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Measuring symbol and icon characteristics: Norms for concreteness, complexity, meaningfulness, familiarity, and semantic distance for 239 symbols

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This paper provides rating norms for a set of symbols and icons selected from a wide variety of sources. These ratings enable the effects of symbol characteristics on user performance to be systematically investigated. The symbol characteristics that have been quantified are considered to be of central relevance to symbol usability research and include concreteness, complexity, meaningfulness, familiarity, and semantic distance. The interrelationships between each of these dimensions is examined and the importance of using normative ratings for experimental research is discussed.

There is now a growing body of research examining the characteristics considered important in determining how easy symbols[1] are to use. The catalyst for these studies has been the expansion in the use of symbols to convey information instead of written messages. Symbolic information is now commonplace in airports, in railway stations, and on roads (Arnstein, 1983; Zwaga & Easterby, 1984). It also forms an integral component of computer interfaces and serves to convey functional information on a variety of equipment such as cars, farm equipment, fighter aircraft, and naval tactical data systems (Cahill, 1975; Deaton, Barnes, Kern, & Wright, 1990; Flach & Vicente, 1989; P. Green, 1993; Kirkpatrick, Dutra, Lyons, Osga, & Pucci, 1992). Symbols are used not only because they provide a universal, international, mode of communication, but also because they can often be recognized and used more quickly than their word equivalents (Ellis & Dewar, 1979; Muter & Mayson, 1986).

Although symbols appear to be an effective means of communicating information, they can often be interpreted in a number of different ways, and we lack a clearly defined set of rules that would enable us to disambiguate their meaning in the same way as spoken or written communication. This means that when designers are developing symbols, they need to make them as easy to understand and use as possible. One way of ensuring this is to draw on the numerous guidelines that delineate good symbol design practice (e.g., Bocker, 1993; Gittens, 1986) or to use symbol listings drawn up by international standards organizations (e.g., British Standards Institution 1989; International Standards Organisation [ISO], 1982, 1994). The benefits that these design aids can bring, however, is necessarily constrained by what we know about symbol design. If symbol design is to progress, we need to know more about *why* some symbols are easier to use than others. This has been the goal of research in this area.

A major obstacle facing researchers attempting to answer this question has been the difficulties in quantifying symbol characteristics so that they can be experimentally controlled. A good way of controlling symbol characteristics experimentally is to obtain subjective ratings of each characteristic. Although there has been a long tradition in psycholinguistic research of using normative ratings to control item characteristics for words (e.g., Benjafield, Frommhold, Keenan, Muckenheim & Mueller, 1993; Friendly, Franklin, Hoffman, & Rubin, 1982; Gilhooly & Logie, 1980; Paivio, Yuille, & Madigan, 1968; Quinlan, 1992) and pictures (Martein, 1995; Sanfeliu & Fernandez, 1996; Snodgrass & Vanderwart, 1980; van Schagen, Tamsma, Bruggemann, Jackson, & Michon, 1983), *no* normative ratings for symbols have yet been produced. As a result, researchers have been forced to

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develop their own, sometimes idiosyncratic, sets of symbols for experimentation. This has had the advantage that symbols are often very well suited for the experimental purpose for which they have been designed, but has the disadvantage that differences in the symbol characteristics being manipulated are more often the result of the judgment of individual experimenters rather than of appropriate experimental control. This problem is addressed in the present paper by providing normative ratings for symbol characteristics.

Symbol Characteristics

The choice of symbol characteristics to be rated was determined in light of an extensive review of the literature (McDougall, Curry, & de Bruijn, 1996). This review identified a number of symbol characteristics of central concern to researchers. These included concreteness, visual complexity, meaningfulness, familiarity, and semantic distance. Current research on each of these characteristics is briefly reviewed below. This is followed by a description of the way each of these characteristics was quantified. Symbol characteristics that are self-evident (such as color) or those that can be defined only in relation to other symbols in a display (such as discriminability, distinctiveness, and configurality) are not included for consideration here.

Concreteness and visual complexity. One of the strongest claims made for symbols, and particularly for icons, is that they are easier to use because they are concrete. Concrete symbols tend to be more visually obvious because they depict objects, places, and people that we are already familiar with in the real world (Rogers, 1989; Stammers & Hoffman, 1991; see, e.g., Items 36, 90, 176, and 214 in the Appendix). Abstract symbols, in contrast, represent information using graphic features such as shapes, arrows, and so on (see Items 79, 119, and 185). Performance advantages for concrete symbols over abstract symbols have been found, and this appears to be consistent with the visual obviousness hypothesis (A. J. K. Green & Barnard, 1990; Rogers & Oborne, 1987; Stammers & Hoffman, 1991).

One of the reasons why concrete symbols are more visually obvious may simply be because the extra detail provided in concrete symbols makes them easier to use. Research carried out by Garcia, Badre, and Stasko (1994) has confirmed that concrete symbols used in experiments contain more detail than abstract symbols. Using a measure of visual complexity, they found that concrete symbols created for a number of studies were more complex than the abstract symbols used (i.e., Arend, Muthig, & Wandmacher, 1987; Rogers, 1986; Rohr & Keppel, 1985; Stammers, George, & Carey, 1989). On this basis, it would appear that concrete symbols are necessarily more complex in order to provide the detail required.

In contrast, however, design guidelines typically suggest that the design of symbols or icons should be kept as simple as possible. As far back as 1970, Easterby suggested that designers follow a "simplicity principle" because he felt that extra detail did not contribute to unambiguous and rapid interpretation of a symbol. This minimalist design approach has been endorsed by Rogers (1989). In a recent study, Byrne (1993) created a series of simple and complex symbols and examined the effect of symbol complexity on search performance. Search times were found to be shorter for simple, as opposed to complex, symbols. Byrne's findings seem to support the proposition that simplicity is the best policy in symbol design, particularly if response time is an important consideration.

These two strands of research pose an interesting dilemma for applied practice. While some researchers would seem to recommend the increase of detail to promote symbol efficacy, others advocate the removal of detail to achieve exactly the same objective. The reason for these two sets of conflicting recommendations may well be that researchers have confounded concreteness with complexity when devising symbol sets for experimentation. This paper will address this possibility by examining the correlation between rated concreteness and complexity. A strong correlation between these two dimensions would provide support for the notion that concreteness and complexity are parallel characteristics. If no correlation is found, this would suggest that these two symbol characteristics have indeed been confounded in prior research.

Concreteness and meaningfulness. Other researchers have focused on the fact that concrete symbols are more meaningful than abstract symbols. The relationship between concreteness and meaningfulness has perhaps been most thoroughly examined by Rogers (1986, 1989; Rogers & Oborne, 1987). She assessed participants' performance using six types of symbols that varied in degree of concreteness. As can be seen from Figure 1, symbols consisted of (1) abstract symbols (Set 1), (2) concrete analogies associated with action (Set 2), (3) concrete objects that are operated on in some way (Set 3), and (4) combinations of the above (Sets 4, 5, and 6).

When participants were asked to match written functions to symbols, performance was found to be poor for abstract symbols and even worse when concrete analogies were used to depict functions. Rogers therefore concluded that a critical determinant of a symbol's usability was the meaningfulness of the relationship between what was depicted in the symbol and the function it refers to, rather than its concreteness per se. The nature of the relationship between meaningfulness and concreteness was therefore examined in this study.

Earlier research suggests that the relationship between abstract symbols and their functions may be more diffuse than that for concrete symbols (Howell & Fuchs, 1968; Jones, 1983). Jones asked participants in her study to draw symbols for function names that she had provided. The drawings produced for each concept were then sorted into categories by judges. Jones found that the number of categories for each function was correlated with concreteness. As each function became more abstract, the meaning of each drawing appeared to grow more diffuse,

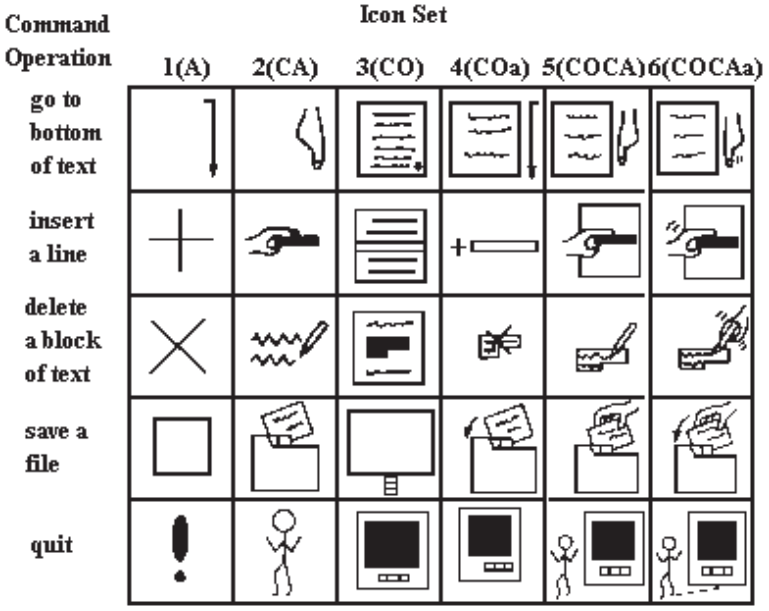

Figure 1. Six types of symbols used by Y. Rogers. A, abstract symbols; CA, concrete analogy associated with action; CO, concrete object operated on. From *Pictorial Representation of Abstract Concepts in Relation to Human Computer Interaction* (p. 141), by Y. Rogers, 1988, unpublished doctoral dissertation, University of Wales Swansea. Reprinted with permission.

resulting in more categories. This suggests that the meaning for abstract functions may be less stereotypical than for concrete functions and may affect the ease with which mappings may be made between symbol and function. This possibility was examined further in this study. Participants were asked to guess the meaning, or function, of each symbol they were shown. It was then possible to assess the extent to which there was agreement between participants about possible symbol meanings (see discussion of concept agreement, below) and to evaluate the relationship between concreteness and meaning stereotypicality.

Semantic distance. Semantic, or articulatory, distance is a measure of the closeness of the relationship between the symbol and what it is intended to represent. In some cases the relationship is very clear (e.g., when a picture of a printer is used to denote the "print" function in a word processing package; see Figure 2). In other cases the relationship is less obvious (e.g., the triangle used to represent a "hazard ahead," also in Figure 2). In this case the relationship between what is depicted in the symbol and the function it represents is much weaker, and it is only our familiarity with the symbol that allows us to interpret it.

A number of classification systems have been developed in order to attempt to characterize the different relationships that obtain between symbols and their functions. An early taxonomy proposed by Peirce (see Hartshorne, Weiss, & Burks, 1958) contains three categories of signs (or symbols), each of which relates to a different type of symbol–function relationship: (1) icon—a direct symbol–function relationship (see Figure 2A).; (2) index—an implied rather than a direct symbol–function relationship (see Figure 2B); and (3) symbol—an arbitrary relationship between symbol and function (see Figure 2C).

Several other classification systems have been developed along similar lines (see, e.g., Blattner, Sumikawa, & Greenberg, 1989; Familant & Detweiler, 1993). Although these classification systems are meant to represent different *types* of symbol–function relationship, they also appear to represent a continuum of the closeness of the relationship. For example, in Peirce's taxonomy, icons represent the closest relationship, index a moderately close relationship, and symbol a very distant relationship. We therefore propose that the symbol–function relationship can be very effectively treated as a semantic distance continuum. A similar approach to this has been adopted by Moyes and Jordan (1993), who emphasized the importance of closeness of the symbol–referent relationship in determining usability. Subjective ratings along a

Figure 2. Symbols with direct, implied, and arbitrary relationships to their function referent. Note—Figure 2A is reprinted with kind permission from the Microsoft Corporation.

continuum therefore provide a good indication of the closeness of the symbol–function relationship.

