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Derivational Rules and the Internal Lexicon

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This study examines two views of lexical storage and word production: a Derivational hypothesis whereby complex nouns such as GOVERNANCE and GOVERNMENT are generated by rules for combining stems and affixes separately stored in the internal lexicon, and an Independent Unit hypothesis whereby GOVERN and GOVERNMENT constitute independent lexical units which are read out directly from lexical store. To test these hypotheses subjects were presented auditorily with verbs (e.g., DECIDE) and had to produce a related noun (DECISION) as fast as possible. Reaction times and errors were related to derivational complexity, thereby supporting the Derivational rather than the Independent Unit hypothesis. A model of lexical retrieval processes incorporating derivational processes is proposed.

Psychologists have long been interested in derivational processes for retrieving information from memory (Bartlett, 1932; Miller, 1962; Bernstein, 1967) although documenting these processes has proved difficult. For example, no consensus has been achieved on the nature of derivational processes for retrieving sentential information. The present study examined derivational processes within a somewhat simpler domain: word production. The basic issue was how we produce words such as DECISION. One hypothesis, consistent with linguistic models of the lexicon (see Chomsky, 1970), postulates phonological rules for producing such words. Under this Derivational Hypothesis (DH) we produce DECISION by adding an -ION suffix to a base form resembling DECIDE and by applying rules for vowel and consonant alteration. Information specifying the suffix (e.g., -ENCE, -MENT, or -ION) for nominalizing a particular stem could be stored in abstract rather than in phonetic form, thereby economizing on storage, but economic arguments favoring DH have always seemed implausible since DH complicates mechanisms for learning, perceiving, and producing words. For example, DH requires a complex perceptual system for distinguishing between truly derived words (e.g., DEFENCE, OFFENCE, FIXATION, ADDITION) and phonologically similar but nonderived words (e.g., CONDENSE, IMMENSE, NONSENSE, ATTRITION). The DH also requires a complex learning mechanism for reorganizing the internal store in cases where the child acquires a derivative (e.g., ELEVATOR or ELEVATION) before its base (ELEVATE).

According to a competing hypothesis, words such as DECIDE and DECISION are learned, perceived, and produced as independent units. Under this Independent Unit hypothesis (IH), speakers produce DECISION by direct readout from the internal lexicon, without applying derivational rules to DECIDE. Under IH, the fact that we so readily retrieve related words such as DECIDE–DECISION suggests the possibility of associative connections between these otherwise independent word units.

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Preliminary findings of Steinberg (1973) using a word creation paradigm seemed to favor IH rather than DH. Steinberg had subjects add Latinate suffixes (e.g., -IC or -ITY) to words such as MAZE. The subjects rarely produced these nonwords (MAZITY or MAZIC) with a vowel alternation similar to SANE–SANITY or VAIN–VANITY. However, there are several problems with the word creation paradigm (see also Aronoff, 1976). For example, speakers may know that words such as MAZE are non-Latinate and do not undergo Latinate vowel alternational. As Marchand (1969) points out, rhyme with RECEIVE–RECEPTION would not make anyone derive BELIEVE–BELEPTION, nor would the pattern COMSUME–CONSUMPTION produce GROOM–GRUMPTION or BOOM–BUMPTION. Nobody, unless he or she was trying to be witty, would extend a derivational pattern to words outside the derivational system to which the words belong. And since many words in Steinberg's experiments belonged to the Anglo-Saxon derivational system for which nonalternation as in MAZE–LIKE is the general rule, nonoccurrence of Latinate vowel alternations is neither surprising nor critical to DH.

There is also some question as to whether the way we coin new words such as MAZIC or MAZITY has any necessary connection to the way we store and retrieve already existing words such as VANITY, especially since one and the same word can be created in one way but produced in a quite different way. For example, the word RADAR was created by abbreviating the phrase RADIO DETECTING AND RANGING, but, clearly we no longer produce the word RADAR by abbreviating this phrase in our minds. And the independence of creation and production processes in this case suggests that independence should be assumed until proven otherwise for other cases. In particular, it is possible that we produce words such as VANITY or DECISION using vowel alternation rules which are no longer available, acceptable, or in vogue as means of creating new words.

