

DISJUNCTURE AS A CUE TO CONSTRUCTS

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Recent research at Haskins Laboratories has demonstrated that in a number of test situations the stress of words is more efficiently marked by change of pitch than by change of either duration or intensity. The test items involved unit morphs (*subject-subject*)¹ and derivatives (*undertaking-undertaking*);² the judgments were merely of stress vs. non-stress. Inasmuch as the structure of English words, particularly of compounds, has been identified with more than two levels of stress, it occurs to us that the relative importance of intensity should be tested in more complicated surroundings.

The test items chosen for the purpose are the presumably minimal pair *lighthouse-keeper* and *light* (with contrastive stress) *housekeeper*. The reasons for choosing them are two:

1. Spectrograms show, in addition to differences of pitch and intensity, a third factor which is conceivably significant: spacing. It is manifested in two ways: by wider or narrower gaps (intervals of relative silence) between the syllables, and by lengthening and shortening of the syllables themselves. This leads us to the hypothesis that one way in which connectedness between syllables may be signaled is by "disjuncture," which we define as 'separation of syllable centers.' It is not feasible to speak of mere 'separation of syllables,' because in an alternative pair such as *highline voltage* and *high* (contrastive stress) *line voltage* there are no interruptions, and yet the spacing is still there in the form of

lengthening.³ Such a pair, however, is not convenient for manipulation, because any attempt to vary the distance between syllable centers by cutting out or adding portions would mean altering not silences but sounds, and would degrade the sounds. The gaps in *lighthouse-keeper* vs. *light housekeeper*, made possible by the voiceless consonants, provide something that can be cut or expanded with little or no distortion. For the purpose of the experiment, disjuncture refers to separation by these gaps, although we attach no more importance to it than to separation by lengthening.

2. The *lighthouse-keeper* vs. *light housekeeper* pair has been repeatedly used in the literature to illustrate certain assumptions. According to Smith,⁴ they are to be marked, respectively, *light+house+keeper* and *light+house+keeper*, with (') signifying the loudest stress, (^) the next loudest, and (") the next, the weakest being left unmarked (these stresses are termed "primary," "secondary," "tertiary," and "weak"). The plus sign refers to internal open juncture, a manner of transition between syllables that distinguishes, e.g., an intersyllabic cluster /s+k/ from an intrasyllabic cluster /sk/. Smith's analysis is repeated by Stockwell⁵ in a criticism of Weinreich,⁶ and, in a modified form, by Chomsky, Halle, and Lukoff.⁷

* We acknowledge our recognition of this point to Professors Fred W. Householder, Jr., and J. D. O'Connor.

⁴ Henry Lee Smith, Jr., *Linguistic Science and the Teaching of English*, Cambridge, 1956, 37-43.

⁵ Robert P. Stockwell in *Language* 32.379 (1956).
⁶ Uriel Weinreich, "Stress and Word Structure in Yiddish," in Weinreich, ed., *The Field of Yiddish*; New York, 1954, 1-27.

⁷ Noam Chomsky, Morris Halle, and Fred Lukoff, "On Accent and Juncture in English," in *For Roman Jakobson* The Hague, 1956, 65-80. The Chomsky-Halle-Lukoff notation differs from the Smith notation in that it introduces an "external juncture" in *light housekeeper* (written *light = house-keeper*). This external juncture (equals sign) contrasting with internal juncture (hyphen) seems to suggest something like the varying disjunctures that are subject of our experiment, but actually are not, for the authors state: "The junctures ... do not represent physical entities, but are introduced for the purpose of reducing the number of physical features that must be considered phonemic" (66). The physical features are those noted by Trager-Smith and Newman (65 fn.), and accordingly do not involve disjuncture as we define it. In the Smith analysis, neither *lighthouse-keeper* nor *light housekeeper* contains a "phonological juncture," which distinguishes "constructions" from "constructs," and accordingly both qualify as "constructs"—the latter are defined as segments characterized by predictable patterns of stresses and "plus" junctures only. See Smith, "Superfixes and Syntactic Markers," mimeographed brochure dated 13 April 1956, esp. p. 3.

