ROSSITER

'Penguins don't fly': An investigation into Typicality and its effect on Naming in Aphasia.

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Contents:

Abstract:

The study investigates typicality as a variable in naming for people with aphasia. Normative data was collected from 32 subjects to obtain overall mean typicality ratings for 167 items.

The effect of typicality on naming for a group of 20 people with aphasia was then examined using matched sets and logistic regression analyses, for both the group as a whole, and individual participants. When potential confounding variables (frequency, familiarity, imageability, concreteness, age of acquisition and word length) were controlled using matched sets, a significant typicality effect was found for the group and two individual participants, demonstrating better naming for typical items. Logistic Regression analysis also showed a significant typicality effect for the group and five individuals, in the same direction. However, in both group and individual regression analyses, typicality was found to be a relatively weak naming predictor in comparison to other variables, particularly, age of acquisition, word length and operativity.

The clinical and theoretical implications of these findings are discussed.

Introduction

'The trouble me that talking....I tripping up in words really. Tripping up in words. What's the name of so and so?'

- Talking about Aphasia (p.1 Parr et al, 1997)

Naming difficulties:

Naming difficulties are commonly cited as a primary cause of concern for people with acquired aphasia (Nickels, 1997; Nickels and Best, 1996). As a result, a great deal of research has been undertaken both in an attempt to understand and investigate the factors contributing to naming difficulties and in order to try and remediate these through specific therapy treatments. Although treatment for naming disorders, using a range of facilitation and therapy techniques including semantic, phonological and orthographic methods has often proved successful for treated items, it has been largely resistant to generalisation, demonstrating little evidence of improvement for untreated items (Pring et al, 1993; Howard et al, 1985a).

Several theoretical models have been proposed to explain word retrieval for speech production, including Morton's Logogen Model (1970, 1979) and Butterworth's Semantic Lexicon Model (1989). Although both models are represented by discrete stages, Morton's Logogen theory argues for a single semantic system leading to a phonological output lexicon. In contrast, Butterworth's model includes two levels of lexical retrieval, semantic and phonological, providing some explanation of 'tip-of-the-tongue' phenomena and phonological errors, which are unaccounted for in Morton's model. Connectionist frameworks, (Dell, 1986; Stemberger, 1985) which have become increasingly influential, also include two levels of representation, corresponding to a semantic and phonological level. However, Connectionist models propose *interactive* activation of units or 'nodes', resulting in a bidirectional flow between levels.

Further research relating to the exact organisation and structure required for spoken word production is still necessary. However, a number of different variables have been shown to influence lexical access, both for people with normal language processing skills and individuals with naming disorders, including frequency, familiarity, imageability, concreteness and age of acquisition (Ellis, Lum and Lambon Ralph, 1996; Nickels, 1997). The impact of these variables and others, on naming for people with aphasia, will be discussed below.

Variables affecting naming in Aphasia:

The frequency of a word, based upon objective counts of written and spoken language (e.g. Kucera and Francis, 1967) has been acknowledged as a factor in determining the speed and accuracy of naming for people with aphasia, with lower frequency words often resulting in slower response times for a range of naming tasks (Howard et al, 1984; Newcombe et al, 1965). Explanations for frequency effects have placed the deficit within the semantic system (Shallice, 1987) and from the link between the semantic and phonological output lexicons (Ellis, Miller and Sin, 1983). Gernsbacher (1984) has argued that familiarity; an individual's rating of how familiar they are with a specific word, is more relevant as a factor affecting naming than frequency per se. The importance of familiarity has also been emphasized by Funnell and Sheridan (1992), although it should be highlighted that some variability exists in the definition of familiarity across different studies.

Imageability (the ease with which a visual/auditory image of the referent of a word can be generated) and concreteness (the degree with which it is available to sensory experience), which are highly correlated variables, have also been cited as influential in affecting naming for people with aphasia. Research predominantly demonstrates increased naming accuracy for items

with higher imageability (Nickels and Howard, 1995b). The findings of the Nickels and Howard study (1995b) also suggest that rated age of acquisition, requiring adults to estimate the age at which they believe they acquired a specific word as a child, is an influential factor affecting naming in aphasia, when other variables including frequency, imageability and word length are controlled. Nickels and Howard (1995b) suggest that a variety of factors contribute to age of acquisition. These include semantic factors (e.g. earlier acquisition of basic level objects) and phonological factors (e.g. ease of articulation), making the loci of damage difficult to place.

In addition, Gardner (1973) has proposed that operativity acts as a further variable affecting naming. Making a distinction between operative items, that are manipulable, discrete, firm and open to a variety of sensory modalities (e.g. apple) and figurative items, that are difficult to grasp and usually only available visually in sensory terms (e.g. cloud), Gardner's findings suggested that people with aphasia were better at naming operative items. In a later study, Howard et al (1995) investigated the influence of operativity in a group of eighteen people with aphasia and found that although overall effects of operativity were rare, there was some evidence to indicate improved naming performance for certain aspects related to operativity, such as items available to multiple senses, although this was not conclusive.

A more robust, consistent variable found to affect naming performance for people with aphasia is word length (number of phonemes/syllables). Most frequently, a pattern emerges demonstrating poorer naming ability for words of increasing length (Caplan, 1987; Goodglass et al, 1976) although this does not apply in all cases (Best, 1995). It has been argued that length effects arise from damage at the post-lexical stage of the speech production model, representing difficulty either at the level of phonological encoding (Caplan, 1987) or a result of a buffering deficit (Miller and Ellis, 1987)

Animacy has been cited as a further variable affecting naming, supported by several clinical case studies, revealing the presence of apparent category-specific deficits in naming, for people with acquired communication difficulties. Different theories and models of semantic memory have been put forward in attempts to explain these deficits, most commonly demonstrating impairment for living/animate categories, such as *animals* and *vegetables* relative to non-living/inanimate categories such as *tools* and *clothing* (Sartori and Job, 1988; Warrington and Shallice, 1984). However, the reverse dissociation has also been found (Best, Schroder and Herbert, 2004; Sacchett and Humphreys, 1992). Warrington and Shallice (1984) argue that living items are highly dependent on visual semantic representations involving perceptual information (e.g. a zebra has stripes), whereas non-living items primarily involve functional semantic representations and information (e.g. cut with a knife).

Previous research has suggested that variables predicting naming accuracy are often inter-related (Feyereisen, van der Borght and Seron, 1988; Morrison, Ellis and Quinlan, 1992;). For example, the Feyereisen et al study (1988) found age of acquisition, familiarity and frequency to be highly correlated. It is therefore important to control for potential confounding variables, in order to accurately identify which variable is responsible for an observed effect.

In contrast to the variables outlined above, the effect of *typicality* as a potential factor affecting naming ability for people with aphasia has not been studied in great detail and this study will therefore aim to investigate the influence of typicality, whilst controlling for other known psycho-linguistic variables.

Typicality:

Rosch (1975), in her seminal research study investigating typicality, refers to the 'internal structure' (p193) of semantic categories and how these may be represented cognitively. The traditional view of categories as entities with clear-cut boundaries, where items possessing a set of criterial features or attributes, are given full and equal membership is questioned by Rosch (1975) who instead proposes that the internal structure of natural semantic categories are more accurately represented in terms of a prototypical or best example of a category with the greatest degree of membership. This is followed by other exemplars with decreasing similarity to the prototype and consequentially, a reduced degree of category membership.

Typicality may therefore be described as 'the extent to which an item is a prototypical exemplar of a category' (Uyeda and Mandler, 1980) or how closely the characteristics or features of an item match the prototype of a specific category. Depending on the type of category, typicality might relate to an item's appearance, physical characteristics or function, use and context. For example, categories involving living items (e.g. animals, birds and vegetables) may refer primarily to perceptual attributes such as appearance and physical characteristics, whereas non-living items (e.g. tools, furniture and clothing) are more likely to be associated with function and use (Sartori and Lombardi, 2004).

Typicality has been shown to influence categorisation tasks for people with normal language processing skills. Rosch (1975) found a difference in latency of response between highly typical and atypical items when subjects, provided with a category label, were asked to determine whether or not two words belonged to the same category; with a shorter reaction time demonstrated between typical versus atypical pairs. Further research has

supported a robust typicality effect demonstrating faster reaction times when verifying category membership for typical items (LaRochelle and Pineu, 1994; Smith, Shoben and Rips, 1974) In addition, Rosch (1975) found that subjects produced typical items before atypical items in verbal category generation tasks.

Although relatively few studies have investigated the effect of typicality for people with aphasia, Grober et al (1980) conducted a category verification task involving people with acquired aphasia. This study used three different groups; those with anterior brain damage (predominantly non-fluent aphasia), those with posterior brain damage (predominantly fluent aphasia) and a control group. Whilst the control group demonstrated the shortest reaction time, all three groups responded faster to the typical items than the atypical items. Noticeably, accuracy of category judgement was lower for both typical and atypical items for those individuals with fluent aphasia, when compared to the other groups. These findings have been supported by later research (Kiran and Thompson, 2003a).

In addition, research by Grossman (1980) requiring individuals with fluent and non-fluent aphasia to undertake verbal fluency tasks yielded interesting results. Grossman's findings indicated that the majority of responses for people with non-fluent aphasia were more central items, with fewer peripheral items. Conversely, individuals with fluent aphasia produced fewer central responses and were noted to produce examples which did not belong to the category label given.

More recently, a treatment study by Kiran and Thompson (2003b) investigated the effect that training using sets of category exemplars of either high or low typicality, had on naming for four people with fluent aphasia. The findings indicated that therapy involving training of atypical items resulted in generalisation to naming of intermediate and typical items within that specific

semantic category. However, the reverse effect was not found, when training using typical items. Kiran and Thompson (2003b) therefore argue that semantic complexity; training more complex items with a greater diversity of semantic features in order to facilitate training to simpler untrained items, may play an important role in the treatment of naming deficits.

An earlier study by Plaut (1996) adds some weight to Kiran and Thompson's findings. Based upon a connectionist framework, Plaut's study involved training a computer network to recognise a set of artificial atypical and typical items. The network was subsequently damaged and retrained using a typical and atypical set of items. Plaut's findings suggested that retraining on non-prototypical words produced greater generalisation than retraining on prototypical words. Whilst improvement on untreated typical items was apparent for both the typical and atypical sets, improvement for untreated atypical items only occurred when retraining the atypical set. Noticeably, performance of untreated atypical items deteriorated when retraining using the typical set.

These findings have possible implications for the effective treatment of people with naming deficits. However, there are some potential limitations to Kiran and Thompson's (2003b) study, which should be acknowledged. These include methodological considerations such as the relatively small number of participants and items involved, limited number of categories treated, variability in treatment length (ranging from 8-28 weeks), severity of aphasia and time post-onset. When considering Kiran and Thompson's results, it is also important to note that although generalisation was observed, this only applied to items *within* the specific semantic category treated.

The current study aims to answer the following questions:

1. Can typicality be reliably measured across a range of natural semantic categories?

2. Do correlations exist between typicality and other psycho-linguistic variables known to influence naming ability?

3. i) Does typicality influence naming performance for people with aphasia?

   i) Are there differences in the effect of typicality between people with fluent versus non-fluent aphasia?

   ii) If there is an observed typicality effect, is this influenced by the severity of an individual's naming disorder?

Question 1:

In order to answer this question, data will be collected to obtain normative typicality ratings, replicating earlier studies investigating typicality, (Rosch, 1975; Uyeda and Mandler, 1980) for 200 items across a number of different categories. This data will be varied for age, gender and educational background, in order to identify any possible differences or effects between these variables. In addition, some comparison of inter-study reliability will be gathered/conducted for those items also included in Rosch and Uyeda and Mandler's earlier studies (1975, 1980), both to determine further whether typicality can be considered a reliable measure and to identify any changes in

perception of typicality, (e.g. social or contextual) that may have occurred over time.

Question 2:

In light of the different factors affecting naming for people with aphasia highlighted above, this study will also examine possible correlations arising between typicality and other variables such as imageability, age of acquisition and frequency. The relationship between typicality and word production frequency is of particular interest, as research suggests the two variables are highly correlated and can be difficult to separate (Kellar and Kellas, 1978). Findings from earlier studies have also shown significant positive correlations between typicality and item dominance in category norms (Mervis, Catlin and Rosch, 1976). As research has suggested typical items are learnt earlier (Mervis and Pani, 1980), the relationship between typicality and age of acquisition should also be considered.

Question 3:

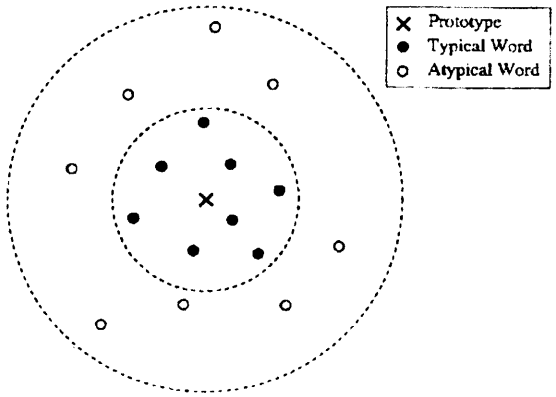
Using the normative mean typicality ratings obtained for these items, any effect that typicality may have on picture-naming performance for twenty people with aphasia will be examined, both for individuals and the group as a whole, whilst controlling for the variables of frequency, familiarity, imageability, concreteness, operativity, word length and age of acquisition. This will be measured statistically by using logistic regression and matched sets in order to control for the above variables.

One prediction may be that people with aphasia will be better at naming more typical items. Karalyn Patterson (2007) suggests that, based upon a connectionist model of semantic memory involving a distributed-representation network, (Rumelhart and Todd, 1993) 'the most typical concepts within a semantic category, which share the greatest number of microfeatures with other category members will be more robustly

represented, efficiently recognized or retrieved and relatively resistant to disruption by brain disease or injury' (p.814). This prediction has been supported by earlier research involving people with aphasia (Howard and Best, 1996, unpublished).

However, the reverse prediction may also be made. Plaut (1996) has argued that typical items occupy a central semantic space, close to the prototype of a category, whilst atypical items are located on the periphery; (Figure 1) a pattern which corresponds to the 'family resemblance' model proposed by Rosch and Mervis (1975). Consequentially, if typical items within a category share a greater number of overlapping features, it may be argued that they will be more susceptible to interference from those semantic neighbours with very similar features for individuals with aphasia and therefore, less easily retrieved. Plaut's findings support this prediction as, after damage, but before retraining, lesions to the system resulted in impaired performance on typical words relative to atypical words (1996).

Figure 1:
Representation of the relationship in semantic space between the category prototype and its typical vs. atypical members, as depicted in Plaut (1996).



Finally, in view of earlier research findings suggesting different patterns between individuals with fluent and non-fluent aphasia (Kiran and Thompson, 2003a, Grober et al 1980; Grossman, 1980) any difference in typicality effects between aphasia types will also be investigated, alongside possible differences brought about by the severity of naming disorder. Although this final relationship has not been investigated for people with aphasia, for some individuals with semantic dementia, an interaction between typicality and severity of condition has been demonstrated (Patterson, 2007).

Methodology

Assigning items to categories:

Participants:

Before collecting normative typicality ratings, 7 participants (3 Speech and Language Therapists and 4 Speech and Language Therapy Students) were asked to perform a category verification task in order to provide agreement that the semantic category label given for each drawing was appropriate. All participants were native speakers of English.