The present study used a production rather than a creation task to test between IH and DH: Subjects heard verbs such as CONCLUDE and DECIDE which they had to nominalize as quickly as possible. Rationale was as follows: If subjects apply derivational rules to form nouns in this task (a natural strategy under DH), then certain nominalizations should take longer than others. For example, nominalizations such as DECIDE–DECISION should take longer than CONCLUDE–CONCLUSION, because of the additional vowel alternation rule. On the other hand, if words such as DECISION are produced as independent units without rules for consonant and vowel alternation, then DECIDE–DECISION should take no longer than CONCLUDE–CONCLUSION (all other factors being equal).

The nominalizations ended in either -ENCE, -MENT, or -ION, suffixes chosen as having comparable syntactic and semantic effects when added to a base verb. Reaction time and error probability were dependent variables and the following four classes of stimuli constituted independent variables: -ENCE suffix verbs (e.g., RESIDE), -MENT suffix verbs (e.g., ADVANCE), high-complexity -ION verbs (e.g., DECIDE), and low-complexity -ION verbs (e.g., CONCLUDE). High-complexity -ION derivatives, e.g., DECISION, required more phonological changes to form noun from verb (under DH) than low-complexity derivatives, e.g., CONCLUSION. The DH predicted longer reaction times for high than for low complexity -ION forms, whereas IH predicted no difference since both high- and low-complexity -ION nouns are read directly from the internal lexicon under IH.

The -ENCE and -MENT suffix verbs were designed to test for a recently postulated derivational process known as syllabic regrouping (see MacKay, 1972), the process that changes the syllabic position of the stem-final segment in certain derivations. The N in GO-VERN, GO-VER-NANCE, and GO-VERN-MENT (hyphens indicating syllable boundaries) illustrates this process. Since the N is syllable-final in GOVERN and GOVERNMENT but syllable-initial in GOVERNANCE, it must change syllabic position in deriving GOVERN–GOVERNANCE, but not GOVERN–GOVERNMENT. And since -ENCE suffixes almost always require this syllabic regrouping process, whereas -MENT suffixes never do, the syllabic regrouping hypothesis predicts longer reaction times for forming -ENCE than -MENT suffix nouns (despite the greater phonological length of the -MENT suffix, a difference which should hinder rather than help this hypothesis).

Method

Subjects were 16 native speakers of English enrolled at UCLA (mean age 21.1). None reported abnormal hearing or articulatory difficulties. Fourteen wrote with their right hand at two with their left. Subjects were instructed that they would hear verbs such as ILLUSTRATE which they had to transform into related nouns as rapidly as possible by adding -ION, -ENCE, or -MENT.

Experimental materials consisted of 77 verbs (see Table 1) recorded clearly and at normal rate, one every 10 seconds approximately, on two tapes in different random orders using a Model 4070 TEAC stereo tape recorder. Half the subjects heard one tape and half heard the other, and their responses were recorded on a Revox A77. Thirty-five additional verbs provided practice trials preceding the experiment proper. For practice but not experimental trials subjects were told whether their response was correct or incorrect and had before them the three suffixes typed in capital letters on a 3 × 5-inch index card (order randomized across subjects).

Stimuli and responses were semantically abstract Latinate forms with moderate frequency of use. The second syllable for all but five stimuli received main stress. Each verb allowed one of the three suffixes (following Webster's unabridged): 20 took -ENCE, 20 took -MENT, and 37 took -ION. There were no distinguishable semantic effects of adding -ENCE vs -MENT vs -ION since all of the nominalizations had a meaning such as FACT OF, RESULT OF, or ACT OF (VERB) + ING, e.g., one meaning of ADVANCEMENT as in HE OBSERVED THE DIVISION'S ADVANCEMENT can be represented as ACT OF ADVANCING. However, 12 of the nominalizations (such as DIVISION in the example above) had an *additional* meaning or meanings which bore no systematic relation to the meaning of the stimulus verb, a factor which had no discernible effect on the reaction time results.