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¹ Dennis Fry, unpublished research. It is assumed that the etymological prefix here is not to be regarded as a separate morph in the treatment of Modern English.
² Dwight L. Bolinger, research in progress.

In Smith's analysis, the systems of stress and of pitch (intonation) are regarded as independent,⁸ interacting phonologically only to the extent of allophonic changes in pitch, presumably slight, conditioned by changes in stress (loudness).⁹ The minimal pair is therefore ideal for testing the reliability of intensity alone in making the distinction, since the pitch is defined as non-distinctive.

From the Smith analysis, and from our hypothesis, we derive two contrary sets of markings: one in which loudness (= intensity, under the conditions of the experiment) operates to distinguish the minimal pair by raising the intensity level of *house* above that of *keep*, or of *keep* above that of *house*; the other in which the disjuncture operates to distinguish the minimal pair by separating *light* and *house* more than *house* and *keeper*, or conversely, *house* and *keeper* more than *light* and *house*. The experiment attempts to determine whether the intensity differences are effective under two sets of conditions: (1) with disjuncture differences going counter to intensity differences, which may be called the extreme case; (2) with intensity differences carrying the burden alone and unopposed, which may be called the neutral case.

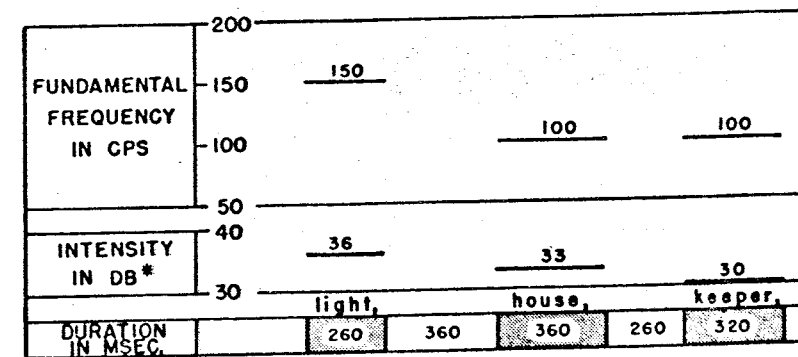
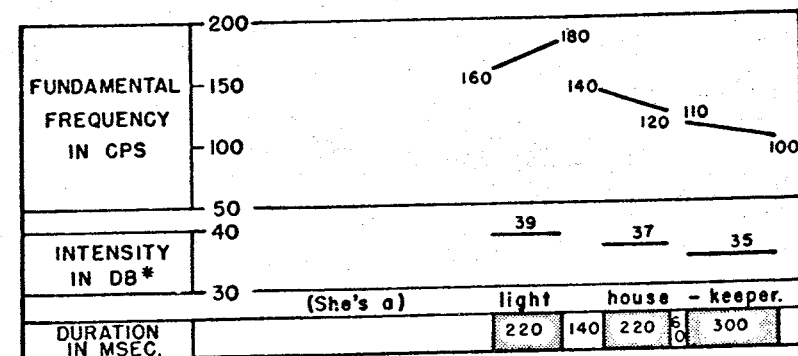
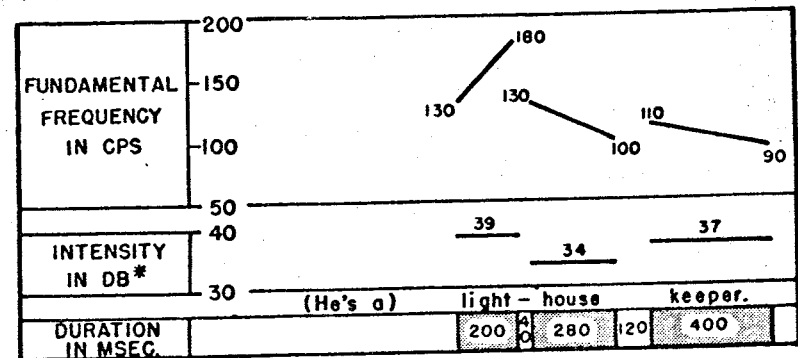
STIMULI. The original stimuli consisted of the words *light*, *house*, and *keeper*, recorded in three different contexts: M (Man) *He's a lighthouse-keeper*; W (Woman) *She's a light housekeeper*, with contrastive stress on *light*; and U (Unbiased) *light, house, keeper*, with wide pauses between the words. The M and W phrases were uttered according to the requirements of the Smith notation, and with the disjunctures as they occurred automatically, as detailed in Fig. 1.