Stimuli:

- Picture stimuli; 200 black and white line drawings of objects, including both living (e.g. animals, vegetables, flowers) and non-living items (e.g. musical instruments, tools, weapons). The pictures were compiled from several sources (including Nickels 1992, European Naming Test, unpublished and informal therapy materials).
- Additional normative data, collected prior to this study for the psycho-linguistic variables of familiarity, frequency, imageability, concreteness, operativity and age of acquisition were also available for each line drawing.[1]

Procedure:

In order to organise the data for typicality rating, each individual line drawing was allocated a specific semantic category label – (e.g. peacock=bird, jacket=clothing). For some pictures, where more than one category label might have been appropriate, a choice was given (e.g. tank=vehicle/weapon). All 7 participants were then asked to carry out a category verification task,

[1] Frequency values were obtained from the Celex Database (1993). Operativity ratings were taken from an earlier study (Howard, Best, Bruce and Gatehouse, 1995). Data for remaining variables were sourced from the MRC psycholinguistic database (Coltheart, 1981).

indicating whether they considered the category label appropriate. For those pictures where a choice of categories were provided, participants were asked to circle which, if any, they considered most appropriate or state that either were acceptable. In addition, each participant had the option of providing their own suggestion for an appropriate category label.

Pictures with agreement of 5/7 or above were automatically put forward for the typicality rating task. Those pictures with agreement of 4/7 or less were not put forward for rating: (*medal, picture, grave, hedge, flower, cigarette, iron, signal, submarine, lighter, label, microphone, binoculars, pocket, family, money, clock, worm, telephone, scissors, baby, paint, library, devil, noose, bridge, camera, magnet*)

Following the category verification task, four pictures were considered potentially suitable for two category labels; *(rocket=space/transport, tree=found in a garden/plant, pillow=bedroom/sleeping, tractor=vehicle/farm)* and in these cases student and supervisor discussed which category they considered to be most appropriate.

A total of 172 pictures of the original 200 items included in the verification task were taken forward to the next stage in order to obtain normative typicality ratings.

Obtaining Normative Typicality Ratings:

Participants:

Data was gathered from 32 participants in order to gain normative typicality ratings for each individual line drawing. All participants were native speakers of English. The variables of age, gender and educational background were controlled, resulting in the following eight sub-groups:

Table 1: Normative sub-groups

Group	Mean age
4 younger men with a university degree	28.5 years
4 younger men without a university degree	26 years
4 older men with a university degree	60.25 years
4 older men without a university degree	56.5 years
4 younger women with a university degree	26.5 years
4 younger women without a university degree	22.75 years
4 older women with a university degree	56.5 years
4 older women without a university degree	55.25 years

A sample size greater than 30 participants was used, with the aim of providing a heterogeneous group, particularly as previous studies collecting normative typicality ratings have used restricted samples to some extent, such as the use of undergraduate psychology students, with little variation in age (Rosch 1975, Uyeda & Mandler 1980). Although Kiran and Thompson (2003b) made some efforts to remediate this by using both younger and older participants, their sample size of twenty could still be considered relatively small.

Stimuli:

Picture stimuli; 172 black and white drawings (see above).

Procedure:

Participants were asked to rate how typical they considered each item to be of the specific category given. Each participant was provided with written instructions (Appendix 1), which were reiterated verbally before starting the task. This included a description of typicality and examples of both typical and atypical exemplars of a given category (e.g. robin vs. ostrich for the category bird) in order to illustrate and explain typicality as a concept. Participants were asked to provide both a quantitative and qualitative rating.

Replicating previous studies investigating typicality (Kiran and Thompson, 2003b; Rosch, 1975; Uyeda and Mandler, 1980), a seven point scale was used to rate typicality quantitatively, with 1 being considered the most typical example, 7 the least typical example and 4 indicating a moderate fit.

A qualitative measure was employed in addition to this quantitative rating. For those items rated 1-3, participants were instructed to provide 1 reason why they considered an item typical. For those items rated 5-7, participants were asked to provide 1 reason why they considered an item atypical. Finally, for those items given a rating of 4 indicating a moderate fit, participants were instructed to provide one reason why they considered it typical and one reason for it being less typical.

If participants were unable to think of any reasons for specific items, they were advised to leave a blank space, as this may provide information regarding the diversity of semantic features for a particular item. The qualitative rating was used in order to highlight which attributes or features were considered most salient in determining the typicality or atypicality of an item and to provide further information which may help to explain any discrepancies or variations in the quantitative ratings.

The order of picture presentation was altered for different participants in order to avoid any possible effects of task fatigue which may have confounded rating results. In total there were four orders of presentation. In each subgroup of four participants, the presentations were allocated randomly to ensure variability across the group.

Following typicality ratings, five further items were removed, as the validity of the category label provided was questioned by 10 or more participants in the qualitative data; *bow (clothing) collar (clothing) sleeve (clothing) and aerial (part of a building) and letter (stationery).* In addition, none of these items

were generated in the Battig and Monatague normative tables (1969). This left a total of 167 items to be analysed against the naming data from the group of clients with aphasia (Appendix 2).

Naming Data for people with aphasia:

Participants:

Data from a group of 20 people with acquired aphasia were used in this study. All participants were at least one year post-stroke and aged between 38 and 77 years. The participants (11 men and 9 women) reflected a heterogeneous population of people with aphasia; comprising 8 fluent and 12 non-fluent speakers (see Table 2 below). All participants were native speakers of English.

Table 2: Background Information for participants with aphasia

	Age	Gender	Type of Aphasia	Years post-onset
AD	58	Male	Non-fluent	1
BB	50	Male	Non-fluent	1
CD	70	Female	Fluent	4
CS	65	Male	Fluent	4
HP	77	Female	Fluent	2
JL	64	Male	Non-fluent	4
KI	68	Male	Non-fluent	4
KN	52	Male	Fluent	4
LO	65	Female	Fluent	2
MH	45	Male	Non-fluent	5
PQ	65	Male	Non-fluent	5
RK	38	Female	Non-fluent	12
AF	64	Female	Non-fluent	2
BG	71	Male	Non-fluent	3
ET	69	Male	Fluent	1
JD	65	Female	Fluent	1
MC	52	Male	Non-fluent	5
ML	42	Female	Non-fluent	7
PP	75	Female	Fluent	2
VC	56	Female	Non-fluent	2

Materials:

- Picture stimuli; 200 black and white line drawings, (see above) which were presented to 20 people with aphasia in a picture confrontation naming task. All drawings had 95% naming agreement amongst normal control subjects.

Procedure:

Picture-Naming Assessment:

Each participant carried out a confrontation picture-naming assessment for 200 items on two occasions, at least 8 weeks apart. Participants were presented with 100 items per session (one week apart) with a single order of presentation. The data was collected prior to commencement of this project, forming pre-therapy baseline assessments, as part of wider therapy studies.

Creating the Matched Sets:

Using the normative mean typicality ratings obtained, 39 items were assigned to a high typicality set and 39 items to a low typicality set, so the means between each set were significantly different *(t=10.16).* In contrast, mean normative data for the variables of familiarity, imageability, concreteness, age of acquisition, operativity, word length and frequency were closely matched between the sets (Table 3). Naming performance on each set could then be measured, in order to look for any typicality effect within the group of people with aphasia.

Table 3: t-values (indicating the difference between high and low typicality sets) for each variable.

	Typicality	**Familiarity**	**Imageability**	**Concreteness**	**Age of Acquisition**
t-value	10.16	0.25	0.10	-0.18	-0.15
	Operativity	**Log comb. with word frequency**	**Log comb. with lemma frequency**	**Number of syllables**	**Number of phonemes**
t-value	0.48	-0.01	0.08	0.16	0.21

Appendix 3 provides full details of items included in the matched sets and data for the different variables listed above.

Logistic Regression:

Although matched sets are useful as a means of controlling for confounding variables, there are some limitations to this method (Howard et al, 1995; Cutler, 1980). These include the removal of otherwise relevant data, resulting in a reduced sample size, and the possibility that even small differences in variables between sets may be contributing to an observed effect. Logistic regression will therefore be used in this study as an additional means of measuring the effect of typicality, using a broader sample of data (164 items).

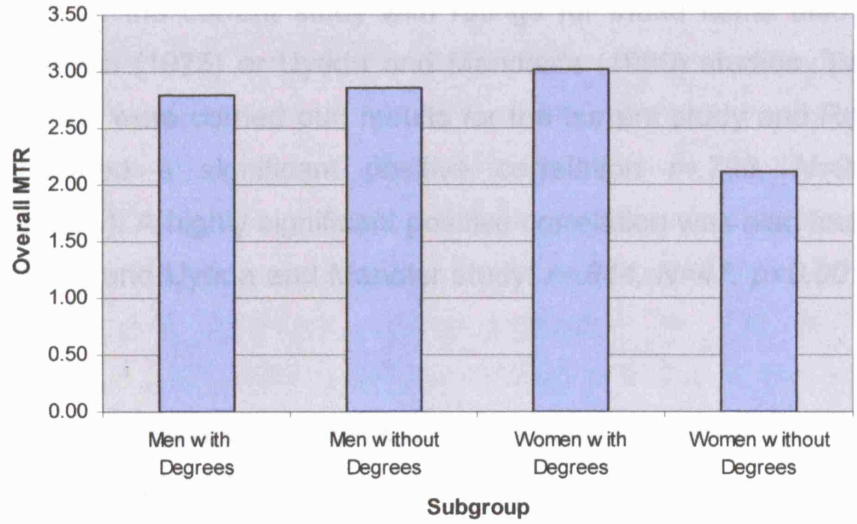
Results:

Q1. Can typicality be reliably measured?

Normative typicality ratings: Quantitative Measure

The first question examined was whether typicality can be reliably measured across different categories. The normative sample collected was varied for gender, age and educational background. A between-subject univariate ANOVA was performed to identify any significant differences in overall mean typicality rating, arising from these variables. The main effects of age and gender were not significant; *Age F=0.49, p=0.826, Gender F=1.370, p=0.253.*The effect of educational background was not significant, although results approached significance at the 0.05 level; *Educational background F=3.819, p=0.062)* However, a significant interaction was observed between gender and educational background, (Figure 2) suggesting that women without degrees tend to rate items as more typical in comparison to other participants.

Figure 2: Overall Mean Typicality Rating (MTR) for subgroups based on Gender and Educational Background



Qualitative Measure:

In addition, data obtained from the qualitative ratings indicate those features and attributes considered to be most salient in terms of typicality for individual items (Appendix 4). 38 items obtained 50% or more agreement amongst participants for a single feature/attribute. Noticeably, those 4 items demonstrating the highest level of agreement were the two most typical and two least typical items from the group of 38 (Table 4). In total, 26 items were given a qualitative rating by all 32 participants. In contrast, for 33 items, four or more participants did not provide a qualitative rating (see Appendix 4ii).

Table 4: Showing 4 items with the highest level of agreement for a single reason (attribute or feature) to justify the typicality rating given.

Item	Category	Reason	Percentage	MTR	Rank
Penguin	Bird	Cannot fly	84%	5.28	1st
Bread	Food	Staple/common	78%	1.25	2nd
Rocket	Transport	Unusual/rare	72%	6.06	3rd
Beak	Part of a bird	Defining characteristic	72%	1.25	3rd

Inter-Study Reliability:

In order to obtain a measure of inter-study reliability, a Pearson-r correlation was conducted comparing the overall mean quantitative typicality ratings obtained for the current study with ratings for those items also included in either Rosch (1975) or Uyeda and Mandler's (1980) studies. Two separate correlations were carried out; results for the current study and Rosch's study demonstrated a significant positive correlation $r=.798$, $N=35$, $p<0.001$ (Appendix 5). A highly significant positive correlation was also found between the current and Uyeda and Mandler study: $r=.844$, $N=47$, $p<0.001$ (Appendix 6).

Q2. Do correlations exist between Typicality and other psycho-linguistic variables?

In addition to the mean typicality ratings collected in the current study, normative data for the variables of familiarity, imageability, age of acquisition,

operativity, frequency and word length were entered into a correlations matrix to identify any significant relationships between typicality and other psycho-linguistic variables. As shown in Table 5, typicality is significantly positively correlated with age of acquisition and significantly negatively correlated with familiarity, operativity and frequency. The full correlation matrix is provided in Appendix 7, which demonstrates the strongest inter-correlation between familiarity and frequency (p=0.666).

It should be highlighted that in order to replicate earlier studies collecting typicality ratings, a rating scale of 1 (typical) to 7 (atypical) was used, resulting in a numerically low overall rating corresponding to a highly typical item and a numerically high rating corresponding to an atypical item. Therefore, the negative correlations observed indicate that highly typical items are highly familiar, operative and frequent.

Table 5: Variables found to be significantly correlated with typicality

	Familiarity	Age of Acquisition	Operativity	Log combined with Lemma Frequency	Log combined with H Frequency
Typicality	-.372	.176	-.246	-.266	-.238
Sig.	.010	.010	.010	.010	.010

When investigating the specific relationship between typicality and word production frequency, mean typicality ratings from the current study and overall frequency response from the Battig and Montague Normative Category Tables (1969) were converted into rankings for those items included in both studies (see Appendix 8). A Spearman-r correlation was carried out, demonstrating a significant positive correlation: $r= .796$, $N=75$, $p<0.001$ (Appendix 8). The direction of this correlation indicates that highly typical words tend to be those more frequently produced.

Q3.i) Does typicality influence naming ability for people with aphasia?

Matched Sets:

The effect of typicality on naming for people with aphasia was investigated using matched sets analysis, for both the group and individual participants.

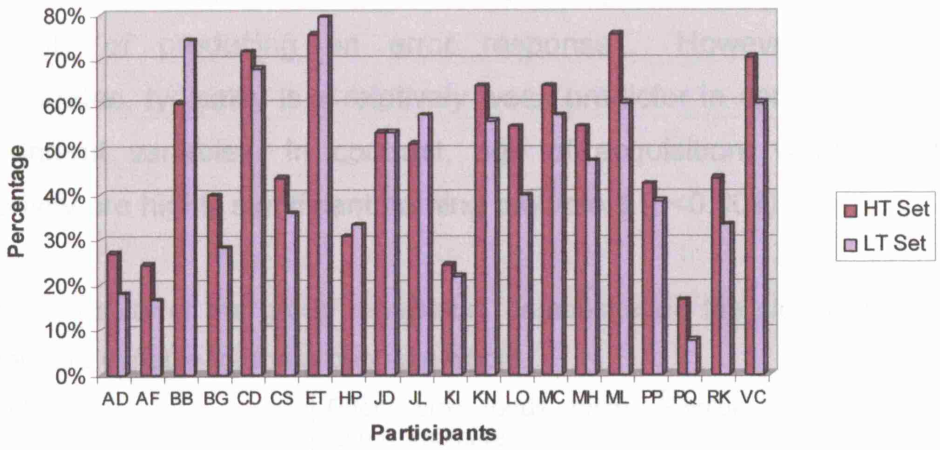
Group Matched Sets:

Total scores correctly named for high (N=39) and low (N=39) typicality sets were gathered for each participant with aphasia across both assessments (e.g. 1=correct, 0=incorrect). A paired sample t-test was then carried out in order to measure the difference in total score between high and low typicality sets for the group as a whole. This was found to be statistically significant: *HT Set Mean=38.60 LT Set Mean=34.65, t(20)=3.061 p=0.006, 2-tailed.*

Individual Participants: Matched Sets

Figure 3 shows the percentage of high and low typicality items correctly named for both assessments for each individual with aphasia, demonstrating that 15 participants correctly named a higher percentage of items in the high typicality set across both attempts. Conversely, 4 individuals correctly named a higher percentage in the low typicality set. For one participant, JD, there was no difference between the sets.