The -ION nouns fell into two categories: 19 high-complexity -ION nouns and 18 low-complexity -ION nouns (see Table 1). The high- and low-complexity materials involved similar types of vowel alternation (e.g., /u/–/ʌ/ in PRESUME–PRESUMPTION) and consonant alternation (e.g., /d/–/s/ in COMPREHEND – COMPREHENSION), but glide deletion often accompanied simple vowel alternation in the high-complexity materials. For example, vowel alternation in REPEL–REPULSION is simpler than in DECIDE–DECISION due to glide deletion, which changes the long vowel, [ay], to a short one, [i]. And some of the high-complexity -ION nouns involved alternation of syllabic stress. For example, PERMIT–PERMISSION is simpler than INHIBIT–INHIBITION because of the change in stress pattern.

Materials were controlled across categories for length (in phonemes and syllables) for nature of word-initial segment (consonant vs vowel), and for stimulus as well as response frequency using the data of Carroll, Davis, and Richman (1971). Average frequency was one per million for all but one of the categories: -ENCE suffix verb stimuli occurred six per million, a divergence which could only hinder rather than help the hypothesis under test.

Stimuli were presented over Pioneer stereo earphones (Model SE 30A) using the TEAC (attached to a Model KA2000 Kenwood solid-state stereo amplifier). Each stimulus set off a Model SI Standard electric timer via one channel of a Model 6602A Lafayette voice key. A Monarch Model TM-18 microphone was situated about 3 inches from the subject's

TABLE 1

THE MATERIALS

	Practice stimuli	
INVENT	CONTRIBUTE	CORRESPOND
CONSIGN	ATTAIN	CONFIDE
ENTRAP	REPRESS	RESEMBLE
DEVELOP	CONSECRATE	INTIMATE
RESIDE	HINDER	ILLUSTRATE
SUBVERT	ARRANGE	INFER
OFFICIATE	FLAGELLATE	EXPEDITE
PREFER	ASTONISH	GENERATE
	Experimental stimuli	
1. -MENT suffix verbs		
EXCITE	ENACT	MANAGE
INVOLVE	INDUCE	RESENT
ADJOURN	ACHIEVE	COMMAND
ASSIGN	GOVERN	CONFINE
ASSESS	REFRESH	REFINE
EQUIP	CONCEAL	DERAIL
ADVANCE	PUNISH	
2. -ENCE suffix verbs		
EXIST	EMERGE	TRANSFER
ADHERE	APPLY	COMPLY
OBSERVE	INSIST	REPENT
APPEAR	RECUR	DEPEND
ASSIST	CONTRIVE	CONCUR
EXPECT	PERFORM	RESIST
INDULGE	SEVER	
3. Low-complexity -ION verbs		
CONCLUDE	EXCLUDE	EXPEL
CONNECT	CREATE	IMPEL
CORRODE	EXTEND	PROPEL
INVADE	EVICT	APPREHEND
PERMIT	COMPEL	COMPREHEND
PROGRESS	REPEL	CONTRADICT
4. High-complexity -ION verbs		
DECIDE	RESUME	REDUCE
DERIDE	CONSUME	EDIT
DIVIDE	DECLINE	ATTRIBUTE
COLLIDE	PRESUME	INHIBIT
SUSPECT	ASSUME	MUTATE
EXISE	ELIDE	CREMATE
	REVISE	

lips so that responses triggered the voice key to stop the timer.

