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RESEARCH REPORT

# A TAXONOMY OF SEMANTIC RELATIONS FOR THE CLASSIFICATION OF GRE ANALOGY ITEMS

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This paper presents a taxonomy of the semantic relations that appear in GRE verbal analogy items. The impetus for development the taxonomy was the need to classify analogy items for a study of the sources of item difficulty conducted by Bejar, Embretson, Peirce, and Wild (1984); it is based on the taxonomies developed by Chaffin and Herrmann (1984) and Whitely (1977). Our purpose in presenting it here is to make the taxonomy available to a wider audience in the hope that it will be a useful tool in both the development of and in research on analogy items.

## BACKGROUND

Classifications of semantic relations between concepts have been proposed by scholars from a number of different disciplines. In each case the interest has been to identify a limited number of relations that can function as explanatory primitive constructs in theories of mental function. The earliest taxonomies of relations between concepts were proposed by the early experimental psychologists at the end of the nineteenth century. For example, relying on both associative and introspective data, Wundt (1893) classified a wide range of relations. At least thirteen other classification systems were proposed prior to 1911 (Warren, 1921). More recently relations have been used as primitive theoretical constructs in theories of memory in which knowledge is represented by concepts connected by relations (e.g., Anderson, 1976; see Johnson-Laird, Herrmann & Chaffin, 1984 for a review). In a similar vein computational linguists have compiled lists of relations designed to capture the major relations between words that are of importance in constructing dictionaries and that occur in sentences (Evens, Litowitz, Markowitz, Smith & Werner, 1980). A commitment to parsimony has restricted the number of relations used by such models.

Other researchers have taken an empirical approach to the classification of semantic relations. Chaffin and Herrmann (1984) asked subject to sort examples of 31 relations discussed in the psychological and linguistic literature. Subjects identified five major families of relations: contrast, class inclusion, similar, case, and part-whole. Whitely (1977) describes a taxonomy based on subjects' sorting of relations used in analogies in published aptitude tests. Subjects distinguished 10 types of semantic relations: similarities, opposites, attribute, functional, semi-causal, conversion, part-whole, class-member, and quantitative.

## METHOD

The present taxonomy was developed by classifying 180 items which appeared in the ten disclosed forms of the GRE General Test

studied by Bejar et al., (1984). A taxonomy of 14 families was developed by subdividing the five families found by Chaffin and Herrmann (1984) and supplementing them with categories proposed by Whitely (1977). This preliminary taxonomy was then modified to fit the 180 GRE items. Families that rarely occurred were eliminated or merged with other similar families, and relations that occurred frequently were identified as distinct families. The nature of each family was defined by identifying sets of relations that are members of that family. The relations exemplified by the 180 items were classified repeatedly by the two authors; differences were resolved by discussion and by modifying the taxonomy until each of the 180 items was classified as an example of a specific family and member relation.

## THE TAXONOMY

The taxonomy consists of ten families of relations, which are briefly described here.

1. CLASS INCLUSION: One word names a class that includes the entity named by the other word.
2. SIMILAR: One word represents a different degree or form of the object, action, or quality represented by the other word.
3. CONTRAST: One word names an opposite or incompatible of the other word.
4. ATTRIBUTE: One word names a characteristic quality, property, or action of the entity named by the other word.
5. NON-ATTRIBUTE: One word names a quality, property, or action that is characteristically <u>not</u> an attribute of the entity named by the other word.
6. EVENT RELATION: One word names an action which the entity named by the other word is usually involved in, or both words name entities that are normally involved in the same action in different ways, e.g., as agent, object, recipient or instrument of the action.
7. CAUSE/PURPOSE: One word represents the cause, purpose or goal of the entity named by the other word, or the purpose or goal of using the entity named by the other word.
8. SPACE/TIME: One word names a thing or action that is associated with a particular location or time named by the other word.
9. PART-WHOLE: One word names a part of the entity named by the other word, or something that is characteristically not a part of the entity named.
10. REPRESENTATION: One word names something that is an expression or representation of, or a plan or design for, or provides information about, the entity named by the other word.