Figure 3:Percentage of correct responses across both naming attempts (out of 78 items) for high and low typicality sets



In addition, in order to measure significant typicality effects for individual participants, each individual item (N=78, grouped into the high and low typicality sets) was given a combined score corresponding to the number of times correctly named across both occasions (e.g. 0=not named on either occasion, 1=named correctly on one occasion, 2=named correctly on both occasions.) An independent t-test was then carried out measuring the difference in total score between the high and low typicality sets. Using a one-tailed hypothesis that individuals would be better at naming high typicality items, based on findings from prior studies with people with aphasia, two participants reached significance level ($p<0.05$): *LO p=0.049, ML p=0.026.*

Logistic Regression:

Binary Logistic Regression was also used to predict the effect of typicality on naming for the group and individual participants. In contrast to matched sets analysis, this method incorporates other independent variables into the regression model, measuring their relative strength as predictors of naming (i.e. estimating the increase or decrease in the odds of getting a correct or incorrect response).

Group Logistic Regression:

Findings from the group regression analysis suggest typicality is a significant predictor of naming ($p=0.036$), with higher typicality items decreasing the probability of producing an error response. However, as Table 6 demonstrates, typicality is a relatively weak predictor in comparison to other independent variables. In contrast, age of acquisition, word length and operativity are highly significant naming predictors ($p<0.001$).

Table 6: Results of the group regression, demonstrating the significance of each independent variable for the group as a whole.

Variable	Effect size (odds ratio) Exp B Estimate	P value
Typicality	1.049	0.0359
Time	1.135	0.0396
Imageability	1.003	0.0012
Age of Acquisition	1.507	<0.0001
Operativity	1.206	<0.0001
Frequency	1.209	0.0052
Word Length	1.182	<0.0001

Table 7: Results of the group regression demonstrating the effect size (as measured by the log odds ratio) of typicality, entered firstly as a single variable and secondly, with age of acquisition, the strongest predictor of naming, included.

Variable/s included	Effect size (odds ratio) Exp B Estimate	P value
Typicality	1.170	<0.0001
Typicality+Age of Acquisition	1.049	0.0359

In addition, Table 7 shows a measure of the effect size (derived from the odds ratio exponent B estimate) of typicality entered alone and with age of acquisition included in the model. Notably, when age of acquisition and typicality are included together, typicality has the same effect size as when all other independent variables are entered into the model.

Individual Logistic Regression:[2]

Typicality was initially entered into the regression model as a single variable and was found to have a significant effect for 5 individuals: *JD, KN, LO, PP* and *RK*. The results are shown in Table 8. Here, 'percentage model' refers to the percentage of cases (correct vs. incorrect responses) correctly predicted by the model. However, significant Hosmer-Lemeshow tests for *LO* and *JD*, indicate the regression model cannot be considered a good fit of the data for these individuals.

Table 8: Results demonstrating significant typicality effects for 5 individuals, when typicality is entered as a single variable in the logistic regression model.

Participant	**Percentage Model**	**Typicality sig.**	**Percentage Model including typicality**	**Exp B Estimate Effect size(odds ratio)**
JD	52.1%	0.005	54%	0.745
KN	57.9%	0.007	59.1%	0.755
LO	51.8%	<0.0001	57.3%	0.648
PP	61.3%	0.005	60.7%	0.735
RK	61.3%	0.005	61.3%	0.730

A stepwise forward conditional regression was carried out for these 5 individuals, inserting the independent variables of imageability, age of acquisition, operativity, word length and frequency, to identify which were the strongest predictors of naming.[3] The categorical variable 'time' was also included to account for any significant differences between naming attempts. Using this method of stepwise regression enables the most significant variables affecting naming to be added to the model for each individual until it cannot be improved e.g. the greatest percentage of cases (correct response vs. incorrect response) accurately predicted. The results are presented in Table 9.

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[2] Data for 164 items from each occasion were entered together; N=328items (1=correct response, 0=incorrect response) as the dependent variable 'score'. Normative data values for each of these 328 items were then entered for the independent variables.

[3] In order to avoid possible masking effects, strongly inter-correlated variables were not entered for the individual regression, resulting in the omission of familiarity and concreteness.

Table 9: Results demonstrating the two strongest naming predictors, using a forward conditional stepwise regression technique.

Part.	Best predictor	Sig.	Model %	2nd Predictor	Sig.	Model %
JD	Age of Acquisition	<0.0001	61.3%	Frequency	0.008	64.9%
KN	Age of Acquisition	0.001	63.4%	Phonemes	0.002	66.5%
LO	Age of Acquisition	<0.0001	67.7%	Frequency	0.001	66.5%
PP	Age of Acquisition	<0.0001	69.8%	Phonemes	<0.0001	70.4%
RK	Frequency	<0.0001	66.2%	Operativity	0.0006	69.8%

Typicality was not found to be the strongest predictor for any of these 5 participants. In fact, when all independent variables were entered in a forward conditional stepwise regression, typicality remained a significant variable for only one individual, LO as the third strongest predictor, (p=0.016).

Independent Variables Predicting Naming Response:

Using a forward conditional method, age of acquisition was the strongest predictor of naming for 10 individual participants and the second strongest for 4 participants. Word length (number of phonemes) was also a significant variable, being the strongest predictor for 5 participants and the second strongest predictor for a further 5 participants. For 2 participants, frequency was the strongest predictor of naming and for a further 2 participants, operativity proved the most influential variable (see Appendix 9).

Q3.ii) The effect of typicality on people with fluent vs. non-fluent aphasia

Data from the matched sets (N=78 items) was used in order to look for a difference in the effect of typicality between people with fluent and non-fluent aphasia. An independent t-test was carried out to measure the difference between high and low typicality scores between the fluent group (N=8) and non-fluent group (N=12). This was not found to be statistically significant: *fluent group mean=3.125, non-fluent group mean=4.500 (t=0.512, df=18, p=0.615)*

Q3.iii) ***The effect of typicality based upon severity of naming disorder***

Severity was determined using the mean proportion of correct responses over both naming assessments. Participants were then assigned to two groups: those with the 10 highest scores and 10 lowest scores, representing a 'less severe' and 'more severe' group respectively. An independent t-test was conducted to measure the difference between high and low typicality scores between the 'more severe' and 'less severe' group. This was not statistically significant: *'less severe' group mean=2.700, 'more severe' group mean=5.200, (t=0.967, df=18, p=0.376).* A Pearson-r correlation was carried out to investigate the association between the severity of naming disorder and the difference between the high and low typicality scores for all participants. Although this was not significant, *(r= -.228, N=20, p=0.333)* a negative correlation indicated that those with a less severe naming disorder, have a (non-significant) tendency to be less influenced by typicality; i.e. a smaller difference between scores (combined across both attempts) on high and low typicality sets.

Discussion:

Summary of Results:

Results for the group as a whole (N=20) demonstrated a significant typicality effect, using both matched sets and logistic regression analysis, showing better naming for typical items. Individual results show typicality effects for 2 participants (1-tailed) using matched sets data, and 5 participants using regression techniques. The direction of these effects again demonstrates preferential naming for typical items.

Each of the original questions set out in the introduction will be referred to in turn. This will be followed by a general discussion of the possible clinical implications and potential areas of future research suggested by the findings of this study.

Q1. Can typicality be reliably measured across a range of natural semantic categories?

Results from the current study suggest that the mean overall typicality rating (across 164 items) for each individual does not differ significantly as a result of possible effects of gender, age or educational background. There is, however, a significant interaction between gender and educational background; most noticeably, that women without university degrees demonstrate a tendency to rate items as more typical than other participants.

Whilst these results do not provide information regarding variations in rating for individual items or specific categories (it is not within the remit of this project to analyse the ratings at this level of detail, but would be of future interest) the current findings indicate that typicality, as a concept, can be measured, as proposed in earlier research (Rosch, 1975).

In addition, highly significant correlations between the ratings obtained from the current study and Rosch's (1975) and Uyeda and Mandler's (1980) earlier research, demonstrate a degree of inter-study reliability, adding further weight to the premise that typicality can be reliably rated, despite possible changes over time and the use of normative samples from different geographical populations (e.g. American versus United Kingdom). However, for a small number of items, there is some indication that time and context can influence and change perception of typicality. For example, desk was rated in the current study as less in use and therefore less typical, and cowboy was referred to as specifically American and therefore less typical (see Appendix 4).

Ratings for both these earlier studies were obtained from orthographic representations alone, whereas the current study collected typicality ratings from orthographic and pictorial representations combined. This suggests that for those items included in the correlations, the use of pictures was not a significant confounding variable. However, some degree of caution is necessary as these correlations are taken from a relatively small sample of items (N=35, N=47) and categories (N=9, N=15) and are not therefore representative of all 167 items rated in the current study.

Category membership, size and complexity:

A limitation of both the Rosch (1975) and Uyeda and Mandler (1980) studies, is the relatively small number of semantic categories used to obtain normative typicality ratings; 10 and 18 respectively. The current study therefore aimed to collect typicality ratings from a wider range of categories (65 in total). However, using a larger number of categories raised several issues relating to category size and internal structure, which might impact upon typicality.

A significant limitation of obtaining typicality ratings for the current study was that items included were necessarily restricted to those used in the aphasic

picture naming task. In order to provide some consensus regarding the most suitable category membership for each item, a verification task was conducted before ratings were obtained. As a result, some items were assigned to wider superordinate categories, with several category members (e.g. animal) whereas other items were allocated to more specific subordinate categories (e.g. amphibian, reptile), with relatively few category members.

Data from this study suggest that typicality rating may significantly alter as a result of the hierarchical category level assigned. This can be clearly illustrated using the superordinate category of animals, which has a hierarchy of subordinate categories. For example, 'frog' and 'snake', which have been classified as atypical animals in previous studies (Patterson 2007), were assigned to the subordinate categories 'reptile' and 'amphibian' in the current study, both containing fewer category members. These items were rated as highly prototypical exemplars (Appendix 2).

Diverging opinions regarding category membership for the item 'spider' can also be seen from the qualitative data. Although initially classified in the category verification task as an insect and possessing certain attributes common to insects (e.g. "small", "crawls"), nine participants in the ratings task indicated that they did not consider a spider to be a true member of this category, primarily because it has 8 legs.

Whilst there is strong evidence to support a prototype structure in semantic categorisation, the question of appropriate category membership and difficulties arising from items which could be classified as members of more than one semantic category are potential obstacles to the effective measurement of typicality. For example, Loftus (1975) has questioned the findings of Rosch (1975), arguing that some *atypical* items used in her research are not in fact members of the category provided and would be more appropriately classified as a *typical* member of another semantic

category. The current study includes some items which could be considered members of more than one category. For example 'rocket', an atypical form of 'transport' may be viewed as a typical member of the category 'space'. Equally, 'clown' an atypical 'Occupation/Profession', may be considered a typical member of the category, 'Circus'.

Another possible limitation of the current study is the presence of two items which are subordinate categories in themselves (e.g. vegetables=food, furniture=found in a building). Whilst all items used could be considered concrete to some degree, as they are represented pictorially, some may be considered members of more abstract semantic categories than others (e.g. mermaid=myth vs. apple=fruit).

The category 'occupation/profession' (N=18 items), although listed in the Battig and Montague normative tables (1969), may be considered less cohesive in terms of internal structure compared to other categories. This is illustrated to some extent by the qualitative ratings data. Whilst data suggest the attribute "gets paid/has a salary" was considered a defining feature of this category, none of the 18 items included, obtained agreement of 50% or above in the qualitative ratings. Furthermore, for 11/18 items, four or more participants were unable to provide a qualitative reason to justify their typicality rating (Appendix 4ii). The validity of ratings for the category 'musical instruments' may also be less reliable, as Sartori and Lombardi (2004), have demonstrated that there is a high degree of similarity and overlap between category members.

Q2. Do correlations exist between typicality and other psycho-linguistic variables known to influence naming ability?

Results suggest that typicality, as derived from ratings obtained in the current study, is significantly correlated with several variables known to affect naming ability.

Firstly, a significant positive correlation between typicality and age of acquisition suggests that typical items (with low mean numerical ratings) tend to be acquired earlier, as proposed in earlier research (Meints, Plunkett and Harris 1999, Mervis & Pani 1980). However, this correlation, (r=.176), although significant (possibly as a result of the large data sample), is lower than expected.

Significant moderate correlations were also found between typicality and familiarity, operativity and frequency, indicating that highly typical items tend to be highly familiar, operative and frequent.

Of these, familiarity, described by Nickels (1997) as a form of *subjective frequency*, was found to be the most strongly correlated variable with typicality for the 164 items included in the current study. This association suggests that as a measure, typicality may have an important subjective component, which is further implied by the qualitative data, as evidenced by the number of participants who referred to personal experience (Appendix 4). Of all the variables included in the correlation matrix, familiarity and frequency demonstrate the highest correlation, (*r=.666*) supporting previous research (Brown and Watson, 1987, as cited in Nickels, 1997).

Typicality and Word Production Frequency:

The current study aimed to examine further the relationship between typicality and word production frequency, which previous research suggests is closely related; both variables being considered to contribute to the measurement of a category's internal structure (Kellar and Kellas, 1978). Using the Battig and Montague (1969) normative category tables as a measure of word production frequency, a highly significant Spearman-r correlation *(r=.796)* was found between this variable and typicality, indicating a strong association between rankings of these two factors.

There are, however, limitations to these findings, largely due to the use of pre-determined items from the aphasic naming task. These include; a reduced sample of comparable items (N=75) and restricted range of semantic categories (Appendix 8). In addition, for the majority of categories, only a small number of items (e.g. 2-5) were available to compare rankings.

In contrast, a correlation conducted by Uyeda and Mandler (1980) is likely to have provided a more accurate measure, as it included a wider range of items for each category (N=30) derived from the Battig and Monatague (1969) normative tables. Although Uyeda and Mandler (1980) found the highest correlation between word production frequency and typicality, (supporting results from the current study), this was only moderate *(r=.546)*. Therefore, for future replications, it would be beneficial to include a greater number of items for all categories investigated, enabling comparison of correlations obtained between different semantic categories.

Despite these methodological limitations, a clear relationship between typicality and word production frequency is indicated. Noticeably, for 10/15 categories (using rankings based on the available items in both studies), the most typical item was also the most frequently generated of those items included in the current and Battig and Montague (1969) studies. Moreover, for four categories (*fruit: apple, tool: hammer, vegetable: carrot, kitchen utensil: knife*) the most typical item was also the most frequently produced and had the greatest number of initial responses following verbal presentation of the superordinate category label. This pattern, described as 'Item Dominance' has also been closely associated with typicality (Mervis, Catlin and Rosch, 1976), supporting Rosch's normative findings that people generate highly typical items initially in production tasks (1975).

Finally, qualitative ratings data suggest that, despite instructions stating that typicality did not equate to how common an item was, participants frequently provided reasons associated with "commonality" to justify both high and low quantitative typicality ratings. This suggests an inherent link between the two concepts, which is ultimately difficult to separate.

3. Does typicality influence naming performance for people with aphasia?

As interpreting results between inter-correlated variables can be problematic, two forms of statistical analysis were used to investigate this question; matched sets and logistic regression (Ellis, Lum and Lambon Ralph, 1996).