RESULTS AND DISCUSSION

Response Times

Response times were determined by subtracting voice key time from stimulus duration (determined by Siemens Oscillomink). This procedure seemed essential since stimulus duration varied across conditions, and since stimulus offset to response onset measures were the most conservative for hypotheses under test. Compensation for voice key lag time was unnecessary since average lag time determined by comparison with printout of the Oscillomink receiving identical inputs did not differ across conditions.

Response times were in general shorter for correct than for incorrect responses ($p < .05$, two-tailed sign test with subjects as unit of analysis) but varied with error type: Response times were faster for nonalternations, e.g., EXPELSION, then for correct responses ($p < .01$, stimuli as unit of analysis).

Response times (shown by condition in Table 2) were analyzed four ways: including and excluding errors and using parametric and nonparametric analyses. All four analyses gave similar results, but only analyses excluding errors are reported here. Correct response times were 140 milliseconds longer for -ENCE than for -MENT suffix verbs ($p < .001$, two-tailed sign test with subjects as unit of analysis) and 173 milliseconds longer for high- than low-complexity -ION verbs ($p < .01$ level, same test). Low-complexity -ION verbs required about 277 milliseconds longer than -ENCE suffix verbs ($p < .001$ level, same test). Two-way analyses of variance with proportional corrections for differences in sample size showed significant differences between -ENCE vs -MENT, $F(1, 15) = 13.69$, $MSE = 4.20$, $p < .01$, and between high- vs low-complexity -ION verbs, $F(1, 15) = 15.88$, $MSE = 5.90$, $p < .01$. Both analyses showed significant subject differences ($p < .001$), but no significant subject-by-condition interactions ($p > .10$). In order to avoid the "language-as-fixed-effect fallacy" (cf. Clark, 1973; Winer, 1971), word medians were compared using a Mann–Whitney U test for -ENCE vs -MENT and for high- vs low-complexity -ION. Both comparisons were statistically reliable ($p < .05$), which provides support for generalizing these effects to any comparable set of words.

A final analysis assessed the effects of complexity level, the number of phonological differences between verb stimulus and noun response, discussed below. We viewed complexity level as an approximate index of the complexity of phonological operations required to derive noun from verb, although

TABLE 2

CORRECT RESPONSE TIME (IN SECONDS) AND PROBABILITY OF FOUR CLASSES OF ERROR (PER SUBJECT PER STIMULUS)

Condition	Correct response time (seconds)	Error probability				
		Nonresponse	Misinflection	Misalteration	Miscellaneous	Total
-MENT suffix verbs	.529	.000	.000	.000	.000	.000
-ENCE suffix verbs	.669	.003	.100	.014	.003	.120
Low-complexity -ION verbs	.946	.021	.100	.024	.003	.148
High-complexity -ION verbs	1.119	.064	.115	.013	.015	.207

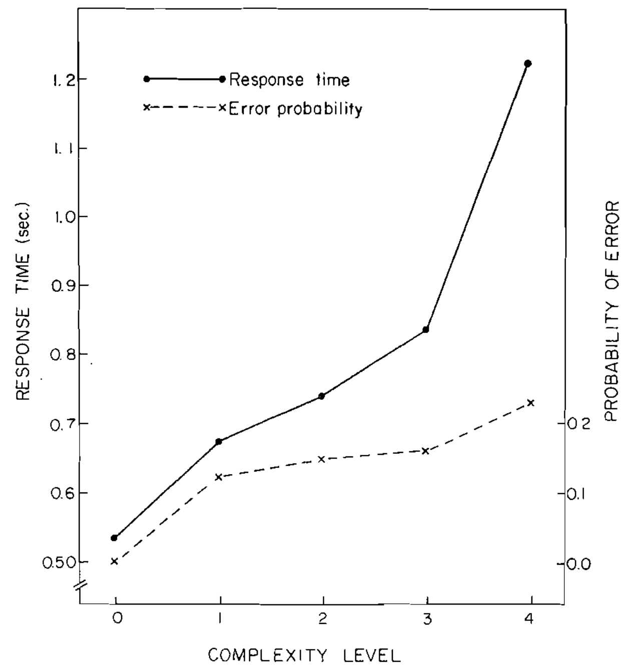

FIG. 1. Response time (left ordinate) and probability of error (right ordinate) as a function of derivational complexity, the number of phonological changes required to derive noun from verb.

