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The Phoneme as a Basic-Level Category: Experimental Evidence from English[1]

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ABSTRACT

This paper presents the results of a *concept formation* experiment that provides evidence on the possible existence of a basic-level of taxonomic organization in phonological categories as conceived of by phonetically naïve, native speakers of English. This level is roughly equivalent to the phoneme as described by phonologists and linguists. The reason why the phoneme could be considered as the basic level of taxonomies of phonological categories is discussed.

KEYWORDS: classical view of categorization, taxonomies, basic level, phonological categories, concept formation.

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I. HIERARCHICAL ORGANISATION OF CONCEPTUAL CATEGORIES

One basic characteristic of human conceptual categories and concepts is that they do not exist independently of one another in memory. Instead, they tend to be organised into systems where they are related to one another in various ways. In this respect, it has been claimed that most (if not all) of our cognitive categories are hierarchically organised (Neisser & Weene, 1962: 640) and the most typical type of hierarchical organisation is, in turn, the taxonomic one. In taxonomies, categories are organised by the 'type' relation, which specifies that one category is a type or kind of another. Thus, the category WHITE-TAILED SEA EAGLE (which is instantiated by many different white-tailed sea eagles in the real world) is a type of SEA EAGLE, which is in turn a type of EAGLE and this a type of BIRD. The category BIRD is a type of ANIMAL and this a type of LIFE FORM.

Hierarchical taxonomic organisation has been the focus of a great deal of experimental research in the cognitive sciences for the past fifty years. In this body of research, taxonomic organisation is usually conceived of as a vertical axis in which there are different levels of abstraction, occupied by different contrasting categories. These levels of abstraction are more inclusive as we move upwards and less inclusive as we move downwards. Thus each category within a taxonomy includes others (unless it is the lowest level category) or is included in others (unless it is the highest level category). For example, the categories WHITE-TAILED SEA EAGLE, BALD SEA EAGLE and WHITE-BELLIED SEA EAGLE are included in the category SEA EAGLE, which is in turn included, together with other categories like GOLDEN EAGLE or HARPY EAGLE in the category EAGLE. The category EAGLE is included, alongside categories like ROBIN, FLAMINGO, etc. in the category BIRD and the latter, with categories like REPTILE, MAMMAL or INSECT in the category ANIMAL. The category ANIMAL, with others like PLANT or BACTERIA are included in the higher-level category LIFE FORM.

One important fact about empirical research on hierarchical taxonomic organisation is that for that it has for centuries been conceived of according to the so-called 'classical' Aristotelian theory of categories and categorisation, which claims that categories are discrete entities characterized by a set of properties shared by all their category members and necessary and sufficient to establish category membership. According to the classical view, categories should be clearly defined and mutually exclusive (any given entity of a given classification universe belongs unequivocally to one, and only one, of the proposed categories). This view has typically been the dominant position in philosophy (see e.g. Margolis, 1994; Rey, 1983, 1985; Sutcliffe, 1993 for recent defences), psychology, with the traditional concept formation and learning experiments of the behaviourists initially (e.g. Hull, 1920) and the information processors later (e.g. Bourne, 1966, 1970; Bruner *et al.*, 1956; Hunt, 1962), linguistics (e.g. Chomsky & Halle, 1968; Katz & Postal, 1964), etc. The classical view of categorization provides an intuitively appealing account of classification and the nature of conceptual structure. However, the view has been running into numerous problems since experimental research started to be conducted. These problems include the classical view's failure to account for the lack of defining features for many categories, the use of non-necessary features in categorisation by subjects, the existence of unclear category members, or the phenomenon of typicality and typicality effects (see Mompeán, 2002 for a review of these problems).

Another problem of the classical view of categories and categorisation that empirical research has revealed is the inconsistency of many taxonomic phenomena with the classical theory's view. For instance, classical taxonomies (particularly scientific system) appear to have an excessive number of levels from the non-scientist, everyday person's point of view (Ungerer & Schmid, 1996: 64). In modern Linnaean taxonomies, for instance, all species can be simply classified in a ranked taxonomy starting with *domains*, and the latter into *kingdoms.* Kingdoms are divided into *phyla* (for animals) or *divisions* (for plants). Phyla and divisions are divided into *classes*, and they, in turn, into *orders*, *families*, *genera*, and *species*. However, between these levels there are many others, which have been added in certain disciplines whose subject matter is replete with species requiring classification (see URL 1 for a review). In contrast, people's folk taxonomies are often not so elaborated. Thus, in anthropological and ethnobiological taxonomic studies (e.g. Berlin, 1978, 1992; Berlin *et al.*, 1973; Brown *et al.*, 1976), five levels are often posited: *unique beginner*, *life form*, *generic*, *specific*, and *varietal*. In cognitive psychology (e.g. Rosch, 1978; Rosch *et al.*, 1976) and related disciplines, three levels are often set up: *superordinate* (which includes *unique beginner* and *life form*), *basic*, and *subordinate* (which includes *specific* and *varietal*). However, most authors implicitly or explicitly acknowledge that any taxonomy is best considered as a continuum of differentiation with no strict layers on which any category falls (Murphy & Brownell, 1985; Rosch *et al.*, 1976; Tanaka & Taylor, 1991; Ungerer & Schmid, 1996).

A further problem of the classical theory's view on taxonomic organisation is the well-known finding that there seems to be, in conceptual taxonomies, a particular level of specificity that enjoys psychological salience or primacy. This is the *generic* level (in ethnobiological terms) or *basic* (in cognitive psychological terms) level. For example, the basic level of abstraction in the hierarchy that goes (from top to bottom), from LIFE FORM to

WHITE-TAILED SEA EAGLE, is the category BIRD. For a large number of years, investigators have shown that the basic level has a special status in a variety of tasks,[2] which makes no sense in the classical theory's view on hierarchical structure, in which no particular level of abstraction should have a special status (Mervis, 1980: 285).

The special centrality of the basic level is revealed in tasks that reflect the contents of category knowledge, inference drawing and recall/recognition memory. In this respect, the basic level (e.g. CHAIR, CAR, DOG) is the level at which subjects list more attributes for category members (e.g. Horton & Markman, 1980; Mervis & Greco, 1984; Mervis & Rosch, 1981; Murphy & Brownell, 1985; Rosch *et al.*, 1976).[3] The richer attribute structure or feature information that basic-level categories possess may be the reason why the basic level is also the level at which more inferences can be drawn -particularly in comparison with superordinate categories- (Gelman & Markman, 1986; Gelman & O'Reilly, 1988). Finally, the basic level is the preferred level for retaining episodic information in memory that is used later for recall. Thus, subjects presented with either subordinate terms (e.g. sports car) or superordinate terms (e.g. vehicle) tend to falsely report basic-level terms (e.g., car) instead (Pansky & Koriat, 2004).

The special salience of the basic level is also revealed in tasks that involve people's perception of objects or the mental capacity to image them. In this respect, the basic level is the highest level in which category members have similar overall perceived shapes so that, as a consequence, the average shape of a number of instances of basic-level categories like CHAIR, for instance, are still recognisable or identifiable as an instance of that category (e.g. Rosch, 1978; Rosch *et al.*, 1976).[4] The basic level is also the highest level at which it is possible to form a relatively concrete mental image of an average member of the category (in the absence of that object) which is isomorphic to an average category member, an ability known as "imaging capacity" (Bolton, 1977: 56). As a case in point, people have mental images of basic-level categories like CHAIR but they do not have abstract mental images of superordinate categories like FURNITURE that are not images of basic-level objects like chairs, tables, beds, etc. (Rosch, 1978; Rosch *et al.*, 1976).

Further tasks reflect people's motor or verbal behaviour towards members of categories. In this respect, the basic level is the highest level in a taxonomy at which a person uses similar motor actions for interacting with category members (Rosch *et al.*, 1978).[5] In addition, basic-level categories (and basic-level category names) are primarily used when identifying objects in controlled context-free free-naming tasks (e.g. Jolicoeur *et al.*, 1984; Murphy & Brownell, 1985; Murphy & Wisniewski, 1989a; Rosch *et al.*, 1976; Smith *et al*, 1978; Tanaka

& Taylor, 1991).[6] In addition, such identifications are usually faster at the basic level than at any other abstraction level. In more naturalistic situations like normal everyday conversation, basic-level category names are also more frequently used (Anglin, 1977; Berlin *et al.* 1973; Brown, 1958, 1976; Cruse, 1977; Downing, 1977).[7]

Finally, it seems that basic-level categories are, throughout develoment, often learned first (basic-level names certainly are) and that they are easier to learn in experimental situations (see e.g. Callanan, 1985; Horton & Markman, 1980; Mervis, 1987; Mervis & Crisafi, 1982; Rosch *et al.*, 1976; Waxman *et al.* 1991).[8]

II. HIERARCHICAL ORGANISATION OF PHONOLOGICAL CATEGORIES

In view of the extensive amount of research carried out on different sorts of conceptual categories in general (mainly of a visual or semantic type) and on taxonomic organisation of such categories in particular, the approach can be explored of whether phonological categories are also hierarchically structured. This approach rests upon two assumptions. The first assumption is that people actually group sounds into categories or, as Nathan claims (1996: 112), that "…sounds... are categorized in the same way as all other things in the world are". This, however, is a well-established fact as shown by the long history of research in the fields of speech perception and experimental phonology where, with different techniques like phoneme monitoring (see e.g. Foss, 1998), absolute identification and differential discrimination -in either its same-different or ABX versions- or concept formation (see e.g. Weitzman, 1993) have shown that speakers can group sounds into categories and use these categories for further processing and interaction. The second assumption is that people's ability to categorise sounds into categories may result in the creation or formation of conceptual categories to which technical concepts used by linguists like 'phoneme', 'fricative', etc. more or less correspond.

