WORD NEIGHBOURS AND ONALOSIS

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This article is a partial update of my “Statistics of Word Neighbours” in the November 1997 Word Ways, and provides the facts lying behind the findings in the recent series (August 2000 through May 2001) of articles on word ladders. Two words are neighbours if they differ in a single letter. In this article, each such word is credited as having a neighbour, i.e. the link between them is counted twice (please refer to the earlier article for prior work and more information). The following table updates various parts of the article.

<table>
<thead>
<tr>
<th>Word Length</th>
<th>Average percent neighbours for each position</th>
<th>Percent onalosis</th>
<th>Percent isolanos</th>
<th>Max n'bour</th>
<th>Percent hets</th>
<th>Avg n'bour</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>778 350 571 608 - - - - - - - - - - - - -</td>
<td>71</td>
<td>0.5</td>
<td>63</td>
<td>76</td>
<td>23.0</td>
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<tr>
<td>5</td>
<td>384 165 271 245 207 - - - - - - - - - -</td>
<td>28</td>
<td>1.7</td>
<td>55</td>
<td>61</td>
<td>12.7</td>
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<tr>
<td>6</td>
<td>157 70 96 92 70 85 - - - - - - - - - -</td>
<td>3</td>
<td>8.6</td>
<td>44</td>
<td>45</td>
<td>5.7</td>
</tr>
<tr>
<td>7</td>
<td>66 28 35 36 24 21 38 - - - - - - - - -</td>
<td>0.04</td>
<td>25</td>
<td>31</td>
<td>32</td>
<td>2.5</td>
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<tr>
<td>8</td>
<td>25 12 15 13 13 9 10 22 - - - - - - - -</td>
<td>0</td>
<td>43</td>
<td>20</td>
<td>20</td>
<td>1.2</td>
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<tr>
<td>9</td>
<td>15 8 9 9 8 9 6 7 16 - - - - - - - - -</td>
<td>0</td>
<td>52</td>
<td>14</td>
<td>12</td>
<td>0.9</td>
</tr>
<tr>
<td>10</td>
<td>7 6 4 4 5 4 5 3 5 13 0 66 15 7 - - - -</td>
<td>0</td>
<td>66</td>
<td>15</td>
<td>7</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Thus, for words of length five, there are on average 3.84 words differing only in the first letter, 1.65 in the second letter, and so on. Over a quarter are onalosis (when every letter can be changed to make another word) and only 1.7 per cent are isolanos (no letters changed will make another word). At least one five-letter word has 55 neighbours, 61 per cent have all their letters different, and each word has nearly 13 neighbours on average. The very sharp drop in neighbourliness, and in heterograms, explains why ladders with given characteristics are impossible to find as the word length increases; alternatively, why short and wholly perfect ladders are ten-a-penny.

The following list of onalosis of length 7 replaces nine found earlier. I have now identified over 2500 of length 6.

<table>
<thead>
<tr>
<th>BLUNDER</th>
<th>BORDELL</th>
<th>BRANDER</th>
<th>BRECHEN</th>
<th>CARNALL</th>
<th>CASTELL</th>
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<tbody>
<tr>
<td>CENTARE</td>
<td>CHAPPER</td>
<td>CHESTON</td>
<td>COLLICE</td>
<td>COMENTE</td>
<td>CONDITE</td>
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<td>CORRAGE</td>
<td>COSTERS</td>
<td>CRISTEN</td>
<td>DELATER</td>
<td>DESPEND</td>
<td>ENGRESS</td>
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<td>FORTHER</td>
<td>FRITTER</td>
<td>GRANTER</td>
<td>HALLAND</td>
<td>HARRIER</td>
<td>MARLINE</td>
</tr>
<tr>
<td>MARRINE</td>
<td>MILLINE</td>
<td>PARTANE</td>
<td>PASTERS</td>
<td>PINNATE</td>
<td>POLITES</td>
</tr>
<tr>
<td>SCALLED</td>
<td>SERENES</td>
<td>SHALDEN</td>
<td>SHANKER</td>
<td>SHILLET</td>
<td>SHIRLEY</td>
</tr>
<tr>
<td>SLUGGED</td>
<td>SOUTHER</td>
<td>SWELLED</td>
<td>TAINTER</td>
<td>TERRANE</td>
<td>THASTER</td>
</tr>
<tr>
<td>TRISTLE</td>
<td>UNTIMES</td>
<td>WINDLES</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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The following are the nearest words of that length to an 'onalosi':

Length 8: CRAMPERS, MISTREST, STANNERS [7 letters changeable]
Length 9: DISTRAINS, ENCRESSED, ENCRESSES, MESSELINE, SWINGLING [7 changeable]
Length 10: DESCONFITS, DISCONFIDS, DYSCUMFYTS (7 changeable, see OED discomfit followed by variants of discomfit, DELECTABLE, DISCASTING, v

ariants of DYSSEISISINS
(OED under mort d'ancestor), and variants of ENCRESSING (OED under increase) [6 changeable]

The words with most neighbours, showing the neighbours by position (number of neighbours brackets) are:

Length 10:
SLATTERING (15): 1 BLATTERING CLATTERING FLATTERING GLATTERING,
2 SCATTERING SHATTERING, SKATTERING SMATTERING SNATTERING SPATTERING SWATTERING, 3 SLITTERING SLOTTERING SLUTTERING, 5 SLATHERING (as before) is followed by DISSEASING, HILLINGTON, KILLINGTON, LIDDINGTON, WILLINGTON (all 1