there are several alternative ways of representing these operations (see Aronoff, 1976). The -MENT suffix forms were considered complexity Level 0, since they required no change in the stem. The -ENCE suffix forms were complexity Level 1, since they required syllabic regrouping of the stem. Five low-complexity -ION forms were complexity Level 1 (COMPEL, REPEL, EXPEL, IMPEL, and PROPEL), since they required only a single change (vowel alternation). Remaining low-complexity -ION forms were complexity Level 2, since they required two changes (syllabic regrouping plus either vowel or consonant alternation). Ten high-complexity -ION forms were complexity Level 3, since they required three changes: syllabic regrouping plus either stress alternation and consonant alternation (e.g., INHIBITION, EDITION) or vowel alternation and glide deletion (e.g., RESUMPTION, PRESUMPTION). Remaining -ION forms were complexity Level 4, since they required four changes (syllabic regrouping, vowel alternations, glide deletion, and consonant alternation, usually). Error probabilities and correct response times under this analysis appear in Figure 1. As can be seen there, both increased with complexity level.

Errors

Postexperimental interrogation concerning erroneous responses (e.g., COLLIDEMENT rather than COLLISION) ensured that subjects knew the nouns required as responses. Error rate was about 13%, with significantly more errors for -ENCE than for -MENT suffix stimuli [$\chi^2(1) = 40.0, p < .001$] and marginally more errors for high- than for low-complexity -ION forms [$\chi^2(1) = 3.06, p < .10$]. Errors fell into four classes described in detail below.

Misinflections ($N = 99$). Misinflections were scored whenever subjects added a suffix not specified in the instructions or added a specified suffix to an inappropriate stem. Misinflections involving unspecified suffixes were rare (N = 16), e.g., CONTRIVE–CONTRIVED, SEVER–SEVERANT, ATTRÍBUTE–ÁTTRIBUTE (stress alteration) as compared with misinflections involving specified suffixes (N = 83) which always resulted in nonwords, e.g., EXCLUDEMENT. Misinflections are difficult to explain under IH since most were nonwords which could not have appeared as units in the internal lexicon. But DH is compatible with several alternative explanations for misinflections. Since suffixes are stored separately from stems and are called upon by rule under DH, misinflections may occur either when the wrong suffix is obtained during phonological retrieval or when abstractly stored information specifying which suffix to add is overlooked.

Misinflections involving specified suffixes displayed a curious frequency asymmetry: -MENT suffixes were added to the wrong stem, e.g., REVISE–REVISEMENT, more often (N = 60) than were -ENCE suffixes (N = 20), e.g., ADJOURN–ADJOURNENCE, or -ION suffixes (N = 3), e.g., REPENT–REPENTION. This asymmetry suggests that syllabic regrouping may not be the *only* difference between -ENCE vs -MENT suffix stimuli, and that there may be an inherent difference between -MENT-vs -ENCE and -ION suffixes. One possibly inherent difference lies in the greater frequency and productivity of the -MENT suffix, since -MENT is used more often than -ENCE and -ION in forming English words. Another possible factor is the greater simplicity of suffix attachment rules for -MENT, since -MENT can always be added without changing a stem, unlike -ION and -ENCE. This explanation raises the question of how suffixes normally are attached and how their attachment interacts with phonological alternations of the stem. Perhaps as Chomsky and Halle (1968) suggest, -MENT normally is attached across a word boundary thereby preventing application of stem alternation rules, whereas -ION and -ENCE normally are attached across a morphene boundary which allows stem alternation rules to apply. However, response time and error differences between high- vs low-complexity -ION stimuli precludes a *general* explanation of the results in terms of either productivity, suffix frequency, or simplicity of suffix attachment rules.

