HIERARCHICAL ORGANIZATION OF ABSTRACT NOUNS: IMPLICATIONS FOR NEUROLINGUISTIC THEORY

By

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To my wife, son, sister, and parents

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This has been a year full of extreme sadness and extreme joy. Thanks go out to everyone who has been there to lend support during the sad times but also those same people who have been there to celebrate the joyous times. Also, I extend enormous thanks to my committee, Dr. Edmonds and Dr. Reilly. Your patience and guidance throughout this process have allowed me to grow immensely as a researcher and writer.

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The organization and neural representation of concrete words has long been an intense area of interest in neurolinguistics. Many theories stress the importance of hierarchical organization of the lexical networks of concrete words (e.g., labrador–dog-animal). Hierarchical lexical organization maps well to the structure of the brain and provides a compelling account of the graceful degradation of naming seen in many neurological disorders. Very little remains known about abstract words (e.g., truth); however, converging evidence suggests that concrete and abstract words are unique in their neural representation. One possibility is that abstract words show a “loose” or non-hierarchical organization relative to concrete words. We investigated clustering of 400 highly abstract and concrete words in multi-dimensional space. Using a 7-pt Likert scale, participants (N=365) rated each target word on the following 12 dimensions: sensation, morality, ease-of-teaching, ease-of-modifying, action, thought, emotion, social interaction, time, space, quantity, polarity. Data reduction using factor analysis revealed three latent factors, corresponding roughly to: concreteness, emotion/social cognition, and magnitude. We then plotted similarities in 3-dimensional space using

hierarchical cluster analysis. These analyses showed that abstract words do cluster in hierarchies, but that these hierarchies are qualitatively distinct from concrete words.

At the most superordinate levels, emotion/social cognition are important grouping factors while at the most subordinate it is magnitude. These putative “clusters” encompass cognitive dimensions that are potentially represented in unique, distributed regions of the human brain (e.g., magnitude as parietally mediated, emotion as right hemisphere or amygdala mediated). We discuss implications for theory of abstract and concrete word representation.

CHAPTER 1
HIERARCHICAL ORGANIZATION OF ABSTRACT NOUNS

Much is known about the structure and organization of concrete concepts (e.g., dog, desk, cup) and their representation in the human brain. However, there remain fundamental gaps in our understanding of how abstract words such as love, truth, and happiness are represented. These gaps in theory have produced an incomplete picture of language and cognition. Abstract concepts comprise a significant portion of adult language. Therefore, a more comprehensive understanding of the underlying structure of abstract words is necessary before we can truly understand the nature of language in a holistic manner.

One of the fundamental principles of neuroscience is that the brain is optimized for hierarchical processing. Although most research on hierarchical processing has focused on sensation and perception (e.g., cortical visual processing), there exists a wide body of literature to support the claim that some elements of language (i.e., word meaning) are also organized hierarchically. Rosch and colleagues (1981; 1975; 1976) performed pioneering work in the domain of hierarchical organization of concrete concepts, postulating that objects are naturally categorized into basic level categories. Objects in these basic level categories share many common attributes, similar motor programs, and similar shapes. These basic level categories combine (superordinate categories) and diverge (subordinate categories) creating a hierarchical organization of concrete concept knowledge. Whereas hierarchical organization of concrete concepts is widely accepted, it remains unclear whether abstract concepts display this same hierarchical organization. An understanding of this hierarchical organization in abstract concepts, if present, would represent a significant step forward in determining a complete theory of

abstract concept structure. Therefore, our aim in this study was to determine whether abstract concepts displayed a hierarchical organization.

Differences between Abstract and Concrete

Theories of the organizational structure of abstract concepts are motivated by a variety of differences between concrete and abstract concepts. Concrete concepts have been operationally defined as being spatiotemporally bound to a definite time and place in space (Hale, 1988). In contrast, abstract concepts are operationally defined by the absence of spatiotemporal binding, existing without ties to a specific time or place in space (Hale, 1988). The differences between abstract and concrete concepts extend past their operational definition as they have been found to posses differences both in their psycholinguistic attributes as well as the richness of their association in the brain.