It is important to note that semantic distance may not necessarily be synonymous with a symbol's meaningfulness. For example, in Figure 2C, the hazard sign may be meaningful to drivers because of their familiarity with it, despite the fact that the semantic distance between symbol and referent is large. The interrelationships between these three dimensions—meaningfulness, familiarity, and semantic distance—were therefore examined in this study.

Familiarity. Familiarity reflects the frequency with which symbols are encountered. This property is thought to be an important determinant of usability. It is evident that user performance improves dramatically as a result of learning symbols and signs (see, e.g., Brems & Whitten, 1987; Margono & Shneiderman, 1987). It is also clear that the effects on performance of other symbol characteristics may diminish as symbol–function relationships are learned. For example, performance differences between concrete and abstract symbols have been found to lessen with familiarity (Arend et al., 1987; Stammers et al., 1989). Similarly, the beneficial effects of use of color in displays has been found to diminish over time as novice users become more expert (Christ & Corso, 1982). Despite such findings, it is interesting to note that although overall performance may improve in response to familiar complex and simple symbols, response times remain slower to complex symbols even after they have been learned (Byrne, 1993). To summarize, the effects of some symbol characteristics on performance, such as color and concreteness, diminish as symbols become more familiar but others, such as complexity, do not. The interrelationships between familiarity and other symbol characteristics were therefore examined in this study.

On the basis of our brief review, it is apparent that each of the symbol characteristics described may have an effect of symbol usability. This paper will therefore provide rating norms for these characteristics to enable their effects on user performance to be systematically investigated. Possible interrelationships between symbol characteristics are also examined. Of particular interest is the possibility that there is no necessary relationship between symbol concreteness and complexity and that these two factors may have been confounded in previous research.

METHOD

Participants

All participants were students from the University of Wales Swansea who were paid £3 for their participation. A total of 200 students took part in this study; 40 students each rated one of the five dimensions of interest—concreteness, complexity, meaningfulness, familiarity, and semantic distance. Since gender differences in ratings have been found in previous norms for words (Benjafield et al., 1993; Benjafield & Muckenheim, 1989; Friendly et al., 1982; Toglia & Battig, 1978), equal numbers of women and men rated each dimension.

Development of the Symbol Set

Symbols were chosen from a wide variety of sources in order to ensure that they were representative of the broad spectrum of applications in which symbols are currently used. These included symbols for use on electrical equipment (e.g., ISO, 1989; International Electrotechnical Commission, 1973), public information symbols (e.g., American Institute of Graphic Arts, 1982; ISO, 1990), military symbology (e.g., North Atlantic Treaty Organization, 1989), Internet websites (e.g., W_3C, 1996), vehicle and aircraft controls and displays (ISO, 1995), and computer interfaces (Microsoft Corporation, 1989, 1995). Initially a large corpus of symbols was formed and a semirandom procedure was used to select a subset of items. It was decided that, for research purposes, a reasonably even distribution of concrete and abstract items, visually complex and simple items, and familiar and unfamiliar items would be desirable. Symbols were therefore chosen from the corpus in order to ensure that each type of symbol was approximately evenly represented. Ten volunteers were asked to classify the symbol corpus into groups in accordance with their concreteness, complexity, and familiarity. Each volunteer was asked to classify items into three classifications denoting both ends of the continuum and a midpoint (e.g., concrete, abstract, moderately concrete). The numbers falling into each classification on the basis of the three symbol characteristics were as follows: concrete ($n = 68$), moderately concrete ($n = 61$), abstract ($n = 69$), complex ($n = 46$), moderately complex ($n = 65$), simple ($n = 69$), familiar ($n = 67$), moderately familiar ($n = 78$), and unfamiliar (n = 54). Although care was taken to ensure that there was as even a spread as possible of symbols, some types of symbols are underrepresented. For example, abstract symbols that are also complex and familiar arise relatively infrequently. This is also the case for symbols that might be characterized as concrete, simple, and unfamiliar.

Symbols were also chosen to reflect the wide variety of functions for which they are currently used. Symbols were divided roughly into four categories of use: computers ($n = 77$), traffic and public information ($n = 48$), industrial ($n = 69$), and household goods ($n = 50$). Computer symbols included icons and symbols used in computer software packages (e.g., Items 48 [color area] and 34 [center alignment] and on Internet websites (e.g., Items 201 [shopping] and 233 [webcrawler]. Traffic and public information symbols included signs used on roads, at railway stations, and airports, as well as symbols used in cars (such as Items 112 [headlamp cleaner] and 40 [choke]). Industrial symbols included those used to signify functions on industrial machines or processes (e.g., Items 80 [engage pile-raising roller], and 129 [laminate]). Industrial symbols also included a small number of military symbols (e.g., Item 70 [diver]). Symbols for household goods encapsulated those found on video recorders (Item 91 [fast forward]), washing machines (Item 185 [rinse]), refrigerators (Item 216 [three-star freezing compartment]), and cameras (Item 238 [zoom]).

Procedure

Symbols were presented to participants in booklets. Each booklet consisted of 20 pages, each page with 12 symbols printed in random order. Alongside each symbol was a 5-point rating scale. Pages were assembled into booklets in accordance with a Latin square design to ensure that each participant was presented with the symbols in a different order. Booklet covers contained a brief description of the dimension that participants were being asked to rate and instructions about how they should carry out the rating process.

Concreteness. Instructions for concreteness ratings were similar to those adopted in previous studies in which concreteness ratings have been obtained (Gilhooly & Logie, 1980; Paivio et al., 1968; Spreen & Schulz, 1966). Symbols were to be regarded as concrete if they depicted real objects, materials, or people; those that did not were to be regarded as abstract (1 = *definitely abstract*, 5 = *definitely concrete*).

Complexity. Complexity ratings were obtained using instructions similar to those adopted by Snodgrass and Vanderwart (1980) when obtaining complexity ratings for black-and-white line drawings. Complexity was defined as the amount of detail or intricacy

in the symbol. Participants were instructed to rate the complexity of each symbol on a 5-point scale (1 = *very simple*, 5 = *very complex*).

In contrast to other studies on symbol characteristics, an attempt was made to quantify the complexity of symbols using a complexity metric. Complexity metrics are typically applied to whole displays rather than individual symbols (Tullis, 1983), but Garcia et al. (1994) recently developed a metric that can be applied to individual symbols. Their metric is based on adding up the number of components present in a symbol. These components consist of the numbers of horizontal, vertical, and diagonal lines, and the number of closed figures, open figures, and letters present in the symbol. It was this measure of complexity that Garcia et al. used to assess the complexity of concrete and abstract symbols employed in previous studies (see above). In the present study, one of the authors (M. B. C.) used the metric to obtain a measure of the complexity of each of the symbols in our set. This was then used to assess the validity of the complexity ratings we had obtained.

Familiarity. Since it was not possible to obtain measures of frequency of occurrence of symbols in the same way as might be possible for words, participants were asked to rate their perceived familiarity with symbols. Familiarity was defined in terms of the frequency with which symbols had been encountered by participants. For example, most people would find the symbol used to indicate men's restrooms as very familiar (despite slight variations in the symbol used). Other symbols may have never, or only rarely, been encountered before. A 5-point rating of scale was used (1 = *very unfamiliar*, 5 = *very familiar*).

Meaningfulness, concept agreement, and name agreement. Participants were asked to rate how meaningful they perceived symbols to be. They were told that symbols that conveyed a great deal of meaning should be given a high rating (4 or 5) and those that conveyed little meaning should be given low ratings (1 or 2). After rating each symbol, participants were asked to state briefly what they felt the meaning of the symbol to be. Those who had provided a rating of 1 (*completely meaningless*) for an item were not required to provide a meaning for that symbol.

The percentage of participants who were able to ascertain the correct function, or meaning, of symbol was calculated. Similar measures of agreement have been obtained in the past for picture norms (Lachman & Lachman, 1980; Snodgrass & Vanderwart, 1980). Strict criteria were adopted for counting instances of correct picture names. Where names were not identical to an established name, they would be counted as incorrect. This included misspellings of the picture name, abbreviations (such as TV for television), and elaborations. The use of such a strict criterion was felt to be inappropriate for symbols since it is the identification of function, rather than the correct label, that is important in determining participants' performance. As a result, we adopted the measure of concept agreement suggested by Martein (1995), which allows for the inclusion of synonyms, common abbreviations, elaborations, multiple names, diminutives, and dialect words. A similar measure of concept agreement has subsequently been employed by Snodgrass and Yuditsky (1996). It should be noted that while high levels of concept agreement are possible for picture names, particularly if the pictures represent common objects, lower levels of agreement might be expected for symbol functions since symbols are inherently more ambiguous.

A further measure, name agreement, was also obtained. This was important when the possible function most commonly assigned to the symbol by participants differed from the given function. Where concept agreement and name agreement differ, this indicates that there is not a good fit between the designated symbol–function agreement and that other, better, possibilities exist.

Semantic distance. As we have already noted, symbols vary in the closeness of the relationship between the graphic and the function being represented. In some cases the relationship is fairly direct (e.g., the printer shown in Figure 2 used as a symbol for printing documents from word processors). In other cases the relationship is much less direct (e.g., the triangle used to indicate "hazard ahead," also in Figure 2). The "semantic distance" between function and symbol might be regarded as quite small in the first case, but much larger in the second case.

Participants were given these examples in order to explain the concept of semantic distance and then asked to provide ratings for the closeness of each of the 240 symbols to their functions (1 = *not closely related*, 5 = *very strongly related*).

RESULTS AND DISCUSSION

Symbol Information

The Appendix provides an alphabetical index of symbols used in this study to allow symbols to be accessed using their function name. Accompanying the symbols in the Appendix are the mean ratings for each symbol characteristic. The complexity metric for each symbol (calculated using the method developed by Garcia et al., 1994) is also listed, as are percentage values for concept agreement and name agreement. Where the most common meaning given for a symbol does not match the given function name (i.e., where name agreement exceeds concept agreement), the alternative is shown at the bottom right-hand corner of the entry for that symbol. Where a value of 2.5% is quoted for name agreement, only one person provided an alternative meaning, or there was no agreement over alternative meanings (a series of individuals provided different alternatives). Where this is the case, no alternative meaning is provided at the bottom of the entry for that icon.

Reliability and Validity

Reliability of the ratings was evaluated using split-half reliability measures. Each group of 40 participants was divided into two subgroups of 20, with equal numbers of women and men in each subgroup. New mean ratings were then calculated for each symbol, and the correlations between subgroup ratings for symbols were calculated. Split-half reliabilities were all above .90 (concreteness = .95; complexity = .94; familiarity = .95; meaningfulness = .96; semantic distance = .95). This indicates considerable between-group stability in the ratings obtained.

Since to our knowledge no ratings have previously been obtained for symbols, the validity of our ratings could not be assessed by comparison with previous work. However, a measure of the external validity of the complexity ratings could be obtained by using the metric developed by Garcia et al. (1994). The distribution of values obtained using the metric was positively skewed, and the data were therefore transformed using a $\log_{10}$ transformation before correlating the metric with the ratings data. The correlation obtained was high (r_s = .73), suggesting that the metric and ratings were tapping a similar construct.

Summary Statistics

Table 1 presents summary statistics for each of the ratings obtained. Included are the overall means, standard deviations, medians, and measures of skew. The range of

values obtained from participants is indicated by minimum and maximum values. Mean ratings were generally grouped around the midpoint of the 5-point rating scale, and dispersion of scores about the mean was similar for all rated symbol characteristics. With the exception of the complexity metric and concept agreement, all variables were normally distributed. Both the complexity metric and concept agreement were transformed using a $\log_{10}$ transformation to reduce skew before further analyses were conducted.

Interrelationships Between Symbol Characteristics

Correlations between symbol ratings and measures of concept agreement, name agreement, and the complexity metric are shown in Table 2.