Misalternations (N = *18*). Misalternations were scored whenever subjects produced an inappropriate segment, e.g., EXPELSION, PERMITSION, or inappropriate stress, e.g., CÓNTRIVANCE. There were ten nonalterations, e.g., PROPELSION, and eight stress misapplications, e.g., TRÁNS-FÉRENCE, where both first and second syllables were stressed. Misalternations never occurred in conjunction with other errors and cannot be explained in terms of stimulus misperception or response unfamiliarity, since subjects usually corrected these errors, e.g., EXPELSION, I mean, EXPULSION. The IH explains neither the occurrence of misalternations, since EXPULSION, CONTRÍVANCE, and PERMISSION appear in the internal lexicon but not EXPELSION, CÓNTRIVANCE, or PERMITSION, nor the fact that misalternations always displayed actual (though inappropriate) derivational possibilities: stress misplacement and nonalternation of consonants or vowels. But DH is compatible with both aspects. Under DH, misalternations reflect application of inappropriate derivational rules. The wrong alternation rules have been called upon, nonalternation appropriate for, say, RECUR–RECURSION in producing EXPEL–EXPELSION and stress alternation appropriate for, say, REFÉR–RÉFERENCE in producing CONTRÍVE–CÓNTRIVANCE. The fact that nonalternations were faster than correct responses is also compatible with DH.

Both misalternations and misinflections pose difficulties for a phonological similarity hypothesis. Under this hypothesis, verb stimuli in the present task activate a form in the internal lexicon, and subjects search the lexicon until they locate a noun which is phonologically similar to the stimulus verb. Degree of phonological similarity determines search time, thereby explaining the relation between response time and derivational complexity. However, phonological similarity cannot explain occurrence of nonwords as occurred in misalternations and misinflections, since nonwords do not appear in the internal lexicon.

Miscellaneous errors ($N = 9$). These included repetitions, hesitations, and irrelevant word responses. Within-word hesitations ($N = 4$) of .5 seconds or more, e.g., ATTRIBU—TION were counted as errors since instructions explicitly prohibited pausing. Irrelevant word responses, e.g., TRANSFER–TRANSFUSION, IMPEL–IMPALEMENT, DERAIL–DERISION were rare ($N = 3$) and may reflect stimulus misperception. Repetitions ($N = 2$), e.g., ASSIST–ASSIST were equally rare and may reflect inappropriate application of a null alternation rule.

Nonresponses ($N = 26$). Nonresponses were scored whenever subjects failed to respond within 5.0 seconds, a time limit designed to prevent interference between successive stimuli. Subject interrogation following the experiment indicated that nonresponses were due to semantic ambiguity (discussed below) rather than stimulus misperception or response unfamiliarity.

Subsidiary Results

Semantic effects. The task of producing isolated words permits sophisticated experimental control but seems open to the criticism that it fails to engage the semantic processes which dominate normal lexical retrieval. However an unexpected effect of stimulus ambiguity suggested that semantic factors played a role even in the present task. By way of illustration, consider the verb DECLINE which has three different meanings, roughly "to refuse," "to descend," and "to inflect words." As might be expected, most subjects (80%) saw one or both of the first two meanings. Interestingly, however, only the 20% who saw the third meaning were able to respond at all, as if the nominalization DECLINE–DECLENSION depended on perceiving the appropriate meaning of DECLINE. This effect of ambiguity suggests that the information determining how to nominalize a verb stem may be stored with the semantic rather than the phonological representation of the stem. A similar hypothesis seems necessary to account for an unexplained semantic effect reported in MacKay (1976), where subjects were instructed to produce the past tense of verbs such as PAT but often produced PET instead of the required PATTED, as if the feature or rule marker + [PAST] applied not to a strictly phonological representation, which would invariably result in the required PATTED, but to a semantic representation, thereby generating the almost synonymous past tense form, PET.