Psycholinguistically, abstract concepts have a greater incidence of polysemy (i.e., multiple meanings that are semantically related) and homonymy (i.e., multiple meanings that are not semantically related; Crutch & Jackson, 2011). The increased incidence of polysemy weakens the relationship between word and concept due to the semantically related meanings of a word occupying a similar semantic space. Abstract concepts, therefore, are considered to be more difficult to learn than concrete concepts. This finding has received converging support from developmental studies of learning in young children and also in retrospective analyses of age of acquisition (Gilhooly & Logie, 1980; Reed & Dick, 1968). A consistent finding in both domains is that abstract words tend to be acquired much later than concrete words(Bonner, et al., 2009).

Although psycholinguistic differences reveal some differences in the structure and organization of abstract and concrete concepts, a phenomenon known as the word concreteness effect has unveiled additional evidence for differences in the structure and

organization of concrete and abstract concepts. The word concreteness effect is a term describing the collective advantage for concrete over abstract words in a variety of domains, including recall accuracy (Walker & Hulme, 1999), age of acquisition (Gilhooly & Logie, 1980), word list memory (Allen & Hulme, 2006), naming latency (Bleasdale, 1987), word recognition (Schwanenflugel, Harnishfeger, & Stowe, 1988), and resilience to neurological injury (Franklin, Howard, & Patterson, 1995; Katz & Goodglass, 1990; Martin & Saffran, 1992; Roeltgen, Sevush, & Heilman, 1983; Warrington, 1975).

Theories of Abstract Structure and Organization

Many theories have emerged in an attempt to explain the word concreteness effect. There are two theories, however, that have been particularly influential, the Context Availability Model (Schwanenflugel, et al., 1988; Schwanenflugel & Shoben, 1983) and the Dual Coding Theory (Paivio, 1991).

The Context Availability Model proposes the dissociation between abstract and concrete concepts is due to differences in verbal context. In the Context Availability Model, verbal context can be understood as information (supplied by discourse or the individual's prior knowledge) that allows for enriched association between concepts. Increased association is postulated to lead to a richer representation of the concept in the brain (Schwanenflugel, et al., 1988; Schwanenflugel & Shoben, 1983). Concrete concepts, therefore, have greater availability to contextual information due to greater availability of contextual information. Stronger availability of contextual information for concrete concepts can be illustrated by comparing a concrete concept such as dog with an abstract concept such as magnitude. While associated information for a concept such as dog is readily available, the associated information for a concept such as magnitude is less available.

The Dual Coding Theory postulates that differences in processing between concrete and abstract concepts arise from the presence of both linguistic information and experiential (i.e., visual and verbal codes) information, whereas abstract concepts are only supported by linguistic information (Paivio, 1991). The Dual Coding Theory predicts that the concreteness effect is the result of dual, redundant representation for concrete words in two parallel semantic systems (i.e., visual and verbal). Dual Coding Theory has consequently been described as representing a class of multiple semantics theories, premised on the idea that conceptual knowledge is supported by dissociable semantic memory subsystems.

Both the Dual Coding Theory and Context Availability Model postulate that inherent differences between concrete and abstract concepts have led to differences in the structure and organization of concrete and abstract concepts. A more recent theory on the structure and organization of semantic memory by Kousta and collegues (2011; 2009) argues that all concepts, whether concrete or abstract display an embodied structure and organization. The word concreteness effect has often been postulated to be incongruent with an embodied structure and organization for abstract concepts. Kousta and colleagues (2011), however, were able to eliminate the word concreteness effect by controlling for context availability and imageability. They explain that unlike concrete concepts, which are mostly supported by sensorimotor information, abstract concepts are mostly supported by affective information.

Although the theory by Kousta and colleagues contributes an important piece to our overall understanding of abstract concept structure and organization, there are still important questions that remain unanswered. It is still wholly unclear whether abstract

concepts display a hierarchical organization as is seen in concrete concepts. For this question to be answered, however, it was necessary to determine the features of abstract concepts as the features of a concept are an important aid in their organization.

As previously discussed, sensorimotor information has been found to play a role in the structure and organization of concrete concepts (Paivio, 1991; Schwanenflugel, et al., 1988). We hypothesized, however, that generating features for abstract concepts, due to their low imageability, would likely involve a broader set of cognitive domains such as affective information. In this study, we attempted a novel approach to analyzing the features of abstract words that considered this broader set of cognitive domains.

