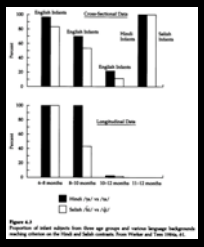
Psych 229: Language Acquisition

Lecture 10

Speech Perception Continued

Werker (1995): Speech Perception

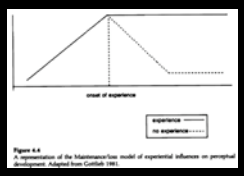


Werker (1995): Speech Perception

Maintenance & Loss Theory

"What can we conclude from these findings? First, infants stop being "universal listeners" for phoneme distinctions by the end of the first year of life. Second, it appears that the role of experience is to "maintain" those perceptual sensitivities that are already evident in the young infant. Without such exposure, initial abilities will be lost.

The role of experience is to maintain sensitivity to only those phonemes that the infants hears. Sensitivity to nonexperienced (nonnative) contrasts declines and/or disappears."



Werker (1995): Speech Perception

A problem

If it doesn't sound like speech, adults can tell the difference. Werker & Tees (1984) with truncated portions of syllables of non-native contrasts.

Non-linguistic perception

Pisoni et al. 1982, Werker & Logan 1985: adults can be trained if given enough trials or tested in sensitive procedures with low memory demands

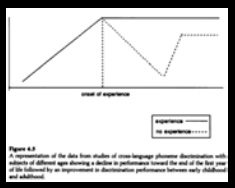
Can be taught

Maintenance & Loss predicts age-related decline should be absolute

Werker (1995): Speech Perception

Another problem

Decline and then recovery (after 4 years old) should never happen.



And another

Some non-native contrasts are easy for older infants adults to discriminate. (Click languages (Zulu) - click sounds like "tsk tsk" nonspeech)

	Dental	Alveolopalatal	Alveolar lateral
Voiceless unaspirated velar plosive	k|á:gà 'to whitewash'	k|á:k|á 'to undo'	k|á:gà 'put into a fix'

http://hctv.humnet.ucla.edu/departments/linguistics/VowelsandConsonants/course/chapter6/zulu/zulu.html

Werker (1995): Speech Perception

Is just hearing examples of the sounds in the input enough?

Pegg & Werker (1994): adult English speakers to English 6-8 month olds and 10-12 month olds on systematic allophonic distinctions in English ("t" in top vs. "t" in stop)

stop top

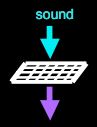
..top

Conditioned Head Turn Procedure: adults & 6-8 month olds notice difference, but 10-12 month olds don't

Apparently not…

Werker (1995): Speech Perception

Another theory: functional reorganization
Changes attested experimentally reflect operation of postperceptual processes that kick in for language



Explanatory power: the whole story
Very young infants respond to any detectable phonetic variation - so can pick up any salient ones in surrounding language. Adults have bias for phonemic information since those are the ones relevant to language. If in non-language setting, can tell the nonphonemic differences.

But why can't 12 month olds (up to 4 year olds) do the same?

Werker (1995): Speech Perception

The connection with word-learning

Starting at around 1 year of age, infants are poised to begin to learn words, a task they will devote considerable energy to over the next several years. A language-specific bias to attend to only those differences that are used to contrast meaning in the native language will help the child map sound on to meaning. Sensitivity to too much variation could result in errors, making the child map different meanings on to different productions of a single phoneme. Attention to just that variation that is phonemic in the native language would protect the child from this kind of error and would make the word-learning process that much more efficient.


Adults already have their vocabularies fairly stable

Adults, whose vocabularies are well established and relatively stable, have the cognitive "distance" and strategic skills to listen for whatever information is required in a particular task. Thus, if the task requires listening to nonnative phonetic distinctions, the adults will—with varying amounts of practice or training—be able to demonstrate such an ability.

Linking to the critical period

Similarly, young children moving to a new linguistic environment would have the auditory sensitivity to listen to the relevant phonetic detail to acquire words in their new language. This could account for the finding that young children can move into a new language environment and acquire a second language accent-free.

Werker (1995): Speech Perception

But a slight problem, with respect to the critical period…there *is* one
Functional reorganization would imply continued flexibility throughout life. Maybe the problem is that there's a difference between perceptual accent (ability to perceive non-native differences) and productive accent (ability to produce non-native differences).

Could be a separate critical period for each.

Also a problem with word-learning connection - kids don't seem to show phonetic distinction when word-learning
12-18 month olds treat "dog" and "bog" as the same.

