics : theory and practice*. Munich: Lincom Europa.

Alario, F. X., Perre, L., Castel, C. and Ziegler, J. C. 2007. "The role of orthography in speech production revisited". *Cognition* 102. 464-475.

Aoyama, K., Flege, J. E., Guion, S. G., Akahane-Yamada, R. and Yamada, T. 2004. "Perceived phonetic distance and L2 learning: The case of Japanese /r/ and English /l/ and /r/". *Journal of Phonetics* 32 (2). 233-250.

Bassetti, B. 2006. "Orthographic input and phonological representations in learners of Chinese as a Foreign Language". *Written Language and Literacy* 9 (1). 95-114.

Battye, A. Hintze, M.-A. & P. Rowlett 2000. *The French Language Today : a linguistic introduction*. London: Routledge.

Biber, D. and Reppen, R. 2002. "What does frequency have to do with grammar teaching?" *Studies in Second Language Acquisition* 24 (2). 199-208.

Boersma, P., Escudero, P. and Hayes, R. 2003. "Learning abstract phonological from auditory phonetic categories : an integrated model for the acquisition of language-specific sound categories". In Sole, M. J., Recansens, D. and J. Romero (eds.). *Proceedings of the 15th International Congress of Phonetic Sciences*, Barcelona. 1013-1016.

Boersma, P. and Hamann, S. 2007. "Phonological perception in loanword adaptation". *Old World Conference in Phonology* 4, Rhodes.

Bradlow, A. R. (2008). "Training non-native language sound patterns: Lessons from training Japanese adults on the English /r/-/l/ contrast". In Hansen Edwards, J. G. and M. L. Zampini (eds.), *Phonology and Second Language Acquisition*. Amsterdam: John Benjamins. 287-308.

Bradlow, A. R., Akahane-Yamada, R., Pisoni, D. B. and Tohkura, Y. 1999. "Training Japanese listeners to identify English /r/ and /l/: Long-term retention of learning in perception and production". *Perception & Psychophysics* 61 (5). 977-985.

Bradlow, A. R. and Bent, T. 2008. "Perceptual adaptation to non-native speech". *Cognition.* 106 (2). 707-729.

Bradlow, A. R., Pisoni, D. B., Akahane-Yamada, R. and Tohkura, Y. 1997. "Training Japanese listeners to identify English /r/ and /l/: IV. Some effects of perceptual learning on speech production". *Journal of the Acoustical Society of America* 101. 2299-2310.

Chambers, K. E., Onishi, K. H. and Fisher, C. 2004. "Learning different phonetic distributions in onset and coda position". *9th Conference on Laboratory Phonology*, University of Illinois, 23-24 june.

Coulmas, F. 1989. *The Writing Systems of the World*. Oxford: Blackwell.

Detey, S. 2005. *Interphonologie et représentations orthographiques. Du rôle de l'écrit dans l'enseignement/apprentissage du français oral chez des étudiants japonais.* Unpublished Ph.D. dissertation, Université de Toulouse-Le Mirail.

Detey, S. 2007a. "De la didactisation des grands corpus oraux pour l'enseignement / apprentissage des langues étrangères : le projet PFC-EF pour le français". *Flambeau* 32-33, Tokyo University of Foreign Studies. 1-22.

Detey, S. 2007b. “Transcription, translittération et didactique de l’oral en FLE au Japon : katakana, rômaji et orthographe française”. *Revue japonaise de didactique du français, Etudes didactiques* 2 (1). 19-36.

Detey, S., Durand, J., Laks, B. and Lyche, C. (eds) to appear. *Le français parlé contemporain dans ses variétés : ressources pour l’étude du français*. Paris : Ophrys.

Detey, S., Durand, J., Laks, B., Lyche, C. and Nouveau, D. 2007. “Voix de la francophonie, éducation langagière et corpus numérisé : PFC-EF, des ressources pour la didactique du français”. In Detey, S. & D. Nouveau (eds.). *Bulletin PFC* 7. 11-29.

Detey, S., Durand, J. and Nespoulous, J.-L. 2005. “Interphonologie et représentations orthographiques. Le cas des catégories /b/ et /v/ chez des apprenants japonais de Français Langue Etrangère”. *Revue PArole* 34/35/36 (supplément). 139-186.

Detey, S. and Nespoulous, J.-L. 2008. “Can orthography influence L2 syllabic segmentation? Japanese epenthetic vowels and French consonantal clusters”. *Lingua* 118 (1). 66-81.

