International Society on Infant Studies
Infancy

*Infancy*, ***16***(4), 392–417, 2011

ISSN: 1525-0008 print / 1532-7078 online
DOI: 10.1111/j.1532-7078.2010.00050.x

WILEY-BLACKWELL

# Infants' Discrimination of Familiar and Unfamiliar Accents in Speech

Joseph Butler, Caroline Floccia, and Jeremy Goslin
*School of Psychology*
*University of Plymouth*

Robin Panneton
*Department of Psychology*
*Virginia Tech*

This study investigates infants' discrimination abilities for familiar and unfamiliar regional English accents. Using a variation of the head-turn preference procedure, 5-month-old infants demonstrated that they were able to distinguish between their own South-West English accent and an unfamiliar Welsh English accent. However, this distinction was not seen when two unfamiliar accents (Welsh English and Scottish English) were presented to the infants, indicating they had not acquired the general ability to distinguish between regional varieties, but only the distinction between their home accent and unfamiliar regional variations. This ability was also confirmed with 7-month-olds, challenging recent claims that infants lose their sensitivity to dialects at around that age. Taken together, our results argue in favor of an early sensitivity to the intonation system of languages, and to the early learning of accent-specific intonation and potentially segmental patterns. Implications for the development of accent normalization abilities are discussed.

Studies on language discrimination highlight young infants' sensitivity to linguistic rhythm through their ability to distinguish pairs of languages belonging to distinct rhythmic categories (e.g., English [stress-based] versus Japanese [mora-based], Nazzi, Bertoncini, & Mehler, 1998; English versus

Correspondence should be sent to Joseph Butler, School of Psychology, University of Plymouth, Drake Circus, PL4 8AA, Plymouth, UK. E-mail: joseph.butler@plymouth.ac.uk

Italian [syllable-timed], Mehler & Christophe, 1995; Dutch [stress-based] versus Japanese, Ramus, Hauser, Miller, Norris, & Mehler, 2000), but not languages belonging to the same category (e.g., English versus Dutch, Nazzi et al., 1998). In addition, at least by 5 months of age, infants are also able to distinguish their own language from another of the same rhythmic class (Bosch & Sebastián-Gallés, 1997; Nazzi, Jusczyk, & Johnson, 2000). That is, an English-learning infant distinguishes between English and Dutch, but not the two syllable-timed languages Spanish and Italian, or the two stress-timed languages Dutch and German. Nazzi et al. (2000) propose that infants' early perception is characterized by a sensitivity to linguistic rhythm, which, together with repeated exposure to the native language, allows the child to construct a representational space for families of languages, organized initially around the rhythmic properties of the native language. However, infants' sensitivity to language-specific prosodic cues extends beyond the use of rhythmic information, as Nazzi et al. (2000) showed that American English-learning infants could distinguish between American English (AmE) and British English (BE). Nazzi et al. (2000) attributed this discrimination ability to the use of contrasting intonation patterns and syllable duration.

The findings by Nazzi et al. (2000) have led to more recent investigations of infants' discrimination of, and preferences for, native versus nonnative regional accents (Diehl, Varga, Panneton, Burnham, & Kitamura, 2006; Kitamura, Panneton, Diehl, & Notley, 2006a; Kitamura, Panneton, Notley, & Best, 2006b). In these preliminary reports, American and Australian infants aged 3–8 months were presented with AmE and Australian English (AuE) utterances, spoken by adult females. Using a visual fixation preference task, in contrast to the discrimination procedure used by Nazzi et al., these studies found that 6-month-old American infants and 3-month-old Australian infants preferred AuE over AmE. However, older samples of infants in both cultures (i.e., Australian 6-month-olds and American 8-month-olds) no longer showed significant preferences for either accent, suggesting that, as infants' experience of both native and nonnative varieties of their maternal language grows, they become less sensitive to the phonetic differences apparent between regional accents, and attention becomes more directed toward similarities between speakers. It was also suggested that the earlier decline in preference for the AuE accent in Australian infants (as compared to American infants) is due to greater exposure to AmE in the Australian mass media (Kitamura et al., 2006b). From these results, it would appear that prolonged and repeated exposure to the native language leads to the perceptual assimilation of accent-related variations, possibly because of increased phonetic normalization capacities, an idea we will return to in the general discussion. These interpretations received further support from a study by Phan and Houston (2006), who also found a decline in 7- to

24-month-old infants' ability to discriminate accent-related cues in isolated words. When presented with word repetitions produced in either their native north midland American accent versus an unfamiliar southern American accent, only 7-month-olds could discriminate the accents while 11-, 18-, and 24-month-olds showed no signs of discrimination. This suggests that as infants gain more experience with their native language, they begin normalizing surface variability in speech inputs. This normalization may ultimately lead to the development of stable phonological lexical entries by providing invariant phonetic information across indexical variations.

Although such surface normalization may occur in later infancy, other evidence suggests that the ability to perceive and attend to indexical detail remains intact throughout early childhood, and is utilized under specific situations. For example, results of a study by Kinzler, Dupoux, and Spelke (2007) show that both older American infants and children can use accents to guide social behavior, with 10-month-old and 5-year-olds showing a preference for people speaking with their own accent compared to others speaking with a foreign accent. Therefore, it is possible that children's sensitivity to accents in speech does not diminish with repeated exposure, but rather that they learn to filter out irrelevant accent cues in speech to suit the situation.

One potentially important difference between studies showing a decline in native accent sensitivity and those showing persistent native accent sensitivity is the switch from regional (or dialects[1]) to foreign accents. It has been suggested that regional and foreign accents may recruit different kinds of normalization mechanisms (e.g., Floccia, Butler, Goslin, & Ellis, 2009b; Floccia, Goslin, Girard, & Konopczynski, 2006). A foreign accent can be seen as a compromise between two phonological systems (the one defining the native language of the speaker, and the other of the target language) resulting in a wide range of inter- and intraspeaker variability. In contrast, a regional accent is characterized by a stable interspeaker phonological system. Therefore, it is difficult to equate Kinzler et al.'s (2007) foreign accent results with 10-month-olds to the regional accent results found by Kitamura and colleagues (2006a, 2006b) as well as by Phan and Houston (2006). Recent studies by Girard, Floccia, and Goslin (2008) and Floccia, Butler, Girard, and Goslin (2009a) have reported that both French (Girard et al., 2008) and English 5-year-old children (Floccia et al., 2009a) show a much greater sensitivity to foreign accent cues than to regional accent cues in categorization tasks. Indeed, in both studies children were not significantly

[1]Following Wardhaugh (1992), the term accent (or dialect) refers to the language varieties spoken by communities from various regions of the world, within a given language (Standard English for example). Grammar and vocabulary are broadly similar, only pronunciation differs.

above chance when categorizing sentences by regional accent, but could use a foreign accent as an effective discrimination cue. This suggests that the potential decline in sensitivity for native varieties of the maternal language observed in infancy could last until around 5 years of age, although this would have to be reversed at some point as adults are reasonably accurate in perceiving and identifying regional accents in their maternal language (e.g., Clopper & Pisoni, 2004). In addition, it suggests that the perception of foreign accents may not rely upon the same mechanisms as perception of regional accents, and importantly, may not undergo the same decline during infancy.

In this study, we expand the original hypothesis by Nazzi et al. (2000), and subsequent associated findings, by investigating infants' abilities to discriminate between native and nonnative regional accents of their maternal language (Experiment 1), and between two nonnative regional accents (Experiment 2). If infants' representation of their native language at 5 months is such that they can distinguish between the fine-grained intonation patterns and perhaps the segmental information of any maternal language variety, there should be evidence of discrimination in both experiments. If, on the other hand, infants only have a detailed representation of the features characterizing their native variety, there should only be evidence of discrimination in Experiment 1, but not Experiment 2.