"dog" or "bog"

Werker (1995): Speech Perception

A possible out
Maybe kids overgeneralize in what word forms can be - if they don't need a distinction to separate words in their (very small) lexicon, they don't use it.

Barton (1976): 2 year olds can distinguish phonemic-contrastive words if they're very familiar - "pear" vs "bear"


Idea: Only represent the level of phonetic detail required to distinguish words in lexicon

Prediction: Performance on discrimination correlates with vocabulary size and contents?

Werker & Tees (2002): Speech Perception Decline Trajectory

When do infants lose the ability to distinguish phonetic contrasts from other languages?

Experiment 1: Salish contrasts [language = native American Thompson]

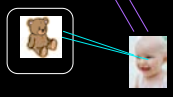
The consonantal system of this language has two contrasting series of back stops, including plain and glottalized versions of rounded and unrounded sounds. These are variously called velars (*k*'s) and uvulars (*q*'s) or pre- and postvelar sounds (Mayes, 1979). In English, there is no distinction between back consonants, in that only velar stops carry phonemic significance. The Thompson pair chosen contrasts glottalized velar and glottalized uvular sounds, /kǐ/-/qǔ/. English infants, English adults, and Thompson adults were compared on their ability to discriminate the non-English, Thompson contrast, /kǔ/-/qǔ/.

The English contrast used was the place of articulation distinction, /ba/-/da/, in which bilabial and alveolar voiced stop consonants are differentiated. Four exemplars of /ba/ and four exemplars of /da/ were used.

Werker & Tees (2002): Speech Perception Decline Trajectory

ba…ba…ba…ba… da…

Head Turn Paradigm

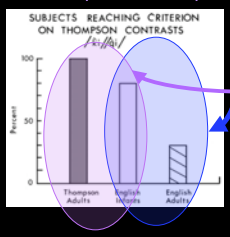


How do we know failure to discriminate is due to not being able to hear the non-native difference and not for some other reason?

The criterion for successful discrimination was 8 out of 10 correct responses to change trials with no more than two errors (i.e., two misses or two false positives).[1] The criterion for deciding an infant could not discriminate a contrast had two phases. First, the infant had to successfully discriminate /ba/-/da/ directly before and after failing to reach criterion on a non-native contrast. This was done to ensure that the failure of the infant was due to an inability to readily perceive the sound difference, and was not due to non-specific factors such as boredom, dirty diapers, etc. Two infants (1 male, 1 female) were eliminated from further analysis because they failed this phase. Second, the infant was given 25 change trials on the non-native contrast in their unsuccessful attempt to reach criterion. Adults were also given 25 change trials in which to reach criterion.

Werker & Tees (2002): Speech Perception Decline Trajectory

6-month old performance compared to adults



Significantly different (X^2)

Not significantly different (X^2)

Werker & Tees (2002): Speech Perception Decline Trajectory

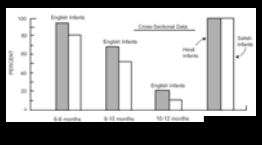
When do infants lose this ability?

The second experiment was designed to establish the developmental time period in which the decline in speech discriminative ability occurred. In this endeavor, subjects were tested on both the Thompson /ka/-/qa/ contrast, as well as on one of the Hindi contrasts (/ta/-/ʈa/) employed in our earlier research (Werker et al., 1981). Two contrasts were used to increase our confidence in the generality of any results we might obtain.

Table 1
Infant discrimination performance on two non-English speech contrasts

Reached criterion	6–8 months	8–10 months	10–12 months
The retroflex/dental contrast /ta/-/ʈa/			
Yes	11	8	2
No	1	4	8
The velar/uvular contrast /ka/-/qa/			
Yes	8	8	1
No	2	6	9

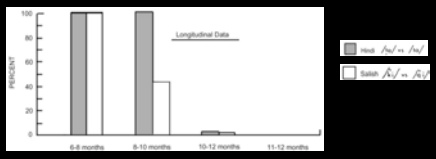
all differences significant



Werker & Tees (2002): Speech Perception Decline Trajectory

Expt 2: How about a within-subjects comparison, just to make sure?

Six subjects, 3 males and 3 females, were tested successively at three ages. Subjects were chosen who were particularly cooperative in the procedure at 6–8 months of age, in the hope that these same subjects would be relatively more cooperative at 10–12 months of age.



Werker & Tees (2002): Speech Perception Decline Trajectory

Why is losing the ability to discriminate useful?