Dohlus, K. 2005. “Phonetics or phonology: Asymmetries in loanword adaptations – French and German mid front rounded vowels in Japanese”. *ZAS Papers in Linguistics* 42. 117-135.

Durand, J., B. Laks and C. Lyche. 2002. “La phonologie du français contemporain : usages, variétés et structure ». In Pusch, C. & W. Raible (eds.). *Romanistische Korpuslinguistik- Korpora und gesprochene Sprache / Romance Corpus Linguistics - Corpora and Spoken Language*. Tübigen: Gunter Narr Verlag. 93-106.

Durand, J., Laks, B. and Lyche, C. 2005. “Un corpus numérisé pour la phonologie du français ». In Williams, G. (ed.). *La linguistique de corpus*. Rennes: Presses Universitaires de Rennes. 205-217.

Durand, J. and Lyche, C. 2003. “Le projet « Phonologie du français contemporain » et sa méthodologie ». In Delais-Roussarie E. & J. Durand (eds.), *Corpus et variation en phonologie du français. Méthodes et analyse,* Toulouse: Presses universitaires du Mirail. 213-278.

Eckman, F. R. 2004. “From phonemic differences to constraint rankings : research on second language phonology”. *Studies in Second Language Acquisition* 26 (4). 513-549.

Eisenstein, M. R. 1986. “Target language variation and second language acquisition: learning English in New York city”. *World Englishes* 5 (1). 31-46.

Escudero, P. 2005. *Linguistic Perception and Second Language Acquisition. Explaining the attainment of optimal phonological categorization*. Doctoral dissertation, Utrecht University. LOT Dissertation Series 113.

Escudero, P. 2007. “Second Language Phonology: the role of perception”. In M. C. Pennington (ed.) *Phonology in context*. New York: Palgrave Macmillan. 109-134.

Escudero, P. and Boersma, P. 2004. “Bridging the gap between L2 speech perception research and phonological theory”. *Studies in Second Language Acquisition*, 26, 4. 551-585

Flowerdew, J. 1996. “Concordancing in language learning”. *The power of CALL*, M.C. Pennington (ed). Houston: Athelstan. 97-114.

Foulkes, P. and Docherty, G. J. 2006. “The social life of phonetics and phonology”. *Journal of Phonetics* 34 (4). 409-438.

Goto, H. (1971). “Auditory perception by normal Japanese adults of the sounds "l" and "r"”. *Neuropsychologia* 9. 317-323.

Hansen Edwards, J. G. & M. L. Zampini (eds.) (2008). *Phonology and Second Language Acquisition*. Amsterdam: John Benjamins.

Hardison, D. M. 1999. “Bimodal speech perception by native and nonnative speakers of English : Factors influencing the McGurk effect”. *Language Learning* 49. 213-283.

Hattori,K. and Iverson,P. 2007. “Examination of similarity between English /r/, /l/, and Japanese flap: An investigation of best exemplars by English and Japanese speakers.” *Proceedings of the 16th International Congress of Phonetic Sciences*, Saarbrücken. 1777-1780.

Iverson, P., V. Hazan and K. Bannister. 2005. “Phonetic training with acoustic cue manipulations: A comparison of methods for teaching English /r/-/l/ to Japanese adults”. *Journal of the Acoustical Society of America* 118. 3267-3278.

Iverson, P., Kuhl, P. K., Akahane-Yamada, R., Diesch, E., Tohkura, Y., Kettermann, A. and Siebert, C. 2003. “A perceptual interference account of acquisition difficulties for non-native phonemes”. *Cognition*, 87. B47-B57.

Kamiyama, T. 1994. *Tuttle New Dictionary of Loanwords in Japanese,* Rutland (Vermont), Charles E. Tuttle.

Kess, J. F. and Miyamoto, T. 1999. *The Japanese Mental Lexicon : psycholinguistic studies of kana and kanji processing*. Amsterdam, John Benjamins.

Khul, P. K. 2000. “A new view of language acquisition”. *Proceedings of the National Academy of Sciences USA* 97. 11850-11857.

Klatt, D. H. 1979. “Speech perception: a model of acoustic-phonetic analysis and lexical access”. *Journal of Phonetics* 7. 279-312.

Kraljic, T., Brennan, S. E. and Samuel, A. G. 2008. “Accommodating variation: dialects, idiolects, and speech processing”. *Cognition* 107 (1). 54-81.