The two assumptions mentioned above have traditionally been uncommon in the history of linguistics but they are central in cognitive linguistics (Fraser, 2006), where the view has long been held (mainly in relation to phonemic categories) that phonological terms also refer to conceptual categories (or concepts) in the sense that speakers can assign phonetically different sounds to them and draw inferences based on them (e.g. Fraser, 2006; Mompeán, 2004; Nathan, 1986, 1996; Taylor, 2002, 2003, 2006). Therefore, if language users can form metalinguistic phonological categories, the latter can probably be related to one another hierarchically. Again, this approach has only been explored in cognitive linguistics. Thus, Taylor (2002: 145-150) discusses a plausible taxonomy of phonological segments with the superordinate category SEGMENT at the top of the hierarchy and lower levels of abstraction represented by categories like VOWEL and CONSONANT (at a little lower level than the category SEGMENT), PHONEME categories (further down) and ALLOPHONE categories at the bottom of the taxonomy. Taylor (2002: 149-150; 2006: 44), Nathan (2007) and Mompeán (1999) go further to suggest that, in a taxonomy of phonological concepts, the level of the traditional phoneme probably has some basic-level status. However, empirical studies on the issue are almost inexistent. The only exception (to the author's knowledge) is Jeri J. Jaeger's doctoral dissertation (Jaeger, 1980, also summarised in Jaeger, 1986). Using the experimental paradigm known as *concept formation*, Jaeger found that the percentage of adult subjects who formed the category PHONEME K (i.e. /k/) was higher –100% in her CF experiment -and the number of trials to criterion was fewer- than the number of subjects who formed 'feature' categories like -ANTERIOR, +ANTERIOR, +SONORANT, and +VOICE, exemplified each by different phonemes and learned, respectively, by 79%, 50%, 50% and 38%-50% of experimental subjects (the number of trials was also higher in the 'feature' categories). Jaeger interpreted her results as evidence that phonemes were basic-level categories as compared to feature categories.

Pioneering and insightful as Jaeger's work is for the study of taxonomic hierarchies in phonology, her work seems to have failed to fully outline the structure of a taxonomic hierarchy for the categories she studied. For instance, if feature categories of the type that she studied are subordinate categories (taking for granted that phoneme-sized categories are the basic-level), then by the 'type' relation taxonomies are based on, all the member of a given 'feature' category should also be members of a single higher-level (basic-level) phoneme category. However, this is not true for the categories she studied. Thus, for the category +VOICE, Jaeger included, as positive tokens, words which began with [v, ð, z, m, n, r, w, j, l]. Clearly, not all the sounds of that category instantiate a single phoneme category. This means that 'feature' categories (which may be less salient than phoneme categories as Jaeger showed) should be best conceived of as superordinate, not subordinate categories. Subordinate categories can be allophones, but Jaeger did not look at these categories nor to categories higher in a taxonomy such as CONSONANT or SPEECH SEGMENT. In addition, Jaeger included in her discussion references to an experiment where the category learned was Vowel Shift alternations of the type *serene-serenity*, *divine-divinity*, etc. popularised by Chomsky &

Halle (1968), for which speakers scored relatively high (73% of speakers formed the category) and she later claimed that "….phoneme-based categories appear to be at a more basic level of abstraction for English speaking subjects than do the phonetic features-based categories, with the rule-based category somewhat intermediate" (Jaeger, 1980: 372) and that "…the phonemic level is the basic level of categorisation for speech sounds, and features are a subordinate level" (p. 381). The Vowel Shift rule category is clearly to be excluded from a taxonomy of speech sounds that includes phonemes, allophones or features at different levels of abstraction. An allophone can be an instance of a phoneme and the latter an instance of a 'feature' category, but neither of these, by themselves, can be an instance of a category that is relational and includes two phonemes.

Another problem of Jaeger's discussion of taxonomic organisation is her confusion between taxonomic and partonomic hierarchies. Based on her experimental research, Jaeger claims that, for English speakers, the phoneme has basic-level status in taxonomic phonological hierarchies whereas "…. syllables, words, etc. are superordinate levels", which is not the case of Japanese speakers, for whom "…the syllable is the basic level of categorization of the sounds of their language; words, etc. are superordinate, and phonemes, features, etc. are subordinate" (Jaeger, 1980: 146). However, units like the syllable, the phonological word, etc. should not be brought up in discussions of the taxonomic organization of categories since such terms refer to a conceptual organization of a hierarchical, but not taxonomic type. As Taylor warns (2002: 149), "...the relation between the syllable and phoneme is not a schema-instance relation, but the relation of a whole to a part". In fact, there has also been research on partonomic organisation and partonomies (see e.g. Tversky, 1989, 1990; Tversky & Hemenway, 1984, 1991) which are organised by the 'part relation', which specifies that one concept represents a part of another. Thus, in the well-known *body part* partonomy, a finger is a part of a hand, which is a part of the arm, which is a part of the body. Fingers are not included in the class of hands, which are not included in the class of bodies. Similarly, the kind of relationship that exists between phonemes, rhymes, syllables, and phonological words (this list is not exhaustive), is of a partonomic nature (a phoneme is a part of an onset or rhyme, which are a part of a syllable, which is a part of a phonological word, etc.).[9]

Given the small empirical evidence available on phonological taxonomic organisation, the main aim of this paper is to provide some empirical evidence on speakers' ability to categorise sounds at different levels of abstraction that can be taxonomically related and find out whether any of the levels of abstraction has greater salience (or basic-level status). More specifically, the research questions investigated in this paper are: a) can speakers categorise sounds at different levels of abstraction that can be taxonomically related? and b) if so, is there any level of abstraction that is more salient than the others?

Based on all the research discussed above, the hypotheses entertained in this paper are that: a) speakers will be able to categorise sounds at different levels of abstraction that can be taxonomically related; and b) that some evidence of a basic level of abstraction in phonological taxonomies will also emerge. To test these hypotheses, four different experiments were conducted in order to investigate four categories that, from now on, will be referred to as CONSONANT, PLOSIVE, PHONEME P, and ASPIRATED P. This study is based on the assumption that these categories are taxonomically organised, which further assumes that any given sound can be cross-classified (a given sound can be an instance, for instance, of the categories ASPIRATED P, PHONEME P, PLOSIVE, and CONSONANT at the same time).

III. METHOD

III.1. Participants

Eighty native speakers of English between the ages of 18 and 45 (mean age 23 years) took part in the experiments reported below. There were 38 men and 42 women. The subjects were recruited on the University of Murcia campuses or in the town of Murcia through advertisements. None of them had received formal instruction in phonetics and/or phonology in the past and all of them had reached university. For this reason, the whole group could be described as educated (and so fully literate in English) but phonetically naïve. Subjects reported no history of a speech or hearing disorder.

III.2. Apparatus

All the experimental events in the experiments reported below were controlled by a computer in which a software implementation of the experimental technique called *concept formation* (henceforth CF) had been installed.[10]

The CF technique consists of a *training* session followed by a *test* session (see Jaeger, 1986; Mompeán, 2002, for a full overview of the specifics of the technique). The aim of the *training* session is to 'teach' the experimental subjects a phenomenon under investigation. This is done by training them to classify a (usually large) set of items into different groups or categories that have been pre-defined by the experimenter. Thus, subjects are trained to respond to a particular type of stimuli that exemplifies a given category (i.e. positive stimuli) in one way, and to respond to another type of stimuli that does not exemplify that category (i.e. negative stimuli) in a different way. In the training session there are three critical events: stimulus presentation, response, and informative feedback. These three events, occurring in that order, constitute one trial on the problem.[11] After each stimulus is presented, and the subject has some notion of what the category involves, the subject's task consists in trying to give the correct response (as instructed) after which the actual correct response is indicated with the provision of feedback. Feedback informs subjects about the status of each instance they are exposed to (whether it is a positive token of the to-be-formed category or not).

In the *test* session, the subject's task is the same as in the previous one except there is no feedback because an aim of this session is to find out whether the subject has actually guessed what the target category was. In principle, if the subject reached criterion in the training session, s/he should have no problems in continuing to provide correct responses to positive and negative stimuli of the type presented in the training session. However, to guarantee that the subject has actually found out what category the experimenter had in mind, the test session also makes use of the so-called *control* tokens (positive or negative instances of the category not yet encountered by the subject), which are checks on the possibility that the subject has not formed a category different from that intended by the experimenter, or that s/he may have just memorized the members of the category encountered in the training session. If the subject generalizes his/her responses to these new cases correctly, the classificatory behaviour more clearly indicates that the subject has actually 'formed' the category.

III.3. Stimuli

The stimuli used in the present study consisted of 400 monosyllabic English words (100 per experiment), produced by a 22-year-old female native RP speaker of English from the south of England.

In the training sessions of each experiment, there were 32 positive and 28 negative items. The negative tokens also included *interfering* and *non-interfering* items. Interfering items in this study were those containing potential orthographic and/or phonetic interference. In the test sessions there were 19 positive, 12 negative (some of them controls) and 9 test tokens (not analysed for the present study),[12] in all experiments except for experiment 4, where no test items were included and 22 positive and 18 negative tokens were used instead.

The positive stimuli of both the training and the test sessions exemplified, for the category CONSONANT, word-initial instances of plosives, fricatives, affricates and nasals while negative stimuli were words beginning with a vowel. For the category PLOSIVE positive stimuli were words beginning with oral plosives while negative stimuli consisted of words beginning with fricatives and nasals. The category PHONEME P was instantiated by different allophonic realisations of /p/ in pre-nuclear and post-nuclear positions with different types of release, degree of aspiration, etc. while negative stimuli did not contain any realisation of /p/. The category ASPIRATED P was exemplified by aspirated pre-nuclear realisations of /p/ (before a vowel or a devoiced approximant) while negative items included pre-nuclear and post-nuclear realisations with inaudible release, masked release, weak (if any) aspiration, etc.