Real life is messy: need functionally useful categories

Links to the more abstract system of phonology

In addition, highly refined infant discriminative abilities followed by a selective loss (and/or broadening) of category boundaries could facilitate the learning of particular languages and dialects by allowing for the selective tuning of initial sensitivities in accordance with a specific phonology. It is probably no accident that this decline, or tuning, occurs at about the age that the child is beginning to understand and possibly produce sounds appropriate to his/her native language. It could be expected that this perceptual reorganization is closely related to the acquisition of phonological contrasts.

Dietrich, Swingley, & Werker (2007): What Is Contrastive

But losing the ability to discriminate isn't all there is to it…

This early devel-opment is shown when infants begin to lose the ability to differ-entiate some of the speech sounds their language does not use, while retaining or improving discrimination of language-relevant sounds. However, this aspect of early phonological tuning is not sufficient for language learning. Children must also discover which of the phonetic cues that are used in their language serve to signal lexical distinctions.

Not everything should be viewed as informative…at least for word segmentation

Many phonetic properties of speech remain discriminable to infants even when the native language does not use those properties to distinguish words. For example, pitch variation is a salient phonetic property of speech but is not used systematically in English for marking different words (in contrast to "tone" languages, like Mandarin, in which syllables comprising the same phonetic segments have wholly different meanings depending on their tone). Vowel duration is another example. Vowel duration is a salient phonetic property that is used to distinguish words in some languages (such as Japanese and Finnish) but not others (such as English and French).[9] For cases like pitch and duration variation, the problem to be solved is not about ignoring variation, but assigning it the correct linguistic function. English vowel duration, for example, is used in signaling linguistic stress (6, 7), and assigning prosodic structure (8–10), speech features children must learn to understand and produce (11–13).

Looking at 18-month olds

However, 18-month-olds are less constrained than older children in their willingness to interpret nonlinguistic symbols like gestures, pictographs, and even beeps as if they were words (ref. 17; see also ref. 14), suggesting that they might also interpret salient phonetic variation as signaling a lexical distinction even if this interpretation was not licensed by the language's phonology.

Dietrich, Swingley, & Werker (2007): What Is Contrastive

Dutch vs. English vowel lengthening

Ex: tam vs. taam

Surrounding linguistic environment has different information

Phonetic studies suggest that differences between the long and short vowels of Dutch are larger than any analogous differences for English (22).

Dutch motherese doesn't have lengthening

Informally, as well, Dutch native speakers consistently affirm that the ad libitum vowel lengthening characteristic of American English infant-directed speech (*Where's the baaaall?*) is not natural in Dutch, and is excluded for words containing the [u] vowel (presumably because such lengthening would change the vowel's phonological category, or at least render the vowel ambiguous).

Prediction (if linguistic environment influences)

Dutch learners should interpret vowel duration as lexically contrastive in low vowels; English learners should not, even though at this age they readily discriminate vowels varying in duration (R. Mugitani, F. Pons, C.D., J.F.W., and S. Amano, unpublished data).

More specifically…

18-month-olds have phonological systems that support interpretation of phonetic variation according to the demands of the native language, we would expect Dutch learners, but not English learners, to treat vowel-duration variants as different words. Alternatively, if children use any salient phonetic variation as indicating lexical contrast, learners of both languages should interpret vowel duration as signaling two words.

Dietrich, Swingley, & Werker (2007): What Is Contrastive

Experiment Methodology

Word learning was tested by using the Switch procedure, a habituation method that permits within-subjects comparison of responses to novel and familiar pairings of auditory stimuli with visual stimuli (24). Children were habituated to two scenes: one in which a novel object was named using varied tokens of a particular syllable, and one in which a different novel object was named using varied tokens of a different syllable. Upon habituation, children were presented with four test trials. On two of these trials (the "same" or baseline trials), children viewed the same word–object pairings shown during habituation. On two other test trials (the "switch" trials), children viewed audiovisual scenes in which the word–object pairings were swapped.

…this is a *tam*…look at the *tam*

Same:
look at the *tam!*

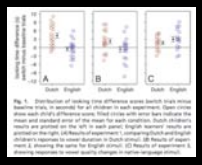
Switch:
look at the *taam!*

Three experiments were conducted, each with separate samples of Dutch-learning and English-learning children. In each experiment, children were habituated to two alternating audiovisual scenes: one moving object with repeated presentation of a word, and a second moving object with repeated presentation of another word. The object films were the same in all studies. Auditory stimuli are described in more detail in Methods.