The M version had an updash on *light* from 130 to 180 c(ycles) p(er) s(econd) and a downslide on *house* from 130 to 100; *keep* was at about 110 cps. *Keep* therefore rises somewhat above the lowest point reached in *house*, which satisfies the condition of an "allophonic" rise on the more heavily stressed syllable. The vowel in *keep* is about

⁸ Pitch phenomena are described as significant in terms of levels (four) and junctures (three), the latter occurring at transition points.

⁹ "English utterances containing more than one vowel exhibit marked differences in loudness, concentrated on the vowels." Trager and Smith, *Outline of English Structure* §1.61. Norman, Oklahoma, 1951. "There is only one component that matters—loudness." E. C. Trager, "Superfix and Sememe," *General Linguistics* 2.2 (1956).

SCHEMATIC SPECIFICATIONS OF THE ORIGINAL STIMULI



*Relative to background noise level.

Fig. 1. Measurements of the three original tape-recorded utterances. Durations, fundamental frequencies, and relative intensities (at the syllable peaks) were determined from Kay sonagrams and amplitude displays.

3 d(ei)b(els) above that of *house*. The gap between *house* and *keeper* is three times as wide as that between *light* and *house*. The words *he's a* were cut out of the tape recording before any testing was performed.

The W version had an updash from 160 to 180 cps on *light*, a downslide from 140 to 120 on *house*, with *keep* at about 110 cps. The vowel in *house* is about 2 db above that of *keep*, so that *house* is both louder and "allophonically" higher in pitch than *keep*. The gap between *light* and *house* is seen to be twice as wide as that between *house* and *keeper*. The words *she's a* were removed from the stimulus.

The U version was a control stimulus in which relative disjuncture would not be present to distinguish the two meanings.

Modified stimuli were derived from copies of the original stimuli through alterations of the disjunctures in the recordings. The gaps between the words were variously lengthened and shortened as schematized in the left-hand portion of Fig. 2. We see, for example, that the disjunctures of M were made to resemble the disjunctures of W (M→W) by increasing the gap between *light* and *house* while reducing the gap between *house* and *keeper*. M was made to resemble U (M→U) by enlarging both gaps. By means of similar alterations W was changed toward M and toward U (W→M, W→U), while U was made to resemble M and W (U→M, U→W).

There were in addition two other modified stimuli. One of these, shown at the bottom of the figure, was an attempt to see what would happen when the alterations U→M and U→W were combined. Since U→M had reduced only the gap between *light* and *house*, while U→W had reduced only the gap between *house* and *keeper*, it seemed reasonable to ask whether the reduction of both intervals would be equivalent to reducing neither interval.

The other modified stimulus was a second version of W→M, created because of the intrusion of the other feature of disjuncture, lengthening, in the production of the [s] of *house* in the original recordings. The friction portion of [s] occupied 140 m(illi)sec(onds) in M, 160 msec. in U, but only 100 msec. in W. The consequence of this was that *house* sounded too abrupt in the first version of W→M, which led us to attempt a second version wherein half the silence (100 msec.) consisted of additional [s] friction to ease the abruptness of [s]. This disparity in friction durations was