A brief description does not, however, adequately characterize the 10 families. A more comp lete description is provided in the appendix which lists the specific relations belonging to each family, with several word pairs as examples to illustrate each specific relation. The specific relation listed in the appendix do not encompass every possible relation in each family, but provide a general sense of the family and a list of the specific relations that occurred in the items examined.

## DISCUSSION OF THE TAXONOMY

### I. Completeness of the Taxonomy

The taxonomy is not an exhaustive list of all possible relations because the generation and identification of relations is a productive ability; the number of different relations is indefinitely large. The purpose of the taxonomy is rather to identify families of relations which encompass as many kinds of semantic relations as possible and to identify the most salient relations within each family. As new instances are classified, the taxonomy may require modification: families of relations and family member relations may need to be added, or merged. It is our expectation, however, that most new relations will fit comfortably within the ten families of the present taxonomy.

The identification of families of relations was influenced by the frequency of occurrence of relations belonging to that family in the items studied and whether the family was discussed in the literature. Types of relations that occurred frequently in the items studied were identified as distinct families, while those that occurred infrequently were not. For example, non-attribute relations were identified as a separate family of relations because they occurred frequently in the items studied, while prevention (non-cause) and non-part relations were identified as members of the cause/purpose and part-whole families respectively, because such relations occurred infrequently.

The families and members included in the taxonomy were principally those that occurred frequently in the GRE analogy items studied. In addition, relations were included in the class inclusion and contrast families which do not appear in the GRE but which have been identified in the literature (Wierzbicka, 1984; Chaffin & Herrmann, 1984).

### II. How to Use the Taxonomy

While some GRE analogies are easily classified using the taxonomy, others are more difficult because they do not neatly or completely match any of the member relations. This occurs for three major reasons. First, some item rationales (the statement

of the relation shared by the stem and key pairs of words) go beyond the basic relation suggested by a family because of some qualification they contain. For example, the rationale for the stem-key pairs carpenter:saw::tailor:needle would be "B is a tool A uses in his/her work". The same rationale could be used for for the stem-key pairs carpenter:saw::tailor:scissors, but in this case a more precise rationale is available, "B is an instrument A uses in his/her work for the purpose of cutting." The more precise rationale would be required if the item contained another agent-instrument pair such as plumber:wrench as a distractor. Both sets of stem-key pairs would be classified as agent-instrument relations, but the rationale of the second is not fully represented by this classification.

The second reason some GRE analogies do not fit neatly into the taxonomy is that they are hybrids of two (or possibly more) families, i.e., their rationales contain elements of more than one family. In some cases an item might yield two different rationales: for example, the item shudder:disgust::gasp:surprise could be classified in either the cause/purpose family or the representation family, since one might phrase the rationale "B can cause one to A"/"B can cause an A in a person" or "An A is a physical expression of B"/"To A is to physically express B". In other cases, there is only one rationale, which contains elements of two (or more) families: for example, the rationale for the item harbinger:event::prologue:narrative is "A is something which precedes B and gives some idea of what B will consist of", a combination of space/time and representation. We have classified items such as the latter in the family that seems to represent the most salient element of the rationale or the family that most distracters in the item are drawn from. One must always bear in mind that a given set of stem and key may yield more than one rationale, depending on the nature of the distracters.

A third reason that the relation of a word pair may not exactly match any member relation in the taxonomy is the possibility of morphological variation. Relations can be varied by changing the part of speech of one or both of the words. We have listed as members of the taxonomy those variations that had the greatest frequency in the items examined; those with lower frequencies we have omitted, although items employing such part-of-speech variants form equally good relations. For example, there is no member relation in the taxonomy into which the word pair vigor:flag (a noun-verb combination) fits precisely, whereas vigorous:flag (an adjective-verb combination) would be classified as an item attribute:non-action relation (6f). The attribute and non-attribute families especially could be expanded by including more combinations of nouns, verbs, and adjectives (the only parts of speech which GRE analogies currently use).