As far as (negative) interfering items are concerned, orthographic interference was considered likely in words containing letters that are typical spellings of the target sounds but that are silent or have phonetic values other than their prototypical ones in those words. For instance, in experiment 2 (category PLOSIVE) a word beginning with <ps> like *psalm* was considered potentially interfering since the letter <p>, a typical representation of the voiceless bilabial plosive, is a silent letter. Phonetic influence may derive from the presence of phonetically similar sounds to the ones that instantiate the target category but that are not to be included in the category. For instance, in experiment 3 (category PHONEME P), it was considered that phonetic interference could be caused by the presence of /b/ in word-initial position as it is partially or wholly devoiced in that position. As far as controls are concerned, these included, for instance, phonemes not previously found in the training session (e.g. /t/ in the category PLOSIVE) or allophonic realisations not previously encountered (e.g. in the category ASPIRATED P).

The Appendix at the end of this paper contains the actual list of words used and their category status (positive, negative, interfering, non-interfering, control, test) for each of the four experiments carried out.

III.4. Procedure

All the CF experiments were conducted in a sound-attenuated room and experimental events were controlled by a computer in which a software program specifically designed to perform the CF experiments had been installed (see Mompeán, 2002 for details). The experimental events were monitored by an experimenter on-line from an adjacent room.

For this study, the 80 subjects were randomly assigned to one of four groups (20 per experiment). Subjects were given a sheet of instructions asking them to perform a task in which they had to focus on the sounds of words, never the spelling. The instructions told them that some words had "...a certain type of sound in the initial position of the word..." (exp. 1 & 2), "...a certain type of consonantal sound somewhere in the word…" (exp. 3), or that all words contained basically the 'same' consonantal sound but that some examples of the consonantal sound had "certain characteristics" (exp. 4).

The instructions also told the subjects that after listening (over headphones) to each word (only once), they would be provided with an answer as to whether or not the word had included the to-be-identified type of (consonantal) sound. Red/green rectangles on the screen of the computer would then disappear/remain on the screen depending on whether the words presented contained/lacked the to-be-identified type of sound. The instructions also told the subjects to begin responding (by pressing either a red or a green key on the keyboard) as soon as they heard each new word once they had some idea of what the target type of sound was. Subjects were also informed that after a certain number of trials, feedback would be no longer provided (though they would be told when feedback provision would stop).

The training session began only when the experimenter was sure, through a short conversation after the subjects read the instructions, that the subject had understood the instructions well. Subjects were run individually.

IV. RESULTS

The results show that the four categories investigated were positively 'formed' by over 50% of the experimental subjects in each experiment, ranging from 60% of speakers (category CONSONANT) to 100% (categories PHONEME P and ASPIRATED P). The results also show that not all categories were equally salient or as easy to form. The measures gathered in this study giving evidence about the difficulty of the categories are: 1) the number of subjects who reached criterion in the training session, 2) the average number of correct responses in the training session, 3) the standard deviation (and range) of the individual scores of correct responses in the training session, and 4) the percentages of correct responses to positive and negative stimuli in both the learning and test sessions of each experiment. The order in which positive, negative and test tokens were presented in the four experiments was constant so the results are comparable across the four experiments.

The first three pieces of evidence are included in Table 1. Subjects were considered to have 'formed' a given category if they reached 37 correct responses, which guaranteed that their classifying behaviour had not been random in the training session (P-value 0.03 < 0.05). Given this, the number of criterial subjects in the four CF experiments was 12 (exp. 1), 14 (exp. 2) and 20 (exp. 3 & 4). The table also shows that the average number of correct responses in the training session was 48.67 (range: 37-59, s.d. = 6.50) in exp. 1, 47 (range: 37-59, s.d. = 7.06) in exp. 2, 56.55 (range 51-60, s.d.= 2.06) in exp. 3, and 51.4 (range 37-59, s.d. = 5.15) in exp. 4.

Category (experiment)	**Criterial subjects**	**Mean correct responses (Training session)**	**Range & Standard Deviation**
CONSONANT (exp. 1)	12	48.67	Range: 37-59. s.d= 6.50
PLOSIVE (exp. 2)	14	47	Range: 37-59. s.d= 7.06
PHONEME P (exp. 3)	20	56.55	Range: 51-60. s.d= 2.06
ASPIRATED P (exp. 4)	20	51.4	Range: 37-59. s.d= 5.15

Table 1: Criterial subjects per category and experiment and category, subjects' mean correct responses (maximum 60) in the training session, range and standard deviation.

The number of correct, incorrect, and null responses to positive, negative and total stimuli as well as percentages of correct responses to each stimulus type in the training session are shown in Table 2.

Category	**Stimulus type**	**Type of response**			**% correct responses**	**Items**	**Responses elicited**
		C	**I**	**N**			
CONSONANT	Positive	322	33	29	83.85%	32	284
	Negative	286	30	20	85.12%	28	336
	Total	608	63	49	84.44%	60	720
PLOSIVE	Positive	364	74	10	81.25%	32	448
	Negative	290	98	4	73.98%	28	392
	Total	654	172	14	77.86%	60	840
PHONEME P	Positive	598	12	30	93.44%	32	640
	Negative	532	12	16	95%	28	560
	Total	1130	24	46	94.17%	60	1200
ASPIRATED P	Positive	554	27	59	86.56%	32	640
	Negative	473	39	48	84.46%	28	560
	Total	1027	66	107	85.58%	60	1200

Table 2: Category studied, number of correct (C), incorrect (I) and null (N) responses and percent correct responses to positive, negative and total stimuli, items and responses elicited (training session)

This table also shows the number of items per type of stimulus, and the number of responses elicited (which results from multiplying the number of items by the number of subjects who reached the established criterion in the training session). The equivalent information obtained from subjects' performance in the test session is shown in Table 3.

As tables 2 and 3 show, in all four experiments, the percentages of correct responses to both positive and negative stimuli substantially increase in the test session as compared with the training session. In other words, correct responses (see also Table 4) were significantly more frequent in the test session than in the training session as shown by respective contrasts of proportions (exp. 1 -CONSONANT-: 84.44% vs. 93.01%; exp. 2 -PLOSIVE-: 77.86% vs. 89.40%; exp. 3 -PHONEME P-: 94.17% vs. 98.71%; exp. 4 -ASPIRATED P-: 85.58% vs. 97.5%; p-value: 0.000 < 0.05).

Category	**Stimulus type**	**Type of response**			**% correct responses**	**Items**	**Responses elicited**
		C	**I**	**N**			
CONSONANT	Positive	218	2	8	95.61%	19	228
	Negative	128	15	1	88.89%	12	144
	Total	346	17	9	93.01%	31	372
PLOSIVE	Positive	248	13	5	93.23%	19	266
	Negative	140	25	3	83.33%	12	168
	Total	388	38	8	89.40%	31	434
PHONEME P	Positive	379	0	1	99.74%	19	380
	Negative	233	2	5	97.08%	12	240
	Total	612	2	6	98.71%	31	620
ASPIRATED P	Positive	434	5	1	98.64%	22	440
	Negative	346	10	4	96.11%	18	360
	Total	780	15	5	97.5%	40	800

Table 3: Category studied, number of correct (C), incorrect (I) and null (N) responses and percent correct responses to positive, negative and total stimuli, items and responses elicited (test session)

Category (experiment)	**Stimulus type**	**% correct responses**	
		Training session	**Test session**
CONSONANT	Positive	83.85%	95.61%
	Negative	85.12%	88.89%
	Total	84.44%	93.01%
PLOSIVE	Positive	81.25%	93.23%
	Negative	73.98%	83.33%
	Total	77.86%	89.40%
PHONEME P	Positive	93.44%	99.74%
	Negative	95%	97.08%
	Total	94.17%	98.71%
ASPIRATED P	Positive	86.56%	98.64%
	Negative	84.46%	96.11%
	Total	85.58%	97.5%

Table 4. Percentages of correct responses to positive, negative, and total stimuli in both the training and test sessions.

The results clearly show that the category PHONEME P (exp. 3) was the easiest to form of the four categories studied. PHONEME P and ASPIRATED P were the only categories for which all experimental subjects reached criterion. However, subjects in experiment 3 made more correct responses in the training session as an average than subjects in any of the other three experiments, the scores of the different subjects (i.e. range 51-60) were higher and differed less than those of the experimental subjects in the other experiments and the standard deviation of those scores (i.e. 2.06) was also the lowest. In addition, the subjects in experiment 3 made more correct responses to both positive and negative items in both the learning and the test sessions than the subjects in experiment 4. Thus, although the 20 experimental subjects of experiments 3 and 4 formed the categories PHONEME P and ASPIRATED P respectively, subjects in experiment 3 performed better than those in experiment 4 and much better than in experiments 1 (category CONSONANT) and 2 (category PLOSIVE).

V. DISCUSSION

In retrospect, it is not at all surprising that the categories CONSONANT and PLOSIVE, based on criteria like degree of constriction of the oral tract (plus velic closure/opening in the case of PLOSIVE), were more difficult to form than the categories ASPIRATED P and PHONEME P. Previous studies have found that 'feature' categories (instantiated by different speech segments that do not belong to the same segment-sized category) are more difficult to form than categories instantiated by speech segments that are classified as members of the same phoneme category (according to adult standards). Jeri J. Jaeger's (1980) CF experiments discussed above are a example of this. John Ohala's (1986) study is also revealing. In this latter work, Ohala taught one group of adult English-speaking subjects to group the [k] in a word like *school* with [kʰ] as in *cool*, and he taught another set of subjects to group [k] with [ɡ], as in *ago* and [ɡ̊], as in *good*. The first experimental group formed the category easily but many subjects in the second group could not form it at all, and those who did described the category in a disjunctive way (e.g. "[ɡə] sounds or the [kʰə] sound after *s*"). According to Ohala, the findings revealed that [kʰ, k] was more likely to be a pre-established grouping for subjects than [ɡ̊, ɡ, k], which is based on features like 'velar', 'stop' and 'oral', but whose instances do not belong to a single phoneme category for the experimental subjects as in the case of [kʰ, k]. As another case in point, Fodor and his co-workers (Fodor *et al.*, 1975) found that infants grouped syllables beginning with /p/ (e.g. /pi/, /pu/) more readily than syllables sharing phonetic features like 'voiceless', 'plosive', and 'oral', as is the case of /pi/ and /ka/, but not grouped in a segmental phoneme-sized category according to adult standards. Finally, it should be mentioned that the fact that 'feature'-based categories are more difficult to form than segment-based categories also explains why allophonic categories like ASPIRATED P and PHONEME P were easier to form than the categories CONSONANT and PLOSIVE.