Concreteness and complexity. One aim of this study was to examine the possibility that prior research may have confounded the effects of concreteness and complexity. This was suggested by the contrast between research and design practice. An assumption implicit in the research literature is that concrete symbols are easier to use because of the extra visual detail they contain. When Garcia et al. (1994) measured symbol complexity using a metric, it was found that concrete symbols used in a number of experiments were indeed consistently more complex than the abstract symbols presented. However, design guidelines often argue that simplicity makes symbols more usable and that detail should be removed rather than added (Easterby, 1970; Rogers, 1988). Given current design practice, it therefore seems plausible to suggest that there is no necessary relationship between concreteness and complexity.

A strong correlation between visual complexity and concreteness would provide support for the notion that concreteness and complexity are inevitably intertwined. The absence of a correlation would suggest that concrete symbols can also be simple. Table 2 shows that there was no significant correlation between the two variables and that concreteness and complexity are therefore two separable dimensions. It also suggests that concreteness and complexity may have been confounded in some previous studies.

A number of examples in the Appendix show that it is possible to keep extra visual detail (and hence complexity) to a minimum while utilizing users' preexisting world knowledge (e.g., Items 24, 94, 96, 114, 156, 202, and 214). On this basis it would seem that the use of a visual metaphor along with the simplicity principle is likely to produce particularly effective symbols.

Table 1
Summary Statistics for All Symbol Characteristics

Measure	*M*	Median	*SD*	Min	Max	Skew
Concreteness	3.26	3.20	0.97	1.60	4.93	0.92
Complexity rating	2.62	2.64	0.83	1.04	4.60	0.16
Familiarity	2.97	3.01	0.92	1.38	4.95	0.16
Meaningfulness	2.80	2.80	0.94	1.28	4.75	0.04
Semantic distance	2.59	2.52	0.98	1.02	4.90	0.52
Complexity metric	8.60	6.00	8.28	1.00	51.00	2.23
Concept agreement (%)	15.49	2.50	22.39	0.00	82.50	1.47
Name agreement (%)	31.39	25.00	23.04	2.50	87.50	0.56

Other correlations. Other interrelationships between symbol characteristics are shown in Table 2. Although concreteness did not correlate with visual complexity, it was found to be closely related to meaningfulness. These findings provide support for the suggestion made by Y. Rogers and others that concrete symbols tend to be more meaningful than abstract symbols. This is probably because use of familiar real-world objects in concrete symbols allows the user to ascertain their meaning even when they are encountered for the first time. Abstract symbols, in contrast, are only likely to become meaningful when users learn the symbol–function relationship. As can be seen from the Appendix, the few items that were meaningful but not concrete tended to be ones with which users were familiar (e.g., symbols denoting female and male genders, Items 93 and 143; symbols denoting eject and fast-forward functions on a video recorder, Items 74 and 91). We would therefore predict that the relationship between concreteness and meaningfulness would diminish as symbol–function relationships are learned. This notion is supported by previous research showing that the effects of symbol concreteness on performance diminish over learning trials (Arend et al., 1987; Stammers et al., 1989).

In the context of this study, meaningfulness and familiarity appear to be virtually interchangeable ($r_s = .93$). For familiar items, participants could readily access a meaning, even though it might not be correct, by drawing on their real-world experiences. For example, Item 176 in the Appendix is used to denote *portable file*. In order to access meaning for this symbol, most participants used a picture-labeling strategy and stated that it was a sign for luggage storage. Thus the symbol appeared meaningful and familiar while, at the same time, most participants were ignorant of its function. In these cases, the most popular name for the symbol did not match the given function name. Where items were *not* familiar, access to meaning was much more difficult. For example, Item 126 shows a jacketed reactor, an item unfamiliar to most individuals. This makes it difficult to adopt the labeling strategy used for other, more familiar, symbols.

Further support for the notion that participants often adopted a labeling strategy in order to access meaning comes from the pattern of correlations shown in Table 2 for concept agreement and name agreement. Concept agreement measures the percentage of participants who were able to give the appropriate function name, or meaning, for the symbol. In contrast, name agreement is a measure of the percentage of participants giving the most common meaning, irrespective of whether it was correct or not. The concept agreement rating was most closely related to the semantic distance rating. This seems likely to be because in rating semantic distance, participants were given the function label. Correlations of concept agreement with familiarity and meaningfulness ratings, where the function label was not provided, were lower. This sit-

Table 2
Correlations Between Symbol Characteristics

Measure	Conc	Comp Rating	Comp Metric	Fam	Mean	SemD	Con Agree	Name Agree
Concreteness	1.00							
Complexity rating	*n.s.*	1.00						
Complexity metric	*n.s.*	.73	1.00					
Familiarity	.78	−.31	−.27	1.00				
Meaningfulness	.82	−.25	−.19	.93	1.00			
Semantic distance	.65	*n.s.*	*n.s.*	.55	.61	1.00		
Concept agreement	.41	−.17	*n.s.*	.51	.51	.69	1.00	
Name agreement	.46	−.22	*n.s.*	.79	.86	.54	.46	1.00

Note—Conc, concreteness; Comp Rating, complexity rating; Comp Metric, complexity metric; Fam, familiarity; Mean, meaningfulness; SemD, semantic distance; Con Agree, concept agreement; Name Agree, name agreement.

uation was reversed for name agreement. Correlations were highest with meaningfulness and familiarity, since items for which a labeling strategy were used were incorporated within the measurement of name agreement.

CONCLUSIONS

There has been a long tradition in psycholinguistic research of using normative ratings to manipulate or control variables in the course of experimentation (e.g., Gilhooly & Logie, 1980; Martein, 1995; Paivio et al., 1968; Sanfeliu & Fernandez, 1996; Snodgrass & Vanderwart, 1980). This means that research concerning the processing of pictures and words can be carried out after potential artifacts have been eliminated. In contrast, research examining the effects of symbol characteristics on user performance is a relatively recent undertaking and, as a result, researchers have been forced to rely on creating their own, sometimes idiosyncratic, symbol stimuli. This paper used the ratings methodology to quantify the characteristics of a broad range of symbols that may be used as experimental stimuli. The dimensions for which ratings were obtained are correlates of symbol usability given prominence in previous research. The importance of appropriate experimental control was evident when the relationship between concreteness and visual complexity was investigated. In general, with the exception of measures of visual complexity, relationships between ratings were close. In particular, strong correlations were apparent between concreteness, meaningfulness, and familiarity. However, there is some evidence to suggest that these relationships may break down as users learn symbol–function relationships. In this way, symbols differ from words where relationships between word characteristics are much more stable. This is because the relationship between written words (the symbol) and what they refer to is already known.

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NOTE

1. Unless otherwise specified, the term *symbol* refers to icons, pictograms, symbols, and signs.

APPENDIX
Symbols and Ratings Listed in Alphabetical Order

1 Add task

Concreteness:	2.47
Complexity:	2.55
Familiarity:	3.05
Meaningfulness:	3.45
Semantic Distance:	2.03
Complexity Metric:	2
Concept Agreement:	0.00
Name Agreement:	42.50
	correct

2 Added fabric web width

Concreteness:	2.27
Complexity:	2.80
Familiarity:	1.93
Meaningfulness:	1.98
Semantic Distance:	1.89
Complexity Metric:	14
Concept Agreement:	0.00
Name Agreement:	7.50
	narrowing

3 Adjust contrast

Concreteness:	2.68
Complexity:	1.55
Familiarity:	3.20
Meaningfulness:	2.93
Semantic Distance:	2.50
Complexity Metric:	2
Concept Agreement:	5.00
Name Agreement:	7.50
	colour

4 Air cooled condenser

Concreteness:	1.85
Complexity:	3.50
Familiarity:	1.75
Meaningfulness:	1.33
Semantic Distance:	1.56
Complexity Metric:	7
Concept Agreement:	0.00
Name Agreement:	5.00
	magnet

5 Air vent - right and left outlets

Concreteness:	1.98
Complexity:	2.60
Familiarity:	2.05
Meaningfulness:	2.10
Semantic Distance:	2.57
Complexity Metric:	10
Concept Agreement:	7.50
Name Agreement:	15.00
	exits

6 Airborne troops

Concreteness:	2.80
Complexity:	1.18
Familiarity:	3.00
Meaningfulness:	2.65
Semantic Distance:	1.57
Complexity Metric:	2
Concept Agreement:	2.50
Name Agreement:	37.50
	ice cream

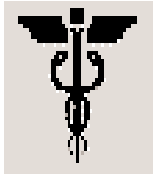
7 Airbrush

Concreteness:	2.22
Complexity:	3.90
Familiarity:	1.55
Meaningfulness:	1.60
Semantic Distance:	2.24
Complexity Metric:	16
Concept Agreement:	7.50
Name Agreement:	7.50

8 All operators

Concreteness:	2.80
Complexity:	2.10
Familiarity:	2.50
Meaningfulness:	2.32
Semantic Distance:	1.74
Complexity Metric:	4
Concept Agreement:	0.00
Name Agreement:	17.50
	people

9 American health service



Concreteness:	2.70
Complexity:	3.97
Familiarity:	2.70
Meaningfulness:	2.28
Semantic Distance:	1.60
Complexity Metric:	6
Concept Agreement:	0.00
Name Agreement:	10.00
	medical

10 Apple computer

Concreteness:	2.93
Complexity:	4.13
Familiarity:	1.98
Meaningfulness:	1.70
Semantic Distance:	1.64
Complexity Metric:	14
Concept Agreement:	5.00
Name Agreement:	5.00

APPENDIX (Continued)

11 Arc ignition by contact

Concreteness:	3.13
Complexity:	2.37
Familiarity:	2.65
Meaningfulness:	2.35
Semantic Distance:	1.68
Complexity Metric:	8
Concept Agreement:	0.00
Name Agreement:	20.00
	tap

12 Archive

Concreteness:	2.15
Complexity:	3.47
Familiarity:	1.95
Meaningfulness:	1.50
Semantic Distance:	1.50
Complexity Metric:	7
Concept Agreement:	0.00
Name Agreement:	5.00
	bundle of wood

13 Atomic site

Concreteness:	3.18
Complexity:	2.53
Familiarity:	3.73
Meaningfulness:	2.78
Semantic Distance:	2.31
Complexity Metric:	4
Concept Agreement:	2.50
Name Agreement:	20.00
	atom

14 Automatic control (closed loop)

Concreteness:	1.85
Complexity:	2.73
Familiarity:	1.93
Meaningfulness:	1.68
Semantic Distance:	1.39
Complexity Metric:	4
Concept Agreement:	0.00
Name Agreement:	10.00
	spinning

15 Axe

Concreteness:	3.85
Complexity:	1.25
Familiarity:	3.12
Meaningfulness:	3.30
Semantic Distance:	3.95
Complexity Metric:	2
Concept Agreement:	40.00
Name Agreement:	40.00

16 Baggage lockers

Concreteness:	4.27
Complexity:	2.58
Familiarity:	4.13
Meaningfulness:	3.87
Semantic Distance:	4.14
Complexity Metric:	5
Concept Agreement:	55.00
Name Agreement:	55.00

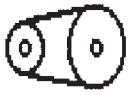
17 Balance

Concreteness:	2.50
Complexity:	2.38
Familiarity:	2.60
Meaningfulness:	3.17
Semantic Distance:	3.86
Complexity Metric:	4
Concept Agreement:	37.50
Name Agreement:	37.50

18 Beating process of fabrics

Concreteness:	2.55
Complexity:	2.22
Familiarity:	1.65
Meaningfulness:	1.48
Semantic Distance:	1.41
Complexity Metric:	7
Concept Agreement:	0.00
Name Agreement:	5.00
	bomb

19 Belt drive



Concreteness:	3.38
Complexity:	1.68
Familiarity:	3.10
Meaningfulness:	2.51
Semantic Distance:	2.90
Complexity Metric:	6
Concept Agreement:	0.00
Name Agreement:	57.50
	pulley