## III. Potential Uses

Computer generation of items. The taxonomy can be used to generate analogy items which have some of the characteristics of GRE and SAT analogies. Procedures for constructing analogy items from a taxonomy are described by Ross, Herrmann, Vaughan & Chaffin (1987; see also Chaffin & Herrmann, 1987) who describe a semantic relations test (SRT) based on the Chaffin and Herrmann (1984) taxonomy. Their procedures have been embodied in a program, the Analogy Item Generator (AIG), implemented in Pascal for the IBM-PC. One version of the program that generates GRE-type items will be described briefly.

The AIG generates items by selecting two word pairs that share the same specific relation to serve as the stem and key for an item. Distractors are selected from other specific relations in the same family as the stem and key (homogenous items) or from relations in other families (heterogeneous-same items). Homogenous items are generally more difficult than heterogeneous-same items. (The AIG can also generate a third type of item in which the stem and key come from different specific relations within the same family and the distractors come from other families. These heterogeneous-different items are less similar to GRE items.) The program allows selection of the type of item(s) to be generated and the relation family or families to be used. The program samples randomly without replacement from the word pairs available until all have been used, at which point the word pairs are reused.

For the generation of GRE-type items the taxonomy was reduced from ten to eight families; the two class inclusion relations and the single contrast relation were absorbed into the similarity family. Three specific relations were selected for each family and five word pairs were selected to exemplify each specific relation. Most of the word pairs selected were taken from released GRE analogy items. Some word pairs were generated by the authors.

Examples of homogenous items generated by the program are shown in Table 1. Inspection suggests that at least some of the items are in the same range of difficulty as GRE items. AIG and GRE items differ in several ways, some superficial and others more fundamental. One superficial difference is that the AIG currently uses three rather than five choice pairs. A second superficial difference is that GRE analogies use the same form class(es) in the key and distractors, whereas AIG items are not constrained in this way. More importantly, for AIG items the match of the stem and key is less close than for most GRE items. Close matches have the drawback of making an item easier. A second important difference is that some GRE items have a semantic theme (or vertical relation) common to all the choices, as in

TABLE 1

Examples of Homogenous Analogy Items Produced by the Analogy Item Generator

| FAMILY | Stem | Choice A | Choice B | Choice C |
|---|---|---|---|---|
| 1. Similars | POEM<br>SONNET | SIMMER<br>BOIL | WOOD<br>SAWDUST | EMOTION<br>RAGE |
| 2. Attribute | VIABLE<br>LIVE | MUTABLE<br>CHANGE | GLASS<br>FRAGILE | MALLEABLE<br>MOLDED |
| 3. Non-attribute | LETHARGIC<br>STIMULATED | RETICENT<br>TALK | MAVERICK<br>CONVENTIONAL | FALLACIOUS<br>PROVED |
| 4. Event | SCULPTOR<br>STATUE | JURY<br>DECISION | JUDGE<br>LITIGANT | WOODCUTTER<br>AXE |
| 5. Cause/Purpose | ENIGMA<br>PUZZLEMENT | PESTICIDE<br>VERMIN | ASSASSIN<br>DEATH | JOKE<br>LAUGHTER |
| 6. Space/Time | BELT<br>WAIST | DESK<br>CHAIR | BRACELET<br>WRIST | ARTERY<br>BLOOD |
| 7. Part-whole | BELL<br>CLAPPER | MOSAIC<br>TILE | CAR<br>ENGINE | LENS<br>GLASS |
| 8. Representation | CHOREOGRAPHY<br>DANCE | ENCOMIUM<br>PRAISE | ALIAS<br>NAME | BLUEPRINT<br>BUILDING |

Answers: 1-c, 2-a, 3-c, 4-a, 5-c, 6-b, 7-b, 8-c

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CLAPPER:BELL::(a) tongue:mouth (b) needle:phonograph (c) hammer:piano (d) horn:automobile (e) speaker:radio

Here the pairs are united by a common theme of "sound production". The effect of such themes on item difficulty is not known (but see Schmitt, Bleistein & Scheuneman, 1987). AIG items do not have a semantic theme; any themes that do occur are accidental.

Test development. In the process of item development, the most obvious use of the taxonomy is to suggest rationales on which analogy items might be based. At present those who write GRE analogy items have only their imaginations to rely on in the generation of new items. It should be immediately noted that the taxonomy cannot supplant those imaginations, for it cannot by itself yield novel relations of the kind described above.