The greater salience of PHONEME P in the present study over the categories PLOSIVE and CONSONANT and the relatively greater salience over the category ASPIRATED P seems to suggest that the category may have some sort of basic-level status in taxonomies of phonological categories for phonetically naïve subjects. This suggestion is based on the fact that in learning tasks in general and CF experiments in particular, basic-level categories are easier to form than non-basic-level categories (Jaeger, 1980: 366), which has already been shown for different sorts of categories other than phonological ones in cognitive and developmental psychology (see references in Section I). If this is so, and given the 'type' relation on which taxonomies are based, allophones would be subordinate categories and 'feature' categories would be superordinate categories (see e.g. Figure 1).

Level	**Category**
Superordinate	CONSONANT PLOSIVE
Basic	PHONEME P
Subordinate	ASPIRATED P

Figure 1: Plausible taxonomic organisation of the categories CONSONANT, PLOSIVE, PHONEME P, and ASPIRATED P

If the phoneme level is actually the most salient level of abstraction in taxonomies of phonological categories for subjects literate in an alphabetic writing system (like the experimental subjects that took part in this study), an explanation of why this could be so is called for. In this respect, the literature on taxonomic organisation mentions two main types of determinants of basic-level status. On the one hand, the basic level is often determined by the structure of the world as it is perceived and processed by cognitive systems (see e.g. Corter & Gluck, 1992; Jolicoeur *et al.*, 1984; Jones, 1983; Lin *et al.*, 1997; Mervis & Rosch, 1981; Rosch, 1978). On the other hand, the basic level also depends on general cultural significance (Berlin, 1992; Berlin *et al.*, 1973; Dougherty, 1978; Stross, 1973) as well as on individual familiarity, expertise or knowledge (Honeck *et al.*, 1987; Medin *et al.*, 1997; Tanaka & Taylor, 1991). In short, the basic level is determined both by the structure of the world and by the contributions of the human perceiver or categoriser like his/her goals, culture, expertise, knowledge, etc. and both types of factors typically interplay to define, for a given subject or population of subjects, the basic level in a given taxonomy (Dougherty, 1978; Mervis, 1980; Rosch *et al.*, 1976).

What 'structural' factors could make the phoneme level have basic-level status? Following a well-known structural explanation of basic-level status that claims that the basic level achieves the optimal balance between informativeness and distinctiveness, the basic level is the level at which categories maximize within-category similarity (i.e. relatively many properties are shared by all category members) while minimizing between-category similarity (i.e. relatively few properties are shared by non-members), attaining optimal cognitive economy (Mervis & Rosch, 1981; Rosch et al., 1976) or cognitive efficiency (Murphy, 1991a,b). Given this, the phonemic level could have basic-level structure because the members of the category (i.e. allophone categories) tend to be more structurally (phonetically) similar to one another than members of higher order 'feature' categories like PLOSIVE, which are based on a single feature or a few features but whose members differ significantly in other important feature specifications (e.g. voicing, place of articulation, aspiration, etc.).[13] This kind of structural similarity tends to make phoneme categories more stable, maximising informativeness (Taylor, 2002: 150): words can be distinguished from one another simply by a change in the phonemic specification of the word. In this respect speakers, even illiterates, are very good at minimal pairs discrimination (see e.g. Adrian *et al.*, 1995; Loureiro *et al*. 2004). It is also the case that the structural similarity of the members of allophonic categories may be as high as that in phoneme categories. However, the gain in informativeness is at the cost of a loss in distinctiveness, which is why listeners are not generally aware of allophonic variation (Abercrombie, 1967: 85, 87; Kreidler, 1989: 98; O'Connor, 1973: 121) and can only be so with special phonetic training (Donegan & Stampe, 1979: 162-164; Nathan, 1996: 112, 1999: 312-313; Pike, 1943: 115; etc.) or why it can be hypothesised that allophone categories will not develop conceptually unless they are somehow perceptually salient, like flaps or glottal stops in English.

Moreover, phonemes are the highest level at which speakers can kinaesthetically sense (in the absence of any audible production) the articulatory movements of an average category member, which seems to relate to Taylor's (2002) assertion that phonemes are the highest units for which speakers can conceptualise or "…. bring to mind an image of the /p/-phoneme in terms of its sound and its articulatory parameters…" (p. 150) and is compatible with the finding that the basic level is the highest level in a taxonomy at which a person uses similar motor actions or movements for interacting with category members (Rosch *et al.*, 1978). In contrast, fewer similar motor actions are used to interact with members of superordinate categories so speakers "… can hardly conceptualise a schematic stop, even less a schematic obstruent…" (p. 150) and, although speakers behave in a very similar way with members of subordinate categories, no more movements are made in common to subordinate than to basic level categories (Rosch, 1978; Rosch *et al.*, 1976).

What cultural or knowledge factors could make the phoneme level have basic-level superiority? The alphabetic writing system seems to be to a great extent responsible for the higher conceptual salience of phonemes. As Taylor (2002: 149) or Nathan (2007) point out, alphabetic writing systems are based on the salience of this level and they never represent sub-phonemic variants by distinct symbols. Thus, the writing system of a language like English represents the phonemic level (although more imperfectly than other languages like Spanish or Turkish) but does not reflect allophonic variation or higher-order phonetic and/or phonological relations, the conceptual salience of the phonemic level is increased. When mastering an alphabetic writing system, speakers "…must realize that *cat*, *act*, and *tack* contain the 'same sounds' arranged in different sequences" (Taylor, 2002: 149), equivalence across phonetic contexts (Pierrehumbert, 2003: 118) being the key characteristic of phonemes (Taylor, 2006). Once subjects have mastered alphabetic writing and the principle that each individual letter corresponds to one single sound, they will interact with, use and manipulate the phonemic level in different ways (to spell, for rhymes, puns and similar language play, etc.). Speakers may even come to think of sounds in terms of letters, since the latter provide a visual representation of the cluster of articulatory parameters that the production of the members of phoneme categories involve.

The structural salience of the system is no doubt reinforced for subjects trained in alphabetic writing but perhaps not exclusively caused by it. Before learning an alphabetic writing system (or any other type of writing system), speakers already posses some *phonological awareness* or degree of sensitivity to the sound structure (mainly of word structure) of oral language like syllables, onsets, rhymes, or phonemes as shown by their ability to recognise, discriminate, and manipulate the sounds of the language (see e.g. Bryant, 1990; Goswami & Bryant, 1990). In this respect, research on phonological awareness has shown that, irrespective of their language background, children become increasingly sensitive to smaller and smaller parts of words as they grow older. Children can detect or manipulate syllables before they can detect or manipulate onsets and rimes, and they can detect or manipulate these before they can detect or manipulate individual phonemes within intrasyllabic word units (Anthony & Francis, 2005: 256). As far as phoneme awareness is concerned, research has also shown that characteristics of oral languages (e.g. saliency and complexity of word structures, phoneme positions, articulatory factors, etc.) influence the degree of awareness of phonemes among pre-literate children (Anthony & Francis, 2005: 257), although "…most children achieve minimal levels of phoneme awareness prior to literacy instruction" (ibid) and the same is true of adult illiterates (see e.g. Adrian *et al.*, 1995; Loureiro *et al*. 2004; Tarone & Bigelow, 2005 for a review). However, phoneme-level awareness and skills develop fast once alphabetic writing is learned -and faster in children acquiring orthographically consistent languages with consistent spelling-to-sound and consistent sound-to-spelling relations like Italian or German (Anthony & Francis, 2005: 257; Goswami, 2002). In any case, the relationship between literacy and developing phonological awareness (including phoneme awareness) appears to be reciprocal (Anthony & Francis, 2005; Perfetti *et al*. 1987). Children's preliterate phonological awareness and the phonological awareness they develop while learning the names and sounds of letters in their alphabet help children learn to read but reading and writing provide feedback that influences individual's phonological awareness development. According to Ravid and Tolchinsky (2002: 432), "….specific aspects of language awareness, especially phonological and morphological awareness, both promote and are promoted by learning to read and write...".

VI. CONCLUSION

This paper has provided some empirical evidence on the potential existence of a basic level in taxonomies of phonological categories that are plausible for adult literate speakers of English. In this respect, four CF experiments were carried out to find out whether any of the four categories studied at different levels of abstraction in the taxonomy, i.e. CONSONANT, PLOSIVE, PHONEME P, and ALLOPHONE P, was more salient as shown by the ease with which phonetically naïve subjects could 'form' the categories. The results show that the category PHONEME P was the easiest to form, suggesting that the phoneme level may have some sort of basic-level status in phonological taxonomies. The reasons why this level could be more salient were also discussed and it was claimed that they might be due to structural (e.g. greater similarity of the members of the category, i.e. its allophones and greater distinctiveness from other categories) as well as cultural factors (e.g. greater salience boosted by alphabetic literacy).