Kraljic, T. and Samuel, A. G. 2007. “Perceptual adjustments to multiple speakers”. *Journal of Memory and Language* 56. 1-15.

Labrune, L. 2001a. “Phonologie du japonais”. In Blin, R. and I. Tamba (eds.), *Faits de Langues « coréen-japonais »*. Paris: Ophrys. 89-110.

Labrune, L. 2001b. “Structure de la syllabe japonaise”. In Blin, R. and I. Tamba (eds.), *Faits de Langues « coréen-japonais »*. Paris: Ophrys. 112-122.

LaCharité, D. and Paradis, C. 2005. “Category preservation and proximity versus phonetic approximation in loanword adaptation”. *Linguistic Inquiry* 36 (2). 223-258.

Laks, B. 2002. “Description de l'oral et variation : la phonologie et la norme”. *L’information grammaticale* 94. 5-10.

Levy, E. S. and Strange, W. 2008. “Perception of French vowels by American English adults with and without French language experience”. *Journal of Phonetics* 36 (1). 141-157.

Lively, S. E., Logan, J. S. and Pisoni, D. B. 1993. “Training Japanese listeners to identify English /r/ and /l/. II: The role of phonetic environment and talker variability in learning new perceptual categories”. *Journal of the Acoustical Society of America* 94, pp 1242-1255.

Lively, S. E., Pisoni, D. B., Yamada, R. A., Tohkura, Y., & Yamada, T. 1994. “Training Japanese listeners to identify English /r/ and /l/. III: Long-term retention of new phonetic categories”. *Journal of the Acoustical Society of America* 96. 2076-2087.

Logan, J. S., S. E. Lively and D. B. Pisoni. 1991. “Training Japanese listeners to identify English /r/ and /l/: A first report”. *Journal of the Acoustical Society of America* 89 (2). 874-886

Magnuson, J. S. and Yamada, R. A. 1996. “The effects of talker variability on the perception of English /r/ and /l/ by Japanese listeners: Subject differences and acoustic correlates”. *Proceedings of the 1996 International Conference on Spoken Language Processing* (CD-ROM), SuP1P1.17. 1-4.

Magnuson, J. S., Yamada, R. A., Tohkura, Y., Pisoni, D. B., Lively, S. E. and Bradlow, A. R. 1995. The role of talker variability in nonnative phoneme training. *Proceedings of the 1995 Spring Meeting of the Acoustical Society of Japan.* Tokyo: Acoustical Society of Japan. 393-394.

Major R. C., Fitzmaurice S. M., Bunta, F. and Balasubramanian C. 2005. “Testing the effects of regional, ethnic, and international dialects of English on listening comprehension**.** *Language Learning* 55 (1). 39-72.

McQueen, J. M., Cutler, A. and Norris, D. 2006. “Phonological abstraction in the mental lexicon”. *Cognitive Science* 30. 1113-1126.

Meunier, C. 2005. “Invariants et variabilité en phonétique”. In Nguyen, N., Wauquier-Gravelines, S. and J. Durand (eds.) *Phonologie et phonétique : Forme et substance*. Paris: Hermès. 349-374.

Nguyen, N. 2001. “Rôle de la coarticulation dans la reconnaissance des mots”. *l'Année Psychologique* 101. 125-154.

Nguyen, N. 2005. “La perception de la parole”. In Nguyen, N., Wauquier-Gravelines, S. and J. Durand (eds.) *Phonologie et phonétique : Forme et substance*. Paris: Hermès. 425-447.

Nguyen, N., Wauquier-Gravelines, S., & Tuller, B. (in press). “The dynamical approach to speech perception: from fine phonetic detail to abstract phonological categories”.

In Chitoran, I., Coupé, C., Marsico, E. and F. Pellegrino (eds.) *Approaches to Phonological Complexity*. Berlin: Mouton de Gruyter.

Norris, D. G., McQueen, J. M. and Cutler, E. A. 2003. "Perceptual learning in speech". *Cognitive Psychology* 47. 204-238.

Otaka, H. 2004. "Can't the nasal sequence [nn] be regarded as a geminate in Japanese ?". *Ex* 3. 61-77. Kwansei Gakuin university.

Otake, T., G. Hatano, A. Cutler and J. Mehler. 1993. "Mora or Syllable ? Speech segmentation in Japanese". *Journal of Memory and Language* 32. 258-278.

Peperkamp, S. and Dupoux, E. 2003. "Reinterpreting loanword adaptations : the role of perception". *Proceedings of the 15th International Congress of Phonetic Sciences*, Barcelona: UAB. 367-370.