However, the taxonomy may suggest a complete rationale in many cases, and provide item writers with the kernel of a rationale in others.

A second use of the taxonomy is to provide distractors for items. If one were writing, for example, an item whose stem-key rationale was classified as an item:component relation, one might look to other members of the part-whole family for distractor rationales. Experience in combining these family members may suggest ways of increasing item difficulty since some members may provide close distractors for other members. Easier distractors will generally come from a family of relations other than that to which the stem-key rationale belongs.

Another use of the taxonomy would be as an additional dimension to already-existing test specifications. The taxonomy could be used to control the frequency of different types of relations, which is currently not controlled. In some respects the families of the taxonomy complement existing specifications. For example, some families tend to elicit concrete words while others elicit abstract words; concreteness/abstractness of words is an element in the current specifications. In other respects the taxonomy may add new dimensions to the specifications. For example, some families tend to use nouns while others tend to use verbs or adjectives and some combinations of these three parts of speech; part of speech is not an element of the current specifications. Preliminary evidence described below suggests that there may be additional aspects of the taxonomy that would be relevant in considering the distribution of analogy items in a test, e.g., it appears that some categories may produce harder items than others, and that vocabulary difficulty may affect overall difficulty in some categories to a greater degree than in others.

Theoretical primitives. The taxonomy may be of use to researchers in cognitive science interested in relations as theoretical primitives. GRE analogy items have two properties that recommend them for the study of semantic relations. First, GRE analogies provide a pool of word pairs from which one of the major difficulties in relation classification has been largely removed. The relation of many word pairs is ambiguous. The word pairs for GRE items are carefully selected to provide relatively unambiguous examples of relations. Ambiguity is further decreased by provision of two pairs exemplifying the same relation -- the stem and the key. Second, a taxonomy that encompasses the variety of relations used in GRE analogies may be well on the way to being a complete catalogue of the variety of relations found in natural languages. The relations found in GRE analogies are designed to test the comprehension abilities of college graduates and so use a wide variety of complex relations.

Research. A third use of the taxonomy is as a research tool. The original motivation for the development of the taxonomy was to study the relationship of type of semantic relation and difficulty in GRE analogy items. Bejar (1987) found that the classification of analogy items in terms of the relation family of the stem and key accounted for more of the variance in item difficulty than any other variable. Chaffin and Peirce (1987) found that English and History majors performed better than Electrical Engineering, Computer Science and Math majors on GRE analogy items involving property relations, while the latter performed better on items involving pragmatic relations. (The difference between property and pragmatic relations is described below). These results suggest that the type of relation involved in analogy items may be an important determinant of performance. In contrast Schmitt et al. (1987) found no relation between type os semantic relation and differential performance of blacks and whites.

One practical problem for most studies of analogy items is that, with ten major families, the number of items in each family will be small (Schmitt et al., 1987). One solution to this problem is to combine families to produce fewer categories of relations. Several investigators have noted the existence of two major types of relations called variously internal and external relations (Wundt, 1893), property and stationary relations (Klix, 1980), and logical and pragmatic relations (Chaffin & Herrmann, 1984; in press). The first type of relation is based on an overlap of attributes or properties of the two concepts; these property relations include: class inclusion, similarity, contrast, attribute, and non-attribute. The second type of relation is based on a pragmatic association due to the co-occurrence of the two things in the world; these pragmatic relations include: event, cause/purpose, and space/time relations. Two families, part-whole and referential relations, do not fit comfortably into this dichotomy, having some characteristics of each type of relation.

## IV. CHARACTERISTICS OF GRE ANALOGY ITEMS

The characteristics of GRE analogy items were examined by classifying 125 items from seven GRE forms (18 per form) that were not used in the initial development of the taxonomy. Each item was classified by both authors. For 36 items on which the initial classification was done independently, the disagreement rate was 17%. Disagreements were reconciled by discussion.

Table 2 gives, for each family, the number of items, mean equated delta, r-biserial ($r_{bis}$), and three measures of written frequency (Kucera & Francis, 1967): the mean frequency of the two words in the stem, of the two words in the key, and of the stem and key together.