Suggestive as the results obtained are, they are limited and more evidence should be obtained to confirm the finding that the phoneme level is the basic level of phonological taxonomies for phonetically naïve subjects. Directions for future research could also involve looking at what the basic level is in taxonomies for subjects whose language uses a writing system that is not alphabetic, which may reveal that phoneme might not be the basic level of abstraction for phonological taxonomies from a universal point of view (but rather depend strongly on the alphabetic/non-alphabetic spelling of the subject's language).

NOTES

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2 These include not only natural or artefactual categories (e.g. Rosch *et al.*, 1976; Rosch, 1978) but also artificial categories (Mervis & Crisafi, 1982; Murphy & Smith, 1982) and a host of other types of categories like environmental scenes (Tversky, 1986, 1990; Tversky & Hemenway, 1983, 1984), events (Morris & Murphy, 1990; Rifkin, 1985), social, ideological, cultural and psychological situations (Cantor *et al.*, 1982), psychiatric diagnoses (Cantor *et al.*, 1980), traits (Brewer *et al.*, 1981; Cantor & Mischel, 1979; Dahlgren, 1985; John *et al.*, 1991), emotions (Fehr & Russel, 1984; Shaver *et al.*, 1987), computer programming concepts (Adelson, 1985), sentences (Corrigan, 1991), etc.

3 On the contrary, fewer attributes are listed for category members at the superordinate level (e.g. FURNITURE, VEHICLE, ANIMAL) and there is virtually no increase for subordinate categories (e.g. ROCKING CHAIR, SPORTS CAR, RETRIEVER) over the basic level unless expert knowledge is developed for them (e.g. Tanaka & Taylor 1991). On a related note, it has also been found that at least for natural and artefactual categories, most of the attributes listed for both basic-level and subordinate categories refer to physical parts like "arms", "legs", "eyes", etc. (e.g. Hemenway, 1981; Mervis & Greco, 1984; Tversky, 1986, 1990, 1991; Tversky & Hemenway, 1983, 1984, 1991). However, parts are neither necessary nor sufficient for establishing a basic-level structure (Murphy, 1991a, 1991b). The few attributes listed for superordinate categories are abstract attributes that refer to the functions of objects.

4. In contrast, members of superordinate categories like FURNITURE do not share a common shape and, as a consequence, a calculated average shape of a number of superordinate objects is not readily recognisable as a member of that superordinate category. Also, some gain in similarity of shapes occurs for subordinate category members (e.g. different instances of the category KITCHEN CHAIR) but this increase in similarity is so small when going from the basic to the subordinate level that the basic level is again preferred (Rosch *et al.* 1976).

5. In contrast, fewer similar motor actions are used to interact with members of superordinate categories. Also, although subjects behave in a very similar way with members of subordinate categories, no more movements are made in common to subordinate than to basic-level categories (Rosch, 1978; Rosch *et al.*, 1976)

6. This is so unless the to-be-identified object (e.g. a chair) has to be categorised as part of a scene or context, such as living room with a sofa, tables, and lamps in which case categorising the object at the superordinate level (e.g. "furniture") is just as fast as categorising the object at the basic level, for example "chair" (Murphy & Wisniewski, 1989a) or when subjects possess a high degree of expertise, in which case spontaneous naming of entities occurs at the subordinate level (Tanaka & Taylor, 1991). In general, the need for specificity or generality

in the information conveyed may require the use of subordinate or superordinate level category names (Cruse, 1977; Rosch *et al.*, 1976).

7. Several studies (e.g. Lassaline *et al.*, 1992; Mervis & Crisafi, 1982; Murphy & Smith, 1982; Murphy & Brownell 1985) rule out the possibility that the basic level is due to linguistic factors like word length and frequency, which reflect properties of the category names rather than properties of conceptual representations. However, basic-level names differ from category names of superordinate and subordinate categories since they are typically shorter, underived, morphosyntactically regular, etc. (see Berlin, 1978, 1992; Brown, 1958, 1976; Brown *et al.*, 1976; Mervis & Rosch, 1981 for lengthier discussions), or the first to be learned developmentally (Anglin, 1977; Blewitt & Durkin, 1982; Dougherty, 1978; Mervis, 1980, 1984; Mervis & Mervis, 1982; Poulin-Dubois *et al.*, 1995; Rescolda, 1980; Shipley *et al.*, 1983; Stross, 1973; White, 1982) or primarily used by parents or caretakers in their speech to children (Anglin. 1977; Blewitt, 1983; Brown, 1956, 1976; Callanan, 1983, 1985; Poulin-Dubois *et al.*, 1995; Shipley *et al.*, 1993; White, 1982).

8. However, despite the common belief that first-learned words correspond with first-learned categories (both described as 'basic level') leading to the belief that language acquisition is a reasonably good indicator of early cognition, this is not necessarily so since toddlers, for instance, often overextend their first words. McDonough (2002), for instance, conducted two experiments that examined two-year-olds' production and comprehension of basic-level terms. The results showed overextensions both in production (e.g. children labelled a rocket 'airplane') and comprehension (e.g. they pointed to a rocket when airplane was requested). McDonough argues that toddlers extend labels to a wider conceptual domain because they have not clearly differentiated basic-level concepts from related conceptual categories.

9. In any case, even in partonomic organisation of phonological categories we can look into questions of what the basic level is, since the existence of a basic level has also been claimed for partonomies (see e.g. Rifkin 1985; Tversky 1989, 1990) but explicit reference should be made to whether taxonomic or partonomic organisation is being discussed. This issue can be linked to discussions in the speech perception literature on the 'basic' unit of speech perception (see e.g. Goldinger & Azuma, 2003), phonological awareness and phonemic awareness literature (e.g. Read *et al.* 1986), or the 'basic-level' salience of the phoneme, the syllable or the phonological word for speakers with different writing systems (alphabetic, logographic, syllabary-based, etc.)

10. The CF paradigm was originally and extensively used in psychology during the behavioural and information processing eras for a wide range of purposes. The technique has also been employed to address different phonological and/or phonetic questions (e.g. Jaeger, 1980, 1984; Jaeger & Ohala, 1984; Wang & Derwing, 1986; Weitzman, 1992).

11. As pointed out by Taylor (2006), the word *category formation* can be conceived of as a problem solving task in which subjects have to work out the criteria by which a given set of stimuli have been put into a certain category while other stimuli have not. Thus, following Kendler (1961: 447), the noun *concept formation* should be understood merely as referring to a well-known experimental technique, not an abstract psychological process.

12. A further aim of the test session of a CF experiment is to find out about the way the subject classifies instances whose category membership is controversial or unclear for some reason. These stimuli are called *test* tokens and they provide the experimenter with information about the boundaries of categories previously 'formed' by the subject during the training session. Test tokens were included in the first three experiments since the latter also looked at other phonological problems investigated in earlier work by the author (Mompeán, 2002). These problems included the assignment of the so-called semi-vowels in English (i.e. /w, j/) to the category CONSONANT or not, the assignment of English affricates (i.e. /ʧ, ʤ/) to the category PLOSIVE, or the treatment of plosives after tautosyllabic /s/ as instances of the fortis (voiceless) plosives (i.e. /p, t, k/) or not.

13. However, as Mompeán (2004) argues, the members of one and the same phoneme category need not share all the features in common and there may be no single feature that is shared by all members of the category.

REFERENCES

Abercrombie, D. (1967). *Elements of general phonetics.* Edinburgh: Edinburgh University Press.

Adelson, B. (1985). Comparing natural and abstract categories: A case study from computer science. *Cognitive Science*, 9, 417-430.

Adrian, J. A., Alegría, J., & Morais, J. (1995). Metaphonological abilities of Spanish illiterate adults. *International Journal of Psychology*, 30, 329–353.

Anglin, J. M. (1977). *Word, object, and conceptual development.* New York: W. W. Norton & Company.

Anthony, J. L., & Francis, D. J. 2005. Development of Phonological Awareness. *Current Directions in Psychological Science*, 14(5):255-259.

Berlin, B. (1978). Ethnobiological classification. In E. H. Rosch & B. B. Lloyd (Eds.), *Cognition and categorisation.* Hillsdale, NJ: LEA, pp. 9-26.

Berlin, B. (1992). *Ethnobiological classification: Principles of categorisation of plants and animals in traditional societies*. Princetown, NJ: Princetown University Press.

Berlin, B., Breedlove, D. E., & Raven, P. H. (1973). General principles of classification and nomenclature in folk biology. *American Anthropologist*, 75, 214-242.

Blewitt, P. (1983). Dog vs. collie: Vocabulary in speech to young children. *Developmental Psychology*, 19, 602-609.

Blewitt, P. (1994). Understanding categorical hierarchies: The earliest levels of skill. *Child Development*, 65, 1279-1298.

Blewitt, P., & Durkin, M. (1982). Age, typicality, and task effects on categorization of objects. *Perception and Motor Skills*, 55, 435-445.

Bolton, N. (1977). *Concept formation*. Oxford: Pergamon Press.

Bourne, L. E. (1966). *Human conceptual behavior*. Boston, NJ: Allyn & Bacon.

Bourne, L. E. (1970). Knowing and using concepts. *Psychological Review*, 77, 546-556.

Brewer, M. B., Dull, V., & Lui, L. (1981). Perceptions of the elderly: Stereotypes as prototypes. *Journal of Personality and Social Psychology*, 41, 656-670.

Brown, C. H., Kolar, J., Torrey, B. J., Truong-Quang, T., & Volkman, P. (1976). Some general principles of biological and non-biological folk classification. *American Ethnologist*, 3, 73-85.

Brown, R. W. (1958). How shall a thing be called?. *Psychological Review*, 65, 14-21.

Brown, R. W. (1976). Reference: In memorial tribute to Eric Lenneberg. *Cognition*, 4, 125-153.

Bruner, J. S., Goodnow, J. J., & Austin, G. A. (1956). *A study of thinking*. New York: John Wiley & Sons.