Peperkamp, S. and Dupoux, E. 2004. "The acquisition of abstract phoneme categories". *9th Conference on Laboratory Phonology (LabPhon9)*, University of Illinois, 24-26 june.

Peperkamp, S., Pettinato, M. and Dupoux, E. 2003. "Allophonic variation and the acquisition of phoneme categories". In Beachley, B., Brown, A. and F. Conlin (eds.), *Proceedings of the 27th Annual Boston University Conference on Language Development*, Vol. 2, Sommerville: Cascadilla Press. 650-661.

Peperkamp, S., I. Vendelin and K. Nakamura. 2008. "On the perceptual origin of loanword adaptations: experimental evidence from Japanese". *Phonology* 25. 129-164.

Perre, L. and Ziegler, J. C. 2008. "On-line activation of orthography in spoken word recognition". *Brain Research* 1188. 132-138.

Pisoni, D. B., S. E. Lively, R. E. Yamada, Y. Tohkura and T. Yamada. 1993. "Training Japanese listeners to identify english /r/ and /l/: A replication and extension". *Acoustical Society of America 125th Meeting,* Ottawa, 4pSP4.

Pisoni, D. B. and P. A. Luce. 1987. "Acoustic-phonetic representations in word recognition". *Cognition* 25. 21-52.

Rivenc, P. 1979/2000. "Le Français Fondamental vingt-cinq ans après". *Le Français dans le Monde* 148 / *Pour aider à apprendre à communiquer dans une langue étrangère*, Paris: Didier Eruditions – Mons : CIPA. 71-89.

Rose, Y. and Demuth, K. 2006. "Vowel epenthesis in loanword adaptation: representational and phonetic considerations". *Lingua* 116. 1112-1139.

Segui, J. 1989/2003. "La perception du langage parlé". In C. Bonnet, Ghiglione, R. and J.-F. Richard (dir.), *Traité de psychologie cognitive : perception, action, langage*. Paris: Bordas / Dunod. 200-234.

Shinohara, S. 1997. *Analyse phonologique de l'adaptation japonaise de mots étrangers*, Unpublished Ph. D. Thesis, Université de la Sorbonne-Nouvelles Paris-III.

Shirai, S. 1999. *Gemination in loans from English to Japanese.* Unpublished MA thesis, University of Washington.

Smith, R. 2004. *The role of fine phonetic detail in word segmentation*. Unpublished Ph.D. dissertation. King's College, University of Cambridge.

Sommers, M. and Barcroft, J. 2007. "An integrated account of the effects of acoustic variability in first language and second language: evidence from amplitude, fundamental frequency, and speaking rate variability". *Applied Psycholinguistics* 28 (2). 231-249.

Steele, J. 2005. "Assessing the role of orthographic versus uniquely auditory input in acquiring new L2 segments". *7èmes rencontres internationales du réseau français de phonologie*, Aix-en-Provence, France, June 2-4.

Takagi, N. 2002. "The limits of training Japanese listeners to identify English /r/ and /l/: eight case studies". *Journal of the Acoustical Society of America* 111(6). 2887-96.

Tarone, E. 1987. "The phonology of interlanguage". In Ioup, G. and S. H. Weinberger (eds.), *Interlanguage Phonology : the acquisition of a second language sound system*. Cambridge: Newbury House. 70-85.

Trubetzkoy, N.S. 1939. *Grundzüge der Phonologie*. Transl. in French by J Cantineau: *Principes de Phonologie*. Paris: Klincksieck, 1949.

Vendelin, I. and Peperkamp, S. 2004. "Evidence for phonetic adaptation of loanwords : an experimental study". *Actes des Journées d'Etudes Linguistiques 2004 (JEL2004)*, Université de Nantes. 129-131.

Vendelin, I. and Peperkamp, S. 2006. "The influence of orthography on loanword adaptations". *Lingua* 116. 996-1007.

Weber, C. 2006. "Pourquoi les Français ne parlent-ils pas comme je l'ai appris ? ". *Le français dans le monde* 345. 31-33.

Yamada, R. A., Strange, W., Magnuson, J. S., Pruitt, J. S. and Clarke, W. D. 1994. "The intelligibility of Japanese speakers' productions of American English /r/, /l/ and /w/, as evaluated by native speakers of American English". *Proceedings of the International Conference on Spoken Language Processing*. Yokohama: Acoustical Society of Japan. 2023-2026.