FREQUENCY NORMS FOR ACTIONS IN SWEDISH AND AMERICAN SAMPLES

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INTRODUCTION

Action categories constitute a domain of categorization that has received relatively little attention in studies of categorization. Not only do we have the ability to see certain things as *cups*, *cars*, *trees* or *dogs*, for example, but we can also recognize patterns of movement as *running*, *walking*, *kicking* or *jumping*. In addition to having categories for objects, a significant aspect of daily activity is perceiving and categorizing the actions of other individuals. Furthermore, given the cognitive primacy of basic-level categories and the significant role perception plays in the formation of such categories (e.g., Rosch, Mervis, Gray, Johnson and Boyes-Braem, 1976a), it may very well be the case that basic-level perceptual criteria can be applied to, at least, a somewhat limited domain of action categories.

Much of categorization research has investigated the hierarchical and internal structure of categories for objects, viz. natural kinds and artifacts. (See Medin and Smith (1984) and Mervis and Rosch (1981) for reviews.) Other categorical domains have included goal-derived categories (Barsalou, 1985), ad-hoc categories (Barsalou, 1983), artificial categories; geometric forms (Rosch, 1973; Mervis and Crisafi, 1982), and dot patterns (Rosch, Simpson and Miller, 1976b; Hock, Tromley and Polmann, (1988). Another area of categorization research has dealt with low-level perceptual categories in vision, audition and speech perception (Harnad, 1987). And recently, Morris and Murphy (1990) investigated the hierarchical structure of event categories. (See also Barsalou and Sewell (1985), Rifkin (1985) and Lucariello and Rifkin (1986) for further findings dealing with event and script categories.)

This paper presents normative data concerning the response frequencies[1] for a general class of actions. In an action listing task, response frequencies were generated by a native English speaking group and a native Swedish speaking group and then compared in order to determine the cross-cultural/linguistic stability of the most frequently listed actions. The results indicate that general perceptual criteria for the basic-level can be applied to action categories and that the varying response frequencies indicate graded structure within the general class of actions. The amount of agreement between the English and Swedish samples concerning the distributions of the response frequencies suggests a fair degree of stablity across language and culture. The research reported here is concerned primarily with actions that have a strong perceptual basis as demonstrated, for example, by Johansson (1973 and 1975).

THE BASIC-LEVEL: COGNITIVE PRIMACY AND PERCEPTION

A salient finding in categorization research is the cognitive primacy of the basic-level as compared to the superordinate and subordinate levels of categorization (Rosch et al., 1976a; Rosch, 1978; Murphy and Smith, 1982). The basic-level is the primary level at which category differentiation reflects the natural divisions of attribute clusters found in the

[1] I will use the term *response frequency* throughout the remainder of the paper to refer to the total number of times a given item occurs across subjects on a free listing task as used in Battig and Montague (1969). Other people have referred to this measure differently; *associative frequency* (Hampton and Gardiner, 1983); *item dominance* (Mervis, Catlin and Rosch, 1976); *production frequency* (Malt and Smith, 1982) and *output dominance* (Barsalou, 1985).

environment. Numerous studies have shown that the basic-level is psychologically basic with regard to a number of converging operations, e.g., attribute listing, descriptions of motor programs for interacting with objects, shape similarity, the identification of averaged shapes and object recognition (Rosch et al., 1976a; Rosch, 1978). The primacy of the basic-level has also been found in developmental studies. For example Rosch et al. (1976a) found that 3-yr-olds were nearly perfect at sorting objects on the basic-level but were considerably worse at sorting objects on the superordinate level. It has also been shown that the order of category acquisition in children proceeds from the basic-level to the superordinate level and then to the subordinate level (Mervis & Crisafi, 1982).[2] The cognitive primacy of the basic-level is also reflected in linguistic output. Basic-level object names, for example, are usually rather short words that are commonly used to refer to a given object. They are the words that are first learned by children and, hence, first to enter the lexicon. (See Rosch et al., 1976a and Lakoff, 1987.)