With this expanded set of domains and features we then attempted to determine if abstract concepts displayed a hierarchical organization as is seen in concrete words. Our hypothesis was that abstract concepts would display a hierarchical organization as is seen in concrete concepts.

CHAPTER 2
METHOD

Overview

In the experiment to follow we examined Likert scale ratings for concrete and abstract nouns across a variety of cognitive constructs (e.g., emotional valence, social cognition). Our aim was to evaluate the presence of latent factors that organize the lexical networks of abstract and concrete words. We mathematically modeled the clustering of latent variables using standard data reduction procedures (i.e., factor analysis) with hierarchical cluster analysis.

Participants

Participants were recruited through the online crowd-sourcing program, Mechanical Turk (Amazon Incorporated, 2012). Participants were nominally compensated for completing anywhere from 1 to all 12 surveys. Inclusion criteria required participants to be native English speakers residing in the United States. Participants assented informed consent in accord with the experimental protocol approved by the University of Florida's Social and Behavioral Institutional Review Board (IRB-02). Age ranged between 17 and 83 years of age with an average age of 40.77 and a level of education that ranged from 9 to 20 years with an average education of 15.35 years. Two hundred forty nine surveys were completed by females (68.2%) and 116 surveys were completed by males (31.8%).

Materials and Procedure

Four hundred nouns were chosen from the Medical Research Council (MRC) Psycholinguistic Database (Coltheart, 1981) to be included in this study. Ratings of imageability, age of acquisition (AOA), concreteness, and familiarity were accumulated

from the MRC database for all 400 nouns while frequency ratings were gathered from the Brysbaert and New (2009) database. These psycholinguistic variables were input into our analyses as dependent variables. Half of the nouns chosen were classified as concrete and the other half as abstract. Nouns were classified as concrete when imageability scores were above 500. Nouns were classified as abstract when imageability scores were below 450. The average imageability rating for concrete nouns was 611.42 while the average imageability rating for abstract nouns was 303.74.

A broad set of cognitive domains were considered in order to determine the features of abstract concepts. They are as follows: emotion (Vuilleumier, Armony, Driver, & Dolan, 2003), social cognition (Amodio & Frith, 2006), executive function (Stuss, Shallice, Alexander, & Picton, 1995), time (Walsh, 2003) and episodic memory (Moscovitch, Nadel, Winocur, Gilboa, & Rosenbaum, 2006; Squire, 1982), spatial cognition (Burgess, Maguire, & O'Keefe, 2002), and magnitude (Walsh, 2003). From these broad cognitive domains we created 12 finer grained parameters: sensation, morality, ease of teaching, ease of modifying, action, thought, emotion, social interaction, time, space, quantity, and polarity. A description of these parameters as presented to participants can be found in Appendix A.

A survey was created for each of the 12 parameters (12 surveys). Each survey included all 400 nouns in a pseudorandomized order. Participants were asked to make judgments using a seven point Likert scale on whether they agreed or disagreed with a statement regarding the parameter in question (see Appendix B for anchor points). Participants were instructed to use the entire scale and to work quickly but not carelessly.

Data Collection

As stated earlier, participants were recruited through the online program Mechanical Turk. Mechanical Turk represents an online pool of workers from around the globe who perform virtual tasks. Mechanical Turk has been utilized extensively in recent human factors research studies and has been formally evaluated for validity and reliability (Buhrmester, Kwang, & Gosling, 2011). Utilizing this online survey tool allowed us to increase the external validity and inferential power of our task through diverse and rapid sampling. In order to complete our task, the participant had to complete an online survey created within Survey Monkey (SurveyMonkey.com LLC, 2011).

Data Analyses

We excluded participant data that corresponded to one or more of the following conditions: 1) Taking less than 600 seconds (i.e. 10 minutes) to complete the survey, 2) Using less than half of the seven point likert scale (i.e. 3 numbers or less), and 3) More than 20 of the same response in a row.

