Studies of at least two languages, Finnish and Norwegian, have noted that stress is not placed on the penultimate syllable when the final syllable is vowel initial. Karonven (2005) found penultimate secondary stress normally in five-syllable monomorphemic words in Finnish (e.g. kó.les.te.ró.li ‘cholesterol’), but antepenultimate in the case of final hiatus, e.g. té.le.vi.si.o ‘televison.’ Lunden (2006) found penultimate stress normally on vowel-final words in Norwegian (e.g. ba.gá.fe ‘luggage’), but antepenultimate in the case of final hiatus, e.g. fór.li.e ‘foil.’ Steriade (2012) posits that this is predicted by Interval Theory, where weight domains are calculated from a vowel up to the following vowel, as in C•V.C•V• (‘•’ marks interval boundaries), since it can be seen as stress avoiding a very light weight domain (V), in favor of a bigger one (V.C).

This paper puts forward the alternative hypothesis that there is a perceptual basis for the observed stress avoidance; namely: The longer duration typically present in a stressed vowel may be more difficult to perceive directly before another vowel. Norwegian is a good test case, as a stressed vowel in an open syllable will become long, and it is plausible the configuration V•V is a type of context-sensitive markedness. A perception experiment was constructed to test the relative perceptibility of stress in hiatus by non-native speakers.

Forty three-syllable nonce words were read in Norwegian sentences by a native Norwegian speaker, with antepenultimate stress and again with penultimate stress. Twenty of the words had final hiatus (i.e. were of the shape CV.CV.V) and twenty did not (i.e. were of the shape CV.CV.CV). The final two vowels were matched across hiatus and non-hiatus words and were one of four sequences: i-a, i-o, i-e, e-a.

Forty native English speakers were given the 80 words as an MFC task in Praat (Boersma and Weenink 2015). Listeners showed a preference for identifying antepenultimate stress overall (80.3% correct antepenultimate stress identification, compared to 64.25% correct penultimate stress identification), presumably due to bias from English. As can be seen from the results in (1), there was also an overall tendency for more correct identifications when there was no final hiatus. There was, however, a significant difference between the differences of correct responses within each position \( p = 0.001; \) interaction term of stress*hiatus in Generalized Linear Model (GLIM) with response as the dependent variable (DV), fixed factors stress and hiatus, and with subject as a blocking factor).

(1) Percent of correctly-identified stress by position and hiatus-status of the nonce word

<table>
<thead>
<tr>
<th>No hiatus</th>
<th>Antepenult</th>
<th>Penult</th>
</tr>
</thead>
<tbody>
<tr>
<td>82.25%</td>
<td>67.50%</td>
<td></td>
</tr>
<tr>
<td>78.38%</td>
<td>61.00%</td>
<td></td>
</tr>
</tbody>
</table>

The fact that stress is more difficult to perceive on the penult when it is part of a hiatus supports the hypothesized perceptual motivation for avoiding stress in this configuration. While the findings are potentially compatible with Interval Theory, the durations of intervals are less consistent with the position of prominence in the word than the durations of rimes are (both measured from the single speaker used to make the perception stimuli), as shown in (2).
For example, looking at the intervals of no-hiatus words (lower left graph) there is not a large difference between the antepenultimate interval *not* under stress and the penultimate interval under stress (difference is marginally significant: $p = 0.047$; pairwise comparison from GLIM with *interval duration* as DV, factors *stress, position, hiatus*). Turning to intervals under hiatus (lower right graph), we see that penultimate intervals under stress are significantly shorter than antepenultimate intervals under either stress condition ($p < 0.001$).

(2) No hiatus: CV.CV.CV
Hiatus: CV.CV.V

Rimes (0-200ms)

Intervals (0-350ms)

The consistently notably long antepenultimate interval, due to the inclusion of the onset of the penultimate syllable, causes the vowel length difference due to stress to be obscured, as can be seen in the delineations of the sample nonce word in (3).

(3) (a) Antepenultimate stress     (b) Penultimate stress

The consistent relative strength of the antepenultimate interval regardless of stress is problematic for Interval Theory, which lacks a clear mapping from durational strength to word prominence. In the rime durations, on the other hand, the relative durational strength correlates with the prominence in the word. The results of the perception experiment suggest that avoidance of stress in the first syllable of a hiatus configuration is because of a perceptual issue, rather than being due to an avoided weight domain.