One constraining factor in the acquisition and formation of categories is perception, and on the basic-level this is particularly so. Rosch et al. (1976a), Rosch (1978), Neisser (1987), Mervis & Crisafi (1982) and Tversky & Hemenway (1984) express a general consensus that there are two unique properties of the basic-level: (1) members of basic level categories are similar in overall shape and (2) similar with respect to our interactions with them, i.e., they have similar functions, in the case of artifacts. Mervis (1987) refers to these two properties as constituting the "shape/function principle." Accordingly, much of categorization, but by no means all, is a result of the application of this principle.[3] The shape/function principle is largely perceptually driven in the sense that the shape (visual shape) of an object can be obtained by looking at it. Function, on the other hand, may not be so readily analysable with regard to perception as is the notion of shape. However, although one may not be able to tell what the function of an object is by looking at it, some insight concerning object function can be gained by interacting with the object or by watching someone else interact with it. That the shape and function aspects of the principle go hand in hand has been demonstrated by Tversky & Hemenway (1984) where they found that, at the basic-level, the shape of an object (as constituted by its configuration of perceptually salient parts) is generally indicative of its function. The basic-level, then, seems to be the level where perception plays the most decisive role in category formation. From this, it would seem that perception ought to be a suitable basis from which to investigate other categorical domains that may exhibit basic-level effects. One such area is the categorization of actions.

ACTION CATEGORIES AND BIOLOGICAL MOTION

Using perceptual criteria, as mentioned above, to pick out basic-level actions means that there had better be a class of actions to which such perceptual criteria apply. Actions of bodily movement seem to be such a class. As Miller and Johnson-Laird (1976:527) put it:

> Not only are verbs of motion ontogenetically primary, but their meanings have a strong perceptual basis – a correlation that can hardly be coincidental. When someone cogitates or acquiesces or experiences it is not clear just what perceptible signals of those "activities" he will transmit, but when he runs or jumps or climbs there is little question.

Furthermore, there is reason to believe that such actions are perceptually basic in that they can be recognized quickly, not so much on the basis of context as on the basis of the pattern of movement of the parts of the body. A good example of this perceptual basis for action recognition and categorization can be found in the work of Johansson (1973 and 1975) and his colleagues (Kozlowski & Cutting, 1977; Cutting, 1981 and Runeson & Frykholm, 1983). Johansson (1973) describes a study in which he placed small lights on the joints of a person who performed various actions. The surroundings were darkened so that only the lights were visible. He then had subjects view a number of different patterns of human motion. The subjects were readily able to to discern a number of biological motions (running, cycling, climbing, and dancing) by simply viewing the resulting flow patterns of the lights. The demonstration of this patch-light technique has two interesting ramifications for the categorization of actions. In one sense, the patch-light figures contain very little information, if one is interested in context, but in another sense, they contain a great deal of information in the flow pattern of the lights. Secondly, subjects were very good at recognizing a given action on the basis of only viewing a few frames in the motion sequence. This result appears to suggest a significant perceptual role in action categorization and appears to provide a reasonable

[2] See also Horton and Markman (1980) for further evidence of developmental differences in category acquisition.

[3] Medin and Wattenmaker (1987) and Medin (1989) argue for a theory-based approach to categorization in which objects are experienced within a context of background knowledge and that this knowledge is one additional factor that constrains the categorization process.

basis from which to seek empirical support for the notion of basic-level action categories.[4]

The notion that there are basic-level action categories is not novel. In *Women, Fire and Dangerous Things* Lakoff (1987) asserts, "We have basic-level concepts for actions and properties as well. Actions like *running*, *walking*, *eating*, *drinking*, etc., are basic-level, whereas *moving* and *ingesting* are superordinate, while kinds of walking and drinking, say, *ambling* and *slurping*, are subordinate." Despite the intuitive appeal of Lakoff's assertions, there is no empirical work substantiating his specific claims. What is needed is some principled method for establishing criteria for the hierarchical organization suggested by Lakoff.

The studies described below use a free listing task very similar to Battig and Montague (1969). Whereas the Battig and Montague study included 56 categories, the present studies include just one (very general) superordinate category, namely, the category of bodily movement. Furthermore, the purpose of the studies is to get subjects to generate words or phrases for actions based on the findings regarding the perceptual basis of the basic-level.

STUDY 1A

If subjects are given perceptual criteria for action categories and asked to generate lists according to the general perceptual criteria, what kinds of actions can one expect? Are actions categories such that perceptual criteria apply to them as well as objects? Will certain types of words or phrases occur more often than others (graded structure) or will there be a rather even distribution of words? Will the words be similar to the ones mentioned by Lakoff (1987) and Miller and Johnson-Laird (1976)? It certainly seems reasonable to think that subject lists would contain varying response frequencies of action words and that high frequencies would be obtained for words that denote actions like, *eating*, *walking*, *running*, *jumping*, etc. more so than other more context dependent actions like, *buying a car*, *teaching*, *going to a restaurant*, etc. Another issue concerns the relation between response frequencies and the resulting ordinal positions of the listed words. Will words with high frequencies, assuming varied distribution, also be the ones that occur earlier on in the word lists?