Also, in Experiment 3, we examine whether older infants (7-month-olds) continue to show discrimination between their native regional accent and nonnative regional accent, or whether there is a significant decline in sensitivity to accents previously reported between the ages of 6–8 months.

## EXPERIMENT 1

In this experiment, BE-learning 5-month-olds from the West Country[2] were tested for discrimination of their own home (native regional) accent and an unfamiliar (nonnative regional) Welsh accent of English. These two accents share the same rhythmic characteristics, as they are all exemplars of stress-timed English. However, they differ at the segmental (Hughes & Trudgill, 1988) and intonation level (Walters, 2001), providing infants with a wide range of potentially discriminative information, similar to the differences between "standard" BE and AmE.

Throughout the three experiments described in this study, we used an adaptation of the Headturn Preference Procedure (HPP) to provide a dis-

[2]The West Country of England entails Cornwall, Devon, Somerset, Dorset, the city of Bristol, Gloucestershire, and Wiltshire.

crimination measure (see Bosch, 1998), as used by Nazzi et al. (2000). The rationale for doing so was to replicate and extend the initial findings from Nazzi et al. (2000, Exp 5), as well as compare our results with those from the preference procedure used by Kitamura et al. (2006a, 2006b).

### Participants

Twenty 5-month-old (range 4.49–6.07; all healthy by parental report) monolingual infants (11 males and nine females) participated in this study, all of whom were raised in the West Country region of England from birth. For all but three of the infants whose parent(s) originated from the North of England, both of the parents of the children also originated from either the West Country or the South of England. In all cases, parents reported that the children had no significant exposure to Welsh accented speakers, that is, no more than occasionally (e.g., on holiday). Post hoc analyses showed that there was no significant effect of the parents' origins (North versus South) on the infant's discrimination scores. Seven additional infants were excluded from the study due to crying or failure to pay attention to the lights or sounds used in the experiment ($n = 4$), or because at least one of the parents originated from outside England ($n = 3$). None of the infants were more than 6 weeks premature, nor did they have any diagnosed developmental or hearing problems.

### Accent recordings

Recordings were similar to those used in the study of Nazzi et al. (2000). Eight passages consisting of five unrelated sentences (see Appendix) were recorded by four female speakers with a West Country accent (aged 20, 22, 29, 30; all speakers resident in Plymouth throughout their life) and four female speakers with an accent from South Wales (aged 19, 20, 21, 24; all speakers resident in South Wales until at least 18 years of age). Each of the passages was recorded by one speaker of each accent, with each speaker recording two passages each. In order to make the passages interesting to infants, the speakers were instructed to read them in typical infant-oriented style. Passages were recorded using a digital dictaphone and microphone, using 16 bit, 44,100 Hz sampling rate. The average duration for the passages was 20.23 sec (West Country passages—20.57; Welsh passages—19.89).

### Regional accent characteristics

Regional accents can be characterized at the segmental and the supra-segmental level. For the South Wales area, a description of the intonation

system of this accent is provided by Walters (2001) who analyzed samples produced in the Rhondda Valley, an area of South-East Wales. The Welsh accent of English has borrowed many prosodic features from the Welsh language, which resulted in a shortening of stressed vowels and lengthening of succeeding consonants, a pitch-rise from the stressed syllable and an increase in phonetic strength of the posttonic syllables, and finally a shift of word stress from initial to penultimate or ultimate syllable in polysyllabic words. Intonational phrases are of two main kinds: A sequence of rising contours that can end with an ultimately rising nuclear contour, or with an ultimately falling contour. All these features contribute to the popular feeling that Welsh English is a "sing-song" dialect (Wells, 1982, p. 392). At the segmental level, according to Hughes and Trudgill (1988) Welsh English is characterized by its nonrhoticity (no postvocalic "r"), the distribution of /æ/ and /ɑː/ which follows that found in the North of England, and the vowel /ɛː/ in "bird" being rounded to approach /øː/. In addition, the phoneme /l/ is never dark, that is, it is not velarized after a vowel as in English Received Pronunciation (RP). All these features were found in the recordings used in this experiment, as attested by the report of a trained phonetician who listened to our recordings.

The West Country accent of English belongs to the family of Southern English accents (Wells, 1982), and thus has intonation patterns that do not depart significantly from that of the RP English. Bolinger (1989, p. 29) notices in RP English a high proportion of high initial pitches, leading to more frequent and more extended falls than in Network Standard AmE. There is also a higher proportion of terminal rises in BE than in AmE. However, in the West Country short vowels tend to be longer than in other South of England accents, especially in monosyllabic words in phrase-final or prominent position (Wells, 1982, p. 345), resulting in the popular feeling that the West Country accent is slow. At the segmental level, it is distinct from RP English in its rhoticity, the loss of the /æ/ and /aː/ distinction (Hughes & Trudgill, 1988), and by the fact that words like boat and gate have usually retained their monophthong pronunciation (Wells, 1982). Again, these segmental features, especially the rhoticity and the lack of /æ/-/aː/ distinction, were found in our recordings.

Listening to the recordings of the speakers, a trained phonetician verified that the accents were mostly recognizable by their segmental features rather than by their prosodic patterns as the speakers read the passages rather than spoke spontaneously. In addition, all the recordings used in this study (West Country, Welsh, and Scottish) were presented to eight naive adult listeners (all brought up in the South of England, but resident in Plymouth for at least the previous 3 years; mean age: 39.7 years, including four females) in a forced choice accent identification task. Each participant was presented with

32 randomly ordered passages (two passages for each of the four speakers within each accent) and asked to make a choice (West Country, Welsh, Scottish, or French[3]) and confidence rating (1—no confidence to 4—very high confidence) on the accent. Regarding the West Country and Welsh English results, participants identified correctly the West Country passages in 98.4% (from 87.5 to 100%) of cases with a mean confidence of 3.13. The only incorrect response was due to one participant identifying one passage as being Welsh accented with a confidence of 1. The Welsh English passages were correctly identified in 85.9% (from 75 to 100%) of cases with a mean confidence of 3.11. When identified incorrectly, Welsh accented sentences were all identified as being from the West Country (nine responses out of 64), with a confidence of 2.8. Although listeners did not perform at a ceiling level (see Clopper & Pisoni, 2004, for similar observations with American listeners), the high degree of accuracy in accent identification, coupled with the trained phonetician report, suggests that the recordings were representative of the target accents.

## Procedure

The methods and aims of the experiment were fully explained to the parents, who completed an ethical consent form before testing began. Accent discrimination responses were collected using an adaptation of the HPP (see also Nazzi et al., 2000). During the experiment infants were seated on their caregivers lap in the center of the test booth. At the beginning of each trial, a flashing green light was presented at the center-front of the booth to focus the infant's attention to the middle of the test area. This green light was then turned off and replaced with a flashing red light, which could either be to the left or right hand-side of the booth. The location of the red light was chosen on a pseudo-random basis, such that the light could not appear on the same side for more than two consecutive trials. Once the infant turned to look at the flashing light, one of the recorded passages was played from a speaker next to the light (the red light continued flashing during the presentation of the passage). If the passage ended, or the infant looked away from the light for more than 2 sec then all lights and sounds were terminated and after another few seconds a new trial began. If the infant looked away from the light but returned in less than 2 sec, the passage continued playing and the portion of time spent looking away from the light was removed from the total for

[3]The Scottish accent was used in Experiment 2. Another experiment not presented in this paper examined the discrimination of South-West English dialect and French accent. This is why participants were asked to rate French accented sentences as well.

that trial. Control of lights, speech recordings, and the monitoring of the infant's looking times were all synchronized and remotely controlled by the experimenter using a computer program. Both the experimenter and the infant's caregiver wore headphones playing music during the experiment so that neither was aware of the accent of the speech stimuli presented to the infant.