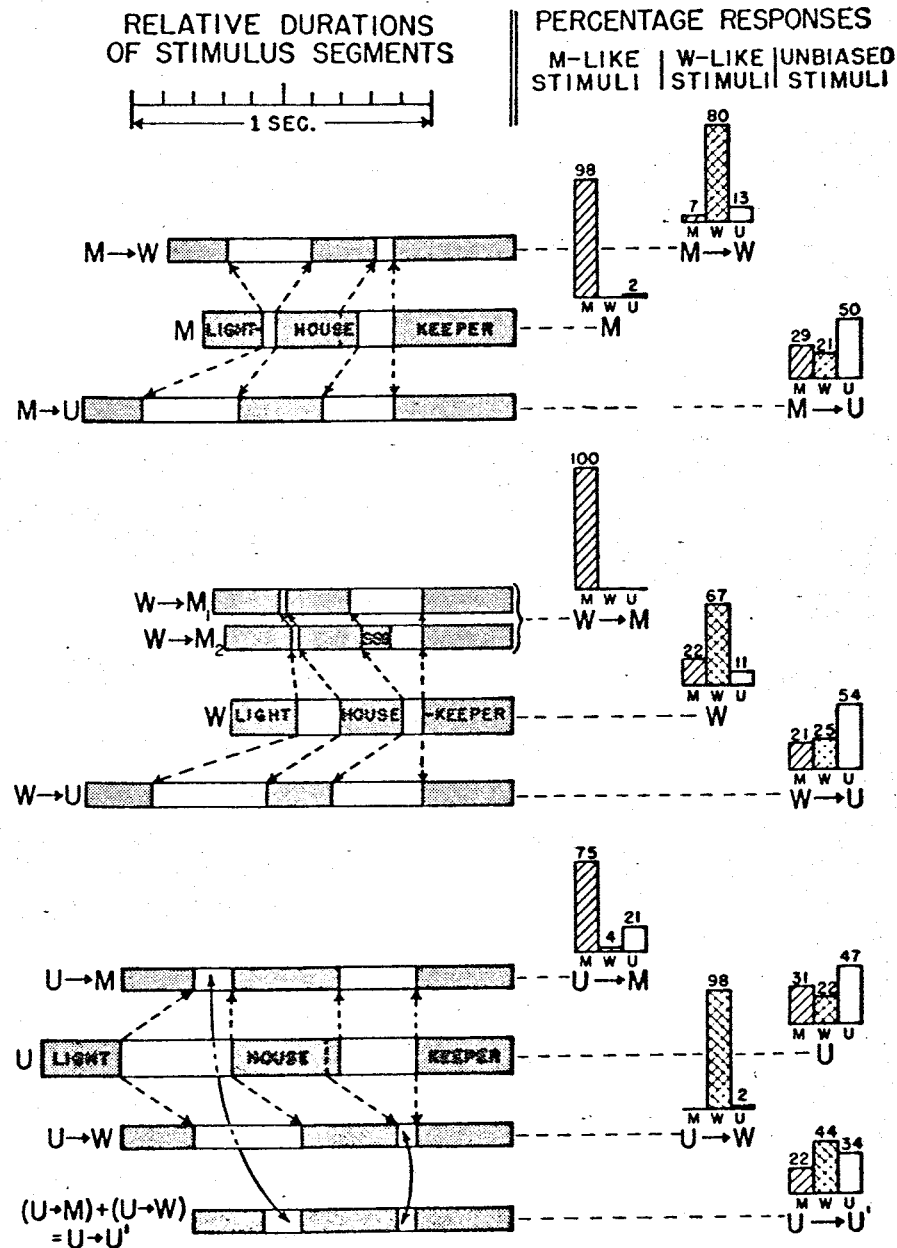


Fig. 2. Specifications and judgments of the eleven different test stimuli. As schematized at the left, the disjunctures in each of the three original utterances (M, W, and U) were modified by adding or subtracting pieces of magnetic tape to make eight new utterances. The arrows indicate these changes. The stimuli were judged to be M, W, or U utterances in proportion to the heights of the bars at the right.

also troublesome in the reverse direction, when we attempted to go from M to W and from U to W; here we simply removed some of the friction (60 msec. in M→W, 40 msec. in U→W), in each case without any degradation of the [s].