Methods

Subjects. A total of 119 native English speaking Hope College undergraduates from five psychology classes volunteered 10 minutes of their time to participate as subjects.

Materials. The subjects were given a sheet of paper with instructions written at the top. Below the instructions, and on the reverse side of the sheet, were numbered blanks for the subjects to fill in during the timed writing session. There were a total of 112 blanks on each sheet.

Instructions. Writing the instructions for the list generation task posed a problem. On the one hand, the instructions had to be easy to understand. For example, I did not want to have to go into an explanation about what the basic-level is and how there might be basic-level actions. On the other hand, the instructions had to be meaningful and somehow constrain list generation to the realm of actions that met certain perceptual criteria. The perceptual criteria used in the instructions were adopted from Mervis & Rosch (1981) where they point out three special properties of the basic level, "(a) a person uses similar motor actions for interacting with category members, (b) category members have similar overall shapes, and (c) a mental image can reflect the entire category." Since (a) is a property that is confined to actions in the service of object function, the criterion "ease of recognition" was used instead in order to maintain the generality of the perceptual criteria. The property that a mental image can reflect the entire category is a result of the similar overall shapes of objects. These two criteria were combined into a single mental imagery criterion. The resulting instructions presented to the subjects were as follows:

> The purpose of this session is to collect verbs that name various actions. You are simply to write down, on the numbered blanks below, words or phrases that name various actions. It is important though that the words or phrases name actions that involve some kind of *bodily*

[4] For the sake of clarity, let me add that it is surely the case that action categories are context sensitive (Vallacher and Wegner, 1987) and, quite likely, more sentive to contextual factors than object categories. My suggestion is that there may be a group of actions that are much less context sensitive than other kinds of actions and that this may depend on the extent to which social setting and perception mutually constrain the categorization of actions. For now, I have chosen to concentrate on the perceptual aspects of action categorization. I am not saying that what distinguishes the basic-level from other levels in a category hierarchy for actions is only the degree of perceptual salience, but rather that perception seems to be one unequivocal factor in the formation of action categories on the basic-level. It seems to me very likely that the function of certain actions, i.e., the fulfilling of some some goal, in a social setting is also highly implicated in the formation of action categories. This is in accordance with the similarity/function principle mentioned above. What is also needed in order to principly establish a basic-level for action categories is evidence for the convergence of operations on some middle level of categorization. The studies described here are admittedly only a first step in this direction.

activity that can easily be recognized when seen and can be visualized as a mental image.

You will be given five minutes to write down as many words or phrases as possible that name different actions of bodily activity. Please write neatly. Thank you for your participation. If you have any questions, I will take them now, but do not mention any possible examples of actions. You can begin when I say "Please begin."

Procedure. After all the subjects received a copy of the instructions, an experimenter read the instructions out loud. No subjects in any of the five classes had any questions.

Results

First, words were scored as the same if they were orthographically identical or only varied according to tense. Subjects appeared to have little difficulty in understanding the nature of the task. The mean number of words per list was 36.36 with a standard deviation of 10.91. The median was 35. The minimum and maximum lengths of the lists were 14 and 72 respectively (range = 58). A total of 920 different words were produced.

In the following analysis of the subject lists, two dependent measures of item salience are used. The total frequency (TF) for each word indicates the total number of times a word appeared across the 119 different lists. The second measure is the mean ordinal position (MOP) and represents the averaged ordinal postion of a word across all the lists on which the word appeared. (Presented in Appendix 1 is a list of the words that have a TF of 3 or more.)

The TFs presented in Appendix 1 confirm the general hypothesis that there would be an uneven distribution of response frequencies for action words (graded structure), i.e., that some words would be more salient examples of bodily action than other words. The words that received the highest frequencies tend to belong the class of action words mentioned by Lakoff (1987) and Miller and Johnson-Laird (1976). That is, words like, *running*, *jumping*, *swimming*, *walking*, and *eating* occurred more often than more context dependent words like, *teaching*, *baking*, *writing a letter*, *eating breakfast* and *arguing*, for example.

A Pearson product moment correlation coefficient was calculated to see if the mean ordinal position of a word tends to decrease as its total frequency increases. The words included in this correlation had a TF of 20 or more. The coefficient for this correlation was $-.70$, $F(1,51) = 47.52$, $p \leq .0001$. This indicates a trend for words with a high TF to also occupy lower ordinal postions on the action lists.