TABLE 2

Number of Items, Mean Equated Delta, Mean R-bis, and Mean Written Frequency of the Stem, Key, and Stem+Key for GRE Analogy Items from Seven GRE Test Forms*.

| | | | | Written Frequency | | |
|---|---|---|---|---|---|---|
| | FAMILY | N | Delta | R-bis | Stem | Key | Stem+ key |
| 1. | Class Inclusion | 8 | 11.32 | .49 | 48.2 | 45.6 | 46.9 |
| 2. | Part-whole | 18 | 11.26+ | .54+ | 59.6 | 39.4 | 49.5 |
| 3. | Similarity | 22 | 13.05+ | .48+ | 33.6 | 36.3 | 34.9 |
| 4. | Contrast | 1 | 7.30 | .64 | 77.0 | 53.0 | 65.0 |
| 5. | Attribute | 22 | 12.92 | .46 | 12.8 | 40.3 | 26.6 |
| 6. | Non-attribute | 9 | 13.54 | .46 | 5.5 | 19.6 | 12.6 |
| 7. | Event | 14 | 10.95 | .48 | 56.3 | 29.3 | 42.8 |
| 8. | Cause/Purpose | 10 | 13.30# | .42# | 11.4 | 43.0 | 27.2 |
| 9. | Space/Time | 9 | 11.77# | .53# | 82.8 | 56.0 | 69.4 |
| 10. | Representation | 12 | 12.72 | .47 | 32.1 | 36.6 | 34.3 |
| | Total/Mean | 125 | 12.31 | .48 | 37.1 | 38.2 | 37.7 |

*Test forms: 3HGR1, 3HGR2, 3HGR3, 3HGR4, 3GGR3, GIGR1, 3IGR2

+ n = 21
# n = 8

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Equated delta is a scale of difficulty on which higher values indicate greater difficulty. $R_{bis}$ is the biserial correlation between an item and the verbal score of the GRE, which consists of four item types: analogy, antonym, reading comprehension, sentence completion.

The families of the taxonomy were created, in part, to reflect the nature of the relations used in GRE analogies. It is, therefore, no surprise that there are a substantial number of items in each family. The exception is the contrast family. Contrast relations are not used for GRE analogies because antonym relations are reserved on the GRE for use in the antonym item type. The family that produced the most difficult items was the non-attribute relations; the easiest were part-whole, and the one contrast item. The part-whole items also had the highest $r_{bis}$ and among the highest frequencies, while the non-attribute items had among the lowest $r_{bis}$ and the lowest frequencies. The differences were significant for stem frequency, $F(8,113)=2.53$, $p<.01$, and approached significance for delta, $F(8,113)=1.81$, $p<.08$.

TABLE 3

Correlations of Equated Delta, R-bis, and Written Frequency of the Stem, Key, and Stem+Key for GRE Analogy Items.

| | | | Written Frequency | |
|---|---|---|---|---|
| | Delta | R-bis | Stem | Key |
| R-bis | -.70 | | | |
| Stem frequency | -.29 | .25 | | |
| Key frequency | -.13 | .20 | .14 | |
| Stem+key frequency | -.28 | -.30 | .76 | .75 |

df = 121 r>.19, p<.05
r> .25, p<.01

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The contrast family was excluded from these analyses. Property relations tended to be more difficult than empirical relations, but this difference was not significant, t(91)=1.45.

The correlations between the variables presented in Table 2 are shown in Table 3. Delta and r-biserial were negatively related; correlations of similar direction and magnitude have been previously noted by Bejar (1987). The relationship of frequency and delta was negative; less common words made more difficult items. Both delta and $r_{bis}$ were more strongly related to the frequency of the stem than to the frequency of the key. This suggests that candidates use a decision strategy that focuses on identifying the stem relation, as suggested in instructions for the GRE, rather than working backwards to the stem relation from the relation of the key (Embretson, personal communication).