PROCEDURE. The three original and eight modified stimuli were arranged into several random orders to be judged by members of the laboratory staff on two separate occasions. With three exceptions,¹⁰ each stimulus was heard five times by nine different subjects. Listeners were instructed to judge the stimuli as *lighthouse-keeper* or *light housekeeper* (contrastive context) or, if they had real difficulty deciding, as "either." In the results that follow we have tabulated these responses as M, W, and U, respectively.

RESULTS. The results are presented in the right-hand portion of Fig. 2, where, opposite each stimulus, is shown its percentage of M, W, and U responses. The response blocks are placed in three columns corresponding to the three patterns of disjuncture. This arrangement enables us to see at once that the stimuli were judged overwhelmingly in accordance with their disjunctures rather than their sources. Intensity, even when unopposed by disjuncture (M→U, W→U), did not have an appreciable effect; there was simply an increase in the number of U responses.

Certain aspects of the experiment strengthen the case for disjuncture, and more particularly, for *relative disjuncture*, as the controlling feature. When the modified stimuli were prepared, we did not give the gaps exactly the same lengths as in the original stimuli, choosing instead to adjust them symmetrically. For example, in M→W, 233 msec. was added between *light* and *house* while 133 msec. was removed between *house* and *keeper*; in W→M₁, 133 msec. was removed from the first interval while 233 msec. was added to the second. Often the effect of these operations was to make the modified disjunctures more extreme than the originals and, as seen in the results, such stimuli yielded more response agreement than did the original stimuli.

The three stimuli derived from U establish that neither of the disjunctures is, by itself, the controlling cue: U→M and U→U' have the same first interval while U→W and U→U' have the same second interval, yet the three stimuli are heard in radically

¹⁰ U→M was heard 6 times by 8 listeners, while M→U and W→U were heard 4 times by 7 listeners.

different ways. Accordingly, we have sought some measure which would relate the two disjunctures and provide a simple description of the experiment. What seems to work best is the ratio of the interval between *light* and *house* to the interval between *house* and *keeper*.

In Fig. 3 we have arranged the stimuli in order of increasing relative disjuncture. (Values less than 1 mean that the first interval is shorter than the second; values greater than 1 mean that the first interval is longer.) Each bar represents all the responses made to a stimulus and is divided according to the distribution of judgments. We see that M responses predominate at the left, W responses at the right. In the light of this form of presentation, it is quite understandable why some of the modified stimuli should elicit a more positive response than the original stimuli.

It is apparent, from the way in which the data arrange themselves in Fig. 3, that if we attempted to apply a scale of relative intensity instead of a scale of relative disjuncture, the results would be chaotic. Even in the most favorable case of all, that of U, in which the speaker was consciously striving to produce something that would be neither M nor W, a difference of 3 db crept in; but this difference had no effect on the responses: in fact, instead of favoring W as they theoretically should if the assumptions about intensity and stress are correct, the responses favored M.

Finally, we may ask why the original W stimulus, a presumably normal utterance, was not completely effective. The answer lies, perhaps, in the test format: the stimuli were presented in isolation whereas contrastive stress usually relies on previous context to make the meaning clear. The absence of context may be thought of as an anti-W cue, requiring extreme disjuncture to be counteracted. The presence of this bias toward M should make us cautious in selecting a specific disjuncture as the dividing line between M and W responses.

CONCLUSIONS. All the modified patterns went in the direction of the modification, not only in an absolute sense but, in most instances, in proportion to the *degree* of modification. Neither in the extreme case of disjuncture opposing intensity, nor in the neutral case of disjuncture relatively balanced, did intensity appear to have the slightest influence in making the distinction.