A post-hoc analysis was done to see if a more sensitive measure of ordinal position would produce an increase in the coefficient for the correlation between TF and word position. The MOP fails to take into account the relative positions of the words across the various lists, and, given the somewhat large standard deviation regarding the lengths of the various lists, the relative positions of the words on the lists may be a more sensitive measure. The mean relative ordinal position (MROP) was obtained by taking the absolute position of a word on a list and dividing it by the total number of words on that given list. This relative position was then summed across all the lists on which the word appeared and divided by the total frequency.

The coefficient for the correlation between TF and MROP was $-.73$, $F(1,51) = 57.18$, $p \leq .0001$. This shows that MROP is only marginally more sensitive, as a measure of word position, than MOP. And a subsequent correlation between MOP and MROP indicates that they are nearly equally sensitive measures of the position of the words as they occur on the lists. The coefficient for MOP/MROP was .97, $F(1,51) = 832.60$, $p \leq .0001$. In what follows, I will use MOP as the reported measure of word position.

STUDY 1B

The Battig and Montague (1969) frequencies were collected at the Universities of Maryland and Illinois. There were 270 subjects from Maryland and 172 from Illinois who were given 56 category labels and asked to write down as many items as they could within 30 seconds for a given class or category. Battig and Montague computed correlation coefficients in order to determine the, in this case, "geographical stability of the response frequencies for the Maryland and Illinois samples." The results revealed strong evidence for geographical stabiltiy. Forty-nine of the 56 categories had a correlation coefficient greater than .90.[5]

Using British subjects, Hampton and Gardiner (1983) collected normative data for 12 of the categories used by Battig and Montague (1969). One purpose of the study was to see if there was any cross-cultural variation between the two populations. The resulting comparisons between the response frequencies for the 12 categories revealed coefficients that ranged from a low of .48 for FISH to a high of .91 for WEAPONS. The mean coefficient for the 12 categories was .76, indicating that the categories, as measured by

[5] The frequency distributions for the categories A STATE and A COLLEGE OR UNIVERSITY were much less stable across the two geographically defined groups. The respective coefficients for these two categories were .297 and .097.

response frequency, are fairly stable across the two groups.[6]

The minimumization of cross-cultural differences in categorization is an additional aspect of basic-level categories (Medin and Basalou, 1987; and Rosch, 1973). The extent to which the basic-level is grounded in perception and by constraints that span the boundries of cultural differences and context sensitve variables ought to be revealed by the stability of the categories across culture and language. The study reported below was conducted in order to investigate the stability of the action categories across cultures (and language). In other words, the hypothesis in this study is that similar categories and response frequencies should appear for the same task used in the previous study with subjects from a different country who speak a different language. If the action categories with the highest frequencies generated in the first study have the quality of being primarily perceptually based in the sense that the pattern of bodily movement is sufficient for recognition and categorization and that actions categorized on the basis of this information are common actions that humans perform, then one would expect a certain stability across cultures and languages. A group of Swedish students was given a set of instructions similar to the instructions described in the study above. The results from this group will be compared to a group taken from the sample of American students used in the previous study. The main comparison between these two groups will be to see if similar action words are also the most frequent for the Swedish group. Cultural-linguistic stabilty will be measured by agreement in TF for the most highly frequent words.

Methods

Subjects. Thirty-nine native Swedish speaking undergraduate students from an introductory psychology course volunteered 10 minutes of their time to participate as subjects. For the English speaking sample, 39 subject lists from the first study were randomly chosen for comparison with the Swedish speaking group.

Material. The materials were the same as described in Study 1A.

Instructions. The English instructions were translated into Swedish.

Procedure. The procedure was the same as in Study 1A. One student, however, had a question concerning the nature of the actions referred to in the instructions. The experimenter re-read the portion of the instructions describing the general class of actions that were to be listed and instructed the subject to write down the actions that best seemed to fit that general description.

Results

For the English-speaking sample ($n = 39$), the mean number of words per list was 37.13 with a standard deviation of 10.58. The minimum and maximum list lengths were 25 and 72 respectively (range = 47). As in the first study, the TF and MOP for all words were calculated across the lists. These measures were then compared with the same measures from the larger sample in order to determine the representativeness of the smaller sample. This was done for words with a frequency of 20 or more in the large sample. The coefficient for the correlation between the TFs was .96, $F(1,51) = 558.91$, $p \leq .0001$, which shows that the smaller sample is representative of the larger sample in terms of the distribution of response frequencies. The correlation between the MOPs for the two samples was somewhat lower, .85, $F(1,51) = 134.67$, $p \leq .0001$. This indicates that word position is less stable than the distribution of response frequencies across the two groups. As in the analysis for the large sample above, a coefficient was calculated for the correlation between response frequency (TF) and word position (MOP) in the smaller sample. The coefficient for this correlation, for words that had a TF of 10 or more, was –.63, $F(1,32) = 21.19$, $p \leq .0001$. As in the large sample there is a trend of decreasing ordinal position as the TF increases.