Length 9:
BATTERING (14): 1 HATTERING MATTERING NATTERING PATTERING TATTERING
YATTERING, 2 BETTERING BITTERING BUTTERING, 3 BANTERING BARTERING,
4 BATHERING, 6 BATTLEING BATTENING
REVELLING (14): 1 BEVELLING DEVELLING LEVELLING NEWELLING, 2 RAVELLING RIVELLING ROVELLING, 3 REPELLING REPPELLING RESELLING RETELLING,
5 REVEALING REVEILING

SLATTERED (14): 1 BLATTERED CLATTERED FLATTERED, 2 SCATTERED SHATTERED SKATTERED SMATTERED SPATTERED SWATTERED, 3 SLITTERED SLOTTER
SLUTTERED, 5 SLATHERED
followed by DISPORTED (13), BATTEREST, ENCRESSES, PATTEREST (all 12)

Length 8:
SLATTERS (20): 1 BLATTERS CLATTERS FLATTERS PLATTERS, 2 SCATTERS SHATTERS SKATTERS SMATTERS SPATTERS SWATTERS, 3 SLITTERS SLOTTERS,
4 SLAHTERS SLAHTERS SLAUTERS SLAWTERS, 5 SLATHERS, 8 SLATTEN SLATTERY
(as before) is followed by: SHARLING (19), STARLING (18), NOTATION (16), BATTERED,
PARTENER, SHEELING, SHIRLING, SWELLING (all 15)

Length 7:
SEALING (31): 1 BEALING DEALING FEALING GEALING HEALING MEALING NEALING PEALING TEALING VEALING YEALING YEALING ZEALING, 2 SCALING SHALING SPALING
STALING SWALING, 3 SEELING SEILING SELLING SETLING, 4 SEAKING SEAMING SEANIN
SEARING SEASING SEATING SEAWING, 7 SEALINE SEALINK
followed by: BARLING, CARLING, WARLING (all 29), BETTERS, SEARING (both 28)

Length 6:
COLLER (44): 1 BOLLER DOLLER FOLLER GOLLER HOLLER KOLLER LOLLER MOLLER
POLLER ROLLER SOLLER TOLLER VOLLER WOLLER, 2 CALLER CELLER CILLER CULLER,
3 CALER COBLER COILER COOLER COULLER COUller COYLER, 4 COLDER COLEER COL
COLKER COLTER COLVER COLWER COYLER, 5 COLLAR COLLOR COLLYR, 6 COLLED
COLLEE COLLEM COLLEN COLLEP COLLES COLLET COLLEY
followed by: COSTER (37), BETTER, LETTER, RESTER, SELLER (all 35)
Length 5:
SEALE (55): 1 BEALE CEALE DEALE FEALE GEALE HEALE KEALE LEALE MEALE NEALE PEALE REALE TEALE UEALE VEALE WEALE YEALE ZEALE, 2 SAALE SCALE SHALE SKALE SMALE SNALE SPALE STALE SWALE, 3 SECLE SEDE SEELE SEILE SELLE SEMLE SETLE SEYLE, 4 SEACE SEAGE SEAKE SEAME SEANE SEARE SEASE SEAZE, 5 SEALD SEALF SEALH SEALL SEALM SEALS SEALT SEALY
SEARE (55): 1 BEARE CEARE DEARE FEARE GEARE HEARE IEARE JEARE KEARE LEARE MEARE NEARE PEARE REARE TEARE VEARE YEARE ZEARE, 2 SCARE SHARE SKARE SLARE SMARE SNARE SOARE SPARE SSARE STARE SUARE SWARE, 3 SECRE SEERE SEGRE SEIRE SELRE SEORE SERRE SEURE SEVRE SEWER SEYRE, 4 SEACE SEAGE SEAKE SEALD SEALE SEAME SEANE SEARE SEASE SEA SEAXE
Followed by: HALLE, SEATE (both 54), SEERE, SEETE, SEITE (all 53), SERES (52), SOURE (51)

Length 4:
SALE (63): 1 AALE BALE CALE DALE EALE FALE GALE HALE JALE KALE LALE MALE NALE PALE RALE TALE VALE WALE YALE, 2 SCLE SELE SILE SMLESOLE SULE SYLE, 3 SAAE SABE SACE SADE SAFE SAGE SAHE SAIE SAKE SAME SANE SARE SASE SATE SAUE SAVE SAWE SAXE SAYE, 4 SALA SALB SALD SALF SALH SALI SALK SALL SALM SALO SALP SALS SALT SALU SALY SALZ
Followed by: HARE, HOLE, SALE, SARE, SERE (all 62), MARE, SEAT, SEET (all 61)

The following are the numbers of multiple onalosis:
Length 7: none
Length 5: sevenfold: SOULE. sixfold: MALES, MILLE, SAULE, SEALE, SHARE, SHERE. 51 fivefold examples, 267 fourfold, 933 triples, and 3024 doubles.
Length 4: 14-fold: SEET. 12-fold: ARES, SAIE, SEAT, SEIE, SOUT. 10-fold: SAAR, SAER, SAIR, SAIT, SAUR, SAYE, SEAR, SEER, SEIR, SEIT, SEYE, SOON, SOOT. 15 ninefold, 41 eightfold, 140 sevenfold, 379 sixfold, 1286 fivefold, 1715 fourfold, 2267 triples, and 3210 doubles.