If we insist that the type *lighthouse-keeper* is normally discrim-

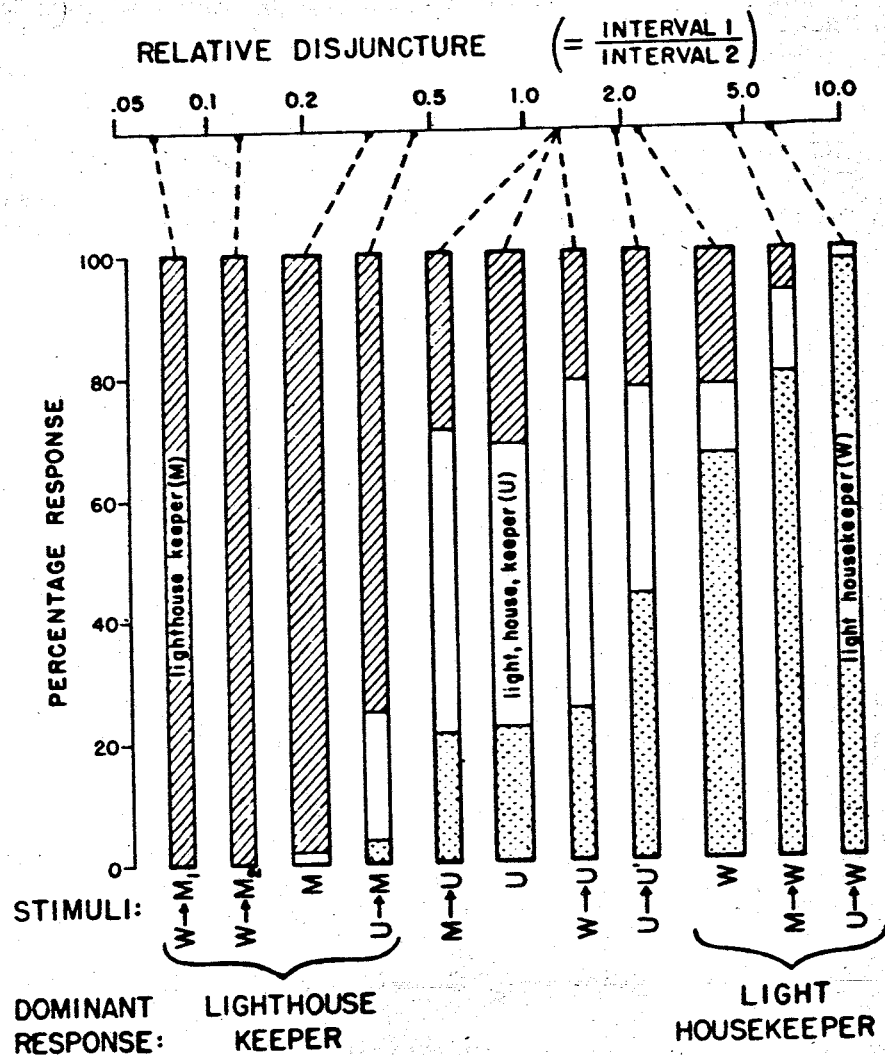


Fig. 3. The data of Fig. 2 replotted in terms of relative disjuncture. The stimuli are represented as bars, ordered according to the ratio of the interval between *light* and *house* (Interval 1) to the interval between *house* and *keeper* (Interval 2). The bars are divided in proportion to the percentage of M, W, and U judgments elicited by each stimulus.

inated by stress from the type *light housekeeper*, the experiment compels us to:

1. Re-define phonemic stress to eliminate reliance upon loudness and to place it upon disjuncture (which would seem rather like a sophistication to save a term); or,
2. Re-define loudness to eliminate reliance upon intensity and place it upon disjuncture.

The common-sense conclusion, however, is that since in *light-house-keeper* the semantic bond between *light* and *house* is closer than that between *house* and *keeper* (immediate constituents are *lighthouse/keeper*), and since the disjunctures transparently supply a physical separation whose width corresponds inversely to the semantic bond, it follows that the disjunctures function directly to carry the information, and not indirectly as components of a hypothetical stress. Rather than attempt to salvage the stresses it would seem better to reconsider the juncture complex, for it is apparent that the uniform "plus" juncture with which Trager and Smith have marked the examples has overlooked the function of disjuncture.