A factor analysis was then performed in the Statistical Package for the Social Sciences (SPSS) version 18, in order to determine potential latent factors across the 12 parameters chosen. Following the identification of latent factors, the factor scores, which are a standard score output of the factor analysis, were correlated with the psycholinguistic variables of imageability, concreteness, familiarity, AOA, and frequency.

A hierarchical agglomerative cluster analysis was then performed in order to determine the cluster properties of the 400 nouns. Agglomerative clustering involves grouping observations with a bottom up approach until all observations become one cluster group. Ward's clustering method was chosen as it has been found to be very

efficient and resistant to outliers (Ward, 1963). In order to determine distance between observations, the Euclidean squared coefficient was used as it is the geometric distance in the multidimensional space.

A method outlined by Aldenderfer and Bashfield (1984) was then implemented to determine what number cluster solution would be appropriate for the data. The method involved comparing cluster solutions with partitional k-means solutions. The two solutions were compared using Cohen's Kappa. After the most appropriate solution was determined, t-tests were completed in order to determine differences between clusters for the chosen psycholinguistic variables and the factor scores of the latent factors.

CHAPTER 3
RESULTS

Data Trimming

The investigator and a rater blind to the purpose of the study displayed a 99.3% inter-rater agreement on surveys to be excluded. Of the original 545 surveys, 180 (33%) were eliminated leaving 365 surveys for final analysis.

Exploratory Factor Analysis

We conducted an Exploratory Factor Analysis using a principal components (PCA) method of extraction, and three latent factors were extracted based on their Eigenvalues (model fit, R^2=.81). We reduced the original set of 12 factors via a Varimax rotation method with Kaiser Normalization. This procedure yielded a new, lower dimensionality space representing linear combinations of groups of factors (approximating latent variables). We saved these factor loadings as new variables (see Table 3-1). Factors agglomerated as follows: 1) Emotion, Polarity, Social, Morality, Action, Thought; 2) Ease of Teaching, Sensation, Ease of Modifying, Time; 3) Space, Quantity.

Factor scores, which are a z-score derivative of the variance, were computed by SPSS using the Anderson-Rubin (1956) method. This method was chosen due to its creation of uncorrelated factor scores.

The three new factors were analyzed in order to determine with which psycholinguistic factors they were significantly ($\alpha \leq .01$) correlated (Table 3-2). Factor 1 was significantly correlated with concreteness (-.557), imageability (-.361), frequency (.255), AOA (.227), and familiarity (.163). Factor 2 was significantly correlated with AOA (-.844), concreteness (.784), imageability (.725), familiarity (.506), frequency (.401).

Factor 3 was significantly correlated only with familiarity (.237). Each of the three new latent factors was given a title, which suggested a common theme displayed by the parameter members. The first factor, which contained the parameters of emotion, polarity, social construct, morality, action and thought, was a factor representing affective association and social cognition. The second factor, which contained the parameters ease of teaching, ease of modifying, sensation, and time, was highly correlated with AOA, concreteness, and imageability and was deemed a factor similar to concreteness. The third factor, which contained the space and quantity parameters, was not found to be highly correlated with any psycholinguistic variable and was deduced to be a factor of magnitude. Figure 3-1 displays the factor scores for each word represented in a three dimensional scatter plot. Concrete nouns are represented by orange circles and abstract nouns are represented by blue X's.

Hierarchical Cluster Analysis

Hierarchical cluster analysis revealed a possible 10, 11, 12 or 13 cluster solution. In order to determine whether this 10, 11, 12 or 13 cluster solution was a good fit for the data, the clusters from the hierarchical cluster analysis were compared to the clusters created by a partitional k-means iterative analysis using Cohen's Kappa (Aldenderfer & Blashfield, 1984). The 12 cluster solution had the greatest Cohen's Kappa (.87) and was therefore considered the best solution.