20 Bending

Concreteness:	2.00
Complexity:	3.40
Familiarity:	1.65
Meaningfulness:	1.35
Semantic Distance:	2.74
Complexity Metric:	5
Concept Agreement:	2.50
Name Agreement:	2.50

APPENDIX (Continued)

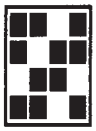
21 Binary file

Concreteness:	1.80
Complexity:	3.88
Familiarity:	2.45
Meaningfulness:	2.28
Semantic Distance:	2.88
Complexity Metric:	51
Concept Agreement:	20.00
Name Agreement:	20.00

22 Biohazard

Concreteness:	1.85
Complexity:	3.65
Familiarity:	2.45
Meaningfulness:	1.85
Semantic Distance:	1.48
Complexity Metric:	6
Concept Agreement:	5.00
Name Agreement:	5.00

23 Bitmap



Concreteness:	2.33
Complexity:	2.93
Familiarity:	2.27
Meaningfulness:	1.68
Semantic Distance:	1.85
Complexity Metric:	12
Concept Agreement:	0.00
Name Agreement:	17.50
	game

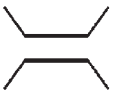
24 Blow moulding

Concreteness:	4.65
Complexity:	1.13
Familiarity:	4.33
Meaningfulness:	3.88
Semantic Distance:	1.35
Complexity Metric:	1
Concept Agreement:	0.00
Name Agreement:	60.00
	bottle

25 Break glass to access

Concreteness:	3.63
Complexity:	3.20
Familiarity:	3.02
Meaningfulness:	2.80
Semantic Distance:	3.31
Complexity Metric:	5
Concept Agreement:	7.50
Name Agreement:	15.00
	revolution

26 Bridging troops



Concreteness:	2.12
Complexity:	1.65
Familiarity:	2.87
Meaningfulness:	2.13
Semantic Distance:	1.61
Complexity Metric:	2
Concept Agreement:	27.50
Name Agreement:	27.50

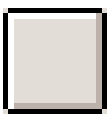
27 Brushing by means of brush belt

Concreteness:	3.03
Complexity:	2.20
Familiarity:	2.20
Meaningfulness:	1.95
Semantic Distance:	1.98
Complexity Metric:	14
Concept Agreement:	0.00
Name Agreement:	12.50
	cog

28 Building

Concreteness:	4.70
Complexity:	3.88
Familiarity:	3.88
Meaningfulness:	3.53
Semantic Distance:	4.67
Complexity Metric:	11
Concept Agreement:	70.00
Name Agreement:	70.00

29 Button



Concreteness:	2.53
Complexity:	2.73
Familiarity:	2.50
Meaningfulness:	1.95
Semantic Distance:	2.74
Complexity Metric:	2
Concept Agreement:	17.50
Name Agreement:	17.50

30 Calendar

Concreteness:	4.30
Complexity:	3.15
Familiarity:	3.22
Meaningfulness:	2.90
Semantic Distance:	3.45
Complexity Metric:	14
Concept Agreement:	22.50
Name Agreement:	22.50

APPENDIX (Continued)

31 Cancer

Concreteness:	4.52
Complexity:	3.42
Familiarity:	3.23
Meaningfulness:	3.73
Semantic Distance:	2.50
Complexity Metric:	13
Concept Agreement:	12.50
Name Agreement:	50.00
	crab

32 Cartoons

Concreteness:	3.83
Complexity:	3.70
Familiarity:	2.43
Meaningfulness:	2.73
Semantic Distance:	2.10
Complexity Metric:	11
Concept Agreement:	0.00
Name Agreement:	20.00
	man

33 CD-interactive

Concreteness:	2.35
Complexity:	3.35
Familiarity:	1.82
Meaningfulness:	1.90
Semantic Distance:	2.00
Complexity Metric:	17
Concept Agreement:	0.00
Name Agreement:	17.50
	CD

34 Centre alignment

Concreteness:	1.85
Complexity:	1.90
Familiarity:	2.05
Meaningfulness:	1.70
Semantic Distance:	2.52
Complexity Metric:	5
Concept Agreement:	0.00
Name Agreement:	5.00
	battery

35 Centre of gravity

Concreteness:	4.40
Complexity:	2.55
Familiarity:	1.78
Meaningfulness:	2.43
Semantic Distance:	1.76
Complexity Metric:	6
Concept Agreement:	0.00
Name Agreement:	15.00
	target

36 Chain reaction

Concreteness:	4.72
Complexity:	3.38
Familiarity:	3.58
Meaningfulness:	3.58
Semantic Distance:	3.00
Complexity Metric:	8
Concept Agreement:	10.00
Name Agreement:	67.50
	dominoes

37 Chain saw

Concreteness:	3.48
Complexity:	2.47
Familiarity:	2.95
Meaningfulness:	3.03
Semantic Distance:	3.05
Complexity Metric:	10
Concept Agreement:	42.50
Name Agreement:	42.50

38 Chemistry

Concreteness:	4.83
Complexity:	3.25
Familiarity:	4.10
Meaningfulness:	3.78
Semantic Distance:	3.90
Complexity Metric:	12
Concept Agreement:	40.00
Name Agreement:	40.00

39 Chess

Concreteness:	4.60
Complexity:	3.43
Familiarity:	4.45
Meaningfulness:	4.18
Semantic Distance:	4.38
Complexity Metric:	8
Concept Agreement:	82.50
Name Agreement:	82.50

40 Choke

Concreteness:	2.40
Complexity:	1.80
Familiarity:	3.20
Meaningfulness:	2.35
Semantic Distance:	1.90
Complexity Metric:	4
Concept Agreement:	15.00
Name Agreement:	15.00

APPENDIX (Continued)

41 Christianity

Concreteness:	4.50
Complexity:	3.95
Familiarity:	4.10
Meaningfulness:	4.10
Semantic Distance:	3.71
Complexity Metric:	10
Concept Agreement:	0.00
Name Agreement:	67.50
	Jesus

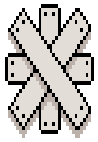
42 Clean edge pins

Concreteness:	2.02
Complexity:	3.10
Familiarity:	1.60
Meaningfulness:	1.42
Semantic Distance:	1.38
Complexity Metric:	6
Concept Agreement:	0.00
Name Agreement:	5.00
	microscope

43 Cleaning of chain-link

Concreteness:	2.28
Complexity:	2.87
Familiarity:	1.70
Meaningfulness:	1.57
Semantic Distance:	1.39
Complexity Metric:	6
Concept Agreement:	0.00
Name Agreement:	12.50
	microscope

44 Closed



Concreteness:	3.20
Complexity:	3.33
Familiarity:	2.60
Meaningfulness:	2.63
Semantic Distance:	2.86
Complexity Metric:	22
Concept Agreement:	10.00
Name Agreement:	12.50
	boarded up

45 Cloth track steaming

Concreteness:	1.85
Complexity:	2.38
Familiarity:	1.72
Meaningfulness:	1.68
Semantic Distance:	1.71
Complexity Metric:	5
Concept Agreement:	0.00
Name Agreement:	5.00
	evaporation

46 Co-operate

Concreteness:	4.35
Complexity:	2.90
Familiarity:	3.93
Meaningfulness:	4.10
Semantic Distance:	3.14
Complexity Metric:	6
Concept Agreement:	0.00
Name Agreement:	22.50
	racial equality

47 Cockpit

Concreteness:	2.65
Complexity:	4.60
Familiarity:	1.73
Meaningfulness:	1.65
Semantic Distance:	2.55
Complexity Metric:	26
Concept Agreement:	0.00
Name Agreement:	7.50
	computer

48 Colour area

Concreteness:	4.47
Complexity:	3.35
Familiarity:	3.40
Meaningfulness:	3.23
Semantic Distance:	2.95
Complexity Metric:	6
Concept Agreement:	2.50
Name Agreement:	20.00
	paint

49 Colour temperature lamp

Concreteness:	3.80
Complexity:	1.92
Familiarity:	3.80
Meaningfulness:	3.43
Semantic Distance:	1.81
Complexity Metric:	10
Concept Agreement:	0.00
Name Agreement:	40.00
	light

50 Communication

Concreteness:	4.30
Complexity:	1.93
Familiarity:	3.90
Meaningfulness:	3.58
Semantic Distance:	3.14
Complexity Metric:	3
Concept Agreement:	5.00
Name Agreement:	52.50
	satellite

APPENDIX (Continued)

51 Compress file

Concreteness:	3.55
Complexity:	4.23
Familiarity:	2.30
Meaningfulness:	2.23
Semantic Distance:	3.05
Complexity Metric:	23
Concept Agreement:	7.50
Name Agreement:	65.00
	vice

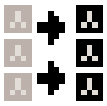
52 Confucianism

Concreteness:	1.65
Complexity:	3.82
Familiarity:	1.45
Meaningfulness:	1.35
Semantic Distance:	1.32
Complexity Metric:	13
Concept Agreement:	0.00
Name Agreement:	2.50

53 Connect

Concreteness:	4.35
Complexity:	2.90
Familiarity:	3.58
Meaningfulness:	3.56
Semantic Distance:	3.38
Complexity Metric:	11
Concept Agreement:	25.00
Name Agreement:	25.00

54 Convert multiple files



Concreteness:	1.92
Complexity:	3.73
Familiarity:	1.55
Meaningfulness:	1.48
Semantic Distance:	1.55
Complexity Metric:	26
Concept Agreement:	0.00
Name Agreement:	7.50
	computer game

55 Conveyer belt

Concreteness:	2.65
Complexity:	1.40
Familiarity:	2.45
Meaningfulness:	2.18
Semantic Distance:	2.71
Complexity Metric:	4
Concept Agreement:	12.50
Name Agreement:	12.50

56 Creel

Concreteness:	1.95
Complexity:	2.75
Familiarity:	1.83
Meaningfulness:	1.73
Semantic Distance:	1.17
Complexity Metric:	25
Concept Agreement:	0.00
Name Agreement:	7.50
	molecules

57 Crop

Concreteness:	1.67
Complexity:	2.50
Familiarity:	1.80
Meaningfulness:	1.38
Semantic Distance:	1.25
Complexity Metric:	4
Concept Agreement:	2.50
Name Agreement:	2.50

58 Cube

Concreteness:	4.20
Complexity:	1.50
Familiarity:	3.75
Meaningfulness:	3.00
Semantic Distance:	4.86
Complexity Metric:	3
Concept Agreement:	35.00
Name Agreement:	35.00

59 Currency exchange

Concreteness:	4.40
Complexity:	2.08
Familiarity:	3.87
Meaningfulness:	3.90
Semantic Distance:	3.07
Complexity Metric:	8
Concept Agreement:	10.00
Name Agreement:	70.00
	money

60 Dam

Concreteness:	3.03
Complexity:	3.05
Familiarity:	3.48
Meaningfulness:	3.48
Semantic Distance:	3.95
Complexity Metric:	8
Concept Agreement:	22.50
Name Agreement:	22.50

APPENDIX (Continued)

61 Dangerous voltage

Concreteness:	3.93
Complexity:	1.23
Familiarity:	4.52
Meaningfulness:	4.18
Semantic Distance:	2.79
Complexity Metric:	1
Concept Agreement:	10.00
Name Agreement:	32.50

lightning

62 Debug

Concreteness:	4.32
Complexity:	4.00
Familiarity:	3.20
Meaningfulness:	3.55
Semantic Distance:	3.48
Complexity Metric:	15
Concept Agreement:	2.50
Name Agreement:	45.00

insecticide

63 Debug

Concreteness:	4.33
Complexity:	2.98
Familiarity:	3.20
Meaningfulness:	3.40
Semantic Distance:	1.93
Complexity Metric:	14
Concept Agreement:	0.00
Name Agreement:	30.00

ladybird

64 Desk set

Concreteness:	2.25
Complexity:	4.25
Familiarity:	1.80
Meaningfulness:	1.60
Semantic Distance:	1.95
Complexity Metric:	40
Concept Agreement:	0.00
Name Agreement:	10.00

computer

65 Device driver

Concreteness:	1.82
Complexity:	2.18
Familiarity:	2.20
Meaningfulness:	1.28
Semantic Distance:	1.11
Complexity Metric:	2
Concept Agreement:	0.00
Name Agreement:	2.50