Word frequency. To determine whether derivational rules operate for frequent but not infrequent words, we split the materials into high- vs low-frequency nouns (half the stimuli in each condition) but found no interesting differences between the two sets of materials. Although low-frequency nouns gave slightly longer response times than high-frequency nouns, the relation between response time and complexity level was identical for both sets of materials. Moreover, there was no significant correlation between word frequency and response time ($r_s = .10, p > .05$).

Age of acquisition. To determine whether derivational processes apply only for nouns learned after the base verb, we split the materials into cases where the base verb did ($N = 25$) or did not ($N = 52$) appear before the noun in grade school readers following Rinsland (1945) but found no difference in effect of complexity level for these two sets of materials. This finding suggests that relative age of acquisition of derivative and base has no effect on lexical organization as reflected in the present task.

Control Study

A control study was undertaken to replicate the main experiment using slightly different procedures and to test an associative model of suffix attachment. Under this model, suffixes are attached to stems via unlabeled associative bonds. For example, -OR, -IVE, and -ION are attached by associative bonds to ACT so as to form ACTION, ACTOR, and ACTIVE. Under this model, time to select the correct associative pathway and activate the correct suffix varies with number of associative pathways and hence with number of suffixes that can be attached to the stem. Nominalization time should vary therefore with number of alternative suffixes that can be added to the stem. Procedures for testing this hypothesis resembled those in the main experiment except that the subjects were instructed to produce nouns which were "related" to the stimuli, e.g., HAPPY–HAPPINESS. There was no mention of -ENCE, -MENT, -ION, or any suffix except that use of -ER (which can be added indiscriminately to most verbs, e.g., DEVELOP–DEVELOPER) was prohibited. Materials were identical to those in the main experiment except for omission of 10 verbs allowing more than one nominalization, e.g., APPEAR–APPARITION, APPEARANCE. Dependent variables were response times and errors. To determine whether the stimuli were correctly perceived, subjects ($N = 12$) wrote out the stimulus word on a check sheet after each trial. Number of suffixes that could be added to the stimuli to derive other verbs, nouns, or adjectives varied from 3 (e.g., IMPEL) to 11 (e.g., EXTEND). The data failed to support the associative model: Response times did not vary systematically as a function of suffix alternatives. This finding suggests that subjects were not scanning the set of suffixes associated with a particular stem so as to determine which one formed a noun.

As in the main experiment, response times increased as a function of complexity level: .872 seconds for complexity level 1, 1.133 seconds for level 2, 1.249 seconds for level 3, and 1.522 seconds for level 4. Errors resembled those in the main experiment and increased with complexity level but were less frequent ($p = .063$ per subject per stimulus). Fewer errors in conjunction with longer response times in the control study suggest a possible speed–accuracy trade-off.

The control study also provided evidence against a suffix testing hypothesis. Under this hypothesis, subjects in the main experiment serially added the three specified suffixes until they found a form resembling a real word which they then produced. Adding -MENT first is the optimal strategy under suffix testing, since -MENT never necessitates altering a verb stem. Suffix testing therefore explains the faster response times for -MENT suffix forms and views misinflections such as RESIDEMENT as due to a failure in checking the internal lexicon for existence of the constructed form. But if the main results were due to specification of which suffixes to add, similar results would not be expected with unspecified suffixes, as in the control study. A second, somewhat stronger point against the suffix testing argument that misinflections are an experimental artifact is the fact that misinflections resembling those in the present experiments, e.g., PECULIARACY for PECULIARITY, GROUPMENT for GROUPING, PERCEPTIC for PERCEPTUAL, SPECIALATING for SPECIALIZING (from Fromkin, 1973) also occur in natural speech production where artifacts are out of the question.