Before the test phase, each infant was familiarized with a particular accent using four passages from two of the speakers of that accent. During this phase the infant was required to accumulate a total of 20 sec of looking time to each of the passages. Half of the infants were familiarized with West Country accented passages, and the other half were familiarized with Welsh accented passages. Once this time-locked habituation was complete, the test phase began, with a randomly ordered presentation of four West Country and four Welsh accented passages (spoken by the four speakers not used during familiarization). Passages were terminated whenever the infant looked away for more than 2 sec, or when the passage ended. However, given that each passage was approximately 20 sec long, and infants' looking times were primarily less than 11 sec on each of these trials (see the standard deviations on Figures 1 and 2), the procedure roughly assimilated to an infant-controlled paradigm. During each of the test-phase trials, the infant's looking times were recorded by the experimenter, with average looking times for each dialect calculated by the computer control program.

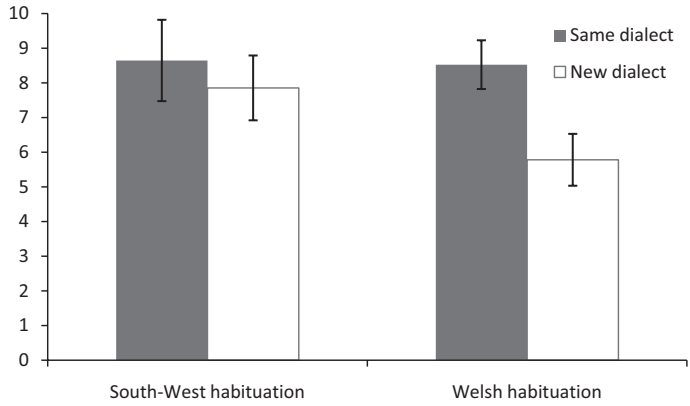


**Figure 1** Experiment 1, West Country versus Welsh English discrimination at 5 months. Average looking times in seconds to the habituated and new accent during test phase, broken down into two accent groups (accent habituated to).

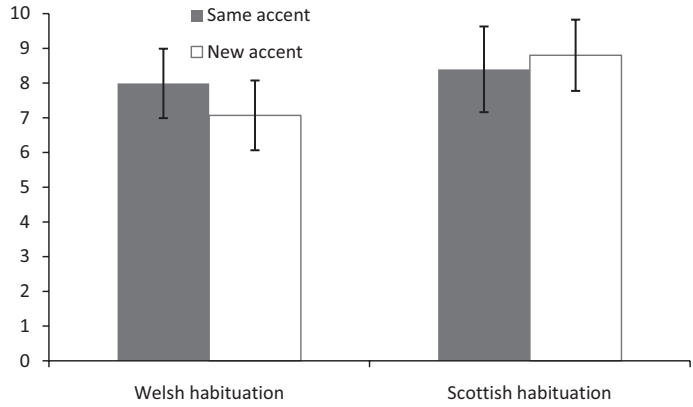


**Figure 2** Experiment 2, Welsh English versus Scottish English discrimination at 5 months. Average looking times in seconds to the habituated and new accent during test phase, broken down into two accent groups (accent habituated to).

## Results and discussion

Figure 1 shows infants' mean looking times for the West Country and Welsh accent passages. Of the 20 infants tested, 16 had longer looking times for the familiarized accent ($M = 8.58$ sec, $SD = 2.98$) compared to the novel accent ($M = 6.82$ sec, $SD = 2.82$). Comparing language of accent familiarization, we found that seven out of 10 infants familiarized with the West Country speech had longer looking times to that accent. For the other 10 infants familiarized with the Welsh accent, nine out of 10 infants had longer looking times to the Welsh accent.

A $2 \times 2$ repeated measures analysis of variance (ANOVA) was carried out on the looking times, with a within-participants variable of accent status (familiar accent, novel accent) and a between-participants variable of language of familiarization (West Country first, Welsh English first). The results of this ANOVA showed a significant main effect of accent status, $F(1, 18) = 6.70$, $p = .019$, $\eta^2 = .271$, with significantly longer looking times for the familiar than the novel accent. There was no significant effect of language of familiarization, $F(1, 18) = 1.02$, $p > .05$, and no interaction between accent status and language of familiarization, $F(1, 18) = 2.05$, $p > .05$.

The results of Experiment 1 demonstrate that 5-month-old infants from the South-West of England discriminate their own native regional accent of BE from a nonnative regional variation, consistent with previous findings from similar-aged infants representing a range of language backgrounds (Diehl et al., 2006; Kitamura et al., 2006b; Nazzi et al., 2000; Phan & Houston, 2006).

While the discrimination of regional accents is consistent with previous studies, the preference for the familiarized over the nonfamiliarized accent was opposite of that found by Nazzi et al. (2000), in which American 5-month-olds looked longer at the nonfamiliarized accent (regardless of native/nonnative status). Observation of novelty/familiarity effects in visual preference-related paradigms (e.g., HPP) is not consistent in the literature. For example, Jusczyk and Aslin (1995) and Saffran, Aslin, and Newport (1996) each found different patterns of significant responding in 7.5- to 8-month-olds who were tested for recognition of words in fluent speech. Whereas the former reported a familiarity effect, the latter observed a novelty effect. Houston-Price and Nakai (2004), reviewing the novelty versus familiarity effects in procedures similar to the one used in the current experiment (a familiarization adaptation of the HPP), mention that at least three factors can influence the observation of a novelty versus a familiarity effect: The number and length of familiarization trials, the age of the children, and the complexity or salience of the stimuli (see also Roder, Bushnell, & Sasseville, 2000, in the visual domain).

Given that infants' ages, number of familiarization trials, and choice of the sentences are similar between our study and that by Nazzi et al. (2000), the significant increase in attention to familiar passages here is most likely related to salience. Contrary to the recordings of Nazzi et al., which were spoken in an adult-directed style (ADS), our recordings were spoken using an infant-directed style (IDS), which has been found to be an attractive speech mode for young infants (Cooper, Abraham, Berman, & Staska, 1997; Cooper & Aslin, 1990; Fernald, 1985). The use of IDS passages may have increased infants' focused attention to the familiarized accent. According to Schöner and Thelen (2006), "The more arousing or interesting or complex the habituating stimulus, the more infants look at it and the longer it takes to reach a habituation criterion" (p. 277). Given our time-locked habituation process it is possible that our IDS led to delayed habituation, when compared to the ADS of Nazzi et al., meaning that children were not fully habituated by the end of the familiarization phase, which resulted in a familiarity rather than a novelty effect.

However, as mentioned by Houston-Price and Nakai (2004), regardless of whether infants attend significantly more to familiar or novel events, the finding that there is systematic differential attention either way is support for perceptual discrimination. With this in mind, the finding that 5-month-old infants increase attention to a change from one accent to another (whether familiar or novel) is positive evidence for accent discrimination. What is not clear from these results is whether infants' discrimination is based upon specific experience with their own particular accent, simply allowing them to discriminate it from another variety, or whether they

have a more general ability, allowing them to discriminate between any accents.

## EXPERIMENT 2

The aim of this experiment was to establish similar aged BE (West Country) 5-month-olds' discrimination of two nonnative regional BE accents (Scottish and Welsh). Infants raised in the West Country were presented with Welsh English (as used in Experiment 1) and Scottish English recordings, which have different phonetic (see Wells, 1982) and intonation patterns (Mayo, Aylett, & Ladd, 1997; Walters, 2001).

### Participants

Twenty healthy monolingual 5-month-old infants (range 4.26–5.93; 13 males and seven females) participated in this study, all of whom were raised in the West Country region of England from birth, and selected on the same criteria as in the previous experiment. Apart from two of the infants whose parent(s) originated from the North of England, both parents of the children also originated from either the West Country or the South of England. In all cases, parents reported that the children had no significant exposure to Welsh or Scottish accented speakers. Post hoc analyses showed that there was no significant effect of the parents' origins (North versus South) on the infant's discrimination scores. Six additional infants were excluded from the study due to crying or failure to pay attention to the lights or sounds used in the experiment ($n = 4$), or because at least one parent originated from outside England ($n = 2$).