## V. CONCLUSION

A taxonomy of semantic relations is of interest for several reasons. First, a taxonomy can be used as a basis for the automatic generation of analogy items. The AIG program provides a preliminary demonstration of what can be achieved in this direction. Second, the taxonomy may prove a useful addition to current test specifications. Third, the taxonomy provides a resource for cognitive theorists who must select relational primitives for use in systems for representing knowledge. The taxonomy has not yet been submitted to direct empirical test, but is derived from empirically based taxonomies, and is based on an intrinsically interesting domain, GRE analogies. Fourth, the taxonomy provides a tool for research. The finding of Bejar (1987) that different

types of analogy items differ in difficulty suggests that the type of semantic relation needs to be considered in any study of analogy items. The finding of Chaffin and Peirce (1987) that different majors differ in their ability to solve different types of analogies, suggests that ability to recongnize particular types of relations covaries with differences in background or ability.

Underlying all theories of mental activity, from Aristotle to recent network models of memory, is the assumption that relations between ideas play a fundamental role in thinking. It is probably this assumption that has ensured analogy items a regular place on tests of mental ability since their first use by Cyrill Burtt (Burtt, 1911). Some account of the variety and nature of the relations between ideas seems, therefore, to be essential to any study of analogies. The taxonomy described here should serve as a tool for the study of this variety.

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## APPENDIX

## A TAXONOMY OF SEMANTIC RELATIONS WITH EXAMPLES

| | | |
|---|---|---|
| 1. | CLASS INCLUSION | |
| a. | TAXONOMIC | flower:tulip emotion:rage poem:sonnet curse:anathema boxing:fighting state:theocracy rectangle:square mountain:volcano |
| b. | FUNCTIONAL | ornament:brooch weapon:knife |
| c. | SINGULAR COLLECTIVE | cutlery:spoon clothing:shirt vermin:rat medicine:aspirin |
| d. | PLURAL COLLECTIVE | groceries:eggs dishes:saucers refreshments:sandwiches valuables:jewelry drugs:amphetamines |
| e. | CLASS: INDIVIDUAL | queen:Elizabeth river:Nile mountain:Everest city:Berlin country:France ship:Revenge |
| 2. | SIMILARS | |
| a. | SYNONYMITY* | car:auto buy:purchase rapid:quick |
| b. | DIMENSIONAL SIMILARITY | breeze:gale enthusiasm:fervour simmer:boil skill:vituosity stream:river |
| c. | DIMENSIONAL EXCESSIVE | eating:gluttony walk:swagger bleeding:hemorrhage stylishness:foppery concerned:obsessed |
| d. | DIMENSIONAL NAUGHTY | copy:plagiarize listen:eavesdrop |
| e. | CONVERSION | apprentice:master colt:horse grape:wine |
| f. | ATTRIBUTE SIMILARITY | rake:fork valley:gutter tower:needle painting:movie |
| g. | COORDINATES | ram:ewe son:daughter |
| h. | CHANGE | cresendo:sound |
| 3. | CONTRAST | |
| a. | CONTRADICTORY* | alive:dead masculinity:femininity remember:forget fertile:sterile guilty:innocent |
| b. | CONTRARY* | old:young happy:sad thin:fat smooth:rough tall:short |

c. REVERSE* attack:defend buy:sell love:hate
expand:contract command:obey

d. DIRECTIONAL* front:back left:right east:west before:after
inside:outside

e. INCOMPATIBLE* happy:morbid frank:hypocritical
vigilant:careless slow:stationary

f. ASYMETRIC CONTRARY hot:cool dry:moist fat:skinny rich:destitute
large:tiny

g. PSEUDOANTONYM popular:shy right:bad believe:deny
push:stretch

h. DEFECTIVE default:payment stutter:speech fallacy:logic
astigmatism:sight limp:walk stutter:speech