For the Swedish-speaking sample, the mean number of words per list was 41.56 with a standard deviation of 12.62. The minimum and maximum list lengths were 20 and 67 respectively (range = 47). A comparison of the list length means for the Swedish and English samples showed no significant difference, $F(1,76) = 2.83$, $p > .05$. Subjects in both groups generated the same average number of words per list. The TF and MOP were calculated for all words across the lists. As in the analyses above, a correlation between TF and MOP was calculated to see if words with the highest frequencies were also the words that occurred earliest on the subjects' lists. The coefficient for this correlation (for words with a frequency of 9 or more) was –.69, $F(1,31) = 28.83$, $p \leq .0001$.[7] This

[6]It should be noted here that "stability" only refers to the stability between the different groups and not between or within subjects. As pointed out by Barsalou (1987), category stability may be much lower for agreement between- and within-subjects.

[7] The reader should note that this correlation included words with a frequency of 9 or more whereas the correlation for the same relation between TF and MOP in the small English speaking sample included words wtih a frequency

finding is consistent with findings of the other two groups.

A second analysis was performed to determine the stability of action categories across the respective cultures and languages. In the Battig and Montague comparisons between the Maryland and Illinois groups, words could be matched on the basis of orthographic form. For example, in the category of A FOUR-FOOTED ANIMAL, the occurrence of the word DEER among the lists for the Maryland subjects was assumed to have the same meaning as the word DEER in the Illinois sample. There was no question of any kind of regional difference in meaning between the two orthographically identical items. For the current analysis, there can be no matching of items based on orthographic similarity. Instead, the words need to be matched according to their semantic similarity. Appendix 2 contains the list of the matched words and their respective TFs and MOPs. The list shows that 29 pairs of words could be very closely matched according to their meanings. For example, the Swedish word SPRINGA has the same semantic content as the English word RUN. They refer to the same kind of pattern of bodily activity. There were, however, a number of words that did not match up quite so well. In these cases, the semantic domain of a word in one language was best matched by including the domains of two or more words from the other language. The semantic domain of PUSHING, for example, has no single Swedish equivalent. A group of four Swedish words was needed in order to match the semantic domain of PUSHING. As an example of the other kind of relation, the Swedish word RIDA means to ride on an animal of some kind. It is not, however, used to refer to riding in a vehicle. Typically, it is used in the sense of HORSEBACK RIDING or RIDING A HORSE. The English word RIDING was included in the group because it can also mean HORSEBACK RIDING.

According to the following analysis, stability is a function of degree of agreement between the TFs for words that occurred 10 or more times in both lists. The correlation between the TFs for the English and Swedish words resulted in a coefficient of .66, $F(1,36) = 27.50$, $p \leq .0001$. A one way ANOVA was also carried out to assess the difference between the TF means for the two groups. The means were not significantly different, $F < 1$. Factoring out the 9 cases where more than one word was included in matching semantic domains revealed little effect on the coefficient, .67, $F(1,27) = 21.49$, $p \leq .005$. These results point to a moderate stabilty for a restricted class of action categories across cultures and language. A more in-depth discussion of the results is presented below.

of 10 or more. This was done in order have approximately the same number of data points in the correlation.

GENERAL DISCUSSION

The first general result has to do with the perceptual (visual) shape of actions. Subjects had no difficulty with the task of applying the perceptual properties of basic-level objects to categories for actions of bodily movement. This seems to support the notion that there is a class of action categories that is largely structured by perceptual invariants having to do with the pattern of movement of body parts rather than social context and goals (Cf. Miller & Johnson-Laird, 1976).

As mentioned previously, category stability, as measured by the correlation between the response frequencies for 56 categories in the Maryland and Illinois samples (Battig and Montague, 1969), was very strong. (See above.) In comparison, the correlation between British and American frequency norms (Hampton and Gardiner, 1983) showed a decrease in the stability of 12 of the categories across the two cultures, mean $r = .76$. Although none of the categories in these studies dealt specifically with actions, the trend can be compared with the current findings concerning the difference between the correlation of response frequencies for the two American samples ($r = .96$) and the Amercian ($s=39$) and Swedish samples ($r = .66$). The stability, across culture and language, of the categories is not unequivocally robust. The change from one culture and language to another has a negative effect on the stablity of the categories. As noted by Hampton and Gardiner, "[A]ssociative frequency may be expected to reflect local differences in language use and item familiarity." It could, however, be argued that, given this effect, there remains a fair amount of stability on which to base further investigations of the structure of action categories. That is, the coefficient .66, as an indication of category stability, is relatively high given the fact that culture and language have a diminishing effect on such a correlation.