### Accent recordings

As in Experiment 1, except that the passages originally spoken by the four West Country speakers in Experiment 1 were re-recorded by four female Scottish speakers (due to restrictions in speakers' availability, two were from Glasgow, and two from Edinburgh, aged 20, 20, 30, and 32 years). All speakers were resident in either Edinburgh or Glasgow until 20 years of age. The average duration for all stimuli passages was 20.95 sec (Welsh passages—19.89, Scottish passages—22.01).

### Regional accent characteristics

As for many cities in the North of the United Kingdom, nuclear rises are very common in Glasgow. The intonation is characterized by a typical rise

evidenced by a pitch increase at the accented syllable, followed by a plateau: It remains high until the very near edge of the phrase, and then falls again (Cruttenden, 1995; Mayo et al., 1997). In Edinburgh, the intonation system is slightly different as declarative sentences usually involve a succession of falling tones (Cruttenden, 1995). However, at the segmental level, the two accents share common features, as all other accents of Scotland (Hughes & Trudgill, 1988, p. 76). The vowels /ɪ/ and /u/ are more central, the diphthong /au/ found in "house" is produced as the monophthong /u/, /o/, and /u/ are sometimes replaced by /e/ (as in "home" and "do"), and /a/ by /ɛ/ (as in "arm"). In addition, there is no h-dropping, and /t/ is often realized as a glottal stop. As for the stimuli of Experiment 1, these passages were analyzed by a trained phonetician as well as being rated by eight naive adult listeners. The phonetician reported that the intonation patterns were recognizable as Scottish, but not particularly representative of the Edinburgh/Glasgow distinction as the stimuli resulted from read speech. Results obtained in the accent identification scores show that Scottish passages were identified as such with a mean accuracy of 91.0% (ranging from 75 to 100%) with a mean confidence of 3.34. Erroneous identifications were evenly split between reports of West Country and Welsh accents (three each, out of 64 possible responses). In a supplementary question to the original rating task, when the listeners identified a particular speaker as Scottish they were then asked to decide whether they were from Glasgow or Edinburgh, and then rate their confidence in this decision. In this case, listener's identification performance was not significantly above chance. Glaswegian sentences were identified with a mean accuracy of 48.4% (exact binomial calculation: $p = .13$) with a mean confidence of 2.01, while Edinburgh sentences slightly better with a mean accuracy of 66.7% ($p = .064$) and a mean confidence of 1.75. Therefore, it would appear that adult listeners were capable of accurately identifying the speakers used in this experiment as either Welsh or Scottish, but were not significantly capable of making any finer distinctions within the Scottish accents.

### Procedure

The procedure was the same as that used in Experiment 1, apart from the replacement of the West Country recordings with the Scottish recordings, resulting in Welsh and Scottish familiarization conditions.

### Results and discussion

Figure 2 shows infants' mean looking times for the Scottish and Welsh accent passages, with an average looking time of 8.19 sec ($SD = 3.46$)

for the familiarized accent, and 7.93 sec ($SD$ = 3.25) for the nonfamiliarized accent. Of the 20 infants tested, 10 had longer looking times for the familiarized accent than the novel accent, with six out of 10 infants familiarized with the Welsh English speech showing longer looking times to that accent, and four out of 10 infants familiarized with the Scottish speech showing longer looking times to that accent.

A 2 × 2 repeated measures ANOVA was carried out on the average looking times with a within-participants variable of accent status (familiar dialect, novel dialect) and a between-participants variable of language of familiarization (Welsh English first, Scottish English first). The results of this ANOVA showed that neither accent status, $F(1, 18) < 1$, nor language of familiarization, $F(1, 18) < 1$, were significant, and that there was no significant interaction between these two factors, $F(1, 18) = 1.11$ (all $p$s $> .05$).

The results of Experiment 2 fail to indicate that 5-month-old infants discriminate between two nonnative regional varieties of their native language. When combined with the results of Experiment 1, this suggests that, at this age, the task for infants to discriminate between nonnative regional accents is more difficult than discriminating their own native regional accent from a nonnative regional one.

However, another interpretation is that the perceptual distance between Welsh and Scottish accents is less than that between West Country and Welsh accents, a possibility that could account for the pattern of results obtained so far. It could also be that having people from Glasgow and Edinburgh among our Scottish speakers might have increased the variability within this accent, which resulted in infants being unable to extract a unique representation of these passages, which in turn resulted in no significant discrimination between accents.

One way to evaluate these possibilities was to ask a group of native English adult listeners with no particular exposure to either of these accents to rate accent similarity and origin. For that purpose, we tested a group of college-aged native American adults from Virginia. If South-West English differs more from Welsh English than Scottish English differs from Welsh English, one would expect American listeners to rate Welsh and South-West English as more distant than Welsh English and Scottish English. This origin identification task was introduced to verify that listeners who had no particular exposure to either of these accents would confuse Welsh English and Scottish as often as they would South-West English and Welsh English.

Eleven female psychology students at Virginia Tech (USA) with a mean age of 20.8 years (range 19–23) were tested in an accent similarity test immediately followed by an accent identification task. Then they were asked to provide questionnaires with respect to native language experience and experience with British/Welsh/Scottish accents. On that basis, one participant

was discarded because she had spent 1 year in London recently. The remaining 10 had had no significant exposure with British accents other than through the media, apart from one who had spent 1 week in Scotland and 1 week in London, and one who had some British friends.

All listeners were presented with the 24 recorded passages (eight per accent) arranged in 12 pairs. Among these 12 pairs, six were repetitions of the same accent (two of each of the following combinations: South-West/South-West, Scottish/Scottish, Welsh/Welsh), and six were made up of two different accents (South-West/Scottish and the reverse, South-West/Welsh and the reverse, Welsh/Scottish and the reverse). Within a given pair, the speakers were always different for the two passages. Order of presentation and identity of the speakers were randomized across participants. Participants were instructed that they would be presented with passages spoken by females from Great Britain, who spoke similar or different accents. The task was to judge the similarity between the accents of the two speakers of each pair on a scale from 0 to 4 (0 corresponded to "Accents are exactly the same" and 4 to "Accents are very different from each other"). Following this, an accent identification task was used, in which participants were presented with the same 24 passages, this time one after the other, and instructed to chose from a list of accent options (South-West, Welsh, Scottish and "I don't know"). They were also asked to rate their confidence regarding their choice on a scale from 1 to 4 (1 corresponding to "not sure at all" and 4 to "very confident"). Order of presentation of passages and accents was randomized across the participants.

Regarding the accent identification task first, results showed that listeners gave the "I don't know" response 29.6% of the time, which was equally distributed among the three accents, $F(2, 18) = 1.02$. Having excluded these responses from the data, analyses showed that listeners correctly identified accents only 38.2% of the time, with again no main effect of accent, $F(2, 20) = 1.62$. That is, the South-West accent was correctly identified at 38.7%, the Scottish accent at 45.6% and the Welsh accent at 30.2%. None of these identification scores differed from each other, neither did they differ significantly from chance level at 33%. Mean confidence was low at 1.62, with again no main effect of accent, $F(2, 18) = 2.07$, $p = .15$. This first analysis shows that American listeners do not have sufficient experience with British accents to distinguish them from each other, on the contrary to the British listeners previously tested in a similar identification task. The confusion matrix presented in Table 1 shows that nearly twice as many responses were confusions between South-West English and Welsh English ($n = 47$) as compared to confusions between Welsh English and Scottish English ($n = 27$). This is a first indication that South-West English is not perceptually more distant from Welsh English than is Scottish English.