Bryant, P. (1990). Phonological development and reading. In P. D. Pumfrey, & C. D. Elliot (Eds.), Children's difficulties in reading, spelling and writing Challenges and responses. London The Falmer Press, pp. 63-82.

Callanan, M. A. (1983). *Parental input and young children's acquisition of hierarchically organized concepts.* Ph.D. Diss. Stanford University, Palo Alto, CA.

Callanan, M. A. (1985). How parents label objects for young children: The role of input in the acquisition of category hierarchies. *Child Development*, 56, 508-523.

Cantor, N., & Mischel, W. (1977). Traits as prototypes: Effects on recognition memory. *Journal of Personality and Social Psychology*, 35: 38-48.

Cantor, N., Mischel, W., & Schwartz, J. C. (1982). A prototype analysis of psychological Situations. *Cognitive Psychology*, 14, 45-77.

Cantor, N., Smith, E. E., French, R. D., & Mezzich, J. (1980). Psychiatric diagnosis as prototype categorisation. *Journal of Abnormal Psychology*, 89, 181-193.

Chomsky, N., & Halle, M. (1968). *The sound pattern of English*. New York: Harper & Row.

Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. *Psychological Review*, 82, 407-428.

Corrigan, R. (1991). Sentences as categories: Is there a basic-level sentence?. *Cognitive Linguistics*, 2, 339-356.

Corter, J. E., & Gluck, M. A. (1992). Explaining basic categories: Feature predictability and information. *Psychological Bulletin*, 111, 291-303.

Cruse, D. A. (1977). The pragmatics of lexical specificity. *Journal of Linguistics*, 13, 153-164.

Dahlgren, K. (1985). The cognitive structure of social categories. *Cognitive Science*, 9, 379-398.

Dell, G. S., & Newman, J. E. (1980). Detecting phonemes in fluent speech. *Journal of Verbal Learning and Verbal Behavior*, 19, 608-623.

Donegan, P. J., & Stampe, D. (1979). The study of natural phonology. In D. A. Dinnsen (Ed.), *Current approaches to phonological theory*. Bloomington: Indiana University Press, pp. 126-173.

Dougherty, J. W. D. (1978). Salience and relativity in classification. *American Ethnologist*, 5, 66-80.

Downing, P. (1977). On 'basic levels' and the categorisation of objects in English discourse. *Berkeley Linguistics Society*, 3, 475-87.

Fehr, B. & Russell, J. A. (1984). Concept of emotion viewed from a prototype perspective. *Journal of Experimental Psychology: General*, 113, 464-486.

Fodor, J. A., Garrett, M. F., & Brill, S. L. (1975). Pi-ka-pu: The perception of speech sounds by pre-linguistic infants. *Perception and Psychophysics*, 18, 74-78.

Fraser, H. (2006). Phonological concepts and concept formation: Metatheory, theory and application. *International Journal of English Studies*, 6(2), 55-75.

Gelman, S. A., & Coley, J. D. (1990). The importance of knowing a dodo is a bird: categories and inferences in 2-year-old children. *Developmental Psychology*, 26, 796-804.

Gelman, S. A., & Markman, E. M. (1986). Categories and induction in young children. *Cognition*, 23, 183-209.

Gelman, S. A., & O'Reilly, A. W. (1988). Children's inductive inferences within superordinate categories: The role of language and category structure. *Child Development*, 59, 876-887.

Goldinger, S. D., & Azuma, T. 2003. Puzzle-solving science: The quixotic quest for units in speech perception. *Journal of Phonetics*, 31, 305-320.

Goswami, U. 2002. In the beginning was the rhyme? A reflection on Hulme, Hatcher, Nation, Brown, Adams and Stuart, 2001. *Journal of Experimental Child Psychology*, *82*, 47-57.

Goswami, U., & Bryant, P. E. (1990). *Phonological skills and learning to read*. London: Erlbaum.

Hampton, J. A. (1982). A demonstration of intransitivity in natural concepts. *Cognition*, 12, 151-164.

Hampton, J. A. (1988). Overextension of conjunctive concepts: Evidence for a unitary model of concept typicality and class inclusion. *Journal of Experimental Psychology: Learing, Memory, and Cognition*, 14, 12-32.

Hemenway, K. (1981). *The role of perceived parts in categorisation*. Ph.D. Diss. Stanford University.

Honeck, R. P., Firment, M., & Case, T. J. (1987). Expertise and categorisation. *Bulletin of the Psychonomic Society*, 25, 431-434.

Horton, M. S., & Markman, E. M. (1980). Developmental differences in the acquisition of basic and superordinate categories. *Child Development*, 51, 708-719.

Hull, C. L. (1920). Quantitative aspects of the evolution of concepts: an experimental study. *Psychological Monographs*, 28. No. 1. (Whole No. 123).

Hunt, E. B. (1962). *Concept learning: An information processing problem.* New York: John Wiley & Sons.

Jaeger, J. J. (1980). *Categorisation in phonology: An experimental approach*. Ph.D. diss., University of California, Berkeley.

Jaeger, J. J. (1984). Assessing the psychological status of the Vowel Shift rule. *Journal of Psycholinguistic Research*, 13, 13-56.

Jaeger, J. J. (1986). Concept formation as a tool for linguistic research. In J. J. Ohala & J. J. (eds.). 1986. *Experimental phonology*. Orlando: Academic Press, pp. 211-238.

Jaeger, J. J., & Ohala, J. J. (1984). On the structure of phonetic categories. *Berkeley Linguistics Society*, 10, 15-26.

John, O. P., Hampson, S. E., & Goldberg, L. R. (1991). The basic level in personality-trait hierarchies: studies of trait use and accessibility in different contexts. *Journal of Personality and Social Psychology*, 60, 348-361.

Jolicoeur, P., Gluck, M. A., & Kosslyn, S. M. (1984). Pictures and names: Making the connection. *Cognitive Psychology*, 16, 243-275.

Jones, G. V. (1983). Identifying basic categories. *Psychological Bulletin*, 94, 423-428.

Katz, J. J., & Postal, P. M. (1964). *An integrated theory of linguistic descriptions*. Cambridge, MA: MIT Press.

Kendler, T. S. (1961). Concept formation. *Annual Review of Psychology*, 12, 447-472.

Kreidler, C. W. (1989). *The pronunciation of English: A course book in phonology*. Oxford, UK: Blackwell.

Lakoff, G. (1987). *Women, fire and dangerous things: What categories reveal about the mind*. Chicago, IL: University of Chicago Press.

Lassaline, M. E., Wisniewski, E. J., & Medin, D. L. (1992). The basic level in artificial and natural categories: Are all levels created equal?. In B. Burns (Ed.), *Percepts, concepts, and categories: The representation and processing of information*. Amsterdam: Elsevier, pp. 327-278.

Lin, E. L., Murphy, G. L., & Shoben, E. J. (1997). The effects of prior processing episodes on basic-level superiority. *Quarterly Journal of Experimental Psychology. Section A: Human Experimental Psychology*, 50: 25-48.

Loureiro, C de Santos, Braga, W. L., do Nascimento Souza, L., Nunes Filho, G., Queiroz, E. & Dellatolas, G. (2004). Degree of illiteracy and phonological and metaphonological skills in unschooled adults. *Brain and Language*, 89(3), 499-502.

Read, C., Zhang, Y., Nie, H., & Ding, B. (1986). The ability to manipulate speech sounds depends on knowing alphabetic writing. *Cognition*, 24, 31–45.

Margolis, E. (1994). A reassessment of the shift from the classical theory of concepts to prototype theory. *Cognition*, 51, 73-89.

Markman, E. M., Horton, M. S., & McLanahan, A. G. (1980). Classes and collections: Principles of organization in the learning of hierarchical relations. *Cognition*, 8, 227-241.

McCloskey, M. E. (1980). The stimulus familiarity problem in semantic memory research. *Journal of Verbal Learning and Verbal Behavior*, 19, 485-502.

McCloskey, M. E., & Glucksberg, S. (1978). Natural categories: Well-defined or fuzzy sets?. *Memory and Cognition*, 6, 462-472.

McCloskey, M. E., & Glucksberg, S. (1979). Decision processes in verifying category membership statements: Implications for models of semantic Memory. *Cognitive Psychology*, 11, 1-37.

McDonough, L. (2002). Basic-level nouns: First learned but misunderstood. *Journal of Child Language*, 29(2), 357-377.

Medin, D. L. (1983). Structural Principles in Categorisation. In T. J. Tighe & B. E. Shepp (Eds.), *Perception, cognition, and development: Interactional analyses*. Hillsdale, NJ: LEA, pp. 203-230.

Medin, D. L., Lynch, E. B., & Coley, J. D. (1997). Categorisation and reasoning among tree experts: Do all roads lead to Rome?. *Cognitive Psychology*, 32, 49-96.

Mervis, C. B. (1980). Category structure and the development of categorisation. In R. J. Spiro, B. C. Bruce & W. F. Brewer (Eds.), *Theoretical issues in reading comprehension*. Hillsdale, NJ: LEA, pp. 279-307.

Mervis, C. B. (1984). Early lexical development: the contributions of mother and child. In C. Sophian (Ed.), *Origins of cognitive skills*. Hillsdale, NJ: LEA, pp. 339-370.

Mervis, C. B. (1987). Child-basic object categories and early lexical development. In U. Neisser (Ed.), *Concepts and conceptual development: Ecological and intellectual factors in categorisation.* New York: CUP, pp. 201-233.

Mervis, C. B., & Crisafi, M. A. (1982). Order of acquisition of subordinate-, basic- and superordinate-level categories. *Child Development*, 53, 258-266.

Mervis, C. B., & Greco, C. (1984). Parts and early conceptual development: Comment on Tversky and Hemenway. *Journal of Experimental Psychology: General*, 113, 194-197.