Matched sets analysis aims to vary one factor (typicality) whilst controlling for other potential confounding variables, by holding them constant. When used to measure the influence of typicality for the group as a whole, a statistically significant effect was found ($p=0.006$), demonstrating better naming ability for high typicality items. This finding supports earlier research investigating the role of typicality in naming for people with aphasia, where a group effect was also significant ($p<0.001$), demonstrating better naming performance for highly typical items (Howard and Best, 1996, unpublished).

In the current study, combined scores across both naming attempts for the matched sets demonstrated better naming performance for the typical item set for 15/20 participants. This trend contrasts with Plaut's (1996) findings using a computer simulated network, which demonstrated more impaired performance for typical words, following lesions to the system. In addition, these findings for the group in general, do not appear to support the theory that people with aphasia, as a result of semantic damage, find it more difficult to name typical items due to the level of semantic similarity shared with other typical members of the same category. For the purpose of the current study, scores obtained from participants with aphasia were recorded as 1=correct

response and 0=incorrect response. However, more detailed information, recording the type of error response is available for all participants, which could be fruitful to analyse in more depth.

Due to the heterogeneity and variability of the aphasic population, which may result in subsequent difficulties interpreting group effects, previous research has emphasised the importance of analysing findings for *individual participants* within a group design (Nickels and Howard, 1995).

Results for individual participants, using matched sets, found no significant effects based upon a two-tailed hypothesis, although 1 participant was close to significance at the 0.05 level; *ML p=0.052*. However, on the basis of a one-tailed hypothesis, predicting that people with aphasia would be better at naming high typicality items (Howard and Best, 1996, unpublished), 2 participants demonstrated a significant effect at the 0.05 level; *LO p=0.049* , *ML p=0.026.*

Although matched sets can be used to measure the effect of typicality, this method of analysis has some limitations and can result in difficulties selecting suitable items, particularly when using inter-correlated variables (Ellis, Lum and Lambon Ralph, 1996). In the current study, the use of matched sets restricted both the sample size, and the range of semantic categories.

Therefore, binary logistic regression was used as an additional method to investigate the influence of typicality for a broader range of items (N=164) for both the group and individual participants. This method also provided valuable information regarding the relative strength of typicality as a predictor of naming in comparison to other independent variables known to affect naming in aphasia. In this study, logistic regression aimed to identify the strength of different variables as significant predictors of naming.

In order to prevent possible suppression effects arising through the inclusion of two predictor variables which could be viewed as measures of the same thing, (e.g. concreteness vs. imageability) concreteness was not entered into the regression model (Ellis, Lum and Lambon Ralph, 1996). On this basis and due to a high correlation between familiarity and frequency [4] (r=.666), familiarity was omitted and the following variables included in the regression model: frequency, imageability, age of acquisition, operativity and word length (number of phonemes).

Results of the group regression also demonstrated a significant typicality effect, when entered as a single variable ($p<0.001$). The direction of the effect demonstrated a decrease in the likelihood of producing an error for high typicality items, again supporting previous research findings (Howard and Best, 1996, unpublished). Typicality remained significant ($p=0.0359$) when other independent variables were entered into the model, but was the weakest predicting variable, with the exception of the categorical variable time. Interestingly, the same effect size was reported for typicality when entered with age of acquisition alone, as when entered with all of the independent variables. This finding further implies a close association between typicality and age of acquisition.

Individual regression results found typicality to be a significant predictor of naming for five participants when entered as a single variable. However, for the remaining fifteen individuals, typicality did not significantly predict naming response. Results of the forward conditional stepwise regression for JD, KN, LO, PP and RK, demonstrate that typicality only remained a significant naming predictor for one individual, (LO; third strongest predictor $p=0.014$), when other independent variables are added to the regression model. On the basis of these findings, typicality cannot be considered a strong naming predictor for 19/20 individual participants with aphasia.

[4] Colliniearity diagnostics indicated familiarity to have a VIF value greater than 2.5.

In contrast, age of acquisition was found to be the strongest predictor of naming for ten individual participants with aphasia. Word length was the most significant factor predicting naming ability for five participants. These results are consistent with earlier research demonstrating age of acquisition and word length as reliable variables influencing naming in aphasia (Nickels and Howard, 1995b; Caplan, 1987). In addition, individual results for these two variables support the group findings to some degree with age of acquisition and word length demonstrating the largest effect sizes. Imageability demonstrated a relatively small effect as a predictor for individual participants. It should be highlighted however, that there is likely to be a limited range of imageability values amongst items that are represented pictorially.

Some degree of caution should be adopted when interpreting these results as previous research has questioned the reliability and validity of findings from regression techniques alone, particularly when analysing data collected from single administrations (Ellis, Lum and Lambon Ralph 1996). In the current study, data from both naming attempts were included consecutively in the regression model for individual participants (i.e. 328 items in each regression: 2x164 items). In addition, the use of stepwise regression may serve to reduce the accuracy of results, particularly when using inter-correlated variables.

The possible effect of sample differences between the statistical analyses should also be recognised. For example, an unequal proportion of high and low typicality items are included within the regression sample, comprising a large number of typical to mid-range items (e.g. mean rating 2-3). These are largely omitted in the matched sets analysis.

A methodological weakness of the aphasia naming task, which may have confounded the data to some degree, was the single order of presentation used for all participants. As Appendix 10 demonstrates, the initial items of

each stage of presentation were penguin and rocket. Both items were assigned atypical overall mean ratings (penguin=5.28, rocket=6.06). However, total scores correctly named across both attempts; 14/40 and 19/40 respectively, are higher than might have been predicted for such atypical items. This may be partially attributable to their early presentation. For the item, rocket, categorisation issues may also a significant factor; e.g. is rocket more strongly associated with transport (atypical) or space (typical)? In addition, the possibility of task fatigue should also be considered for those items named towards the end of each assessment.

Typicality and its relationship to the type and severity of Aphasia:

The final aim of this study was to investigate any differences in typicality effect arising as a result of aphasia type (e.g. fluent versus non-fluent) or severity of naming disorder.

Whilst earlier research involving category verification tasks has demonstrated a typicality effect for people with non-fluent aphasia that is similar to individuals with normal language processing skills, those with fluent aphasia have shown a different pattern, with reduced accuracy for both typical and atypical items demonstrating less evidence of a 'typicality effect' (Kiran and Thompson, 2003a). In addition, earlier findings demonstrated production of atypical and incorrect category members during verbal fluency tasks for individuals with posterior damage (Grossman 1980). Therefore, a possible hypothesis might be that people with fluent aphasia show less evidence of a typicality effect and may be better at naming less typical items.

Results from the current study, using matched sets data, did not support this hypothesis. An independent t-test, comparing the difference in mean total score between high and low typicality sets between the fluent and non-fluent groups did not demonstrate a significant effect (p=0.615). However, 9/11 non-

fluent participants correctly named more typical items than atypical items. In contrast, 5/8 fluent participants demonstrated this pattern.

In addition, an examination of the relationship between typicality and severity of naming disorder, using matched sets data, did not yield significant results ($p=0.376$). Despite these non-significant findings, a (non-significant) negative correlation indicated that the difference between the means of the high and low typicality sets tended to become smaller, the less severe the naming deficit.

Clinical implications and future areas of research:

The current study has demonstrated that typicality as a concept can be measured for a number of different items. However, further research regarding internal category structure and organisation of semantic category representations is required, in order to investigate the possibility that typicality may be more tangible, easily applied and reliably measured in some semantic categories than others. This may be an inherent difficulty when attempting to measure typicality across a wider range of categories, particularly as recent research has demonstrated different processing for different semantic categories in normal language processing and aphasia (Kiran, Ntourou and Eubank, 2007).

When considering the effect of typicality on naming in aphasia, findings from the current study have possible implications, both theoretically and clinically;

Firstly, all of the significant findings, both for the group as a whole and individual participants, demonstrate a trend indicating better naming performance for typical items. This upholds the findings shown in earlier research investigating typicality effects for people with aphasia (Howard and Best, 1996 unpublished) and shows the reverse direction of that predicted by Plaut's (1996) connectionist network, which demonstrated preferential naming

performance for atypical items following damage, but before retraining. Plaut's theory suggesting improved naming performance for atypical items, due to increased variation of semantic features and the premise that typical items will be harder to name, as they share greater proportion of similar or overlapping semantic features, has not been borne out by group results using either method of analysis. 4/20 individual participants demonstrate better naming of atypical items, as predicted by Plaut. However, none of these results are significant. It should also be cautioned that logistic regression analysis does not suggest typicality to be a strong predictor of naming, when compared to other independent variables as a group or for individual participants.

The current findings also suggest some degree of variability between individual participants, both in terms of typicality and the predictive power of the different independent variables, as shown by the variation in percentage model for individual regressions. This emphasises the heterogeneous nature of the aphasic population.

In addition, a degree of variability has been found in treatment studies based upon typicality for people with aphasia. Findings from a recent study investigating the effect of typicality in anomia treatment for two semantic categories (vegetables and birds) demonstrated different effects for two individuals with different levels of deficit (Stanczak, Waters and Caplan 2006). Whilst some results in the Stanczak et al (2006) study, supported both Kiran and Thompson's (2003b) and Plaut's (1996) earlier findings, including generalisation to typical items when trained with atypical items for the participant with a semantic deficit, other results did not. For example, a marginally significant effect was also found in the reverse direction when trained using a different category. In addition, another participant with only a mild semantic deficit was unable to learn the atypical items, which may have

implications for the efficacy of semantic complexity treatment, as proposed by Kiran and Thompson (2003b).

Further investigation of typicality in relation to aphasia type and severity using a larger sample of participants is warranted in order to identify any differences in the effect of typicality for people with different levels of deficit. In particular, the possibility of an interaction between aphasia type and severity affecting typicality for individuals with anomia may be a potential area of future research. In terms of data available in the current study, more detailed analysis of background language assessments and error patterns may provide useful information for future investigations.

Nevertheless, despite certain methodological concerns and some conflicting findings, Kiran and Thompson's (2003b) treatment study has served to encourage a great deal of research in this area and has strong clinical implications in terms of treatment. These should be examined in further detail, using a greater number of participants with varying levels of deficit and severity, as well as a broader range of semantic categories, before conclusions regarding the most appropriate form of treatment can be made. Finally, in view of the inter-correlations often found between variables influencing naming, therapy studies for naming disorders should use statistical methods and analyses, where possible, to control for confounding variables in order to confirm the validity of any observed effects.

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Appendix 1: Instructions to participants for the Typicality Rating Task

Thank you for agreeing to take part in this study. Read the instructions given below and the accompanying record sheet. Please complete the task listed in Section A before reading the instructions for Section B. Please ask if you have any questions before starting the task.

Many thanks.

SECTION A

- Please find attached a set of black and white line drawings.
- Each picture has been given a specific category *(e.g. robin = bird)* which is listed on your record sheet.
- Please consider how ***typical**** you feel each picture to be of the specific category label given.
- ***Typicality*** is **NOT** how common something is. Instead, it refers to how closely the characteristics or features of an item match the prototype of a category. Typicality might relate to an item's appearance, physical characteristics or function, use and context.
- For example, the typical characteristics or features of a bird might include: having wings, flying, laying eggs. Therefore, a robin could be seen as a highly typical bird, whereas an ostrich could be considered an atypical example of a bird.
- Please give a typicality rating for each picture, by ticking a numbered box on the record sheet provided. The rating scale ranges from 1-7, where 1 is the *most typical* and 7 is the *least typical* example of a category. For those items you consider to be neither particularly typical nor atypical, a mid-point number on the rating scale would be appropriate.
- Each item should be considered independently of others listed in the task.

END OF SECTION A – PLEASE COMPLETE TASK BEFORE TURNING OVER PAGE

SECTION B

- Once you have given each picture a numerical rating, we would like you to provide a reason or description of why you consider each item to be typical or atypical:

- For those items ranked 1-3, please provide a reason why you consider this item to be more typical.

- For those items ranked 4, please provide one reason for why you consider it typical and one reason why you consider it less typical.

- For those items ranked 5-7, please provide a reason why you consider the item atypical.

- Please write your answers in the space provided on the record sheet (blank column at end of sheet). If you cannot think of a reason, then please leave blank.

Thank you very much for your time.

Appendix 2: Overall Mean Typicality Ratings and Standard Deviations for individual items.

Item	Category	Mean	Std. Dev
dinosaur	prehistoric animal	1.13	0.42
apple	fruit	1.19	0.47
king	royalty	1.19	0.59
beak	part of a bird	1.25	0.72
bread	food	1.25	0.57
newspaper	type of reading material	1.28	0.46
hammer	tool	1.34	0.55
triangle	shape	1.34	0.65
vegetables	food	1.34	0.7
frog	amphibian	1.38	0.66
table	furniture	1.38	0.66
horse	animal	1.41	0.71
carrot	vegetable	1.44	0.72
wheel	part of a vehicle	1.44	0.84
jacket	clothing	1.47	0.84
knife	kitchen utensil	1.47	0.67
lamp	lighting	1.47	0.76
ant	insect	1.5	0.76
microscope	scientific instrument	1.5	0.67
saucepan	kitchen utensil	1.53	1.02
spade	garden tool	1.53	0.95
teacher	occupation/profession	1.53	0.98
river	geographical feature	1.56	0.67
violin	musical instrument	1.56	0.98
box	container	1.59	0.71
cow	animal	1.59	0.95
daffodil	flower	1.59	0.95
piano	musical instrument	1.59	0.95
saw	tool	1.59	0.71
bulb	lighting	1.63	0.87
cabbage	vegetable	1.63	0.79
drill	tool	1.66	0.94
mountain	geographical feature	1.66	0.94
envelope	stationery	1.69	1.06
grass	found in garden	1.72	1.05
racquet	sports equipment	1.72	0.89
shoulder	part of the human body	1.72	0.96
spoon	kitchen utensil	1.75	0.98
tulip	flower	1.75	0.98
cotton	sewing	1.78	1.26
snail	mollusc	1.78	1.16
television	household electrical appliance	1.78	1.24

doctor	occupation/profession	1.81	1.15
pear	fruit	1.81	1.23
trumpet	musical instrument	1.81	0.97
window	part of a building	1.84	0.88
magazine	type of reading material	1.88	1.01
crocodile	reptile	1.91	1.23
tea	drink	1.94	1.13
snake	reptile	1.97	1.53
door	part of a building	2	0.95
fox	animal	2	1.14
pillow	bedroom	2	0.92
tiger	animal	2	1.32
button	fastening	2.03	1.09
coffee	drink	2.03	0.97
curtain	soft furnishing	2.03	1.4
policeman	occupation/profession	2.03	1.26
factory	place of work	2.06	1.22
elbow	part of the human body	2.09	1.23
kettle	kitchen utensil	2.09	1.42
sandwich	food	2.09	1.44
coffin	death	2.16	1.72
monkey	animal	2.16	1.51
secretary	occupation/profession	2.16	1.27
banana	fruit	2.19	1.4
bottle	container	2.19	1.2
skirt	clothing	2.19	1.26
crab	shellfish	2.22	1.5
dentist	occupation/profession	2.22	1.36
pants	clothing	2.22	0.97
sock	clothing	2.22	0.83
blouse	clothing	2.25	1.14
fence	found in a garden	2.25	0.98
radio	electrical appliance	2.25	1.24
elephant	animal	2.28	1.46
mermaid	myth	2.31	1.64
pencil	stationery	2.31	1.55
furniture	found in a building	2.34	1.29
saxophone	musical instrument	2.34	1.23
smoke	pollution	2.34	1.56
stable	animal's dwelling	2.34	1.56
squirrel	animal	2.38	1.31
bear	animal	2.41	1.66
brush	beauty accessory	2.41	1.19
buckle	fastening	2.41	1.36
computer	electrical appliance	2.41	1.6
hospital	building	2.41	1.07
pie	food	2.41	1.21
kennel	animal's dwelling	2.44	1.63