TABLE 1
Results of the Accent Identification Task by American Adult Listeners When Presented with Pairs of British Accents

| | | *Responses* | | | |
|---|---|---|---|---|---|
| | | *West Country* | *Scottish* | *Welsh* | *I don't know* |
| Input | West Country | 24 | 6 | 24 | 26 |
| | Scottish | 16 | 31 | 14 | 19 |
| | Welsh | 23 | 13 | 18 | 26 |

This table provides the confusion matrix for this task. Each cell gives the cumulated responses across the 10 participants, with input accent as an entry and given response as an outcome.

Regarding the similarity rating task, mean rating scores (ranging from 0 to 4) were averaged across each combination of accents and displayed in Table 2.

First, on the overall the distance between same-category accents, such as Welsh/Welsh or Scottish/Scottish (mean similarity rating = 2.43), was rated similarly to that between different-category accents, such as South-West/Welsh or Scottish/Welsh—mean similarity rating = 2.53, $F(1, 9) < 1$. These results confirm that American listeners with no particular experience with British accents have difficulties hearing British accent-related differences. We also verified that there was no main effect of accent within the same accent pairs, $F(2, 18) < 1$, showing that listeners rated the three possible arrangements (South-West/South-West, Scottish/Scottish, and Welsh/Welsh) as equally distant (or close). This finding rules out the possibility that there is significantly more variability within the Scottish

TABLE 2
Results of the Similarity Rating Task by American Adult Listeners When Presented with Pairs of British Accents

| | | *Mean similarity rating* | *SD* |
|---|---|---|---|
| Same accent pairs | West Country/West Country | 2.40 | .94 |
| | Scottish/Scottish | 2.70 | .79 |
| | Welsh/Welsh | 2.20 | .71 |
| Different accent pairs | West Country/Welsh | 2.00 | 1.03 |
| | West Country/Scottish | 2.85 | .82 |
| | Welsh/Scottish | 2.75 | .63 |

Ratings range from 0 to 4, with 0 corresponding to "accents are exactly the same" and 4 to "accents are very different from each other." This table provides the mean ratings and standard deviations as a function of accent pairs.

sentences than within the other two accents, which would have prevented infants from performing a robust discrimination between Scottish and Welsh English.

Finally, we found a significant effect of accent within the different accent pairs, $F(2, 18) = 3.81$, $p = .042$, showing that the distance between Welsh English and South-West English (2.00) was rated less than that between Welsh English and Scottish (2.75) or between South-West English and Scottish (2.85).

Together with the results of the identification task, the results of the similarity rating task suggest that American listeners with little to no prior exposure to British accents found the perceptual distance between Welsh English and Plymouth English closer than between Welsh English and Scottish English, a result which does not translate into the findings of our infants' experiments. In addition, it appeared that the variability within the Scottish passages, due to having speakers from Glasgow and Edinburgh, was not perceived as significantly more important than the variability within the Welsh or the West Country passages, in terms of perceptual similarity. Therefore, the only explanation that seems to account for the discrimination results with South-West infants is an early effect of exposure to the South-West accent, which lead children to identify their most familiar variety as opposed to an unfamiliar Welsh accent (Experiment 1) and ignore the differences between the equally unfamiliar Welsh and Scottish accents (Experiment 2). However, it must be noted that these perceptual distance results are obtained from adult participants, and as such it remains possible that adults do not process accented speech like infants, weighting differently the various levels of the speech signal.

As mentioned earlier in the introduction, infants from other populations appear to show a decreasing sensitivity to accent differences from between 6 and 8 months of age (Kitamura et al., 2006a, 2006b; see also Phan & Houston, 2006, for a decline in sensitivity at least at 11 months; finally see also Floccia et al., 2009a, and Girard et al., 2008, for a study on 5-year-olds). It has been suggested that this is due to an increasing ability to ignore irrelevant surface variations and focus on phonetic similarities (see Singh, 2008), with accelerated loss of sensitivity to accents found if infants are regularly exposed to the to-be-tested accents, through the media for example (Kitamura et al., 2006b). However, closer inspection of previous Australian and American studies reveal that perhaps a different interpretation is possible.

In one series of studies (Kitamura et al., 2006a, 2006b, and Diehl et al., 2006, exp. 3), stimuli consist of the short IDS sentences ''We came in our car, didn't we?,'' ''Where's your toy?,'' ''Let's look for a game,'' ''Look at the orange bears,'' and ''Today is going to be so nice'' produced by four speakers for each accent (AuE and AmE) and then arranged as a string of

five sentences (with at least one token from each speaker) in a particular accent. So for example, for a given child, an AuE trial would consist of the sentences ''Where's your toy? Let's look for a game, etc.'' uttered by four different speakers with Australian accents. The AmE trial would consist of the same sentences in the same exact order produced by four different speakers with American accents. Therefore, by alternating presentations of familiar words and sentences in the same order, the structure of the experiment could have helped infants to maintain an abstract representation of the stimuli, ignoring surface variations, an ability reported to grow with repeated exposure (Singh, 2008). In contrast, the familiarization procedure used in the current study, in which there was greater lexical, syntactic, prosodic, and phonetic variability in the stimuli, might contribute to infants' discrimination of the accents.

In light of these concerns, we thought it necessary to re-examine accent perception between 6 and 8 months using the discrimination task used in Experiments 1 and 2. Unlike the repetition of utterance types used by Diehl et al. (2006) and Kitamura et al. (2006a, 2006b), our stimuli included a wide range of phonetically varied sentences, which did not include repetitions of the same sentences across accents so that infants' attention would not be focused on phonetic similarity.

## EXPERIMENT 3

In Experiment 1, we showed that infants were able to distinguish between their own home accent and another regional accent at 5 months of age. In this experiment, we examine whether infants' sensitivity to accents weakens as they get older, as indicated in previous studies (Kitamura et al., 2006a, 2006b; see Phan & Houston, 2006, for a decline at least at 11 months) by repeating the procedure of Experiment 1 with 7-month-old infants.

### Participants

Twenty healthy monolingual infants (10 males and 10 females) with a mean age of 7.36 months (range 5.90–8.56) participated in this study, all of whom were raised in the West Country region of England from birth, and selected on the same criteria as above. Apart from five of the infants whose parent(s) originated from the North of England, both parents of the children also originated from either the West Country or the South of England. In all cases, parents reported that the children had no significant exposure to Welsh accented speakers. Post hoc analyses showed that there was no significant effect of the parents' origins (South versus North) on the infants'

discrimination scores. Four additional infants were excluded from the study due to crying or failure to pay attention to the lights or sounds used in the experiment ($n = 2$), or because at least one parent originated from outside England ($n = 2$).

### Stimuli and procedure

As Experiment 1.

### Results and discussion

Figure 3 shows the mean looking times calculated during the test phase of both accents. Of the 20 tested infants, 13 had longer looking times toward the new over the familiarized accent, with average looking times of 6.60 sec ($SD = 2.39$) for the familiarized accent and 7.97 sec ($SD = 3.41$) for the new accent. Comparing familiarization accents, it was found that seven out of the 10 infants presented with West Country passages had longer looking times to the new accent, while for Welsh passages this dropped to six out of 10. Mean looking times were analyzed using an ANOVA with a within-participants variable of accent status (same versus new accent) and a between-participants variable of language of familiarization (West Country versus Welsh). This analysis revealed a significant effect of accent status,

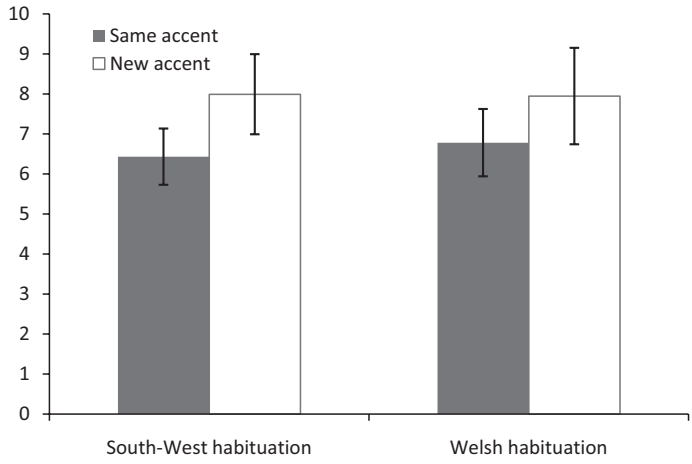


**Figure 3** Experiment 3, West Country versus Welsh English discrimination at 7 months. Average looking times in seconds to the habituated and new accent during test phase, broken down into two accent groups (accent habituated to).