66 Diagnose

Concreteness:	4.47
Complexity:	2.05
Familiarity:	3.57
Meaningfulness:	3.47
Semantic Distance:	2.67
Complexity Metric:	1
Concept Agreement:	0.00
Name Agreement:	45.00

stethoscope

67 Diamond extraction

Concreteness:	2.68
Complexity:	2.28
Familiarity:	2.43
Meaningfulness:	2.88
Semantic Distance:	2.61
Complexity Metric:	6
Concept Agreement:	45.00
Name Agreement:	45.00

68 Discard files

Concreteness:	3.78
Complexity:	1.95
Familiarity:	3.10
Meaningfulness:	3.58
Semantic Distance:	2.43
Complexity Metric:	5
Concept Agreement:	0.00
Name Agreement:	40.00

dustbin

69 Distressed vessel

Concreteness:	3.45
Complexity:	2.35
Familiarity:	2.98
Meaningfulness:	3.05
Semantic Distance:	3.31
Complexity Metric:	3
Concept Agreement:	0.00
Name Agreement:	32.50

rough seas

70 Diver

Concreteness:	2.15
Complexity:	2.38
Familiarity:	1.83
Meaningfulness:	1.45
Semantic Distance:	1.56
Complexity Metric:	5
Concept Agreement:	2.50
Name Agreement:	5.00

front of train

APPENDIX (Continued)

71 Draw

Concreteness:	3.25
Complexity:	2.65
Familiarity:	2.60
Meaningfulness:	2.40
Semantic Distance:	2.52
Complexity Metric:	3
Concept Agreement:	0.00
Name Agreement:	20.00
	fireworks

72 Earthing point

Concreteness:	2.18
Complexity:	2.00
Familiarity:	2.58
Meaningfulness:	2.18
Semantic Distance:	1.58
Complexity Metric:	4
Concept Agreement:	15.00
Name Agreement:	15.00

73 Educate

Concreteness:	3.75
Complexity:	2.25
Familiarity:	3.10
Meaningfulness:	3.33
Semantic Distance:	3.12
Complexity Metric:	3
Concept Agreement:	10.00
Name Agreement:	30.00
	graduation

74 Eject

Concreteness:	2.40
Complexity:	1.45
Familiarity:	3.43
Meaningfulness:	2.85
Semantic Distance:	2.43
Complexity Metric:	2
Concept Agreement:	30.00
Name Agreement:	30.00

75 Electric shaver outlet

Concreteness:	3.52
Complexity:	2.55
Familiarity:	3.35
Meaningfulness:	3.08
Semantic Distance:	3.55
Complexity Metric:	12
Concept Agreement:	0.00
Name Agreement:	57.50
	shave

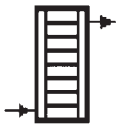
76 Electric transmission

Concreteness:	4.40
Complexity:	3.63
Familiarity:	4.45
Meaningfulness:	4.20
Semantic Distance:	3.48
Complexity Metric:	22
Concept Agreement:	0.00
Name Agreement:	55.00
	electricity pylons

77 Electrical loop

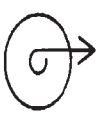
Concreteness:	1.60
Complexity:	2.38
Familiarity:	1.48
Meaningfulness:	1.43
Semantic Distance:	1.95
Complexity Metric:	3
Concept Agreement:	2.50
Name Agreement:	7.50
	maze

78 Electrical precipitator



Concreteness:	2.25
Complexity:	2.65
Familiarity:	1.92
Meaningfulness:	2.16
Semantic Distance:	1.17
Complexity Metric:	14
Concept Agreement:	0.00
Name Agreement:	15.00
	stairs

79 End of reel



Concreteness:	1.92
Complexity:	2.45
Familiarity:	1.70
Meaningfulness:	1.65
Semantic Distance:	2.17
Complexity Metric:	3
Concept Agreement:	0.00
Name Agreement:	5.00
	turns right

80 Engage pile-raising roller

Concreteness:	2.32
Complexity:	3.20
Familiarity:	2.08
Meaningfulness:	1.79
Semantic Distance:	1.92
Complexity Metric:	18
Concept Agreement:	0.00
Name Agreement:	12.50
	water mill

APPENDIX (Continued)

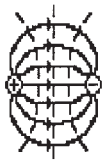
81 Engagement of seat belt

Concreteness:	4.15
Complexity:	2.85
Familiarity:	3.90
Meaningfulness:	4.27
Semantic Distance:	4.26
Complexity Metric:	5
Concept Agreement:	80.00
Name Agreement:	80.00

82 Entrance

Concreteness:	2.38
Complexity:	1.70
Familiarity:	2.60
Meaningfulness:	2.60
Semantic Distance:	3.36
Complexity Metric:	3
Concept Agreement:	45.00
Name Agreement:	45.00

83 Equipotentials



Concreteness:	2.43
Complexity:	3.82
Familiarity:	3.15
Meaningfulness:	2.98
Semantic Distance:	2.78
Complexity Metric:	21
Concept Agreement:	0.00
Name Agreement:	30.00
	magnetic field

84 External cylindrical grinding

Concreteness:	2.58
Complexity:	3.15
Familiarity:	1.78
Meaningfulness:	1.35
Semantic Distance:	2.13
Complexity Metric:	6
Concept Agreement:	2.50
Name Agreement:	2.50

85 External hard disk

Concreteness:	3.08
Complexity:	3.15
Familiarity:	1.98
Meaningfulness:	1.63
Semantic Distance:	1.86
Complexity Metric:	10
Concept Agreement:	2.50
Name Agreement:	2.50

86 External honing

Concreteness:	2.30
Complexity:	2.90
Familiarity:	2.10
Meaningfulness:	1.77
Semantic Distance:	1.66
Complexity Metric:	7
Concept Agreement:	0.00
Name Agreement:	7.50
	electrical

87 Fallout shelter

Concreteness:	2.85
Complexity:	2.65
Familiarity:	3.55
Meaningfulness:	2.58
Semantic Distance:	1.52
Complexity Metric:	4
Concept Agreement:	0.00
Name Agreement:	20.00
	radiation

88 Fan

Concreteness:	2.58
Complexity:	2.40
Familiarity:	2.35
Meaningfulness:	2.30
Semantic Distance:	3.36
Complexity Metric:	9
Concept Agreement:	17.50
Name Agreement:	17.50

89 Farm kitchen

Concreteness:	2.30
Complexity:	2.32
Familiarity:	1.88
Meaningfulness:	1.67
Semantic Distance:	1.14
Complexity Metric:	3
Concept Agreement:	0.00
Name Agreement:	10.00
	pot

90 Fast

Concreteness:	4.72
Complexity:	2.10
Familiarity:	3.73
Meaningfulness:	4.10
Semantic Distance:	3.02
Complexity Metric:	1
Concept Agreement:	15.00
Name Agreement:	52.50
	rabbit

APPENDIX (Continued)

91 Fast forward

Concreteness:	3.28
Complexity:	1.23
Familiarity:	4.27
Meaningfulness:	3.95
Semantic Distance:	3.38
Complexity Metric:	2
Concept Agreement:	62.50
Name Agreement:	62.50

92 Fast rewind

Concreteness:	3.05
Complexity:	1.10
Familiarity:	4.25
Meaningfulness:	3.70
Semantic Distance:	3.00
Complexity Metric:	2
Concept Agreement:	50.00
Name Agreement:	50.00

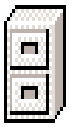
93 Female

Concreteness:	2.15
Complexity:	2.73
Familiarity:	4.75
Meaningfulness:	4.60
Semantic Distance:	2.14
Complexity Metric:	3
Concept Agreement:	60.00
Name Agreement:	60.00

94 Fighter

Concreteness:	4.50
Complexity:	1.88
Familiarity:	4.33
Meaningfulness:	3.90
Semantic Distance:	3.69
Complexity Metric:	1
Concept Agreement:	55.00
Name Agreement:	55.00

95 File manager



Concreteness:	4.55
Complexity:	2.53
Familiarity:	4.00
Meaningfulness:	3.35
Semantic Distance:	3.24
Complexity Metric:	7
Concept Agreement:	10.00
Name Agreement:	47.50
	files

96 Films

Concreteness:	4.60
Complexity:	1.70
Familiarity:	4.55
Meaningfulness:	4.20
Semantic Distance:	4.33
Complexity Metric:	1
Concept Agreement:	80.00
Name Agreement:	80.00

97 Films

Concreteness:	4.47
Complexity:	3.92
Familiarity:	3.67
Meaningfulness:	3.07
Semantic Distance:	2.79
Complexity Metric:	12
Concept Agreement:	2.50
Name Agreement:	25.00
	Marilyn Monroe

98 First aid

Concreteness:	3.50
Complexity:	1.17
Familiarity:	4.80
Meaningfulness:	4.65
Semantic Distance:	2.29
Complexity Metric:	1
Concept Agreement:	30.00
Name Agreement:	35.00
	Red Cross

99 Fixed bed reactor

Concreteness:	2.00
Complexity:	2.75
Familiarity:	1.87
Meaningfulness:	1.70
Semantic Distance:	1.32
Complexity Metric:	14
Concept Agreement:	0.00
Name Agreement:	12.50
	microphone

100 Focal plane

Concreteness:	2.70
Complexity:	1.32
Familiarity:	3.35
Meaningfulness:	3.42
Semantic Distance:	1.62
Complexity Metric:	2
Concept Agreement:	0.00
Name Agreement:	42.50
	underground

APPENDIX (Continued)

101 Food processing industry

Concreteness:	3.18
Complexity:	2.15
Familiarity:	2.69
Meaningfulness:	3.18
Semantic Distance:	2.76
Complexity Metric:	4
Concept Agreement:	0.00
Name Agreement:	45.00
	chef

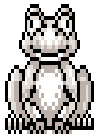
102 Football

Concreteness:	4.93
Complexity:	3.03
Familiarity:	4.53
Meaningfulness:	3.97
Semantic Distance:	4.83
Complexity Metric:	9
Concept Agreement:	75.00
Name Agreement:	75.00

103 Football ground

Concreteness:	2.93
Complexity:	2.15
Familiarity:	2.48
Meaningfulness:	2.40
Semantic Distance:	2.31
Complexity Metric:	8
Concept Agreement:	12.50
Name Agreement:	32.50
	rugby

104 Frog



Concreteness:	4.80
Complexity:	3.45
Familiarity:	3.28
Meaningfulness:	3.05
Semantic Distance:	4.88
Complexity Metric:	28
Concept Agreement:	50.00
Name Agreement:	50.00

105 Fun

Concreteness:	3.57
Complexity:	1.87
Familiarity:	4.15
Meaningfulness:	3.48
Semantic Distance:	3.02
Complexity Metric:	3
Concept Agreement:	0.00
Name Agreement:	35.00
	happy

106 Gastropods

Concreteness:	2.95
Complexity:	1.55
Familiarity:	3.10
Meaningfulness:	3.10
Semantic Distance:	1.74
Complexity Metric:	3
Concept Agreement:	2.50
Name Agreement:	72.50
	ice cream

107 Gents toilets

Concreteness:	4.35
Complexity:	1.35
Familiarity:	4.95
Meaningfulness:	4.17
Semantic Distance:	3.33
Complexity Metric:	2
Concept Agreement:	55.00
Name Agreement:	55.00