mirror	beauty accessory	2.44	1.39
orchestra	music	2.44	1.66
bicycle	transportation	2.47	1.27
muscle	part of the human body	2.53	1.76
drum	musical instrument	2.56	1.64
postman	occupation/profession	2.56	1.48
bucket	container	2.59	1.21
lemon	fruit	2.69	1.4
carpenter	occupation/profession	2.72	1.46
fairy	myth	2.75	1.88
colander	kitchen utensil	2.81	1.64
axe	tool	2.84	1.37
pineapple	fruit	2.84	1.69
basket	container	2.91	1.35
battery	electrical	2.94	1.63
teeth	part of the human body	2.97	1.51
baker	occupation/profession	3.03	1.71
barrel	container	3.03	1.49
desk	furniture	3.03	1.75
saddle	animal accessory	3.03	1.62
tongue	part of the human body	3.03	1.75
medicine	health	3.09	1.61
fire	heating	3.13	1.66
stool	furniture	3.13	1.39
tweezers	beauty accessory	3.13	1.26
parrot	bird	3.16	1.87
star	shape	3.22	1.72
ink	stationery	3.28	1.59
boots	clothing	3.31	1.28
spider	insect	3.31	2.46
lightening	weather	3.34	1.52
tree	plant	3.34	1.84
corkscrew	kitchen utensil	3.44	1.7
camel	animal	3.47	1.93
moustache	facial feature	3.47	1.68
soldier	occupation/profession	3.47	1.7
garage	building	3.53	1.68
tank	weapon	3.53	1.57
tie	clothing	3.53	1.46
hoof	part of an animal	3.59	1.78
butterfly	insect	3.63	1.96
candle	lighting	3.66	1.82
kite	child's toy	3.66	1.6
farm	place of work	3.69	1.51
ski	sports equipment	3.69	1.79
pyjamas	clothing	3.72	1.46
tractor	vehicle	3.75	1.46
butter	food	3.78	1.39

sailor	occupation/profession	3.78	1.88
fisherman	occupation/profession	3.81	1.77
gate	found in a garden	3.84	1.61
tomato	fruit	3.91	1.91
arrow	weapon	3.97	1.77
glove	clothing	3.97	1.51
sink	kitchen utensil	3.97	1.93
muzzle	animal accessory	4	1.55
gardener	occupation/profession	4.09	1.67
typewriter	office equipment	4.09	2.2
footballer	occupation/profession	4.19	2.09
balloon	child's toy	4.25	1.5
castle	building	4.25	1.83
conductor	occupation/profession	4.25	2.13
peacock	bird	4.25	1.72
ladder	tools	4.28	1.53
belt	clothing	4.34	1.6
sugar	food	4.38	1.76
dart	sports equipment	4.41	1.6
caravan	dwelling	4.63	1.64
lighthouse	building	4.88	2.04
tent	dwelling	4.94	1.56
penguin	bird	5.28	1.44
diver	occupation/profession	5.31	1.67
acrobat	occupation/profession	5.44	1.48
clown	occupation/profession	5.5	1.78
cowboy	occupation/profession	5.56	1.64
pyramid	building	5.59	1.36
rocket	transport	6.06	1.24

Appendix 3: Matched Sets Data

	Word	Typ.	Fam.	Image.	Concrete.	AoA	Oper.	Freq.	Lemma Freq.	Syllables	Phonemes
HT Set	dinosaur	1.13	458	608	583	3.77	2.33	0.23	0.72	3	6
	apple	1.19	598	637	620	1.79	5.26	1.25	1.48	2	3
	king	1.19	522	585	559	2.15	2.67	1.95	2	1	3
	beak	1.25	476	574	552	2.78	2.93	0.69	0.83	1	3
	bread	1.25	611	619	622	1.88	4.74	1.87	1.87	1	4
	newspaper	1.28	641	616	576	2.48	4.75	1.79	2.08	3	8
	hammer	1.34	515	618	605	2.58	5.1	0.96	1.04	2	4
	triangle	1.34	512	597	523	3.7	2.37	0.99	1.09	3	7
	shoulder	1.72	553	577	589	2.52	4.11	1.82	2.11	2	5
	table	1.38	599	582	604	1.87	4.6	2.31	2.37	2	4
	horse	1.41	560	624	613	1.83	4.07	1.93	2.12	1	3
	carrot	1.44	539	577	622	2.24	5.27	0.4	0.91	2	5
	jacket	1.47	596	611	635	2.73	4.84	1.54	1.63	2	5
	knife	1.47	573	633	612	2.03	5.01	1.55	1.65	1	3
	ant	1.50	511	613	604	2.23	3.82	0.59	1.07	1	3
	microscope	1.50	493	617	591	4.59	3.88	0.77	0.88	3	9
	saucepan	1.53	578	639	596	2.31	4.9	0.96	1.07	2	6
	spade	1.53	513	578	565	2.16	5.03	0.45	0.67	1	4
	teacher	1.53	599	575	569	2.67	3.54	1.9	2.21	2	4
	violin	1.56	468	606	626	3.28	4.74	0.64	0.76	3	6
	box	1.59	599	591	597	1.99	4.72	1.59	2.01	1	4
	cow	1.59	529	632	621	1.88	3.45	1.34	1.61	1	2
	daffodil	1.59	404	611	595	2.92	4.46	-0.3	0.35	3	7
	piano	1.59	545	630	615	2.67	4.76	1.42	1.44	2	5
	saw	1.59	552	531	532	2.72	4.69	-0.47	0.16	1	2
	bulb	1.63	514	631	577	2.8	5	0.81	1.06	1	4
	cabbage	1.63	504	573	611	2.33	4.99	0.91	1.02	2	5
	drill	1.66	473	571	516	3.58	4.54	0.78	0.9	1	4
	envelope	1.69	542	554	579	3.28	4.51	1.27	1.39	3	7
	racquet	1.72	480	522	513	3.68	4.72	0.89	0.95	2	5
	spoon	1.75	612	584	614	1.66	5.12	1.05	1.19	1	4
	tulip	1.75	546	641	619	3.07	4.47	-0.11	0.37	2	6
	snail	1.78	489	577	579	2.36	3.67	0.41	0.65	1	4
	doctor	1.81	573	600	575	2.52	3.32	2.12	2.27	2	5
	trumpet	1.81	490	628	608	3.11	4.72	0.68	0.89	2	7
	frog	1.38	507	617	619	2.32	4.01	0.62	0.97	1	4
	magazine	1.88	585	588	588	3.31	4.69	1.59	1.81	3	7
	crocodile	1.91	456	601	583	2.89	3.56	0.29	0.75	3	8
	snake	1.97	501	627	621	2.63	3.22	1.15	1.36	1	4
	mean	1.55	533.74	599.87	590.46	2.65	4.27	1.04	1.27	1.82	4.85
	sd	0.21	53.12	28.84	31.30	0.65	0.81	0.67	0.59	0.79	1.71

	count	39	39	39	39	39	39	39	39	39	39
	diff means	-2.51	13.59	3.05	-5.79	-0.10	0.40	0.00	0.05	0.13	0.36
	denom	0.25	53.98	29.23	31.51	0.66	0.82	0.68	0.59	0.80	1.73
	t	-10.16	0.25	0.10	-0.18	-0.15	0.48	-0.01	0.08	0.16	0.21
	mean	4.05	520.15	596.82	596.26	2.75	3.88	1.05	1.22	1.69	4.49
	sd	0.80	59.16	29.35	22.47	0.59	0.87	0.48	0.46	0.73	1.47
	count	39	39	39	39	39	39	39	39	39	39
LT Set	desk	3.03	583	574	583	2.7	4.42	1.92	1.96	1	4
	tongue	3.03	531	621	634	2.17	3.89	1.53	1.6	1	3
	stool	3.13	531	584	592	2.26	4.88	0.95	1.1	1	4
	star	3.22	574	623	574	2.15	1.44	1.73	2	1	3
	ink	3.28	542	589	608	3.42	4.45	0.96	0.99	1	3
	barrel	3.03	487	602	590	3.51	4.04	1.15	1.33	2	5
	boots	3.31	566	604	595	2.05	4.5	1.48	1.59	1	4
	tree	3.34	613	622	604	1.84	3.9	1.86	2.28	1	3
	butterfly	3.63	481	624	593	2.33	3.05	0.69	1.01	3	7
	garage	3.53	527	608	577	3	3.88	1.36	1.4	2	5
	tank	3.53	511	563	581	2.82	3.61	1.31	1.59	1	4
	tie	3.53	559	551	568	3	4.11	1.28	1.53	1	2
	candle	3.66	544	594	565	2.61	4.89	0.89	1.22	2	5
	farm	3.69	564	560	565	2.37	2.55	1.81	1.93	1	3
	ski	3.69	551	615	590	4.23	3.99	0.68	0.89	1	3
	pyjamas	3.72	476	639	596	2.08	4.48	0.91	0.91	3	7
	tractor	3.75	518	585	590	2.42	4.3	0.84	1.03	2	6
	butter	3.78	615	603	618	2	4.5	1.44	1.44	2	4
	glove	3.97	575	596	607	2.21	4.62	0.66	1.29	1	4
	gate	3.84	540	545	573	2.26	4.56	1.69	1.84	1	3
	tomato	3.91	574	610	662	2.26	5.79	0.84	1.15	3	6
	arrow	3.97	490	619	595	3.08	4.31	0.91	1.17	2	3
	sink	3.97	586	599	590	2.13	4.2	1.13	1.16	1	4
	camel	3.47	421	561	597	2.83	3.44	0.91	1.4	2	4
	typewriter	4.09	524	615	611	3.65	4.54	0.94	1.06	3	7
	conductor	4.25	502	584	565	3.31	3.23	0.84	0.93	3	8
	peacock	4.25	458	631	589	3.27	3.68	0.46	0.59	2	5
	belt	4.34	550	494	602	2.93	4.68	1.31	1.43	1	4
	sugar	4.38	608	595	620	2.01	4.49	1.74	1.75	2	4
	dart	4.41	496	597	608	3.66	4.68	0.3	0.5	1	3
	lighthouse	4.88	410	623	589	3.3	2.62	0.42	0.45	2	6
	tent	4.94	521	593	608	2.87	3.78	1.56	1.64	1	4
	penguin	5.28	360	639	596	2.89	2.69	0.59	0.7	2	7
	diver	5.31	448	577	559	3.38	2.93	-0.05	0.36	2	4
	clown	5.50	511	589	627	2.41	3.19	0.45	0.56	1	4
	ladder	4.28	507	639	602	2.7	4.47	1.12	1.2	2	4
	pyramid	5.59	386	613	615	3.74	2.19	0.6	0.84	3	7
	cowboy	5.56	521	584	571	2.49	3.21	0.67	0.8	2	4
	rocket	6.06	525	612	645	2.72	2.99	0.9	1.13	2	5

Appendix 4: Qualitative Ratings Summary

Category	Item	No. of times	Percentage
Amphibian	**Frog**		
	Water/Land	14	44%
	Nothing	3	9%
Animal	**Bear**		
	4 legs	13	41%
	Fur/Hairy	11	34%
	Scary/dangerous/wild	5	16%
	Nothing	2	6%
	Camel		
	4 legs	12	38%
	Hump	8	25%
	Special terrain	8	25%
	Specialised/adaptations	5	16%
	Nothing	3	9%
	Cow		
	4 legs	15	47%
	Fur/coat	6	19%
	Milk/Consumables	4	13%
	Nothing	0	0%
	Elephant		
	4 legs	14	44%
	Large size	12	38%
	Trunk	5	19%
	Tail	4	16%
	Fox		
	4 legs	16	50%
	Fur	11	34%
	Tail	5	16%
	Commonality	4	13%
	Nothing	5	16%
	Horse		
	4 legs	18	56%

Category	Item	No. of times	Percentage
Kitchen Utensil	**Colander**		
	Draining/straining	10	31%
	Food/cooking	9	28%
	In kitchen	5	16%
	Nothing	2	6%
	Corkscrew		
	bottle opening/wine	10	31%
	outside kitchen	7	22%
	Nothing	3	9%
	Kettle		
	Used to boil/heat liquid	15	47%
	Commonality	11	34%
	Nothing	2	6%
	Knife		
	Commonality	13	41%
	used to cut things	8	25%
	Prepare food	7	22%
	Nothing	1	3%
	Saucepan		
	cook with it/heat things with it	19	59%
	Essential	10	31%
	nothing	2	6%
	Sink		
	Not moveable/fabric	12	38%
	Not utensil	12	38%
	Found in kitchens	10	31%
	Not used for cooking	9	28%
	Nothing	1	3%
	Spoon		
	Eating/dining	10	31%
	Commonality	7	22%
	Cooking	6	19%

	Tail	6	19%
	Fur/coat	4	13%
	Nothing	0	0%
	Monkey		
	Fur	9	28%
	4 legs/limbs	7	22%
	Separates arms/legs	6	19%
	closer/similar to humans	5	16%
	Tail	5	16%
	Nothing	2	6%
	Squirrel		
	Fur	13	41%
	4 legs	8	25%
	unusual/bushy/long tail	5	16%
	Small	5	16%
	Nothing	2	6%
	Tiger		
	4 legs	16	50%
	Fur	12	38%
	Strong/hunting /danger	6	19%
	Nothing	2	6%
Animal Accessory	**Muzzle**		
	Dogs	13	41%
	Prevents biting/dangerous attack	5	16%
	Nothing	7	22%
	Saddle		
	Associated with Horses	14	44%
	Ridden animals	8	25%
	Riding	6	19%
	Nothing	4	13%
Animal's dwelling	**Kennel**		
	Specific to dogs	17	53%
	Nothing	4	13%
	Stable		

	Architypal	6	19%
	Stirring/mixing	5	16%
	Nothing	1	3%
Lighting	**Bulb**		
	electrical/means of lighting/light/bright	22	69%
	Commonality	11	34%
	Nothing	2	6%
	Candle		
	Old fashioned/poor light	15	47%
	emits light	12	38%
	Nothing	2	6%
	Lamp		
	Light/illumination/brightness	21	66%
	Archetypal	6	19%
	Need bulb	4	13%
	Nothing	3	9%
Mollusc	**Snail**		
	shell	19	59%
	slimey	6	19%
	Nothing	4	13%
Music	**Orchestra**		
	making sound/music	14	44%
	lots of instruments	5	16%
	Nothing	5	16%
Musical Instrument	**Drum**		
	Noise/loud	7	22%
	beats/rhythm/not notes	8	25%
	Nothing	2	6%
	Piano		
	Archetypal	6	19%
	Played	4	13%
	Makes nice/beautiful sound	4	13%
	nothing	2	6%
	Saxophone		