$F(1, 18) = 4.48$, $p = .048$, $\eta^2 = .199$, but no significant effect of language of familiarization, $F(1, 18) < 1$, and no interaction between accent status and order or familiarization, $F(1, 18) < 1$.

The results of Experiment 3 show that 7-month-old infants from the South-West of England were still able to discriminate between their native regional accent and a nonnative regional accent, as did 5-month-olds in Experiment 1. This finding is not consistent with those of previous studies (Kitamura et al., 2006a, 2006b), which found that infants' sensitivity to accent differences weakens with increasing exposure to the native language (between the ages of 6- and 8-months). As stated earlier, this inconsistency could be due to methodological issues with the previous studies that may have biased the focus of infant's attention on phonetic similarity, rather than accent-driven differences. In this study, the presentation of multiple variable sentences with the same accent could have emphasized the within-category similarity (see Floccia, Nazzi, & Bertoncini, 2000; Madole & Oakes, 1999; Singh, 2008), and promote significant discrimination between the sentences based upon the accent of the speaker, just as was seen with our 5-month-old participants.

Directly comparing the behavior of the 5- and 7-month-old participants, it is perhaps worth noting that the 7-month-olds tended to show longer looking times to the new rather than the familiarized accent. At 5 months this trend was reversed, showing a preference for the familiarized accent. However, this reversal could well be expected following Houston-Price and Nakai's (2004) review of the factors influencing novelty versus familiarity effects in HPP-related procedures. It is now well established that habituation becomes faster as children age, which would lead to a better representation of the habituated accent in 7-month-olds, which in turn leads to a greater reaction to novelty.

## GENERAL DISCUSSION

Using an adaptation of the head turn preference paradigm, we investigated 5- and 7-month-old infants' ability to discriminate regional accents of their native language. This study expands upon the findings of Nazzi et al. (2000) in which it was found that American 5-month-olds could distinguish AmE from BE. We replicated these findings in Experiment 1, showing that 5-month-old infants from the West Country of England could discriminate their own home accent from an unfamiliar Welsh accent. In Experiment 2, we examined whether this discrimination ability was accent generic; that is whether infants could discriminate between any of the accent variations of their native language. However, it was found that 5-month-old infants did

not significantly discriminate unfamiliar Welsh and Scottish accents of English, indicating that accent discrimination at that age was limited to distinguishing their own home accent from another regional accent. This familiarity interpretation was backed up by the similarity ratings and accent identification responses obtained from adult American listeners with no particular prior exposure to British accents. These tasks showed that the Welsh accent was not rated as closer to the Scottish accent than West Country accent. Altogether, our results closely parallel the language discrimination findings reported by Nazzi et al. In that study, 5-month-olds were able to distinguish their own language from another belonging to the same rhythmic class, but not between two unfamiliar languages of the same rhythmic class.

Also, contrary to reports of a decline in American and Australian infants' ability to distinguish between varieties of English at around 6–8 months of age (e.g., Kitamura et al., 2006b), we found that the ability of 5-month-old infants to distinguish between a home and a Welsh accent also extended to 7-month-old infants. We suggested that this disparity was due to the lack of repetition and the wider, more phonetically varied, stimuli used in our experiment, directing children's attention toward accent related variance rather than phonetic invariance.

Another factor which may have influenced infants' accent discrimination was the greater between-speaker variability presented in our study (for the effects of speaker variability in early speech perception, see, e.g., Rost & McMurray, 2009, 2010; Singh, 2008). In each experiment, each child heard two speakers per accent during familiarization, and then four speakers (two per accent) during the test phase, which is similar to what was done in previous studies on language discrimination (Nazzi et al., 1998, 2000), but also in the Kitamura et al.'s preference studies. However, other language discrimination studies have presented infants with only one or two speakers (one bilingual speaker for each experiment in Mehler et al., 1988; one speaker in each language in Moon, Cooper, & Fifer, 1993) and revealed preference for the maternal language. Increased speaker variability may significantly increase cognitive load when the two accents are unfamiliar (Welsh English versus Scottish English as in Experiment 2), compared to when one of the accents is familiar (as in Experiments 1 and 3). Indeed familiarity with one of the accents might help infants to resolve between-speaker variability, or between-accent differences.

What accent-specific features are likely to enhance infants' accent discrimination? The three accents we used in this study differ on both segmental and suprasegmental information, therefore infants may have used one and/or both types of cues. In the Nazzi et al. (2000) study, the authors performed some acoustic measurements of prosodic cues, such as mean syllable duration and intonation patterns, on AmE and BE passages. They found

that BE speakers displayed more variability than AmE speakers in syllable durations, and that BE utterances were more likely to have sentence-initial pitches and terminal rises than AmE sentences. Nazzi et al.'s interpretation of their results was more in favor of a prosodic bias than the use of discriminative segmental information between AmE and BE. To verify whether prosodic differences could have explained infants' performances in the current study, we presented low-pass filtered versions of our stimuli to a pool of British native speakers, and asked them to identify them among a list of choices (West Country, Welsh, Scottish, and French[4]). Eight naive British speakers from the South of England (mean age 43 years, five females) were tested in a forced choice accent identification task. The procedure was identical to that described in the stimuli section from Experiment 1, with all passages being low pass filtered at 300 Hz using Praat (Boersma, 2001) to remove all phonetic information and preserve pitch intonation and variations. Although all participants reported that the task was very difficult, a binomial carried on the cumulated correct responses for each of the accents revealed that participants were above chance level for identifying correctly the Welsh accent (25 correct responses out of 64, $p = .013$ with chance at .25), marginally above chance for the West Country accent (23 correct responses out of 64, $p = .059$), and at chance level for the Scottish accent (21 responses out of 64, $p = .19$). This short study shows that, to a certain extent, adult listeners could make use of prosodic information to distinguish between accents, suggesting in turn that infants might have used this information to process accent characteristics and recognize their home accent. However, prosody might not be the only element that infants relied on in the current study. Recent work in the fourth author's lab with AmE and AuE found that 6-month-old American infants failed to show a preference for AuE over AmE when the utterances were low-pass filtered (400 Hz), which preserved utterance level prosody, but compromised lower-level (e.g., phonemic) information (Diehl et al., 2006). The absence of a preference for low-pass filtered AuE over AmE in 6-month-olds indicates that prosodic information alone is not sufficient to maintain differential attention to a nonnative accent. Consequently, we argue that infants potentially relied on both types of cues (prosodic and segmental) to perform accent discrimination in the current study, given that the utterances varied in terms of both segmental and suprasegmental information.

What could be the benefit of learning the maternal accent fine-grained segmental and suprasegmental properties during the first year of life? One possibility is that it would help the child define prominence in phonological

[4]As in the previous rating study, French accented sentences were used because they were presented to infants in another study.

phrases, which can be dialect-specific (e.g., Grabe, 2004). In turn, prominence location might guide infants during the bootstrapping of syntactic acquisition by indicating whether their language is head-final or head-initial (Christophe, Nespor, Guasti, & Van Ooyen, 2003). Another possibility is that children would learn to focus on accent-specific cues to word segmentation, such as intonation variation. For example Mersad, Goyet, and Nazzi (in press) have recently argued that Parisian French learning infants need more time to segment words from continuous speech than French Canadian learning infants, a consequence of the larger intonation variations in Canadian than Parisian French (Ménard, Ouellon, & Dolbec, 1999) providing more cues for word segmentation (see also Polka et al., 2008).