108 Go rapidly

Concreteness:	4.35
Complexity:	1.93
Familiarity:	4.05
Meaningfulness:	4.05
Semantic Distance:	3.71
Complexity Metric:	1
Concept Agreement:	0.00
Name Agreement:	45.00
	running

109 Graph

Concreteness:	3.63
Complexity:	3.30
Familiarity:	3.53
Meaningfulness:	3.48
Semantic Distance:	4.12
Complexity Metric:	12
Concept Agreement:	52.00
Name Agreement:	52.00

110 Gravel pit

Concreteness:	3.60
Complexity:	1.50
Familiarity:	2.85
Meaningfulness:	2.68
Semantic Distance:	2.02
Complexity Metric:	4
Concept Agreement:	0.00
Name Agreement:	82.50
	digging

APPENDIX (Continued)

111 Handle with care

Concreteness:	2.95
Complexity:	2.65
Familiarity:	3.08
Meaningfulness:	2.50
Semantic Distance:	3.14
Complexity Metric:	3
Concept Agreement:	7.50
Name Agreement:	15.00
	holding

112 Headlamp cleaner

Concreteness:	3.10
Complexity:	2.95
Familiarity:	2.75
Meaningfulness:	2.40
Semantic Distance:	3.03
Complexity Metric:	10
Concept Agreement:	15.00
Name Agreement:	15.00

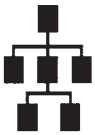
113 Heavy manufacturing

Concreteness:	4.13
Complexity:	3.00
Familiarity:	3.25
Meaningfulness:	2.78
Semantic Distance:	2.12
Complexity Metric:	13
Concept Agreement:	0.00
Name Agreement:	32.50
	cog

114 Heliport

Concreteness:	4.72
Complexity:	1.90
Familiarity:	4.05
Meaningfulness:	3.85
Semantic Distance:	4.00
Complexity Metric:	6
Concept Agreement:	2.50
Name Agreement:	80.00
	helicopter

115 Hierarchy



Concreteness:	2.43
Complexity:	2.47
Familiarity:	2.65
Meaningfulness:	2.75
Semantic Distance:	2.67
Complexity Metric:	15
Concept Agreement:	5.00
Name Agreement:	25.00
	family tree

116 High water level in laundry machines

Concreteness:	3.85
Complexity:	1.63
Familiarity:	3.85
Meaningfulness:	3.36
Semantic Distance:	2.62
Complexity Metric:	2
Concept Agreement:	5.00
Name Agreement:	52.50
	water

117 Hiking trail

Concreteness:	4.10
Complexity:	1.53
Familiarity:	3.38
Meaningfulness:	3.18
Semantic Distance:	2.81
Complexity Metric:	3
Concept Agreement:	5.00
Name Agreement:	37.50
	footprint

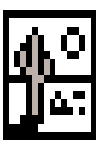
118 Information

Concreteness:	3.20
Complexity:	2.07
Familiarity:	3.05
Meaningfulness:	2.80
Semantic Distance:	1.33
Complexity Metric:	4
Concept Agreement:	0.00
Name Agreement:	25.00
	directions

119 Inject reacting resin

Concreteness:	2.10
Complexity:	3.45
Familiarity:	1.80
Meaningfulness:	1.65
Semantic Distance:	1.71
Complexity Metric:	8
Concept Agreement:	0.00
Name Agreement:	12.50
	flow

120 Insert object linking and embedding file



Concreteness:	2.73
Complexity:	3.40
Familiarity:	2.00
Meaningfulness:	2.05
Semantic Distance:	1.13
Complexity Metric:	12
Concept Agreement:	0.00
Name Agreement:	20.00
	desert

APPENDIX (Continued)

121 Inspect

Concreteness:	4.70
Complexity:	2.33
Familiarity:	3.80
Meaningfulness:	3.80
Semantic Distance:	2.60
Complexity Metric:	6
Concept Agreement:	2.50
Name Agreement:	65.00
	glasses

122 Instrument illumination

Concreteness:	3.55
Complexity:	2.30
Familiarity:	3.78
Meaningfulness:	3.32
Semantic Distance:	2.00
Complexity Metric:	14
Concept Agreement:	0.00
Name Agreement:	30.00
	speedometer

123 Ionising radiation

Concreteness:	3.65
Complexity:	1.53
Familiarity:	4.50
Meaningfulness:	4.10
Semantic Distance:	2.02
Complexity Metric:	4
Concept Agreement:	50.00
Name Agreement:	50.00

124 Iris diaphragm: Open

Concreteness:	2.85
Complexity:	2.17
Familiarity:	2.48
Meaningfulness:	1.92
Semantic Distance:	2.85
Complexity Metric:	7
Concept Agreement:	0.00
Name Agreement:	15.00
	football

125 Iron

Concreteness:	2.38
Complexity:	3.35
Familiarity:	2.42
Meaningfulness:	1.90
Semantic Distance:	1.86
Complexity Metric:	32
Concept Agreement:	0.00
Name Agreement:	5.00
	container

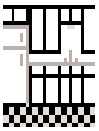
126 Jacketed reactor

Concreteness:	2.13
Complexity:	4.15
Familiarity:	1.38
Meaningfulness:	1.35
Semantic Distance:	1.46
Complexity Metric:	15
Concept Agreement:	0.00
Name Agreement:	2.50

127 Justice

Concreteness:	4.18
Complexity:	3.90
Familiarity:	3.88
Meaningfulness:	3.75
Semantic Distance:	2.74
Complexity Metric:	7
Concept Agreement:	12.50
Name Agreement:	42.50
	scales

128 Kitchen

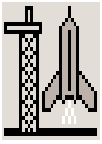


Concreteness:	2.88
Complexity:	4.20
Familiarity:	1.65
Meaningfulness:	2.03
Semantic Distance:	2.79
Complexity Metric:	46
Concept Agreement:	25.00
Name Agreement:	25.00

129 Laminate

Concreteness:	3.28
Complexity:	1.15
Familiarity:	1.92
Meaningfulness:	2.05
Semantic Distance:	2.15
Complexity Metric:	7
Concept Agreement:	2.50
Name Agreement:	17.70
	butterfly

130 Launch application program



Concreteness:	4.68
Complexity:	2.93
Familiarity:	3.18
Meaningfulness:	3.85
Semantic Distance:	3.29
Complexity Metric:	21
Concept Agreement:	0.00
Name Agreement:	42.50
	rocket

APPENDIX (Continued)

131 Library

Concreteness:	4.13
Complexity:	3.30
Familiarity:	3.05
Meaningfulness:	3.23
Semantic Distance:	3.43
Complexity Metric:	13
Concept Agreement:	27.50
Name Agreement:	27.50

132 Lift

Concreteness:	4.45
Complexity:	3.05
Familiarity:	3.82
Meaningfulness:	3.98
Semantic Distance:	4.76
Complexity Metric:	8
Concept Agreement:	65.00
Name Agreement:	65.00

133 Lift

Concreteness:	2.68
Complexity:	2.03
Familiarity:	2.42
Meaningfulness:	2.49
Semantic Distance:	1.90
Complexity Metric:	5
Concept Agreement:	0.00
Name Agreement:	45.00
	two-way

134 Line vessel

Concreteness:	2.08
Complexity:	2.23
Familiarity:	1.70
Meaningfulness:	1.85
Semantic Distance:	1.62
Complexity Metric:	1
Concept Agreement:	15.00
Name Agreement:	17.50
	down

135 Links to other web sites

Concreteness:	3.47
Complexity:	3.30
Familiarity:	3.02
Meaningfulness:	2.90
Semantic Distance:	2.12
Complexity Metric:	8
Concept Agreement:	0.00
Name Agreement:	40.00
	chain

136 Lock

Concreteness:	4.58
Complexity:	1.75
Familiarity:	4.03
Meaningfulness:	3.95
Semantic Distance:	4.57
Complexity Metric:	3
Concept Agreement:	70.00
Name Agreement:	70.00

137 Loudspeaker connection

Concreteness:	3.70
Complexity:	1.13
Familiarity:	3.93
Meaningfulness:	3.27
Semantic Distance:	3.24
Complexity Metric:	2
Concept Agreement:	45.00
Name Agreement:	45.00

138 Lumber industry

Concreteness:	3.23
Complexity:	2.98
Familiarity:	2.45
Meaningfulness:	3.08
Semantic Distance:	3.26
Complexity Metric:	5
Concept Agreement:	10.00
Name Agreement:	25.00
	saw

139 Mace

Concreteness:	4.65
Complexity:	3.30
Familiarity:	2.95
Meaningfulness:	3.35
Semantic Distance:	3.85
Complexity Metric:	12
Concept Agreement:	20.00
Name Agreement:	20.00

140 Macrobiotics

Concreteness:	3.43
Complexity:	2.20
Familiarity:	4.42
Meaningfulness:	3.97
Semantic Distance:	1.24
Complexity Metric:	4
Concept Agreement:	0.00
Name Agreement:	12.50
	yin yang

APPENDIX (Continued)

141 Magnify

Concreteness:	3.48
Complexity:	3.88
Familiarity:	2.20
Meaningfulness:	2.40
Semantic Distance:	3.64
Complexity Metric:	11
Concept Agreement:	15.00
Name Agreement:	30.00
	clock

142 Mail merge main document

Concreteness:	2.95
Complexity:	3.83
Familiarity:	2.28
Meaningfulness:	1.80
Semantic Distance:	1.83
Complexity Metric:	14
Concept Agreement:	0.00
Name Agreement:	10.00
	documents

143 Male

Concreteness:	3.37
Complexity:	1.23
Familiarity:	4.75
Meaningfulness:	4.43
Semantic Distance:	2.14
Complexity Metric:	3
Concept Agreement:	62.50
Name Agreement:	62.50

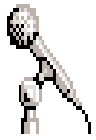
144 Manual control

Concreteness:	4.25
Complexity:	1.95
Familiarity:	3.37
Meaningfulness:	3.03
Semantic Distance:	3.12
Complexity Metric:	1
Concept Agreement:	0.00
Name Agreement:	27.50
	hand

145 Measure

Concreteness:	3.43
Complexity:	3.30
Familiarity:	2.48
Meaningfulness:	2.40
Semantic Distance:	2.90
Complexity Metric:	12
Concept Agreement:	7.50
Name Agreement:	7.50

146 Microphone



Concreteness:	4.83
Complexity:	2.87
Familiarity:	4.20
Meaningfulness:	3.98
Semantic Distance:	4.86
Complexity Metric:	7
Concept Agreement:	65.00
Name Agreement:	65.00

147 Mineral spring

Concreteness:	3.28
Complexity:	2.15
Familiarity:	3.02
Meaningfulness:	3.35
Semantic Distance:	2.26
Complexity Metric:	7
Concept Agreement:	5.00
Name Agreement:	65.00
	fountain

148 Missile in flight

Concreteness:	2.80
Complexity:	1.25
Familiarity:	2.72
Meaningfulness:	2.75
Semantic Distance:	2.55
Complexity Metric:	1
Concept Agreement:	45.00
Name Agreement:	45.00

149 Module

Concreteness:	3.87
Complexity:	2.50
Familiarity:	3.43
Meaningfulness:	3.67
Semantic Distance:	1.50
Complexity Metric:	1
Concept Agreement:	0.00
Name Agreement:	30.00
	jigsaw

150 Mouse

Concreteness:	4.68
Complexity:	3.50
Familiarity:	3.22
Meaningfulness:	3.50
Semantic Distance:	4.57
Complexity Metric:	16
Concept Agreement:	62.50
Name Agreement:	62.50

APPENDIX (Continued)

151 Mouse connection

Concreteness:	3.53
Complexity:	2.37
Familiarity:	3.40
Meaningfulness:	3.22
Semantic Distance:	3.52
Complexity Metric:	4
Concept Agreement:	22.50
Name Agreement:	22.50