Dietrich, Swingley, & Werker (2007): What Is Contrastive

Table 1. Children's mean and (standard deviation) looking times, in seconds, for the Switch and Baseline trials in each of the three experiments

Exp	Contrast	Child's language	Switch Mean	Switch SD	Baseline Mean	Baseline SD
1	Dutch duration	Dutch	9.23	3.55	5.04	3.14
1	Dutch duration	English	6.66	3.09	7.15	2.36
2	English duration	Dutch	8.16	3.49	5.92	2.94
2	English duration	English	7.34	3.97	8.04	4.29
3	Dutch quality	Dutch	5.72	2.59	4.08	1.98
3	English quality	English	9.31	3.78	6.31	2.99



Thus, by 18 months, Dutch and English learners treated vowel duration differently in word learning. Dutch learners kept track of the linkage between a given object and a long-vowel syllable, and another object and a short-vowel but otherwise identical syllable. No such effects were found in the English learners, suggesting the influence of the native-language phonology.

Dietrich, Swingley, & Werker (2007): What Is Contrastive

So why does this happen?
One Idea: Related to vocabulary

Minimal pairs?
stat vs. staat in Dutch
bet vs. beat in English

But how many contrastive words do 18-month olds know?

Apparently, not many…

One frequently raised hypotheses about phonological category learning is that it is driven by contrast in the vocabulary. Dutch children might learn that [ɑ] and [aː] are different because (for example) the words [stɑt] ("city") and [staːt] ("stands") mean different things and are thus used in different contexts. This hypothesis would be supported by evidence that children know such "minimal pair" words by 18 months. However, children that young do not seem to know many word pairs that could clearly indicate a distinction between [ɑ] and [aː]. The Dutch version of the MacArthur–Bates Communicative Development Inventory (CDI) (27, 28), which contains >500 of children's most frequently learned early words, contains no [ɑ–aː] minimal pairs at all. Analysis of 10 children in the Leveli–Fikkert database of Dutch toddlers' speech (29, 30) revealed only one child <21 months of age who was recorded saying any two words whose canonical forms contrasted only in these vowels, and both of these word tokens, which occurred several weeks apart, were coded as imitations rather than spontaneous speech. Finally, a 25,000-word corpus of Dutch infant-directed speech (31) contains only two contrasting pairs: one pair consisting of an adult's nickname and the function word [ɑn] (a preposition and part of a construction indicating the present progressive); and the other pair consisting of the words [slɑp] ("bib") and [slaːp] ("sleep"). Whereas each of these three sources represents only a sample of the likely vocabulary knowledge of the typical Dutch 18-month-old, it seems reasonable to question whether the very consistent contrastive interpretation revealed by the Dutch children in the present experiments could rest on so faint a foundation.

Dietrich, Swingley, & Werker (2007): What Is Contrastive

So why does this happen?
Another Idea: Related to data distribution of phonetic information

The other current hypothesis is that children begin to induce phonological categories "bottom-up," based on their discovery of clusters of speech sounds in phonetic space using perceptual category induction mechanisms (e.g., see ref. 32). Some kind of distributional learning mechanism is undoubtedly implicated in infants' early phonetic category learning, which begins before infants know enough words for the vocabulary-based hypothesis to be feasible (33–35); see refs. 1 and 36 for proposed learning mechanisms). Note, though, that this language-specific perceptual tuning does not necessarily yield categories that are interpreted phonologically; it is a matter of some debate how the phonetic categories that are learned bottom-up then enter into the child's developing system of linguistic contrasts for use in distinguishing words (e.g., see ref. 37).

A necessary condition for such learning to be the driving force behind Dutch children's phonological interpretation in the present studies is that long and short vowels be more clearly separable in Dutch than in English.

English vowels more closely clustered than Dutch vowels

Dietrich, Swingley, & Werker (2007): What Is Contrastive

A caveat on the clustering hypothesis…

A preliminary examination of this problem using corpora of Dutch child-directed speech indicated that the set of long and short instances formed largely overlapping distributions.[2] The phonologically long vowel tends to be acoustically longer than the phonologically short vowel, but this tendency is masked by considerable variation in both categories. Given the lack of clear separation in the Dutch long and short vowels' duration distributions, children probably bring additional information to bear in determining that the [ɑ] and [aː] differ, including spectral cues to the distinction.

Discussion: What additional information would be available and helpful?