Cluster Group Differences

The hierarchical cluster analysis revealed that the 12 clusters combined upwards 5 levels until they merged into one group (see Figure 3-2, 3-3, & 3-4). The membership of each cluster is presented in Appendix C. T-tests were performed to compare differences between neighboring clusters for psycholinguistic variables and factor scores. It should

be noted that since the factor scores are z-scores and come from data measured on the same scale, the mean difference between the two clusters is synonymous with the Cohen's d and will be reported as such. Table 3-3 displays the individual means of the psycholinguistic variables and factor scores for each cluster, while also displaying the mean difference for the closest cluster neighbor. Significant mean differences as indicated by the t-tests are represented by asterisks. Each cluster was then given a description and cluster number as seen in Figures 3-2, 3-3, and 3-4. The description of each cluster represents a common theme seen in the word members of each cluster, while the cluster number represent the hierarchical level, from top to bottom, and order, from left to right. For instance, cluster C2.3 is a cluster in the second level and is third from the left.

Table 3-1. Factor analysis/component matrix for dimensions

	Component		
Predictor	Factor 1	Factor 2	Factor 3
Emotion	.905	.229	-.027
Positive/Negative	.880	-.115	.235
Social	.855	.280	.090
Morality	.794	.479	.057
Action	.722	.517	.169
Thought	.719	.594	.094
Ease of Teaching	-.376	-.880	-.040
Sensation	-.447	-.846	-.026
Ease of Modifying	.104	-.736	.310
Time	.350	.685	.319
Space	-.006	-.208	.846
Quantity	.273	.412	.691

Note: The above component matrix was derived using SPSS-18's factor analysis algorithm employing a Varimax rotation with Kaiser normalization. The rotation converged after five iterations.

Table 3-2. Psycholinguistic and Factor Score Correlation Matrix

	Imag	AOA	Frqy	CNC	Fam	Emo	Cnc/Tch	Mag
Imag	1							
AOA	-.86*	1						
Frqy	.22*	-.44*	1					
CNC	.94*	-.85*	.21*	1				
Fam	.29*	-.56*	.44*	.27*	1			
Emo	-.36*	.23*	.26*	-.56*	.16*	1		
Cnc/Tch	.73*	-.84*	.40*	.78*	.51*	0	1	
Mag	-.01	-.03	.09	-.06	.24*	0	0	1

Note: Imag=Imageability, AOA=Age of Acquisition, Frqy=Frequency, CNC=concreteness, Fam=Familiarity, Emo=Emotion/Social Cognition, Cnc/Tch=Concreteness/Ease of Teaching, Mag=Magnitude, *=p<.01