152 Mouse properties

Concreteness:	4.25
Complexity:	3.25
Familiarity:	3.87
Meaningfulness:	2.93
Semantic Distance:	2.90
Complexity Metric:	4
Concept Agreement:	52.50
Name Agreement:	52.50

153 Museum

Concreteness:	2.15
Complexity:	2.73
Familiarity:	2.00
Meaningfulness:	2.00
Semantic Distance:	1.98
Complexity Metric:	3
Concept Agreement:	0.00
Name Agreement:	7.50
	Greek temple

154 Naughty

Concreteness:	3.85
Complexity:	3.70
Familiarity:	2.83
Meaningfulness:	3.15
Semantic Distance:	3.14
Complexity Metric:	21
Concept Agreement:	0.00
Name Agreement:	87.50
	devil

155 Navy

Concreteness:	4.23
Complexity:	1.40
Familiarity:	4.32
Meaningfulness:	4.13
Semantic Distance:	3.26
Complexity Metric:	3
Concept Agreement:	5.00
Name Agreement:	67.50
	anchor

156 No entry

Concreteness:	4.65
Complexity:	1.60
Familiarity:	3.90
Meaningfulness:	3.97
Semantic Distance:	2.79
Complexity Metric:	1
Concept Agreement:	57.50
Name Agreement:	57.50

157 No entry

Concreteness:	4.43
Complexity:	1.13
Familiarity:	4.87
Meaningfulness:	4.40
Semantic Distance:	2.02
Complexity Metric:	2
Concept Agreement:	82.50
Name Agreement:	82.50

158 No entry

Concreteness:	3.97
Complexity:	1.45
Familiarity:	3.65
Meaningfulness:	3.27
Semantic Distance:	1.71
Complexity Metric:	1
Concept Agreement:	5.00
Name Agreement:	20.00
	man

159 No!

Concreteness:	3.85
Complexity:	2.05
Familiarity:	4.70
Meaningfulness:	3.95
Semantic Distance:	2.07
Complexity Metric:	3
Concept Agreement:	17.50
Name Agreement:	17.50

160 Noise

Concreteness:	2.70
Complexity:	3.18
Familiarity:	3.58
Meaningfulness:	3.08
Semantic Distance:	2.40
Complexity Metric:	1
Concept Agreement:	15.00
Name Agreement:	15.00

APPENDIX (Continued)

161 Non-ionising radiation

Concreteness:	3.50
Complexity:	2.10
Familiarity:	3.67
Meaningfulness:	3.88
Semantic Distance:	1.59
Complexity Metric:	8
Concept Agreement:	15.00
Name Agreement:	20.00
	sound

162 Note

Concreteness:	4.45
Complexity:	3.32
Familiarity:	3.35
Meaningfulness:	3.08
Semantic Distance:	3.95
Complexity Metric:	5
Concept Agreement:	47.50
Name Agreement:	47.50

163 Open half-nut

Concreteness:	2.45
Complexity:	3.47
Familiarity:	1.83
Meaningfulness:	1.98
Semantic Distance:	2.13
Complexity Metric:	11
Concept Agreement:	0.00
Name Agreement:	12.50
	screw

164 Open location

Concreteness:	2.23
Complexity:	3.63
Familiarity:	1.90
Meaningfulness:	1.59
Semantic Distance:	1.33
Complexity Metric:	28
Concept Agreement:	2.50
Name Agreement:	5.00
	keyboard

165 Open shade

Concreteness:	4.05
Complexity:	1.04
Familiarity:	4.23
Meaningfulness:	4.05
Semantic Distance:	1.64
Complexity Metric:	1
Concept Agreement:	0.00
Name Agreement:	77.50
	cloud

166 Opening of selvedge loops

Concreteness:	1.62
Complexity:	2.90
Familiarity:	1.50
Meaningfulness:	1.35
Semantic Distance:	1.68
Complexity Metric:	12
Concept Agreement:	0.00
Name Agreement:	2.50

167 Oscillating motor

Concreteness:	1.88
Complexity:	2.83
Familiarity:	1.85
Meaningfulness:	1.62
Semantic Distance:	1.26
Complexity Metric:	5
Concept Agreement:	0.00
Name Agreement:	5.00
	circuit

168 Paper industry

Concreteness:	3.78
Complexity:	1.80
Familiarity:	3.00
Meaningfulness:	2.88
Semantic Distance:	2.71
Complexity Metric:	4
Concept Agreement:	2.50
Name Agreement:	35.00
	toilet paper

169 Paradox

Concreteness:	2.55
Complexity:	3.72
Familiarity:	3.18
Meaningfulness:	2.25
Semantic Distance:	2.17
Complexity Metric:	3
Concept Agreement:	0.00
Name Agreement:	7.50
	illusion

170 Pause

Concreteness:	2.60
Complexity:	1.20
Familiarity:	3.28
Meaningfulness:	3.03
Semantic Distance:	2.07
Complexity Metric:	2
Concept Agreement:	37.50
Name Agreement:	37.50

APPENDIX (Continued)

171 Peace

Concreteness:	3.62
Complexity:	2.10
Familiarity:	4.35
Meaningfulness:	3.80
Semantic Distance:	1.98
Complexity Metric:	4
Concept Agreement:	42.50
Name Agreement:	42.50

172 Picnic area

Concreteness:	4.00
Complexity:	2.23
Familiarity:	3.90
Meaningfulness:	4.12
Semantic Distance:	3.90
Complexity Metric:	6
Concept Agreement:	57.50
Name Agreement:	57.50

173 Plasticizing cylinder with plunger

Concreteness:	2.15
Complexity:	2.32
Familiarity:	2.15
Meaningfulness:	1.55
Semantic Distance:	2.05
Complexity Metric:	4
Concept Agreement:	0.00
Name Agreement:	5.00
	piston

174 Plate column

Concreteness:	2.83
Complexity:	2.30
Familiarity:	2.73
Meaningfulness:	2.08
Semantic Distance:	1.69
Complexity Metric:	11
Concept Agreement:	2.50
Name Agreement:	10.00
	thermometer

175 Polishing process of fabrics

Concreteness:	2.98
Complexity:	1.95
Familiarity:	2.45
Meaningfulness:	2.03
Semantic Distance:	1.32
Complexity Metric:	3
Concept Agreement:	0.00
Name Agreement:	15.00
	saw

176 Portable files

Concreteness:	4.83
Complexity:	2.60
Familiarity:	3.80
Meaningfulness:	3.75
Semantic Distance:	2.57
Complexity Metric:	9
Concept Agreement:	0.00
Name Agreement:	45.00
	suitcase

177 Press tool

Concreteness:	2.65
Complexity:	3.20
Familiarity:	2.03
Meaningfulness:	1.63
Semantic Distance:	2.38
Complexity Metric:	9
Concept Agreement:	2.50
Name Agreement:	5.00
	machinery

178 Product

Concreteness:	2.25
Complexity:	1.40
Familiarity:	2.12
Meaningfulness:	1.68
Semantic Distance:	1.02
Complexity Metric:	2
Concept Agreement:	0.00
Name Agreement:	7.50
	button

179 Protect from heat and radioactive

Concreteness:	2.50
Complexity:	3.62
Familiarity:	2.20
Meaningfulness:	2.70
Semantic Distance:	2.60
Complexity Metric:	16
Concept Agreement:	0.00
Name Agreement:	20.00
	energy

180 Punch marking

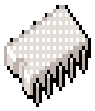
Concreteness:	2.60
Complexity:	2.75
Familiarity:	2.13
Meaningfulness:	1.78
Semantic Distance:	2.68
Complexity Metric:	5
Concept Agreement:	0.00
Name Agreement:	15.00
	drill

APPENDIX (Continued)

181 Radiation of laser apparatus

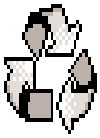
Concreteness:	3.23
Complexity:	2.53
Familiarity:	3.13
Meaningfulness:	3.18
Semantic Distance:	1.83
Complexity Metric:	25
Concept Agreement:	2.50
Name Agreement:	57.50
	sun

182 Random Access Memory (RAM)



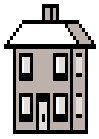
Concreteness:	3.70
Complexity:	3.50
Familiarity:	3.15
Meaningfulness:	2.65
Semantic Distance:	2.00
Complexity Metric:	6
Concept Agreement:	5.00
Name Agreement:	27.50
	microchip

183 Recycle



Concreteness:	3.27
Complexity:	3.05
Familiarity:	4.42
Meaningfulness:	4.25
Semantic Distance:	3.26
Complexity Metric:	9
Concept Agreement:	72.50
Name Agreement:	72.50

184 Return to home page



Concreteness:	4.78
Complexity:	2.95
Familiarity:	3.90
Meaningfulness:	3.75
Semantic Distance:	2.43
Complexity Metric:	13
Concept Agreement:	7.50
Name Agreement:	62.50
	house

185 Rinse

Concreteness:	1.65
Complexity:	3.40
Familiarity:	1.65
Meaningfulness:	1.55
Semantic Distance:	1.55
Complexity Metric:	7
Concept Agreement:	0.00
Name Agreement:	2.50

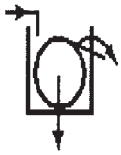
186 Risk of explosion

Concreteness:	3.65
Complexity:	3.72
Familiarity:	3.30
Meaningfulness:	3.15
Semantic Distance:	2.76
Complexity Metric:	26
Concept Agreement:	15.00
Name Agreement:	15.00

187 Roman

Concreteness:	3.93
Complexity:	3.22
Familiarity:	2.97
Meaningfulness:	3.08
Semantic Distance:	3.62
Complexity Metric:	3
Concept Agreement:	25.00
Name Agreement:	25.00

188 Rotary vacuum filter



Concreteness:	1.90
Complexity:	4.00
Familiarity:	1.53
Meaningfulness:	1.50
Semantic Distance:	1.70
Complexity Metric:	9
Concept Agreement:	0.00
Name Agreement:	5.00
	forces

189 Rotation of cylinder with direction of cloth

Concreteness:	1.65
Complexity:	3.40
Familiarity:	1.48
Meaningfulness:	1.45
Semantic Distance:	1.87
Complexity Metric:	10
Concept Agreement:	0.00
Name Agreement:	7.50
	bike

190 Rye

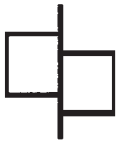
Concreteness:	2.82
Complexity:	1.95
Familiarity:	2.74
Meaningfulness:	2.58
Semantic Distance:	2.17
Complexity Metric:	9
Concept Agreement:	7.50
Name Agreement:	27.50
	arrow

APPENDIX (Continued)

191 Safe

Concreteness:	4.83
Complexity:	3.18
Familiarity:	3.90
Meaningfulness:	4.22
Semantic Distance:	4.62
Complexity Metric:	12
Concept Agreement:	77.50
Name Agreement:	77.50

192 Safety device against overload



Concreteness:	1.98
Complexity:	1.83
Familiarity:	1.95
Meaningfulness:	1.43
Semantic Distance:	1.02
Complexity Metric:	3
Concept Agreement:	0.00
Name Agreement:	5.00
	fault

193 Safety isolating transformer

Concreteness:	2.17
Complexity:	2.55
Familiarity:	2.10
Meaningfulness:	1.53
Semantic Distance:	1.25
Complexity Metric:	4
Concept Agreement:	0.00
Name Agreement:	2.50

194 Scale of measurement

Concreteness:	2.12
Complexity:	3.03
Familiarity:	1.87
Meaningfulness:	1.48
Semantic Distance:	2.38
Complexity Metric:	12
Concept Agreement:	2.50
Name Agreement:	5.00
	distance

195 Scythe

Concreteness:	3.38
Complexity:	1.52
Familiarity:	3.02
Meaningfulness:	2.78
Semantic Distance:	4.23
Complexity Metric:	3
Concept Agreement:	62.50
Name Agreement:	62.50