	Horses	11	34%
	Animals	6	19%
	Shelter	4	13%
	Nothing	3	9%
Beauty accessory	**Brush**		
	arranges hair/improves appearance of hair	17	53%
	Grooming/enhance looks	8	25%
	Commonality	8	25%
	Nothing	1	3%
	Mirror		
	Beauty/reflect beauty	9	28%
	Used for other things - reflection/light	9	28%
	Nothing	2	6%
	Tweezers		
	Pluck hairs	10	31%
	Other use - medical	8	25%
	Beauty	4	13%
	Nothing	2	6%
Bedroom	**Pillow**		
	Sleeping	15	47%
	Commonality	6	19%
	Comfort	5	16%
	Part of bed	5	16%
	Not essential	4	13%
	Nothing	2	6%
Bird	**Parrot**		
	Beak	12	38%
	Tropical/colourful/exotic	11	34%
	Feathers	9	28%
	Flies	8	25%
	Wings	6	19%
	Talks/Mimics	6	19%
	Nothing	0	0%
	Peacock		

	Brass	6	19%
	Blown/reed	4	13%
	Specific to Jazz/brass band	4	13%
	Nothing	3	9%
	Trumpet		
	Brass/metal	8	25%
	Blown	6	19%
	Noise/loud	6	19%
	Orchestra/Band	5	16%
	Nothing	3	9%
	Violin		
	Sounds/notes	11	34%
	Strings	8	25%
	Play it	8	25%
	Commonality	5	16%
	Musician/orchestras	4	13%
	Nothing	3	9%
Myth			
	Mermaid		
	not real/doesn't exist	10	31%
	In fairytales	8	25%
	Nothing	5	16%
	Fairy		
	not real	7	22%
	Mythical/children's tales	7	22%
	Nothing	4	13%
Occupation/Profession	**Acrobat**		
	Specialist/skills	9	28%
	Hobby/Fun	7	22%
	Rare/Unusual	7	22%
	Nothing	2	6%
	Baker		
	Gets paid	9	28%
	Traditional/fewer now	8	25%

	Cant'/limited flight	12	38%
	Feathers	10	31%
	unusual tail	7	22%
	Colourful/beauty	6	19%
	Nothing	1	3%
	Penguin		
	Cant fly	27	84%
	Swims	5	16%
	Nothing	0	0%
Building	**Castle**		
	old/historic/ancient/old fashioned	10	31%
	specialist/restricted use	4	15%
	Nothing	2	6%
	Garage		
	Buildings for humans, not objects	11	34%
	Cars	8	25%
	Roof, 4 walls, bricks	9	28%
	Nothing	0	0%
	Hospital		
	Structure/walls/bricks	12	38%
	For specific function	9	28%
	Commonality	5	16%
	Nothing	3	9%
	Lighthouse		
	Not inhabited	7	22%
	Light/visibility	5	16%
	related to sea	4	13%
	Specialist use	9	28%
	Shape	6	19%
	Nothing	1	3%
	Pyramid		
	Specialist	8	25%
	shape (unusual, not rectangular)	7	22%
	not lived in	7	22%

	skilled/training	5	16%
	Nothing	6	19%
	Carpenter		
	Specialist skills	10	31%
	Paid	5	16%
	Trade/Craft	4	13%
	Rarity	4	13%
	Nothing	7	22%
	Clown		
	Uncommon/specialist	14	44%
	Gets Paid	9	28%
	Doesn't earn much	4	13%
	Entertainment	8	25%
	Nothing	2	6%
	Conductor		
	Specialist/highly skilled	9	28%
	Gets paid	7	22%
	Fun/hobby	7	22%
	Rare/not many	6	19%
	Nothing	4	13%
	Cowboy		
	Uncommon in UK/other countries	9	28%
	Specific to USA	5	16%
	Historic/declining	5	16%
	Films	4	13%
	Paid	4	13%
	Nothing	4	13%
	Dentist		
	Professional	9	28%
	Specialist skills	8	25%
	Paid employment	7	22%
	Nothing	5	16%
	Diver		
	Hobby/Pastime/Recreation/Sport	12	38%

	Houses dead	7	22%
	Historical	4	16%
	Nothing	0	0%
Child's toy	**Balloon**		
	Decoration/entertainment	11	34%
	Temporary	9	28%
	Parties	4	13%
	Nothing	1	3%
	Kite		
	Adults use	8	25%
	Outdoors	8	25%
	Fun	4	13%
	Nothing	0	0%
Clothing	**Belt**		
	Accessory	11	34%
	Holding up/fitting	11	34%
	Nothing	0	0%
	Blouse		
	Protects/covers	11	34%
	Female clothing	11	34%
	Nothing	3	9%
	Boots		17
	protection/for feet	11	34%
	Wear them	9	28%
	Boots/shoes specialism	8	25%
	Commonality	5	16%
	Nothing	0	0%
	Gloves		
	Only for warmth/in winter/specialised	16	50%
	Accessory	9	28%
	Nothing	0	0%
	Jacket		
	Warmth/Protection	13	41%
	Commonality	12	38%

	Highly skilled/specialist	5	16%
	Water-based	4	13%
	Gets paid	4	13%
	Nothing	0	0%
	Doctor		
	Salary/Get paid	6	19%
	Highly trained/skilled	6	19%
	Respected/professional	4	13%
	nothing	3	9%
	Fisherman		
	Water/Fish	7	22%
	Recreation/hobby	4	13%
	Historic	4	13%
	Recreation/hobby	4	13%
	Nothing	4	13%
	Footballer		
	Sport/fun/hobby/not proper job	10	31%
	Well paid	4	13%
	Skilled/specialised	6	19%
	Nothing	3	9%
	Gardener		
	hobby/pleasure/not job	12	38%
	Nothing	4	13%
	Policeman		
	Professional/respected/visible	9	28%
	requires training/skills	6	19%
	Paid employment	6	19%
	Nothing	6	19%
	Postman		
	Common/seen everyday	9	28%
	Gets paid	5	16%
	Service to the public/community	4	13%
	Nothing	5	16%
	Sailor		

	Covers large part of body	7	22%
	Nothing	3	9%
	Pants		
	all wear/ wear everyday	14	44%
	Underwear/not seen	8	25%
	Protects part of body	6	19%
	Nothing	0	0%
	Pyjamas		
	Specific to night/bedroom	16	50%
	Only worn by some	6	19%
	Warmth/protection	5	16%
	Nothing	2	6%
	Skirt		
	only worn by women	9	28%
	covers/protect	6	19%
	Nothing	2	6%
	Socks		
	Commonality	12	38%
	Warmth	8	25%
	Protection	4	13%
	Nothing	4	13%
	Tie		
	Decorative/non functional/unecessary	12	38%
	Accessory/with other clothes	9	28%
	Male attire	4	13%
	Nothing	2	6%
Container	**Barrel**		
	Liquids	11	34%
	Other stuff	10	31%
	Beer	5	16%
	Nothing	0	0%
	Bottle		
	stores/holds/contains liquids	19	59%

	Service/uniform	8	25%
	Work at sea/not land based	6	19%
	Gets paid	5	16%
	Skills/Specialised	5	16%
	Nothing	4	13%
	Secretary		
	Commonality	9	28%
	Paid employment	9	28%
	Works in Office	7	22%
	Nothing	2	6%
	Soldier		
	get paid	8	25%
	dangerous/requires fighting/killing	5	16%
	nothing	3	9%
	Teacher		
	gets paid	9	28%
	Training/skill/qualification	6	19%
	Vocation	4	13%
	Nothing	5	16%
Office Equipment	**Typewriter**		
	Outdated/no longer used	23	72%
	Typing/Speed	8	25%
	Nothing	1	3%
Part of a bird	**Beak**		
	All birds have them/defining characteristic	23	72%
	Eating	4	13%
	Nothing	2	6%
Part of a building	**Door**		
	Entrance/Exit	18	56%
	Commonality	15	47%
	Nothing	1	3%
	Window		
	Commonality	19	59%

	Nothing	1	3%
	Box		
	Holds solid things	16	50%
	Archetypal	10	31%
	For storage	6	19%
	Transportable	5	16%
	Nothing	1	3%
	Bucket		
	Water/liquids	15	47%
	Holds things	8	25%
	Nothing	2	6%
Death	**Coffin**		
	Carry dead body	10	31%
	Associated with funerals	4	13%
	Association not death	6	19%
	Nothing	1	3%
Drink	**Tea**		
	Liquid	9	28%
	Hot	8	25%
	Coffee		
	Commonality	14	44%
	Hot	6	19%
	Liquid	6	19%
	Nothing	3	9%
Dwelling	**Caravan**		
	Temporary/holidays	11	34%
	Mobility	9	28%
	Not 1st choice accomodation	8	25%
	Live in it	4	13%
	Tent		
	Temorary	13	41%
	Camping/holidays	9	28%
	Flimsy/unstable	6	19%
	Sleeo in them	4	13%
	Nothing	2	6%

	Light/visual	8	25%
	Nothing	4	13%
Part of a vehicle	**Wheel**		
	Required for movement	15	47%
	Archetypal	15	47%
	Commonality	5	16%
	Nothing	0	0%
Part of an animal	**Hoof**		
	Specificity	16	50%
	Commonality	5	16%
	nothing	3	9%
Part of the body	**Elbow**		
	Joint	12	38%
	Part of/moves arm	6	19%
	Nothing	3	9%
	Muscle		
	major part/all over body	8	25%
	Movement/Functioning	8	25%
	Nothing	3	9%
	Shoulder		
	Joint/movement	10	31%
	Nothing	8	25%
	Teeth		
	Commonality	10	31%
	need them to eat	6	19%
	Animals as well	5	16%
	Specialist	4	13%
	visible part of the body	4	13%
	nothing	2	6%
	Tongue		
	Essential/All humans	6	19%
	Taste	5	16%
	Speech	4	13%
	Nothing	3	9%
Place of work	**Factory**		

Electrical	**Battery**		
	Powers/generates electricity	20	63%
	Temporary/not mains	5	16%
	Nothing	1	3%
Electrical Appliance	**Computer**		
	Plug in/Electricity	17	53%
	Commonality	7	22%
	Work	4	13%
	Nothing	1	3%
	Radio		
	Plugs in /power	18	56%
	Commonality	8	25%
	Batteries	4	13%
	Nothing	2	6%
	Television		
	Commonality	15	47%
	uses electricity/plugs in	13	41%
	Nothing	2	6%
Facial Feature	**Moustache**		
	Found on face	9	28%
	Optional	8	25%
	only men	7	22%
	Nothing	0	0%
Fastening	**Buckle**		
	Fastens/does up	8	25%
	Associated with belt	6	19%
	Holds things together	4	13%
	Nothing	2	6%
	Button		
	fastening clothes together	11	34%
	Commonality	10	31%
	Nothing	3	9%
Flower	**Daffodil**		
	Petals	9	28%
	Colour	8	25%
	Archetypal function	15	47%
	Large numbers of people	9	28%
	Nothing	5	16%
	Farm		
	Animals/food	8	25%
	Not city or in their experience	8	25%
	Hard/physical work	6	19%
	Live there as well	5	16%
	Nothing	3	9%
Plant	**Tree**		
	Large size	13	41%
	Grows in the ground	9	28%
	Too big/trunk for plant	8	25%
	Green	6	19%
	Leaves	5	16%
	Nothing	2	6%
Pollution	**Smoke**		
	Dirty	5	16%
	Smelly	3	9%
	Highly visible	4	13%
	Nothing	1	3%
Prehistoric Animal	**Dinosaur**		
	Archetypal	10	31%
	Extinct	6	19%
	Size	5	16%
	Nothing	3	9%
Reptile	**Crocodile**		
	Scales/hard, rough skin	17	53%
	Water	4	13%
	Large size	6	19%
	Cold blooded	5	16%
	Ferocity/kills	5	16%
	Nothing	4	13%
	Snake		
	Scales	15	47%

	Stem	7	22%
	Grows in ground	7	22%
	Commonality	7	22%
	Nothing	1	3%
	Tulip		
	Petals	9	28%
	Pretty/colourful	8	25%
	Stem	6	19%
	Grows in the ground	6	19%
	Smell	4	13%
	Nothing	3	9%
Food	**Bread**		
	Staple food/commonality	25	78%
	provides energy/sustenance/nourishment	6	19%
	Nothing	2	6%
	Butter		
	Not a food on its own	15	47%
	Commonality	9	28%
	Used in ccoking	5	16%
	Dairy product	4	13%
	Nothing	0	0%
	Pie		
	Food/edible/eat it	19	59%
	Meat	5	16%
	Pastry	5	16%
	Sandwich		
	edible/food/eat it	15	47%
	Lunch	5	16%
	snack/fast food	6	19%
	Different fillings/composite food	5	16%
	Nothing	3	9%
	Sugar		
	Condiment/added, not food	18	56%
	Little nutritional value	5	16%

	Cold blooded	7	22%
	No legs	7	22%
	Slithers/crawls	4	13%
	Nothing	3	9%
Royalty	**King**		
	Archetypal	15	47%
	Crowned	7	22%
	Nothing	3	9%
Scientific Instrument	**Microscope**		
	Science/laboratory	15	47%
	Close viewing/magnification	9	28%
	Archetypal	8	25%
	Nothing	0	0%
Sewing	**Cotton**		
	Archetypal/essential	22	69%
	Yarn/cloth	4	13%
	Nothing	0	0%
Shape	**Star**		
	complex/not basic	8	25%
	Nothing	5	16%
	Triangle		
	Simplicity/basic shape	13	40%
	straight sides/edges/lines	7	22%
	Nothing	4	13%
Shellfish	**Crab**		
	Hard shell	20	63%
	Eating	6	19%
	Nothing	3	9%
Soft Furnishing	**Curtain**		
	Soft	7	22%
	Material/fabric	6	19%
	can't sit on it/no padding	4	13%
	nothing	2	6%
Sports Equipment	**Dart**		

	Gives energy	3	9%
	Vegetables		
	Healthy/nutritious	10	31%
	Staple/commonality	9	28%
	Food group	6	19%
	Grown	4	13%
	Nothing	2	6%
Found in a building	**Furniture**		
	Always found in building	17	53%
	Outside as well	4	13%
	Nothing	6	19%
Found in a garden	**Gate**		
	entrance/opening	9	28%
	not all gardens have them	8	25%
	Nothing	0	0%
	Grass		
	Commonality	14	44%
	Green	9	28%
	Archetypal	6	19%
	Nothing	1	3%
	Fence		
	Defines Boundary	16	50%
	Commonality	9	28%
	Nothing	1	3%
Fruit	**Apple**		
	Pips/Seeds	9	28%
	Sweet	7	22%
	Commonality	6	19%
	Grows on trees	5	16%
	Architypal	5	16%
	Round	4	16%
	Nothing	1	3%
	Banana		
	Eat it/tasty	8	25%
	Sweet	6	19%

	Not really a sport	13	41%
	Single sport only	9	28%
	nothing	1	3%
	Racquet		
	used with/hits balls	12	38%
	Many Sports	8	25%
	Tennis Squash	7	22%
	nothing	2	6%
	Ski		
	Specialist sport/conditions	17	53%
	different shape	4	
	Nothing	1	
Stationery	**Envelope**		
	Commonality	10	31%
	Associated with letter	9	28%
	Paper	6	19%
	Nothing	4	13%
	Ink		
	Neede to write	9	28%
	Associated with pens	6	19%
	Sationary as paper	6	19%
	Old fashioned	4	13%
	Nothing	2	6%
	Pencil		
	Writing	16	50%
	implement not stationary	4	13%
	Nothing	4	13%
Tool	**Axe**		
	Chpping/cutting/sharp blade	19	59%
	Wood	11	34%
	Hand held	7	22%
	Nothing	1	3%
	drill		
	Commonality	8	25%
	Drill/make holes	5	16%