Mervis, C. B., & Mervis, C. A. (1982). Leopards are kitty-cats: Object labeling by mothers for their thirteen-month-olds. *Child Development*, 53, 267-273.

Mervis, C. B., & Rosch, E. (1981). Categorisation of natural objects. *Annual Review of Psychology*, 32, 89-115.

Mompeán, J. A. (1999). A cognitive view of the concept of the phoneme. *6th International Cognitive Linguistics Conference*. Stockholm University, July 1999.

Mompeán, J. A. (2002). *The categorisation of the sounds of English: Experimental evidence in phonology*. Unpublished Ph.D dissertation. University of Murcia.

Mompeán, J. A. (2004). Category overlap and neutralisation: The importance of speakers' classification in phonology. *Cognitive Linguistics*, 15, 429-469

Morris, M. W., & Murphy, G. L. (1990). Converging operations on a basic level in event taxonomies. *Memory and Cognition*, 18, 407-418.

Murphy, G. L. (1991a). Parts in object concepts: Experiments with artificial categories. *Memory and Cognition*, 19, 423-438.

Murphy, G. L. (1991b). More on parts in object concepts: Response to Tversky and Hemenway. *Memory and Cognition*, 19, 443-447.

Murphy, G. L., & Brownell, H. H. (1985). Category Differentiation in object recognition: Typicality constraints on the basic category advantage. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 11, 70-84.

Murphy, G. L, & Lassaline, M. E. (1997). Hierarchical structure in concepts and the basic level of categorisation. In K. Lamberts & D. Shanks (Eds.), *Knowledge, concepts, and categories*. Cambridge, MA: MIT Press, pp. 93-131.

Murphy, G. L., & Smith, E. E. (1982). Basic-level superiority in picture categorisation. *Journal of Verbal Learning and Verbal Behavior*, 21, 1-20.

Murphy, G. L., & Wisniewski, E. J. (1989a). Categorizing objects in isolation and in scenes: What a superordinate is good for. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 15, 572-586.

Murphy, G. L., & Wisniewski, E. J. (1989b). Feature correlations in conceptual representations. In G. Tiberghien (Ed.), *Advances in cognitive science. Vol. 2: theory and applications*. Chichester, England: Ellis Horwood, pp. 23-45.

Murphy, G. L., & Wright, J. C. (1984). Changes in conceptual structure with expertise: Differences between real-world experts and novices. *Journal of Experimental Psycholgy: Learning, Memory, and Cognition*, 10, 144-155.

O'Connor, J. D. (1973). *Phonetics*. Harmondsworth, Penguin Books.

Nathan, G. S. (1986). Phonemes as mental categories. *Berkeley Linguistics Society*, 12, 212-223.

Nathan, G. S. (1996). Steps towards a cognitive phonology. In B. Hurch & R. Rhodes (Eds.), *Natural Phonology: The state of the art*. Berlin: Mouton de Gruyter, pp. 107-120.

Nathan, G. S. (1999). What functionalists can learn from formalists in phonology. In M. Darnell, E. Moravcsik, F. Newmeyer, M. Noonan, & K. Wheatley (Eds.), *Functionalism and formalism in linguistics*. Vol. 1: *General papers*. Amsterdam/Philadelphia: John Benjamins, pp. 305-327.

Nathan, G. S. (2007). *Phonology in Cognitive Grammar*. Manuscript.

Neisser, U., & Weene, P. (1962). Hierarchies in concept attainment. *Journal of Experimental Psychology*, 64, 640-645.

Newman, J. E., & Dell, G. S. (1978). The phonological nature of phoneme monitoring: A critique of some ambiguity studies. *Journal of Verbal Learning and Verbal Behavior*, 17, 359-374.

Ohala, J. J. (1986). Consumer's guide to evidence in phonology. *Phonology Yearbook*, 3, 3-26.

Pansky, A., & Koriat, A. 2004. The basic-level convergence effect in memory distortions. *Psychological Science*, 15(1), 52-59.

Perfetti, C. A., Beck, I., Bell, L. C., & Hughes, C. 1987. Phonemic knowledge and learning to read are reciprocal. *Merrill-Palmer Quarterly,* 33, 283-319.

Pike, K. L. (1943). *Phonetics: A critical analysis of theory and a technic for the practical description of sounds*. Ann Arbor, MI: The University of Michigan Press.

Poulin-Dubois, D., Graham, S. & Sippola, L. (1995). Early lexical development: The contribution of parental labelling and infants' categorisation abilities. *Journal of Child Language*, 22, 325-343.

Ravid, D., & Tolchinsky, L. (2002). Developing linguistic literacy: A comprehensive model. *Journal of Child Language*, 29, 417–447.

Rescolda, L. A. (1980). Overextension in early language development. *Journal of Child Language*, 7, 321-335.

Rey, G. (1983). Concepts and stereotypes. *Cognition*, 15, 237-262.

Rey, G. (1985). Concepts and conceptions: a reply to Smith, Medin, and Rips. *Cognition*, 19, 297-303.

Rifkin, A. (1985). Evidence for a basic level in event taxonomies. *Memory and Cognition*, 13, 538-556.

Rosch, E. H. (1978). Principles of categorisation. In E. H. Rosch & B, B. Lloyd (Eds.), *Cognition and categorisation*. Hillsdale, NJ: LEA, pp. 27-48.

Rosch, E. H., & Mervis, C. B. (1975). Family resemblances: Studies in the internal structure of categories. *Cognitive Psychology*, 7, 573-605.

Rosch, E. H., Mervis, C. B., Gray, W. D., Johnson, D. M., & Boyes-Braem, P. (1976). Basic objects in natural categories. *Cognitive Psychology*, 8, 382-439.

Shaver, P., Schwartz, J., Kirson, D., & O'Connor, C. (1987). Emotion knowledge: Further exploration of a prototype approach. *Journal of Personality and Social Psychology*, 52, 1061-1086.

Shipley, E. F. (1993). Categories, hierarchies, and induction. In D. L. Medin (Ed.), *The psychology of learning and motivation.* Vol. 30. San Diego: Academic Press, pp. 265-301.

Shipley, E. F., Kuhn, I. F., & Madden, E. C. (1983). Mothers' use of superordinate category terms. *Journal of Child Language*, 10, 571-588.

Sloman, S. A. (1997). Categorical inference is not a tree: The myth of inheritance hierarchies. *Cognitive Psychology*, 35, 1-13.

Smith, E. E., Shoben, E. J., & Rips, L. J. (1974). Structure and process in semantic memory: A featural model for semantic decisions. *Psychological Review*, 81, 214-241.

Smith, E. E., Balzano, G. J., & Walker, J. (1978). Nominal, perceptual, and semantic codes in picture categorisation. In J. W. Cotton & R. L. Klatzky (Eds.), *Semantic factors in cognition*. Hillsdale, NJ: LEA, pp. 137-168.

Stemberger, J. P., Elman, J. L., & Haden, P. (1985). Interference between phonemes during phoneme monitoring: Evidence for an interactive activation model of speech perception. *Journal of Experimental Psychology: Human Perception and Performance*, 11, 475-489.

Stross, B. (1973). Acquisition of botanical terminology by Tzeltal children. In M. S. Edmonson (Ed.). *Meaning in Mayan languages.* The Hague: Mouton, pp. 107-141.

Sutcliffe, J. P. (1993). Concept, class, and category in the tradition of Aristotle. In I. van Mechelen, J. Hampton, R. S. Michalski & P. Theuns (Eds.), *Categories and concepts: Theoretical views and inductive data*. New York: Academic Press, pp. 35-65.

Tanaka, J. W., & Taylor, M. (1991). Object categories and expertise: is the basic level in the eye of the beholder?. *Cognitive Psychology*, 23, 457-482.

Tarone, E., & Bigelow, M. (2005). Impact of literacy on oral language processing: Implications for second language acquisition research. *Annual Review of Applied Linguistics*, 25, 77–97.

Taylor, J. R. (2002). *Cognitive grammar*. Oxford: Oxford University Press.

Taylor, J. R. (2003). *Linguistic categorization*. Oxford: Oxford University Press. First edition: 1989.

Taylor, J. R. (2006). Where do phonemes come from? A view from the bottom. *International Journal of English Studies*, 6(2), 19-54.

Tversky, B. (1985). Development of taxonomic organization of named and pictured categories. *Developmental Psychology*, 21, 1111-1119.

Tversky, B. (1986). Components and categorisation. In C. Craig (Ed.), *Noun classes and categorisation*. Amsterdam: John Benjamins, pp. 63-75.

Tversky, B. (1989). Parts, partonomies, and taxonomies. *Developmental Psychology*, 25, 983-995.

Tversky, B. (1990). Where partonomies and taxonomies meet. In S. L. Tsohatzidis (Ed.), *Meanings and prototypes: Studies in linguistic categorisation*. London: Routledge, pp. 334-344.

Tversky, B., & Hemenway, K. (1983). Categories of environmental scenes. *Cognitive Psychology*, 15, 121-149.

Tversky, B., & Hemenway, K. (1984). Objects, parts, and categories. *Journal of Experimental Psychology: General*, 113, 169-193.

Tversky, B., & Hemenway, K. (1991). Parts and the basic level in natural categories and artificial stimuli: Comments on Murphy (1991). *Memory and Cognition*, 19, 439-442.

Ungerer, F. (1994). Basic level concepts and parasitic categorisation: A cognitive alternative to conventional semantic hierarchies. *Zeitschrift für Anglistik und Amerikanistik*, 42: 148-162.

Ungerer, F. & Schmid, H. J. (1996) *An introduction to cognitive linguistics*. New York: Addison Wesley Longman.

URL1 *Wikipedia* entry ‘Linnean taxonomy’. http://en.wikipedia.org/wiki/Linnaean_taxonomy

Wang, H. S., & Derwing, B. L. (1986). More on English Vowel shift: The back vowel question. *Phonology Yearbook*, 3, 99-116.