4. ATTRIBUTE

a. ITEM:ATTRIBUTE (noun:adjective)
beggar:poor idyll:carefree glass:fragile
soldier:wounded

b. OBJECT ATTRIBUTE:CONDITION (adjective:adjective)
brittle:broken malleable:molded

c. OBJECT:STATE: (noun:noun)
beggar:poverty dupe:credulity
neophyte:inexperience

d. AGENT ATTRIBUTE:STATE (adjective:noun)
contentious:quarrels taciturn:silence
celibate:abstinence

e. OBJECT:TYPICAL ACTION (noun:verb)
glass:break sycophant:flatter soldier:fight
juggernaut:crush quisling:betray

f. AGENT/OBJECT ATTRIBUTE:TYPICAL ACTION (adjective:verb)
(agent:attribute) viable:live menda-
cious:prevaricate irresolute:vacillate
(object:attribute) salient:notice
mandatory:comply palpable:touch
(agent/object attribute) mutable:change
brittle:break

g. ACTION:ACTION ATTRIBUTE* (verb:adverb)
creep:slow

h. ACTION:OBJECT ATTRIBUTE (verb:adjective)
sterilize:infectious capture:elusive
drink:potable

i. ACTION:RESULTANT ATTRIBUTE (verb:noun/adjective)
stipple:dots riddle:holes homogenize:uniform

5. NON-ATTRIBUTE

a. ITEM:NON-ATTRIBUTE (noun:adjective)
harmony:discordant bulwark:flimsy

b. OBJECT ATTRIBUTE:NON-CONDITION (adjective:adjective)
brittle:molded inconsolable:comforted
exemplary:criticized

c. OBJECT:NON-STATE (noun:noun)
laureate:dishonor famine:plentitude

d. ATTRIBUTE:NON-STATE (adjective:noun)
dull:cunning immortal:death
celibate:promiscuity

e. OBJECT:ATYPICAL ACTION (noun:verb)
recluse:socialize ascetic:indulge
patron:disparage

f. AGENT/OBJECT ATTRIBUTE:ATYPICAL ACTION (adjective:verb)
(agent:attribute) reticent:talk
abstemious:gorge
(object:attribute) obtrusive:ignore
garbled:comprehend lethargic:stimulate

g. ACTION:ACTION NON-ATTRIBUTE* (verb:adverb)
creep:fast

h. ACTION:OBJECT NON-ATTRIBUTE (verb:noun/adjective)
embellish:austere obliterate:extant

6. EVENT

a. AGENT:OBJECT (product) tailor:suit oracle:prophesy
jury:decision
(raw material) baker:flour sculptor:stone
(associated object) plumber:pipe

b. AGENT: RECIPIENT doctor:patient mentor:protege judge:litigant
teacher:student

c. AGENT INSTRUMENT farmer:tractor conductor:baton reaper:scythe
forger:pen arsonist:match

| | | |
|---|---|---|
| d. | ACTION: OBJECT | plow:earth baste:chicken sing:dirge winnow:wheat tie:knot pardon:sin |
| e. | ACTION RECIPIENT | bequeath:heir teach:student |
| f. | OBJECT: RECIPIENT | inheritance:heir speech:audience honor:laureate |
| g. | OBJECT INSTRUMENT | patient:stethoscope water:sluice violin:bow pipe:wrench |
| h. | RECIPIENT: INSTRUMENT | heir:testament |

7. CAUSE/PURPOSE

| | | |
|---|---|---|
| a. | CAUSE:EFFECT | enigma:puzzlement joke:laughter |
| b. | CAUSE: COMPENSATORY ACTION | hunger:eat fatigue:sleep |
| c. | ENABLING AGENT:OBJECT | match:candle gasoline:car mnemonic:memory |
| d. | ACTION/ ACTIVITY:GOAL | eat:satiation run:escape competition:prize pursuit:capture fertilize:grow |
| e. | AGENT:GOAL | pilgrim:shrine hunter:quarry assassin:death climber:peak |
| f. | INSTRUMENT: GOAL | anaesthetic:numbness ballast:stability camouflage:deception gun:revenge sophistry:deception |
| g. | INSTRUMENT: INTENDED ACTION | gun:shoot pestle:mash abacus:calculate tractor:plow |
| h. | PREVENTION | pesticide:vermin splint:immobility antidote:poison baste:dryness lubricate:friction |

8. SPACE/TIME

| | | |
|---|---|---|
| a. | ITEM: LOCATION | arsenal:weapon seminary:theologian |
| b. | LOCATION: PROCESS/PRODUCT | bakery:bread school:learning |