General Discussion

The present results are consistent with an interesting model of lexical retrieval. In this model, the lexicon contains a derivational component which is used for retrieving and producing words such as DECISION. Within this derivational component, stems such as DECIDE are stored together with a semantic formative, the inherent feature [+Verb], and an abstract rule marker such as, say, [+noun pattern 47].

The semantic formative is used to address the lexical item and to insert its inherent feature [+Verb] into a phrase marker containing the noninherent feature [+Noun], generated as part of the syntax of the sentence being produced. The mismatch between the noninherent, [+Noun], and the inherent, [+Verb], feature activates the rule marker [+noun pattern 47], which calls up the rules for altering the stem and for adding the independently stored -ION suffix, thereby forming the noun DECISION, which is then inserted into an output buffer.

Under this model, the present task circumvented the normal process of generating the phrase marker into which the inherent feature for a stem is inserted. The task nevertheless provided preliminary evidence for the independent storage of suffixes, for the operation of stem-modifying rules, and for the possibility that abstract markers stored with the semantic (rather than phonological) representation of stems are responsible for triggering these derivational processes.

However, limitations of the present task should be stressed. The paradigm is especially suited for engaging and thereby demonstrating the existence of derivational rules. It does not rule out the possibility that derivatives appear as phonetic units in other quite different memory systems not accessed in the present task. Indeed, the fact that speakers can rapidly produce rhymes for derivatives such as DECISION (e.g., REVISION, PRECISION) even though the base forms (DECIDE, REVISE, and PRECISE) do not rhyme suggests that words may be stored as independent units in some memory system. There may even exist a memory system in which not just words but whole utterances are stored in iconic form and reactivated in all their acoustic vividness under special circumstances, as in Penfield and Roberts (1959). However, such a memory system is almost certainly not the one used in normal speech production, not just because iconic recall of words is so rare and remarkable but also because we normally retrieve words so quickly and flexibly in contexts never encountered before.

Limitations of the present task aside, further elaboration and tests of the derivational model seem warranted. One interesting elaboration concerns the possibility of context-dependent semantic effects associated with the distinction between systematic vs unsystematic meanings of derived words. For example, the word DIVISION has a systematic meaning, namely, "ACT, FACT, OR RESULT OF (VERB) + |-ING|", which parallels the meaning of many other derivatives. But DIVISION also has an unsystematic or nonderived (MILITARY) meaning which is not directly related to the meaning of the base verb, which suggests that DIVISION may be produced via derivational processes in one context, e.g., HE REQUESTED THE DIVISION OF THE SPOILS but not in a context such as THE DIVISION ADVANCED.

Similarities and differences between rules for producing existing words and rules for creating new ones also deserve exploration. One interesting possibility is that inherent markers such as [+noun pattern 47] are only associated with nonproductive rules, i.e., rules which are no longer available for creating new words. That is, rules triggered by inherent markers stored with particular lexical items can be applied only to those items and may therefore be unavailable for forming new words. On the other hand, in the absence of inherent markers, noninherent features such as +[PAST] may directly trigger "regular" rules which are totally independent of lexically stored items and can therefore be used in forming new words. Such a difference in retrieval of productive vs unproductive rules would resolve the seeming paradox in the fact that we can employ some derivational rules such as vowel alternations in producing existing words, even though we apparently no longer use these same rules in creating new words.

Another area for further research concerns the form and scope of derivational rules, which may or may not resemble those of Chomsky and Halle (1968). Further research is also needed to explore the generality of derivational processes and to determine whether suffixes such as -ION are necessary triggers for acquisition and application of derivational rules. Comparison of derivational processes in other motor systems also seems warranted to determine whether other motor systems incorporate two components, one containing basic motor programs and the other a set of context-dependent rules for modifying these basic programs. As Bernstein (1967) suggested, we may use the same basic program for, say, drawing an ellipse as for drawing a circle, plus derivational rules for generating the elliptical surface form.

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