	Peel/Skin	8	25%
	Nothing	1	3%
	Lemon		
	Pips/seeds	7	22%
	Sour/bitter/not sweet	7	22%
	Can't eat on it's own	6	19%
	Peel/rind	4	13%
	Nothing	0	0%
	Pear		
	Sweet	12	38%
	Seeds/Pips	8	25%
	Grows on trees	5	19%
	Shape	4	13%
	Juicy	4	13%
	Nothing	2	6%
	Pineapple		
	Sweet	10	31%
	Unusual/exotic	7	22%
	Prickly/hard skin	6	19%
	Nothing	1	3%
	Tomato		
	Seen more as vegetable	13	41%
	Savoury/not sweet	10	31%
	Seeds/Pips	6	19%
	Nothing	0	0%
Furniture	**Desk**		
	Not house - school/office	17	53%
	Nothing	1	3%
	Stool		
	You can sit on it	14	44%
	Limited comfort	5	16%
	Has legs	5	16%
	Quite specific/limited use	4	13%
	Nothing	2	6%
	Table		

	found in tool boxes	4	13%
	nothing	0	0%
	Hammer		
	Commonality	10	31%
	Hand held	5	16%
	Used to fix things	5	16%
	Bang things in	4	13%
	Nothing	0	0%
	Ladder		
	Not a tool	10	31%
	Not hand held	7	22%
	Means of access	7	22%
	Nothing	2	6%
	Saw		
	used to cut	11	34%
	Commonality	7	22%
	hand held	4	13%
	sharp	4	13%
	nothing	1	3%
Transportation/Vehicle	**Bicycle**		
	Wheels	8	25%
	small scale/limited nos	7	22%
	Gets you around	7	22%
	Commonality	7	22%
	Nothing	2	6
	rocket		
	not common/unusual/rare	23	72%
	Doesn't usually carry people	10	31%
	Space travel	4	13%
	Nothing	0	0%
	Tractor		
	Wheels	10	31%
	Limited to farms/countryside	8	25%
	Not really for transport	6	19%
	Nothing	1	3%

	Commonality	13	41%
	Homes	6	19%
	Eating	6	19%
	Architypal	4	13%
	Nothing	2	6%
Garden Tool	**Spade**		
	used to dig	14	44%
	Commonality	12	38%
	Nothing	1	3%
Geographical Feature	**Mountain**		
	Size	12	38%
	Commonality	7	22%
	Nothing	3	9%
	River		
	Frequent feature	9	28%
	Part of landscape	6	19%
	Water	5	16%
	Maps	4	13%
	Nothing	6	19%
Health	**Medicine**		
	Makes you better	19	59%
	Associated with illness not health	9	28%
	Nothing	2	6%
Heating	**Fire**		
	Heat/Warmth	18	56%
	Old/archaic/inefficient	6	19%
	Nothing	2	6%
Insect	**Ant**		
	Small	14	44%
	6 legs	7	22%
	Many legs	6	19%
	creepy/crawls	5	16%
	Nothing	3	9%

Reading material	**Magazine**		
	words/reading	16	50%
	Pictures/visual	9	28%
	easy reading/undemanding/fun	6	19%
	Nothing	5	16%
	Newspaper		
	Easily read/accessable	12	38%
	Commonality	10	31%
	Printed Words	6	19%
	Pictures	5	16%
	Nothing	3	9%
Vegetable	**Cabbage**		
	Healthy/nutritious	12	38%
	Grown in ground	11	34%
	Green	7	22%
	Commonality	6	19%
	Nothing	3	9%
	Carrot		
	Grown in the ground/garden	11	34%
	Healthy/nutritious	10	31%
	Bright/colourful	4	13%
	Nothing	2	6%
Weapon	**Arrow**		
	Old fashioned /outdated/traditional	14	44%
	Hurts/injures	8	25%
	Sharp	4	13%
	Used with Bow	4	13%
	Nothing	0	0%
	Tank		
	Kills/weapon	11	34%
	Vehicle/transport (may carry weapon)	11	34%
	Large	5	16%
	Nothing	1	3%

	Butterfly		
	Pretty/beautiful/colourful	13	40%
	Wings/Flies	13	40%
	Not a creepy/crawly	5	16%
	ephemeral/change	5	16%
	Small	4	13%
	Nothing	1	3%
	Spider		
	Arachnid	9	28%
	Creepy/crawls	9	28%
	No of legs	8	25%
	Small	7	22%
	Nothing	1	

Weather	**Lightning**		
	Extreme/unusual	10	31%
	Storms	5	16%
	Powerful/dangerous	4	13%
	Nothing	1	3%

Appendix 4i: Qualitative Ratings Summary and Tables

Items with an attribute listed by 50% of participants or more:

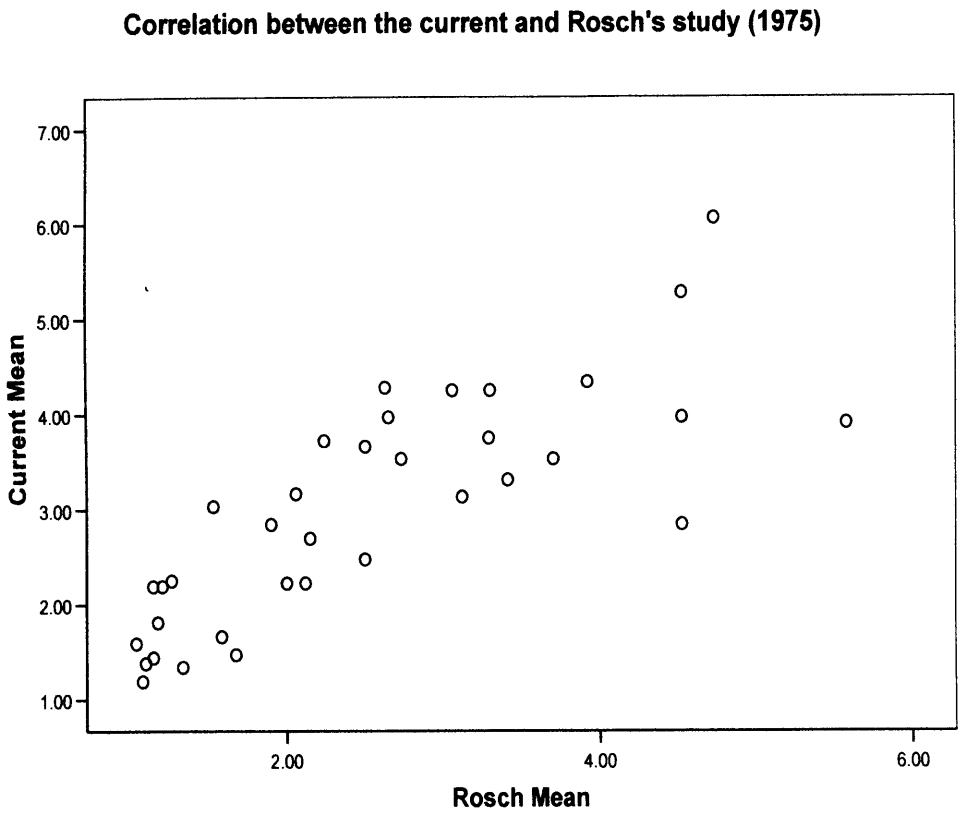
Item	Category	Reason	%	Typicality	Rank
Beak	Part of Animal	Defining characteristic	72%	1.25	3rd
Bread	Food	staple/commonality	78%	1.25	2nd
Horse	Animal	Four legs	56%	1.41	
Lamp	Lighting	Light/illumination/brightness	66%	1.47	8th
Saucepan	Kitchen utensil	Cooking/heat things	59%	1.53	
Box	Container	Holds solid things	50%	1.59	
Bulb	Lighting	electrical means of bright light	69%	1.63	6th
Snail	Mollusc	Shell	59%	1.78	
Cotton	Sewing	prototypical/essential for sewing	69%	1.78	6th
Window	Part of a building	Commonality	59%	1.84	
Magazine	Type of reading material	Words/reading	50%	1.88	
Crocodile	Reptile	Scales/Rough skin	53%	1.91	
Tiger	Animal	Four legs	50%	2.00	
Fox	Animal	Four legs	50%	2.00	
Door	Part of a building	Entrance/exit	56%	2.00	
Bottle	Container	Stores/holds/contains liquids	59%	2.19	
Crab	Shellfish	Hard Shell	63%	2.22	9th
Radio	Electrical Appliance	Plug in/power	56%	2.25	
Fence	Found in a garden	Defines a boundary	50%	2.25	
Pencil	Sationery	For writing	50%	2.31	
Furniture	Found in a building	Always found in building	53%	2.34	
Computer	Electrical Appliance	Plug in/electricity	53%	2.41	
Pie	Food	Edible/eat it	59%	2.41	
Brush	Beauty Accessory	Arranges/improves appearance of hair	53%	2.41	
Kennel	Animal Dwelling	Specific to dogs	53%	2.44	
Axe	Tool	Chopping/cutting/sharp blade	59%	2.84	
Battery	Electricity	Powers/generates electricity	63%	2.94	9th
Desk	Furniture	Specific to school/office	53%	3.03	
Medicine	Health	Makes you better	59%	3.09	
Fire	Heating	Heat/warmth	56%	3.13	
Hoof	Part of animal	Specificity to Bovine/Ungulates	50%	3.59	
Ski	Sports Equipment	Specialist sport/conditions	53%	3.69	
Pyjamas	Clothing	Specific to night/bedroom	50%	3.72	
Gloves	Clothing	specialised/warmth/winter	50%	3.97	
Typewriter	Office Equipment	Outdated/no longer used	72%	4.09	3rd
Sugar	Food	Condiment/added, not food	56%	4.38	
Penguin	Bird	Cannot Fly	84%	5.28	1st
Rocket	Transport	Unusual/rare	72%	6.06	3rd

Appendix 4ii: Qualitative Ratings Summary and Tables

Items for which 4 participants or more did not provide a qualitative rating.

Item	Category	No. of participants left blank	Percentage
Fox	Animal	5	16%
Muzzle	Animal Accessory	7	22%
Saddle	Animal Accessory	4	13%
Kennel	Animal Dwelling	4	13%
Factory	Building	5	16%
Socks	Clothing	4	13%
Pie	Food	4	13%
Furniture	Found in a building	6	19%
River	Geographical Feature	6	19%
Snail	Mollusc	4	13%
Orchestra	Music	5	16%
Fairy	Myth	4	13%
Mermaid	Myth	5	16%
Baker	Occupation/Profession	6	19%
Carpenter	Occupation/Profession	7	22%
Conductor	Occupation/Profession	4	13%
Cowboy	Occupation/Profession	4	13%
Dentist	Occupation/Profession	5	16%
Fisherman	Occupation/Profession	4	13%
Gardener	Occupation/Profession	4	13%
Policeman	Occupation/Profession	6	19%
Postman	Occupation/Profession	5	16%
Sailor	Occupation/Profession	4	13%
Teacher	Occupation/Profession	5	16%
Window	Part of a building	4	13%
Shoulder	Part of the human body	8	25%
Crocodile	Reptile	4	13%
Star	Shape	5	16%
Triangle	Shape	4	13%
Envelope	Stationery	4	13%
Pencil	Stationery	4	13%
Magazine	Type of reading material	5	16%

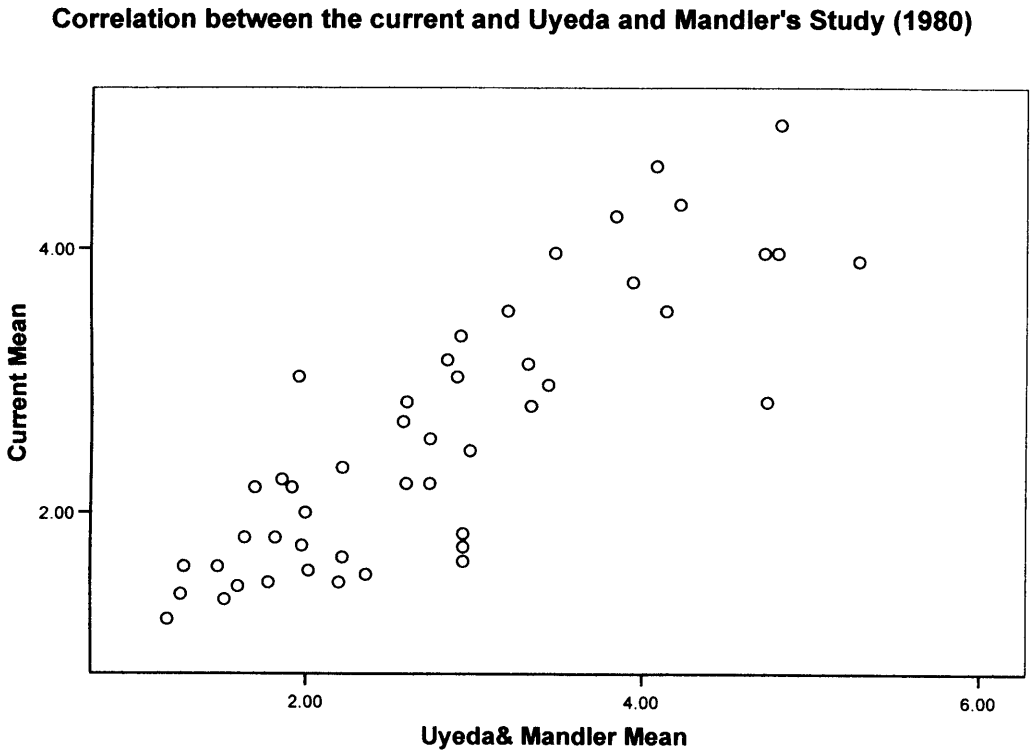
Appendix 5: Correlation between the current and Rosch's study (1975)



Appendix 5i: Data included in comparison of means between current and Rosch's study (1975)

Item	Category	Current Mean	Rosch Mean
Penguin	bird	5.28	4.53
Parrot	bird	3.16	2.07
Peacock	bird	4.25	3.31
Balloon	child's toy	4.25	3.07
Kite	child's toy	3.66	2.51
Glove	clothing	3.97	4.53
Belt	clothing	4.34	3.93
Pants	clothing	2.22	2.01
Boots	clothing	3.31	3.42
Tie	clothing	3.53	3.71
Blouse	clothing	2.25	1.27
Skirt	clothing	2.19	1.21
Sock	clothing	2.22	2.13
Jacket	clothing	1.47	1.68
Pyjamas	clothing	3.72	2.25
Banana	fruit	2.19	1.15
Pear	fruit	1.81	1.18
Pineapple	fruit	2.84	1.91
Tomato	fruit	3.91	5.58
lemon	fruit	2.69	2.16
apple	fruit	1.19	1.08
desk	furniture	3.03	1.54
stool	furniture	3.13	3.13
table	furniture	1.38	1.1
hammer	tool	1.34	1.34
saw	tool	1.59	1.04
axe	tool	2.84	4.53
drill	tool	1.66	1.59
ladder	tools	4.28	2.64
carrot	vegetable	1.44	1.15
tractor	transportation	3.75	3.3
rocket	transportation	6.06	4.74
bicycle	transportation	2.47	2.51
tank	weapon	3.53	2.74
arrow	weapon	3.97	2.66