However, if children need to specify the prosodic and phonological system they are exposed to in order to retrieve accent-specific syntactic-related information or word segmentation cues, they also need to normalize the incoming inputs so that speech produced in an unfamiliar accent would be understood, especially at the segmental level. How do children learn to normalize accent-related variations? While there is little research that addresses this question, some studies have examined how infants achieve phonetic discrimination in the presence of orthogonal variation, such as speaker emotion (Singh, 2008; Singh, Morgan, & White, 2004) or interspeaker differences (e.g., Jusczyk, Pisoni, & Mullenix, 1992; Rost & McMurray, 2009, 2010). Using a high-amplitude sucking (HAS) procedure with an immediate or 2-min delayed stimulus change after the habituation criterion, Jusczyk et al. (1992) found that multiple speakers were detrimental to 2-month-olds' discrimination of /bug/ versus /dug/, especially in the 2-min delay condition. In a similar vein, 7.5-month-old infants could recognize familiarized target words in examples of speech across different speakers only when the speakers are of the same gender, with cross-gender familiarization only occurring at 10.5 months (Houston & Jusczyk, 2000). While these studies suggest that phonetic representations can be hindered by orthogonal speaker variation during the first 6 months of acquisition, in older children the adjunction of variability can be beneficial to the consolidation of phonological categories. For example, following the seminal report by Stager and Werker (1997) according to which 14-month-old children failed to learn new words like /bih/ and /dih/ in the Switch task (which associates presentation of pictures and labeling), Rost and McMurray (2009) hypothesized that children needed more variability in the speech stimuli in order to extract and build a robust phonological representation of the two stimuli. They replicated the study by presenting 36 tokens of each of the to-be-learned items, produced by 18 different speakers. In these conditions, the children showed evidence of word learning, suggesting that repeated exposure to language variability cannot only develop the ability

to use indexical variability in order to achieve stable phonological representations but also consolidate phonological categories (see also Floccia et al., 2000; Singh, 2008). Repeated exposure should allow the progressive abstraction of phonological representations across orthogonal indexical (accent-related) information, possibly thanks to the computation of covariates between different phonemic or prosodic cues (Singh, 2008), or because of sensitivity to the statistical distributions of sounds in their native language (Maye, Weiss, & Aslin, 2007). It is hoped that further investigations into the perception of within-language variations, such as this study, will extend our knowledge of the processes by which the robust, abstract-entries systems of lexical representations found in adults can be developed (Pallier, Colomé, & Sebastian-Gallès, 2001).

In sum, exposure to multiple or unfamiliar accents could perhaps benefit infants' language development, as it provides them with additional variability to help them extract invariant phonological information. If valid then children raised in multidialectal environments (with mother and father speaking different accents for example) could acquire phonological categories earlier than those raised in a monodialectal environment. Further research into the influence of language variety exposure onto perceptual abilities would be needed to answer this empirical question.

## ACKNOWLEDGMENTS

This research was funded by a Ph.D. Studentship grant from the EPSRC, allocated to the first author. Many thanks to Elizabeth Johnson and Thierry Nazzi who kindly provided us with the stimuli to be recorded and used in pilot research.

## REFERENCES

Boersma, P. (2001). Praat, a system for doing phonetics by computer. *Glot International*, *5*(9/10), 341–345.

Bolinger, D. L. M. (1989). *Intonation and its uses*. Stanford, CA: Stanford University Press.

Bosch, L. (1998). Bilingual exposure and some consequences on native language recognition processes at four months. In P. K. Kuhl & L. Crum (Eds.), *Proceedings of the Joint Meeting of the Acoustical Society of America and the International Conference on Acoustics* (pp. 1599–1600). Seattle: Acoustical Society of America.

Bosch, L., & Sebastián-Gallés, N. (1997). Native-language recognition abilities in 4-month-old infants from monolingual and bilingual environments. *Cognition*, *65*, 33–69.

Christophe, A., Nespor, M., Guasti, M. T., & Van Ooyen, B. (2003). Prosodic structure and syntactic acquisition: The case of the head-direction parameter. *Developmental Science*, *6*, 211–220.

Clopper, C. G., & Pisoni, D. B. (2004). Homebodies and army brats: Some effects of early linguistic experience and residential history on dialect categorization. *Language Variation and Change*, *16*(1), 31–48.

Cooper, R. P., Abraham, J., Berman, S., & Staska, M. (1997). The development of infants' preference for motherese. *Infant Behavior and Development*, *20*(4), 477–488.

Cooper, R. P., & Aslin, R. N. (1990). Preference for infant-directed speech in the first month after birth. *Child Development*, *61*, 1584–1595.

Cruttenden, A. (1995). *Intonation*. Cambridge, UK: Cambridge University Press.

Diehl, M., Varga, K., Panneton, R., Burnham, D., & Kitamura, C. (2006, June). *Six-month-old infants' perception of native speech accent*. Paper presented at the annual meeting of the XVth Biennial International Conference on Infant Studies, Kyoto, Japan.

Fernald, A. (1985). Four-month old infants prefer to listen to motherese. *Infants Behavior and Development*, *8*(22), 181–195.

Floccia, C., Butler, J., Girard, F., & Goslin, J. (2009a). Categorisation of regional and foreign accent in 5 to 7-year-old British children. *International Journal of Behavioral Development*, *3*(4), 366–375.

Floccia, C., Butler, J., Goslin, J., & Ellis, L. (2009b). Regional and foreign accent processing in English: Can listeners adapt? *Journal of Psycholinguistic Research*, *38*(4), 379–412.

Floccia, C., Goslin, J., Girard, F., & Konopczynski, G. (2006). Does a regional accent perturb speech processing? *Journal of Experimental Psychology: Human Perception and Performance*, *32*, 1276–1293.

Floccia, C., Nazzi, T., & Bertoncini, J. (2000). Unfamiliar voice discrimination for short stimuli in newborns. *Developmental Science*, *3*(3), 333–343.

Girard, F., Floccia, C., & Goslin, J. (2008). Perception and awareness of accents in young children. *British Journal of Developmental Psychology*, *26*, 409–433.

Grabe, E. (2004). Intonational variation in urban dialects of English spoken in the British Isles. In P. Gilles & J. Peters (Eds.), *Regional variation in intonation* (pp. 9–31). Tuebingen: Niemeyer.

Houston, D. M., & Jusczyk, P. W. (2000). The role of talker-specific information in word segmentation by infants. *Journal of Experimental Psychology: Human Perception and Performance*, *26*, 1570–1582.

Houston-Price, C., & Nakai, S. (2004). Distinguishing novelty and familiarity effects in infant preference procedures. *Infant and Child Development*, *13*, 341–348.

Hughes, A., & Trudgill, P. (1988). *English accents and dialects: An introduction to social and regional varieties of British English*. London: Edward Arnold (Publishers) Ltd.

Jusczyk, P. W., & Aslin, R. N. (1995). Infants' detection of the sound patterns of words in fluent speech. *Cognitive Psychology*, *29*, 1–23.

Jusczyk, P. W., Pisoni, D. B., & Mullenix, J. (1992). Some consequences of stimulus variability on speech processing by 2-month-old infants. *Cognition*, *43*(3), 253–291.

Kinzler, K. D., Dupoux, E., & Spelke, E. S. (2007). The native language of social cognition. *The Proceedings of the National Academy of Sciences of the Unitet States of America*, *104*, 12577–12580.