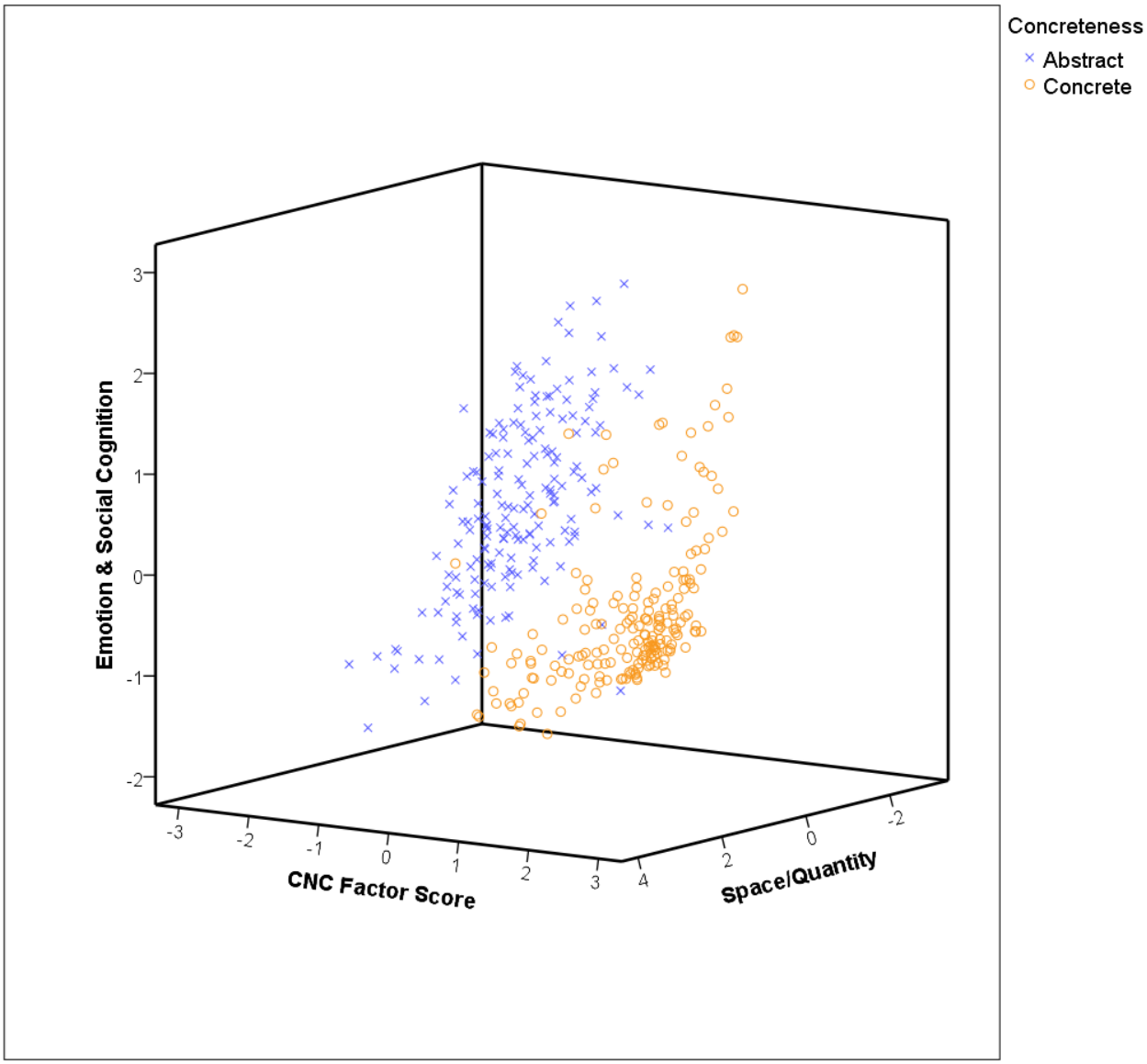


Figure 3-1. Three-dimensional representation of factor scores. Blue X's represent abstract nouns while orange circles represent concrete nouns. CNC= concreteness.