Waxman, S. R., Shipley, E. F., & Shepperson, B. (1991). Establishing new subcategories: The role of category labels and existing knowledge. *Child Development*, 62, 127-138.

Weitzman, R. (1992). Vowel categorisation and the critical band. *Language and Speech*, 35, 115-125.

Weitzman, R. (1993). How to get the horse to open its mouth: Using the concept formation paradigm in speech perception research. In J. A. Nevis *et al.* (Eds.), *Papers in honor of Frederick Brengelman on the occasion of the 25th anniversary of the Linguistics Department at California State University*. Fresno, CA: California State University, pp. 141-149.

White, T. G. (1982). Naming practices, typicality, and underextension in child language. *Journal of Experimental Child Psychology*, 33, 324-346.

Wisniewski, E. J., Imai, M., & Casey, L. (1996). On the equivalence of superordinate concepts. *Cognition*, 60, 269-298.

APPENDIX

Stimulus List for the category CONSONANT (exp. 1)

Ord.	Item	P(+) N(-)		Ord.	Item	P(+) N(-)
LEARNING SESSION						
1.	path	+		53.	change	+
2.	ash	-		54.	aim	-
3.	boom	+		55.	jug	+
4.	ache	-		56.	ebb	-
5.	toad	+		57.	ace	-
6.	duck	+		58.	mug	+
7.	kid	+		59.	itch	-
8.	up	-		60.	name	+
9.	give	+				
10.	eat	-		**TEST SESSION**		
11.	seethe	+				
12.	zone	+				
13.	edge	-		1.	pet	+
14.	fish	+		2.	bath	+
15.	van	+		3.	tooth	+
16.	at	-		4.	ode	- c
17.	egg	-		5.	deep	+
18.	ill	-		6.	hot	test
19.	thing	+		7.	eight	-
20.	off	-		8.	ape	-
21.	that	+		9.	cab	+
22.	each	-		10.	guess	+
23.	hours	-i		11.	oath	- c
24.	cheese	+		12.	fetch	+
25.	job	+		13.	heat	test
26.	miss	+		14.	us	-
27.	out	-		15.	vague	+
28.	neck	+		16.	all	- c
29.	eve	-		17.	seed	+
30.	on	-		18.	youth	test
31.	pub	+		19.	ship	+ c
32.	aid	-		20.	wit	test
33.	beach	+		21.	zoom	+
34.	teach	+		22.	earn	-
35.	oil	-		23.	thin	+
36.	odd	-		24.	then	+
37.	dove	+		25.	urge	-
38.	arm	-		26.	shock	+ c
39.	call	+		27.	orb	- c
40.	goose	+		28.	once	test
41.	ale	-		29.	chase	+
42.	safe	+		30.	yet	test
43.	earth	-		31.	of	-
44.	zip	+		32.	judge	+
45.	fang	+		33.	wall	test
46.	owl	-		34.	if	-
47.	ooze	-		35.	hard	test
48.	ice	-		36.	shell	+ c
49.	vet	+		37.	map	+
50.	thick	+		38.	net	+
51.	age	-		39.	use	test
52.	those	+		40.	art	-

Stimulus List for the Category PHONEME P (exp. 3)

Ord.	Item	P(+) N(-)		Ord.	Item	P(+) N(-)
LEARNING SESSION						
1.	pet	+		53.	print	+
2.	sell	-		54.	fee	-
3.	up	+		55.	pond	+
4.	egg	-		56.	end	-
5.	pay	+		57.	grant	-
6.	plea	+		58.	top	+
7.	drip	+		59.	fist	-
8.	die	-		60.	trap	+
9.	apt	+				
10.	tray	-		**TEST SESSION**		
11.	priest	+				
12.	depth	+				
13.	drill	-		1.	pit	+
14.	path	+		2.	pear	+
15.	ape	+		3.	prow	+
16.	old	-		4.	sheet	-
17.	drift	-		5.	plane	+
18.	golf	-		6.	spend	test
19.	pie	+		7.	near	-
20.	fish	-		8.	slow	-
21.	pray	+		9.	clamp	+
22.	ash	-		10.	pulse	+
23.	bay	-i		11.	bear	- i
24.	place	+		12.	cap	+
25.	opt	+		13.	spa	test
26.	stamp	+		14.	ground	-
27.	sphere	-i		15.	prayer	+
28.	post	+		16.	false	-
29.	graph	-i		17.	drop	+
30.	blast	-i		18.	spy	test
31.	shop	+		19.	glimpse	+ c
32.	east	-		20.	spoon	test
33.	pea-p	+		21.	prince	+
34.	play	+		22.	phone	- i
35.	self	-		23.	paste	+
36.	psalm	-i		24.	ship	+
37.	proud	+		25.	sly	-
38.	sea-see	-		26.	lapsed	+ c
39.	asp	+		27.	slob	-c, i
40.	clasp	+		28.	sponge	test
41.	dry	-		29.	plot	+
42.	damp	+		30.	spray	test
43.	clean	-		31.	cross	-
44.	keep	+		32.	tramp	+
45.	paw	+		33.	sply	test
46.	act	-		34.	nymph	-i
47.	bet	-i		35.	spring	test
48.	trust	-		36.	pure	+ c
49.	plough	+		37.	lamp	+
50.	group	+		38.	rapt	+
51.	fond	-		39.	split	test
52.	imp	+		40.	stealth	-

Stimulus List for the category PLOSIVE (exp. 2)

Ord.	Item	P(+) N(-)	Ord.	Item	P(+) N(-)
LEARNING SESSION					
1.	push	+	53.	cave	+
2.	fall	-	54.	zone	-
3.	bus	+	55.	gull	+
4.	verse	-	56.	shell	-
5.	tall	+	57.	thighs	- int
6.	cash	+	58.	path	+
7.	gas	+	59.	thus	- int
8.	safe	-	60.	ton	+
9.	pace	+			
10.	zeal	-	**TEST SESSION**		
11.	beef	+			
12.	tough	+			
13.	shove	-	1.	pave	+
14.	kill	+	2.	bath	+
15.	girl	+	3.	tool	+
16.	thief	- i	4.	file	- c
17.	these	- i	5.	coal	+
18.	fish	-	6.	chill	test
19.	pill	+	7.	seethe	-
20.	verve	-	8.	veil	-
21.	bill	+	9.	goose	+
22.	sell	-	10.	pause	+
23.	zoos	-	11.	zoom	-
24.	toes	+	12.	ball	+
25.	case	+	13.	jazz	test
26.	gaze	+	14.	shoal	-
27.	knife	- i	15.	dish	+ c
28.	pile	+	16.	thieve	- i
29.	psalm	- i	17.	tale	+
30.	kneel	- i	18.	chief	test
31.	beige	+	19.	deaf	+ c
32.	shave	-	20.	juice	test
33.	tail	+	21.	call	+
34.	cough	+	22.	those	- i
35.	thaws	- i	23.	give	+
36.	miss	- i	24.	pull	+
37.	goal	+	25.	moth	- int
38.	nerve	- i	26.	dull	+ c
39.	puff	+	27.	nose	- i
40.	booze	+	28.	choose	test
41.	this	- i	29.	buzz	+
42.	tease	+	30.	cheese	test
43.	mill	- i	31.	fill	-
44.	cool	+	32.	time	+
45.	gash	+	33.	jail	test
46.	five	-	34.	gnash	- c
47.	mass	- i	35.	choice	test
48.	veal	-	36.	deal	+ c
49.	pass	+	37.	cause	+
50.	bush	+	38.	guess	+
51.	sauce	-	39.	jaws	test
52.	toll	+	40.	these	- i

Stimulus List for the Category ASPIRATED P (exp. 4)

Ord.	Item	P(+) N(-)	Ord.	Item	P(+) N(-)
LEARNING SESSION					
1.	paw	+	53.	poise	+
2.	spend	-	54.	drop	-
3.	push	+	55.	pan	+
4.	rapt	-	56.	spy	-
5.	post	+	57.	clasp	-
6.	pray	+	58.	pots	+
7.	power	+	59.	ship	-
8.	stamp	-	60.	paled	+
9.	pass	+			
10.	up	-	**TEST SESSION**		
11.	pulse	+			
12.	plot	+			
13.	spray	-	1.	payer	+
14.	purr	+	2.	pass	+
15.	pin	+	3.	pegs	+
16.	spoon	-	4.	span	-
17.	spear	-	5.	pen	+
18.	damp	-	6.	clamp	-
19.	pond	+	7.	wept	-
20.	depth	-	8.	top	-
21.	proud	+	9.	pines	+
22.	help	-	10.	pea	+
23.	shop	-	11.	spa	-
24.	pay	+	12.	pool	+
25.	pill	+	13.	palm	+
26.	pence	+	14.	camp	-
27.	cap	-	15.	pie	+
28.	play	+	16.	glimpse	- c
29.	split	-	17.	peace	+
30.	apt	-	18.	keep	-
31.	par	+	19.	poles	+
32.	spring	-	20.	spill	-
33.	pain	+	21.	pear	+
34.	piles	+	22.	tramp	-
35.	spice	-	23.	pun	+
36.	caps	-	24.	pubs	+
37.	prince	+	25.	lapsed	-
38.	gulp	-	26.	pure	+ c
39.	pace	+	27.	group	-
40.	pelt	+	28.	pause	+
41.	trap	-	29.	paved	+
42.	plea	+	30.	sponge	-
43.	splay	-	31.	gasp	-
44.	paste	+	32.	peel	+
45.	print	+	33.	opt	-
46.	spare	-	34.	ape	-
47.	kept	-	35.	punch	+
48.	lamp	-	36.	pull	+
49.	plough	+	37.	pave	+
50.	priest	+	38.	pant	+
51.	ropes	-	39.	drip	-
52.	puff	+	40.	gasp	-