Secondly, concerning the issue of the basic-levelness of the listed actions, it is difficult to say, on the basis of the listing task alone, that the listed actions are, in principle, basic-level actions. It needs to be determined whether or not these actions constitute a level of converging operations as discusssed in Rosch et al. (1976a) and Morris and Murphy (1990). But before constructing hierarchies to use in the investigation of converging priciples, there should be some basis on which to construct them. For object hierarchies, the Battig and Montague (1969) results were used by Rosch et al. (1976a) for their investigations demonstrating the convergence of operations. The current studies are similar in nature in that they attempt to provide empirical support for the

notion of basic-level actions, on which to then construct action hierarchies. The empirical support stems from the basic-level perceptual criteria presented to the subjects in the instructions and from the cross-cultural analysis of the response frequencies. The actions listed in Appendix 2, for example, confirm the intuitions of Lakoff, as mentioned above, concerning which actions may be basic-level.[8]

Finally, the variation of the response frequencies, as indicated by the TFs, points to the graded structure of the general category described in the instructions to the subjects. There are a number of studies that have shown graded structure in common taxonomic categories to be correlated with prototypicality. Mervis, Catlin and Rosch (1976) found that item output (response frequency) was correlated with goodness-of-example ratings, i.e., protypicality. In addition, Rosch et al. (1976b) obtained results using artificial categories which showed that prototypical members tend to be the ones listed first and have the highest frequencies in a listing task. Barsalou (1985) also found a similar correlation between what he called output dominance (response frequency) and goodness-of-example (typicality). If one accepts the assertion that categories for actions of bodily movement have a similar basis in perception as common taxonmic categories, which I will discuss shortly, then this suggests that the graded structure for the general category of bodily movement is also centered around an action prototype, which, in this case, would be RUNNING.

An issue that needs to be addressed in future research has to do with what determines the graded structure (and prototypicality) in action categories. For common taxonomic categories (CTCs), Barsalou (1985) presented evidence for the substantial role that central tendency plays in determining graded structure as measured by goodness-of-example ratings.[9] Partialing out other factors that seemed to be implicated in determining graded structure, he found that central tendency uniquely predicted graded structure as indicated by the correlation between the two variables, r = .71. Briefly, he presented 4 reasons why central tendency may have this predictive value: (1) CTCs contain information about the structure of the environment. (2) CTCs greatly facilitate categorization in that "[b]y representing these categores with their central tendencies, people minimize the average distance from exemplars to classification standards." (3) There is a shared perceptual similarity between exemplars within a given CTC. (4) The frequency of occurrence for CTCs is quite high. That is, people may be quite familiar with members of CTCs.

If there is class of actions that have a significant perceptual basis in categorization and are common actions that are frequently performed and observed, as argued for here, then it seems reasonable to suggest that the resulting graded structure for this class of actions would also be predicted by central tendency. Consequently, Barsalou's reasons for the predictive value of central tendency would be applicable as well. Inasmuch as these are empirical issues, they need to be addressed in the light of further investigations.

[8] There are two possible exceptions here. HOPPING and JOGGING seem to be subordinate instances of JUMPING and RUNNING respectively.

[9] It should be noted that central tendency is not the only determinant of graded structure. Barsalou (1985) stresses the fact that there is no single determinant of graded structure. Graded structure is not a context neutral phenomenon. Different factors may be implicated in the graded structure of categories depending on the context in which memory is active in categorization.

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APPENDIX 1.

Total Frequency (TF) and Mean Ordinal Position (MOP) for Action Words and Phrases.