Appendix 6: Correlation between the current and Uyeda and Mandler's study (1980)



Appendix 6i: Data included in comparison of means between the current and Uyeda and Mandler's study (1980)

Item	Category	Current Mean	Uyeda& Mandler Mean
parrot	Bird	3.16	2.84
balloon	child's toy	4.25	3.84
glove	Clothing	3.97	4.72
belt	Clothing	4.34	4.22
pants	Clothing	2.22	2.74
tie	Clothing	3.53	4.14
blouse	Clothing	2.25	1.86
skirt	Clothing	2.19	1.92
sock	Clothing	2.22	2.6
jacket	Clothing	1.47	2.2
caravan	Dwelling	4.63	4.08
tent	Dwelling	4.94	4.82
banana	Fruit	2.19	1.7
pear	Fruit	1.81	1.64
pineapple	Fruit	2.84	2.6
tomato	Fruit	3.91	5.28
lemon	Fruit	2.69	2.58
apple	Fruit	1.19	1.18
desk	Furniture	3.03	1.96
stool	Furniture	3.13	3.32
table	Furniture	1.38	1.26
colander	kitchen utensil	2.81	3.34
knife	kitchen utensil	1.47	1.78
saucepan	kitchen utensil	1.53	2.36
spoon	kitchen utensil	1.75	1.98
sink	kitchen utensil	3.97	4.8
drum	musical instrument	2.56	2.74
trumpet	musical instrument	1.81	1.82
saxophone	musical instrument	2.34	2.22
piano	musical instrument	1.59	1.48
violin	musical instrument	1.56	2.02
door	part of a building	2	2
window	part of a building	1.84	2.94
tongue	part of the human body	3.03	2.9
shoulder	part of the human body	1.74	2.94
teeth	part of the human body	2.97	3.44
hammer	Tool	1.34	1.52
saw	Tool	1.59	1.28
axe	tool	2.84	4.74
drill	tool	1.66	2.22
carrot	Vegetable	1.44	1.6
cabbage	Vegetable	1.63	2.94
tractor	Transportation	3.75	3.94
bicycle	transportation	2.47	2.98
tank	Weapon	3.53	3.2
arrow	Weapon	3.97	3.48
lightening	Weather	3.34	2.92

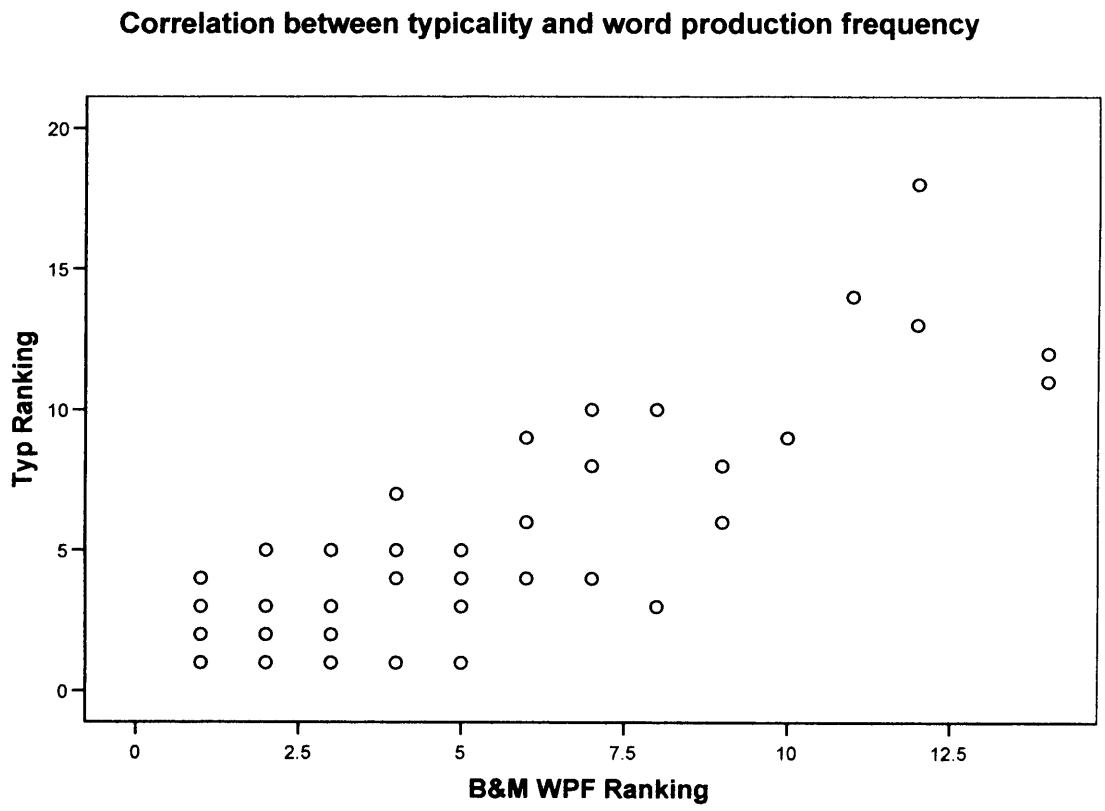
Appendix 7: Correlations Matrix demonstrating correlations existing between the different psycho-linguistic variables

		typ	fam	image	AoA	Oper	LFreq	Phonemes
typicality	Pearson Correlation	1	-.372(**)	-0.095	.176(**)	-.246(**)	-.266(**)	0.047
	Sig. (2-tailed)		0	0.087	0.001	0	0	0.401
	N	328	328	328	328	328	328	328
familiarity	Pearson Correlation	-.372(**)	1	.167(**)	-.462(**)	.347(**)	.666(**)	-.229(**)
	Sig. (2-tailed)	0		0.002	0	0	0	0
	N	328	328	328	328	328	328	328
imageability	Pearson Correlation	-0.095	.167(**)	1	-.129(*)	0.05	0.057	.192(**)
	Sig. (2-tailed)	0.087	0.002		0.02	0.366	0.305	0
	N	328	328	328	328	328	328	328
AoA (Age of Acquisition)	Pearson Correlation	.176(**)	-.462(**)	-.129(*)	1	-.201(**)	-.374(**)	.459(**)
	Sig. (2-tailed)	0.001	0	0.02		0	0	0
	N	328	328	328	328	328	328	328
Operativity	Pearson Correlation	-.246(**)	.347(**)	0.05	-.201(**)	1	-0.024	-.117(*)
	Sig. (2-tailed)	0	0	0.366	0		0.661	0.034
	N	328	328	328	328	328	328	328
LgcombLFreq (Frequency)	Pearson Correlation	-.266(**)	.666(**)	0.057	-.374(**)	-0.024	1	-.223(**)
	Sig. (2-tailed)	0	0	0.305	0	0.661		0
	N	328	328	328	328	328	328	328
Phonemes	Pearson Correlation	0.047	-.229(**)	.192(**)	.459(**)	-.117(*)	-.223(**)	1
	Sig. (2-tailed)	0.401	0	0	0	0.034	0	
	N	328	328	328	328	328	328	328

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Appendix 8: Spearman-r rank correlation demonstrating the correlation between rankings of typicality (current study) and Word Production Frequency, derived from Battig and Montague's Normative Tables (1969)



Appendix 8i: Data included in correlation comparing rankings between Typicality and Word Production Frequency (derived from mean typicality ratings from the current study and raw word production frequencies from Battig and Montague's normative tables (1969)

Item	Category	Typ Ranking	B&M WPF Ranking
penguin	Bird	3	3
parrot	Bird	1	1
peacock	Bird	2	2
glove	Clothing	9	6
belt	Clothing	10	7
pants	Clothing	3	8
boots	Clothing	6	9
tie	Clothing	7	4
blouse	Clothing	5	2
skirt	Clothing	2	3
sock	Clothing	3	1
jacket	Clothing	1	5
pyjamas	clothing	8	9
caravan	Dwelling	1	2
tent	Dwelling	2	1
tulip	Flower	2	1
daffodil	Flower	1	2
banana	Fruit	3	3
pear	Fruit	2	2
pineapple	Fruit	5	5
tomato	Fruit	6	6
lemon	Fruit	4	4
apple	Fruit	1	1
desk	Furniture	2	2
stool	Furniture	3	3
table	Furniture	1	1
spider	Insect	2	2
butterfly	Insect	3	3
ant	Insect	1	1
colander	kitchen utensil	5	5
corkscrew	kitchen utensil	6	6
kettle	kitchen utensil	4	7
knife	kitchen utensil	1	1
saucepan	kitchen utensil	2	3

spoon	kitchen utensil	3	2
sink	kitchen utensil	7	4
drum	musical instrument	5	2
trumpet	musical instrument	3	3
saxophone	musical instrument	4	5
piano	musical instrument	2	1
violin	musical instrument	1	4
baker	occupation/profession	8	7
conductor	occupation/profession	14	11
policeman	occupation/profession	3	5
soldier	occupation/profession	9	10
doctor	occupation/profession	2	1
cowboy	occupation/profession	18	12
dentist	occupation/profession	5	3
carpenter	occupation/profession	7	4
postman	occupation/profession	6	9
footballer	occupation/profession	13	12
gardener	occupation/profession	12	14
sailor	occupation/profession	10	8
teacher	occupation/profession	1	2
fisherman	occupation/profession	11	14
secretary	occupation/profession	4	6
door	Part of a building	2	2
window	Part of a building	1	1
muscle	Part of the human body	3	5
elbow	Part of the human body	2	2
tongue	Part of the human body	5	4
shoulder	Part of the human body	1	3
teeth	Part of the human body	4	1
hammer	Tool	1	1
saw	Tool	2	2
axe	Tool	4	4
drill	Tool	3	3
ladder	Tools	5	5
carrot	Vegetable	1	1
cabbage	Vegetable	2	2
tractor	Transportation	2	2
rocket	transportation	3	3
bicycle	transportation	1	1
tank	Weapon	1	1
arrow	Weapon	2	2

Appendix 9: Summary of a Forward Conditional Stepwise Logistic Regression for each individual with aphasia - Demonstrating: i) The percentage of correct cases (correct and incorrect responses) initially predicted by model ii)The independent variables which act as the strongest naming predictors for each individual and the percentage change brought about in the model as a result of their inclusion.

Part	% model	1st pred	Sig.	% model	2nd pred	sig.	% model	3rd pred	sig.	% model
AD	80.2%	Length	<0.0001	80.8%	Operativity	0.046	80.8%	--	--	--
AF	79.9%	AoA	<0.0001	79.9%	Length	0.024	79.3%	--	--	--
BB	62.8%	Length	<0.0001	67.7%	Freq	0.001	70.1%	Oper	0.011	70.7%
BG	73.5%	Oper	<0.0001	73.5%	AoA	0.022	72.3%	--	--	--
CD	66.2%	AoA	<0.0001	69.2%	Length	0.042	69.2%	Oper	0.033	70.4%
CS	65.2%	Freq	<0.0001	67.1%	Length	0.024	68.3%	--	--	--
ET	75.0%	Length	<0.0001	75.6%	AoA	0.018	78.7%	--	--	--
HP	73.5%	AoA	<0.0001	73.5%	Time	<0.0001	73.8%	--	--	--
JD	52.1%	AoA	<0.0001	62.5%	Freq	0.008	65.5%	--	--	--
JL	51.2%	AoA	0.001	59.8%	--	--	--	--	--	--
KI	77.1%	AoA	0.001	77.1%	Operativity	0.012	77.1%	Length	0.033	76.5%
KN	57.9%	AoA	<0.0001	61.0%	Operativity	0.006	62.2%	Freq	0.044	64.6%
LO	51.8%	AoA	<0.0001	67.1%	Freq	<0.0001	68.9%	Typ	0.016	66.5%
MC	55.2%	Length	<0.0001	68.6%	AoA	0.014	69.2%	Oper	0.039	70.4%
MH	56.4%	Length	<0.0001	63.1%	AoA	<0.0001	64.9%	--	--	--
ML	68.9%	Image	0.016	68.9%	Length	0.003	68.9%	Time	0.029	70.7%
PP	61.3%	AoA	<0.0001	69.8%	Length	<0.0001	70.4%	Operat	0.006	69.8%
PQ	88.1%	AoA	<0.0001	88.1%	--	--	--	--	--	--
RK	61.3%	Freq	0.020	61.3%	Operativity	0.003	66.2%	--	--	--
VC	57.3%	Oper	<0.0001	64.6%	AoA	0.006	65.9%	Time	0.011	64.9%

Appendix 10: Presentation order for picture naming task for people with aphasia

Presentation Order-Stage 1	Picture		Presentation Order -Stage 2	Picture
1	penguin		1	rocket
2	balloon		2	moustache
3	star		3	skirt
4	stable		4	gate
5	crab		5	spade
6	garage		6	saxophone
7	cow		7	bottle
8	horse		8	grass
9	frog		9	piano
10	footballer		10	saw
11	tea		11	soldier
12	sugar		12	elbow
13	medal		13	racquet
14	pie		14	lightening
15	pencil		15	tomato
16	glove		16	fairy
17	banana		17	battery
18	belt		18	diver
19	candle		19	tree
20	gardener		20	smoke
21	television		21	bucket
22	sandwich		22	stool
23	picture		23	wheel
24	magazine		24	curtain
25	grave		25	buckle
26	hedge		26	castle
27	muscle		27	bear
28	flower		28	family
29	pants		29	dart
30	baker		30	money
31	colander		31	doctor
32	aeriel		32	hoof
33	lighthouse		33	tractor
34	axe		34	clock
35	kennel		35	muzzle
36	bulb		36	lemon
37	orchestra		37	dinosaur
38	corkscrew		38	ladder
39	boots		39	sock
40	drum		40	bow
41	mirror		41	worm
42	teacher		42	telephone
43	pear		43	violin

44	kite		44	hospital
45	cigarette		45	caravan
46	tank		46	fisherman
47	conductor		47	acrobat
48	crocodile		48	cowboy
49	iron		49	computer
50	signal		50	scissors
51	submarine		51	cotton
52	king		52	baby
53	collar		53	barrel
54	tie		54	secretary
55	lamp		55	sleeve
56	shoulder		56	paint
57	vegetables		57	ink
58	triangle		58	camel
59	newspaper		59	bicycle
60	hammer		60	letter
61	elephant		61	mountain
62	arrow		62	saddle
63	fire		63	beak
64	kettle		64	envelope
65	blouse		65	cabbage
66	lighter		66	tiger
67	label		67	butter
68	clown		68	window
69	spider		69	tulip
70	parrot		70	ant
71	door		71	tent
72	knife		72	library
73	policeman		73	button
74	sailor		74	dentist
75	factory		75	jacket
76	brush		76	basket
77	tweezers		77	radio
78	desk		78	microscope
79	trumpet		79	carpenter
80	squirrel		80	snake
81	bread		81	spoon
82	microphone		82	tongue
83	saucepan		83	devil
84	teeth		84	sink
85	mermaid		85	box
86	binoculars		86	table
87	pocket		87	noose
88	carrot		88	bridge
89	peacock		89	ski
90	butterfly		90	apple
91	coffin		91	Camera

92	Drill		92	Magnet
93	Pyramid		93	Postman
94	Pineapple		94	Coffee
95	Farm		95	Fox
96	River		96	Pillow
97	Snail		97	Medicine
98	Furniture		98	Fence
99	Monkey		99	Typewriter
			100	Daffodil
			101	Pyjamas