Kitamura, C., Panneton, R., Diehl, M., & Notley, A. (2006a). Attuning to the native dialect: When more means less. In *Proceedings of the Eleventh Australian International Conference on Speech Science & Technology* (pp. 124–129). Auckland, New Zealand: Australasian speech.

Kitamura, C., Panneton, R., Notley, A., & Best, C. (2006b). Aussie, Aussie, Aussie, Oi-Oi-Oi: Infants love an Australian accent. *Proceedings of the conference of the Journal of the Acoustical Society of America*, *120*(5), 3135.

Madole, K. L., & Oakes, L. M. (1999). Making sense of infant categorization: Stable processes and changing representations. *Developmental Review*, *19*, 263–296.

Maye, J., Weiss, D. J., & Aslin, R. N. (2007). Statistical learning in infants: Facilitation and feature generalization. *Developmental Science*, *11*, 122–134.

Mayo, C., Aylett, M., & Ladd, D. R. (1997). Prosodic transcription of Glasgow English: An evaluation study of GlaToBi. In A. Botinis, G. Kouroupetroglou, & G. Carayiannis (Eds.), *Proceedings of the ESCA workshop on intonation: Theory, models, and applications* (pp. 231–234). Athens: ESCA and The University of Athens.

Mehler, J., & Christophe, A. (1995). Maturation and learning of language in the first year of life. In M. S. Gazzaniga, (Ed.), *The cognitive neuro-sciences: A handbook for the field* (pp. 943–954). Cambridge, MA: MIT Press.

Mehler, J., Jusczyk, P. W., Lambertz, G., Halsted, N., Bertoncini, J., & Amiel-Tison, C. (1988). A precursor of language acquisition in young infants. *Cognition*, *29*, 143–178.

Ménard, L., Ouellon, C., & Dolbec, J. (1999). Prosodic markers of regional group membership: The case of the French of Quebec versus France. In J. J. Ohala, Y. Haseyaka, M. Ohala, D. Granville, & A. C. Bailey (Eds.), *Proceedings of the 14th International Congress of Phonetic Sciences*, San Francisco (pp. 1601–1604). Berkeley: University of California.

Mersad, K., Goyet, L., & Nazzi, T. (in press). Cross-linguistic differences in early word form segmentation: A rhythmic-based account. *Journal of Portuguese Linguistics*.

Moon, C., Cooper, R. P., & Fifer, W P. (1993). Two-day-olds prefer their native language. *Infant Behaviour and Development*, *16*(4), 495–500.

Nazzi, T., Bertoncini, J., & Mehler, J. (1998). Language discrimination by newborns: Toward an understanding of the role of rhythm. *Journal of Experimental Psychology: Human Perception and Performance*, *24*(3), 756–766.

Nazzi, T., Jusczyk, P. W., & Johnson, E. K. (2000). Language discrimination by English learning 5 month olds: Effects of rhythm and familiarity. *Journal of Memory and Language*, *43*, 1–19.

Pallier, C., Colomé, A., & Sebastian-Gallès, N. (2001). The influence of native-language phonology on lexical access: Concrete exemplar-based vs. abstract lexical entries. *Psychological Science*, *12*(6), 445–449.

Phan, J., & Houston, D. M. (2006, June). *Infant dialect discrimination*. Paper presented at the annual meeting of the XVth Biennial International Conference on Infant Studies, Kyoto, Japan.

Polka, L., Proulx, J., Mersad, K., Iakimova, G., Sundara, M., & Nazzi, T. (2008, March). *Speech segmentation in French-learning infants: Language-specific and dialect-specific patterns*. Presentation at the XVIth International Conference on Infant Studies, Vancouver, Canada.

Ramus, F., Hauser, M. D., Miller, C., Norris, D., & Mehler, J. (2000). Language discrimination by human newborns and by cotton-top tamarin monkeys. *Science*, *288*, 349–351.

Roder, B. J., Bushnell, E. W., & Sasseville, A. M. (2000). Infants' preference for familiarity and novelty during the course of visual processing. *Infancy*, *1*, 491–507.

Rost, G. C., & McMurray, B. (2009). Speaker variability augments phonological processing in early word learning. *Developmental Science*, *12*(2), 339–349.

Rost, G. C., & McMurray, B. (2010). Finding the signal by adding noise: The role of non-contrastive phonetic variability in early word learning. *Infancy*, *15*(6), 680–635.

Saffran, J. R., Aslin, R. N., & Newport, E. L. (1996). Statistical learning by 8-month old infants. *Science*, *274*, 1926–1928.

Schöner, G., & Thelen, E. (2006). Using dynamic field theory to rethink infant habituation. *Psychological Review*, *113*(2), 273–299.

Singh, L. (2008). Influences of high and low variability on infant word recognition. *Cognition*, *106*, 833–870.

Singh, L., Morgan, J. L., & White, K. S. (2004). Preference and processing: The role of speech affect in early spoken word recognition. *Journal of Memory and Language*, *51*, 173–189.

Stager, C., & Werker, J. (1997). Infants listen for more phonetic detail in speech perception than in word-learning tasks. *Nature*, *388*, 381–382.

Walters, J. R. (2001). English in Wales and a ''Welsh Valleys'' accent. *World Englishes*, *20*(3), 285–304.

Wardhaugh, R. (1992). *An introduction to sociolinguistics* (2nd ed.). Oxford: Blackwell.
Wells, J. C. (1982). *Accents of English, volume 1: An introduction*. Cambridge: Cambridge University Press.

## APPENDIX

Passages recorded for discrimination task

| | |
|---|---|
| 1A | The young boy got up quite early in order to watch the sun rise. |
| | This supermarket had to close due to economic problems. |
| | The committee will meet this afternoon for a special debate. |
| | Having a big car is not something I would recommend in this city. |
| | Mothers usually leave the maternity unit 2 days after giving birth. |
| 1B | The next local elections will take place during the winter. |
| | Some more money will be needed to make this project succeed. |
| | Artists have always been attracted by the life in the capital. |
| | Your welcome speech will be delivered without the press offices' agreement. |
| | The latest events have caused an outcry in the international community. |
| 2A | The local train left the station more than 5 minutes ago. |
| | The first flowers have bloomed due to the exceptional warmth of March. |
| | Trade unions have lost a lot of their influence during the last 10 years. |
| | The green partys' unexpectedly gained strong support from middle class people. |
| | This is the first time an international exhibition takes place in this town. |
| 2B | In this case the easier solution seems to appeal to the court. |
| | The last concert given at the opera was a tremendous success. |
| | They didn't hear the good news until last week on their visit to their friends. |
| | This years' Chinese delegation was not nearly as impressive as last years. |
| | In spite of technical progress predicting the weather is still very difficult. |
| 3A | The art gallery in this street was opened only last week. |
| | In this famous coffee shop you will eat the best doughnuts in town. |
| | Most European banks close extremely early on Friday afternoons. |
| | The government is planning a reform of the educational program. |
| | The recent rainfall has caused very severe damage in the higher valleys. |
| 3B | A hurricane was announced this afternoon on the TV. |
| | This rugby season promises to be a very exciting one. |
| | Science has acquired an important place in western society. |
| | The rebuilding of the city started the very first day after the earthquake. |
| | It is getting very easy nowadays to find a place in a nursery school. |
| 4A | My grandparents' neighbour is the most charming person I know. |
| | Nobody noticed when the children slipped away just after dinner. |
| | The library is open every day from 8 am to 6 pm. |
| | The city council has decided to renovate the medieval center. |
| | Seven paintings of great value have recently been stolen from the museum. |
| 4B | The parents quietly crossed the dark room and approached the boys' bed. |
| | Finding a job is difficult in the present economic climate. |
| | There is an important market twice a week on the main square of the village. |
| | The woman over there is an eminent specialist in plastic surgery. |
| | Most of the supporters of the football club had to travel for an entire day. |