Item	TF	MOP	Item	TF	MOP	Item	TF	MOP
running	115	4.37	drawing	19	28.47	sliding	9	21.89
walking	99	7.32	skiing	19	19.37	shooting	9	26.56
jumping	92	7.61	moving	19	16.21	squeezing	9	24.89
swimming	65	13.94	swinging	19	20.11	tapping	9	18.89
skipping	61	7.54	exercising	18	18.22	biting	9	19.11
writing	56	20.45	leaping	18	18.67	twitching	9	20.11
talking	56	13.71	looking	17	25.82	bouncing	9	16.11
eating	55	17.60	flying	17	15.41	yawning	9	18.78
sleeping	54	17.03	carrying	17	22.00	grasping	9	19.22
throwing	53	16.43	whispering	17	24.94	poking	9	24.11
sitting	48	15.81	tripping	16	19.44	hiking	9	19.11
kicking	47	15.45	fighting	15	15.73	taking	9	25.00
hitting	46	15.63	cleaning	15	29.67	itching	9	14.55
crying	46	18.35	watching	15	24.53	giving	8	27.25
dancing	46	19.96	twisting	15	23.47	whistling	8	21.50
laughing	44	16.96	speaking	14	19.50	fishing	8	19.25
smiling	43	19.49	cooking	14	24.64	nodding	8	15.75
standing	40	14.48	spinning	14	26.21	shopping	8	25.38
jogging	39	11.87	brushing teeth	13	16.46	cutting	8	30.63
driving	38	19.05	holding	13	22.62	typing	8	27.38
yelling	38	17.50	brushing	13	24.69	pointing	8	14.13
falling	37	18.89	staring	13	29.46	tossing	8	25.88
blinking	35	15.20	winking	13	22.31	standing up	8	12.50
pushing	34	21.00	wiggling	13	22.08	shoving	8	23.75
lifting	33	19.61	laying	12	23.67	squinting	8	14.88
drinking	32	21.00	grabbing	12	22.00	breaking	8	35.50
hopping	32	8.47	washing	12	33.58	skating	8	15.63
kissing	30	22.60	slapping	12	23.50	hearing	7	14.43
singing	30	17.43	showering	12	26.25	killing	7	19.57
pulling	30	22.33	kneeling	12	22.08	breathing	7	10.14
reading	28	22.75	studying	12	22.42	pinching	7	22.57
catching	27	21.78	snoring	11	28.73	swallowing	7	27.71
waving	27	18.11	flexing	11	20.09	sniffing	7	19.14
scratching	26	20.35	spitting	11	21.27	dropping	7	21.86
touching	25	15.36	leaning	11	22.73	sitting down	7	12.71
hugging	25	25.88	shouting	11	25.00	bending over	6	18.83
playing	25	19.04	reaching	11	20.46	twirling	6	32.50
punching	24	17.67	clapping	11	17.09	stopping	6	19.00
screaming	24	21.21	rubbing	11	26.82	sculpting	6	47.17
sneezing	24	15.71	turning	11	17.55	pounding	6	39.50
coughing	23	19.04	closing	11	29.27	sledding	6	28.67
rolling	22	22.46	opening	11	29.73	bathing	6	23.00
bending	22	18.27	smelling	10	19.00	snapping	6	18.83
stretching	22	19.59	seeing	10	13.60	sweating	6	17.67
diving	22	22.46	squating	10	21.40	giggling	6	15.67
frowning	22	22.50	galloping	10	11.00	feeling	6	23.33
climbing	21	19.24	acting	10	19.50	snapping-fingers	6	17.00
painting	21	32.48	riding	10	23.60	smoking	6	19.00
dressing	21	23.38	riding a bike	10	24.20	stumbling	6	17.83
biking	21	15.81	tying shoes	9	26.11	sauntering	6	19.00
chewing	20	15.85	sprinting	9	13.89	resting	6	25.17
crawling	20	16.65	working	9	23.78	driving a car	6	23.17
shaking	20	22.15	brushing hair	9	18.00			