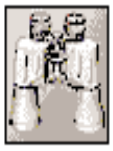
196 Sea mine decoy

Concreteness:	1.80
Complexity:	2.62
Familiarity:	1.58
Meaningfulness:	1.30
Semantic Distance:	1.54
Complexity Metric:	7
Concept Agreement:	0.00
Name Agreement:	2.50

197 Search

Concreteness:	3.20
Complexity:	3.95
Familiarity:	2.15
Meaningfulness:	2.40
Semantic Distance:	2.70
Complexity Metric:	13
Concept Agreement:	0.00
Name Agreement:	32.50
	eye

198 Search



Concreteness:	4.85
Complexity:	3.70
Familiarity:	3.83
Meaningfulness:	3.85
Semantic Distance:	3.29
Complexity Metric:	21
Concept Agreement:	0.00
Name Agreement:	65.00
	binoculars

199 Search

Concreteness:	4.62
Complexity:	2.58
Familiarity:	3.65
Meaningfulness:	3.75
Semantic Distance:	2.43
Complexity Metric:	4
Concept Agreement:	0.00
Name Agreement:	70.00
	torch

200 Select irregular area

Concreteness:	2.20
Complexity:	2.85
Familiarity:	2.28
Meaningfulness:	1.88
Semantic Distance:	1.79
Complexity Metric:	10
Concept Agreement:	0.00
Name Agreement:	20.00
	star

APPENDIX (Continued)

201 Shopping

Concreteness:	4.83
Complexity:	3.12
Familiarity:	4.03
Meaningfulness:	3.90
Semantic Distance:	4.10
Complexity Metric:	7
Concept Agreement:	15.00
Name Agreement:	60.00
	bag

202 Slow

Concreteness:	4.72
Complexity:	1.70
Familiarity:	3.45
Meaningfulness:	3.53
Semantic Distance:	3.26
Complexity Metric:	1
Concept Agreement:	15.00
Name Agreement:	62.50
	turtle

203 Smooth edges

Concreteness:	2.95
Complexity:	4.30
Familiarity:	2.42
Meaningfulness:	2.18
Semantic Distance:	1.50
Complexity Metric:	41
Concept Agreement:	2.50
Name Agreement:	12.50
	paint

204 Sound

Concreteness:	4.35
Complexity:	1.30
Familiarity:	4.60
Meaningfulness:	4.52
Semantic Distance:	3.53
Complexity Metric:	1
Concept Agreement:	2.50
Name Agreement:	75.00
	music

205 Spade

Concreteness:	2.75
Complexity:	1.48
Familiarity:	2.50
Meaningfulness:	1.98
Semantic Distance:	3.62
Complexity Metric:	2
Concept Agreement:	22.50
Name Agreement:	22.50

206 Spark coil-ignition element

Concreteness:	2.25
Complexity:	2.27
Familiarity:	2.55
Meaningfulness:	2.17
Semantic Distance:	1.95
Complexity Metric:	3
Concept Agreement:	0.00
Name Agreement:	15.00
	electricity

207 Spark plug

Concreteness:	2.35
Complexity:	2.83
Familiarity:	3.60
Meaningfulness:	3.20
Semantic Distance:	4.55
Complexity Metric:	15
Concept Agreement:	42.50
Name Agreement:	42.50

208 Sterilizer

Concreteness:	1.85
Complexity:	3.40
Familiarity:	1.90
Meaningfulness:	1.73
Semantic Distance:	1.36
Complexity Metric:	2
Concept Agreement:	0.00
Name Agreement:	7.50
	bacteria

209 Straining element

Concreteness:	2.33
Complexity:	1.80
Familiarity:	1.95
Meaningfulness:	1.62
Semantic Distance:	1.28
Complexity Metric:	1
Concept Agreement:	0.00
Name Agreement:	5.00
	tool

210 Suction removal of trimmed edges

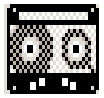
Concreteness:	1.95
Complexity:	3.35
Familiarity:	1.52
Meaningfulness:	1.70
Semantic Distance:	2.49
Complexity Metric:	13
Concept Agreement:	2.50
Name Agreement:	2.50

APPENDIX (Continued)

211 Surgery

Concreteness:	4.45
Complexity:	3.70
Familiarity:	3.10
Meaningfulness:	3.60
Semantic Distance:	3.45
Complexity Metric:	18
Concept Agreement:	0.00
Name Agreement:	40.00
	doctor

212 Tape cassette



Concreteness:	4.88
Complexity:	3.10
Familiarity:	4.53
Meaningfulness:	4.12
Semantic Distance:	4.83
Complexity Metric:	16
Concept Agreement:	72.50
Name Agreement:	72.50

213 Tape recorder

Concreteness:	3.10
Complexity:	1.45
Familiarity:	3.30
Meaningfulness:	2.78
Semantic Distance:	2.69
Complexity Metric:	3
Concept Agreement:	15.00
Name Agreement:	32.50
	camera film

214 Temperature

Concreteness:	4.60
Complexity:	1.18
Familiarity:	4.70
Meaningfulness:	4.25
Semantic Distance:	4.33
Complexity Metric:	2
Concept Agreement:	50.00
Name Agreement:	50.00

215 Thin ice

Concreteness:	3.87
Complexity:	2.75
Familiarity:	3.00
Meaningfulness:	3.92
Semantic Distance:	3.74
Complexity Metric:	7
Concept Agreement:	70.00
Name Agreement:	70.00

216 Three star freezing compartment

Concreteness:	2.63
Complexity:	1.63
Familiarity:	3.13
Meaningfulness:	2.75
Semantic Distance:	2.95
Complexity Metric:	4
Concept Agreement:	12.50
Name Agreement:	12.50

217 Timber

Concreteness:	3.45
Complexity:	2.85
Familiarity:	2.42
Meaningfulness:	1.93
Semantic Distance:	2.55
Complexity Metric:	6
Concept Agreement:	50.00
Name Agreement:	50.00

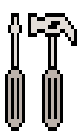
218 Time

Concreteness:	3.75
Complexity:	1.58
Familiarity:	3.95
Meaningfulness:	3.80
Semantic Distance:	3.55
Complexity Metric:	1
Concept Agreement:	32.50
Name Agreement:	50.00
	timer

219 Timed page cancelled

Concreteness:	2.35
Complexity:	3.00
Familiarity:	1.98
Meaningfulness:	2.35
Semantic Distance:	2.60
Complexity Metric:	7
Concept Agreement:	10.00
Name Agreement:	15.00
	no time

220 Toolbox



Concreteness:	4.80
Complexity:	2.55
Familiarity:	3.28
Meaningfulness:	3.73
Semantic Distance:	3.50
Complexity Metric:	9
Concept Agreement:	47.50
Name Agreement:	47.50

APPENDIX (Continued)

221 Topic

Concreteness:	4.63
Complexity:	3.15
Familiarity:	3.50
Meaningfulness:	2.75
Semantic Distance:	1.88
Complexity Metric:	12
Concept Agreement:	0.00
Name Agreement:	32.50
	files

222 Tourist activities

Concreteness:	3.83
Complexity:	1.70
Familiarity:	3.43
Meaningfulness:	3.80
Semantic Distance:	1.50
Complexity Metric:	6
Concept Agreement:	0.00
Name Agreement:	47.50
	tree

223 Toxic substances

Concreteness:	3.97
Complexity:	2.77
Familiarity:	4.65
Meaningfulness:	4.75
Semantic Distance:	3.45
Complexity Metric:	3
Concept Agreement:	47.50
Name Agreement:	47.50

224 Tubular film die

Concreteness:	1.90
Complexity:	2.68
Familiarity:	1.88
Meaningfulness:	1.50
Semantic Distance:	1.18
Complexity Metric:	5
Concept Agreement:	0.00
Name Agreement:	5.00
	circuit

225 Typewriter

Concreteness:	4.93
Complexity:	3.03
Familiarity:	3.88
Meaningfulness:	3.85
Semantic Distance:	4.90
Complexity Metric:	35
Concept Agreement:	75.00
Name Agreement:	75.00

226 Undo

Concreteness:	2.62
Complexity:	1.35
Familiarity:	2.88
Meaningfulness:	2.80
Semantic Distance:	2.26
Complexity Metric:	2
Concept Agreement:	2.50
Name Agreement:	27.50
	turn-around

227 Vertebrates

Concreteness:	2.80
Complexity:	1.55
Familiarity:	2.45
Meaningfulness:	2.55
Semantic Distance:	2.12
Complexity Metric:	1
Concept Agreement:	0.00
Name Agreement:	62.50
	bone

228 Vibrate

Concreteness:	2.02
Complexity:	2.40
Familiarity:	1.80
Meaningfulness:	1.57
Semantic Distance:	2.76
Complexity Metric:	7
Concept Agreement:	5.00
Name Agreement:	7.50
	expanding

229 Video camera

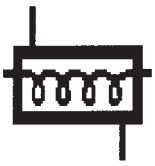
Concreteness:	4.83
Complexity:	3.28
Familiarity:	3.90
Meaningfulness:	3.92
Semantic Distance:	4.69
Complexity Metric:	9
Concept Agreement:	57.50
Name Agreement:	57.50

230 Wall

Concreteness:	3.95
Complexity:	2.78
Familiarity:	3.00
Meaningfulness:	3.13
Semantic Distance:	4.40
Complexity Metric:	12
Concept Agreement:	60.00
Name Agreement:	60.00

APPENDIX (Continued)

231 Water cooled condenser



Concreteness:	2.85
Complexity:	2.70
Familiarity:	2.90
Meaningfulness:	2.18
Semantic Distance:	2.02
Complexity Metric:	8
Concept Agreement:	0.00
Name Agreement:	10.00
	electricity

232 Water power

Concreteness:	3.13
Complexity:	2.55
Familiarity:	2.70
Meaningfulness:	2.40
Semantic Distance:	1.50
Complexity Metric:	1
Concept Agreement:	0.00
Name Agreement:	22.50
	tunnel

233 Webcrawler

Concreteness:	4.58
Complexity:	3.70
Familiarity:	3.33
Meaningfulness:	3.47
Semantic Distance:	3.14
Complexity Metric:	41
Concept Agreement:	0.00
Name Agreement:	52.50
	spider

234 Weight

Concreteness:	3.03
Complexity:	3.08
Familiarity:	2.05
Meaningfulness:	1.97
Semantic Distance:	3.19
Complexity Metric:	3
Concept Agreement:	15.00
Name Agreement:	15.00

235 Wheel

Concreteness:	4.00
Complexity:	3.18
Familiarity:	2.83
Meaningfulness:	2.40
Semantic Distance:	4.48
Complexity Metric:	16
Concept Agreement:	35.00
Name Agreement:	35.00

236 Windscreen demisting and defrosting

Concreteness:	3.50
Complexity:	2.00
Familiarity:	3.90
Meaningfulness:	3.65
Semantic Distance:	2.88
Complexity Metric:	4
Concept Agreement:	40.00
Name Agreement:	40.00

237 Winter sports area

Concreteness:	3.87
Complexity:	2.97
Familiarity:	4.45
Meaningfulness:	4.25
Semantic Distance:	2.24
Complexity Metric:	18
Concept Agreement:	0.00
Name Agreement:	35.00
	snowflake

238 Zoom

Concreteness:	1.85
Complexity:	1.75
Familiarity:	1.95
Meaningfulness:	1.35
Semantic Distance:	1.76
Complexity Metric:	2
Concept Agreement:	0.00
Name Agreement:	5.00
	kite

239 Zoom

Concreteness:	2.05
Complexity:	2.87
Familiarity:	1.73
Meaningfulness:	1.60
Semantic Distance:	1.10
Complexity Metric:	7
Concept Agreement:	0.00
Name Agreement:	7.50
	radio

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