Item	TF	MOP	Item	TF	MOP	Item	TF	MOP
dribbling	6	19.67	picking up	4	24.50	pasting	3	34.33
urinating	6	18.33	extending	4	23.00	baking	3	38.67
flipping	6	17.67	scraping	4	24.25	sailing	3	31.00
shivering	6	19.33	burping	4	29.25	scrubbing	3	34.33
listening	5	19.80	buying	4	30.00	turning around	3	23.00
grimacing	5	31.00	cracking	4	24.75	waking up	3	23.00
playing an instrument	5	25.00	rowing	4	19.50	grinning	3	23.33
petting	5	26.40	hiding	4	35.00	pouring	3	29.67
trotting	5	16.20	puking	4	23.75	banging	3	36.67
comb hair	5	23.60	tapping foot	4	20.00	picking	3	18.00
tasting	5	18.00	digging	4	28.50	smacking	3	21.33
choking	5	19.80	asking	4	23.75	puckering	3	32.00
riding a horse	5	22.60	swaying	4	25.75	opening door	3	21.33
strolling	5	17.00	beating	4	36.25	farting	3	26.00
calling	5	33.80	washing face	4	17.75	counting	3	27.33
sewing	5	37.80	throwing a ball	3	9.33	attacking	3	17.00
stepping	5	17.40	thinking	3	15.33	lifting weights	3	24.67
laying down	5	27.00	having sex	3	12.33	vomiting	3	13.67
slipping	5	33.20	wiggling toes	3	23.67	limping	3	32.00
destroying	5	31.80	blowing nose	3	26.67	lie	3	12.67
stomping	5	23.60	picking nose	3	18.33	hobbling	3	18.67
licking	5	12.40	putting	3	29.00	closing eyes	3	22.33
blowing	4	24.50	hammering	3	39.00	fidgeting	3	27.33
sucking	4	21.50	surfing	3	39.67	bowing	3	23.33
relaxing	4	24.00	smirking	3	24.00	going	3	22.00
pacing	4	25.00	juggling	3	31.67	training	3	33.33
crossing legs	4	17.25	making a fist	3	26.33	receiving	3	34.33
lying down	4	19.50	lie down	3	24.67	passing	3	24.67
going to the bathroom	4	24.75	cracking-knuckles	3	18.67	shuffling	3	19.67
shaving	4	34.25	stabbing	3	29.00	doing jumping jacks	3	16.33
stealing	4	43.00	contracting	3	26.00	undressing	3	32.00
tumbling	4	18.75	vacuuming	3	29.33	nodding your head	3	13.67
helping	4	32.50	sketching	3	26.67	crouching	3	20.33
setting	4	36.75	teaching	3	43.67	paddling	3	32.00
scribbling	4	40.50	spiking	3	32.33	using	3	28.67
combing	4	39.25	rotating	3	25.00	hurting	3	25.00
sweeping	4	31.00	gazing	3	34.67	selling	3	24.00
coloring	4	33.00	wiggling-fingers	3	20.67	tearing	3	14.67
shaking head	4	20.75	raising arm(s)	3	8.00	screwing	3	14.00
pouting	4	27.75	squirming	3	14.00	doing a cartwheel	3	11.33
caressing	4	13.25	sighing	3	27.67	playing sports	3	17.33
making love	4	19.50	flicking	3	18.00	somersaulting	3	29.00
praying	4	26.50	sitting up	3	28.67			

APPENDIX 2 – ACTION PAIRS – ENGLISH – SWEDISH

Item – English	TF	MOP	Item – Swedish	TF	MOP
1. running	38	4.08	springa	35	7.04
2. walking	30	6.83	gå	29	9.62
3. jumping skipping	47	7.97	hoppa	32	5.31
4. hopping	10	11.60	skutta	2	7.50
5. swimming	24	12.42	simma	23	13.04
6. talking	22	12.14	tala prata	19	22.13
7. writing	21	21.95	skriva	29	15.14
8. sleeping	20	18.05	sova	16	15.06
9. throwing	19	12.84	kasta	7	19.86
10. eating	19	17.68	äta	24	13.17
11. laughing	17	14.94	skratta	20	18.65
12. dancing	17	21.65	dansa	18	17.28
13. crying	17	17.65	gråta	19	23.11
14. kicking	16	14.44	sparka	4	24.50
15. falling	15	21.00	falla trilla	7	17.50
16. pushing	14	22.00	putta knuffa(s) köra trycka	10	28.67
17. sitting	14	19.14	sitta	17	18.88
18. kissing	13	27.23	pussas kyssa(s)	18	25.50
19. hitting punching	24	15.18	slå	15	22.60
20. smiling	13	17.77	le	9	20.56
21. lifting	12	12.67	lyfta	7	23.86
22. jogging	12	9.33	jogga	10	15.70
23. driving	12	19.25	köra köra bil	16	19.84
24. pulling	11	24.64	draga	4	33.75
25. yelling	11	16.73	skrika	13	24.92
26. reading	11	19.82	läsa	13	15.23
27. hugging	10	29.30	krama(s)	15	24.33
28. climbing	10	20.60	klättra	6	24.67
29. standing	10	17.50	stå	9	18.00
30. rolling	10	23.90	rulla	5	26.80
31. singing	10	19.10	sjunga	14	22.86
32. catching	10	18.60	fånga	1	10.00

Item – English	TF	MOP	Item – Swedish	TF	MOP
33. riding a bike biking	11	23.79	cykla	24	9.83
34. drinking	9	28.44	dricka	15	19.13
35. making love	1	27.00	älska	21	19.10
36. painting	8	30.75	måla	13	25.69
37. drawing	8	26.13	rita	10	17.60
38. riding a horse horseback riding riding	4	22.00	rida	10	11.20