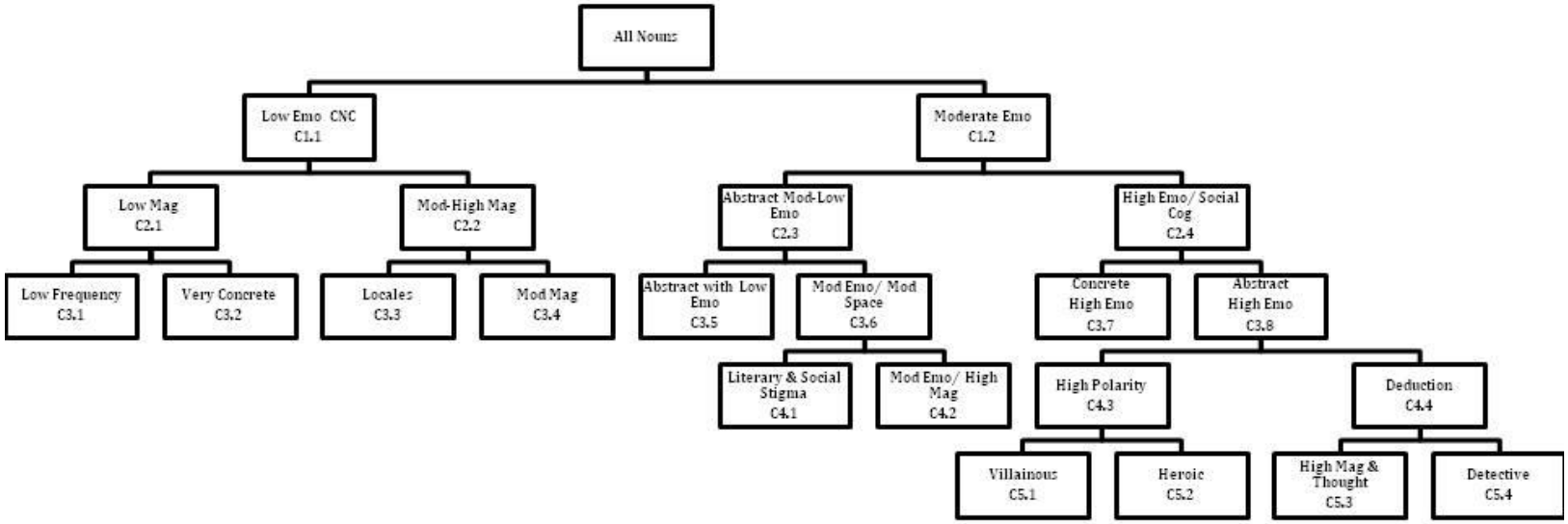


Figure 3-2. Hierarchical cluster analysis with cluster descriptions and numbers

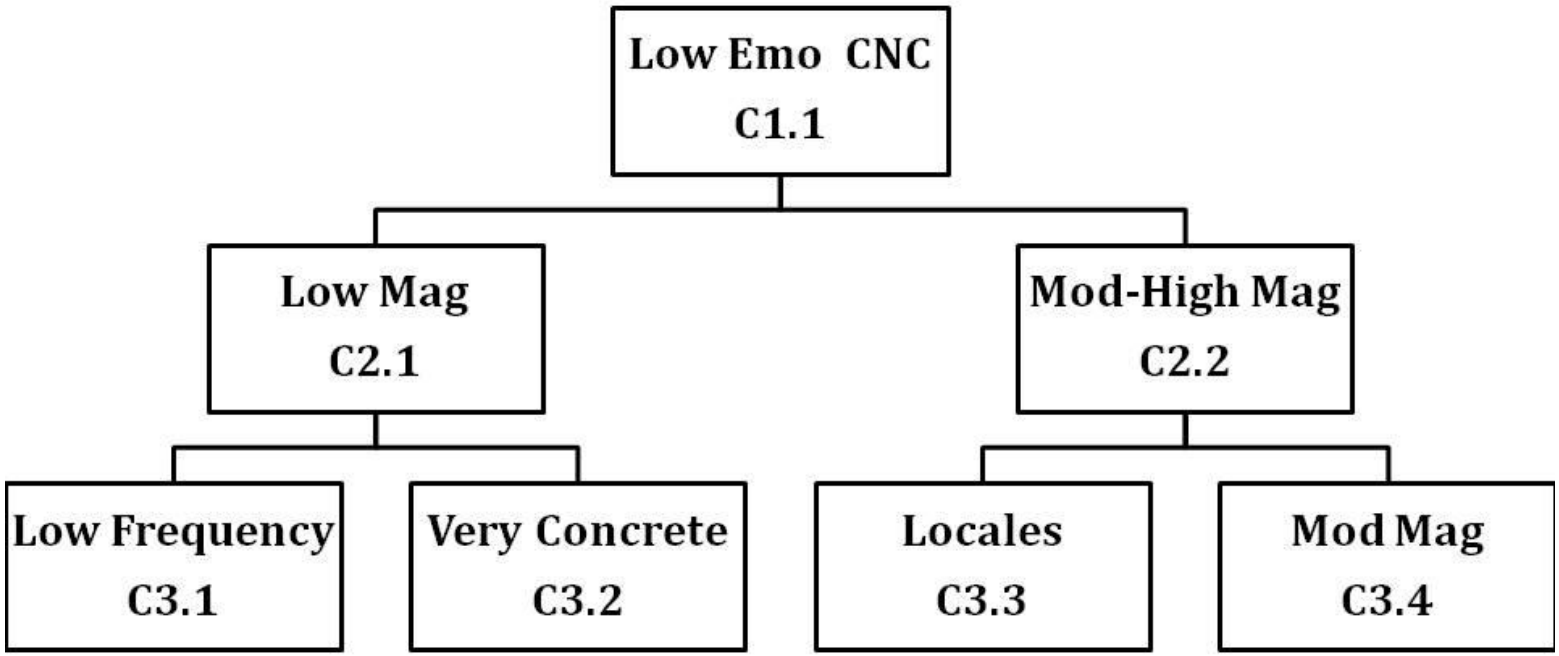


Figure 3-3. Left side of the hierarchical cluster analysis with cluster descriptions and numbers.

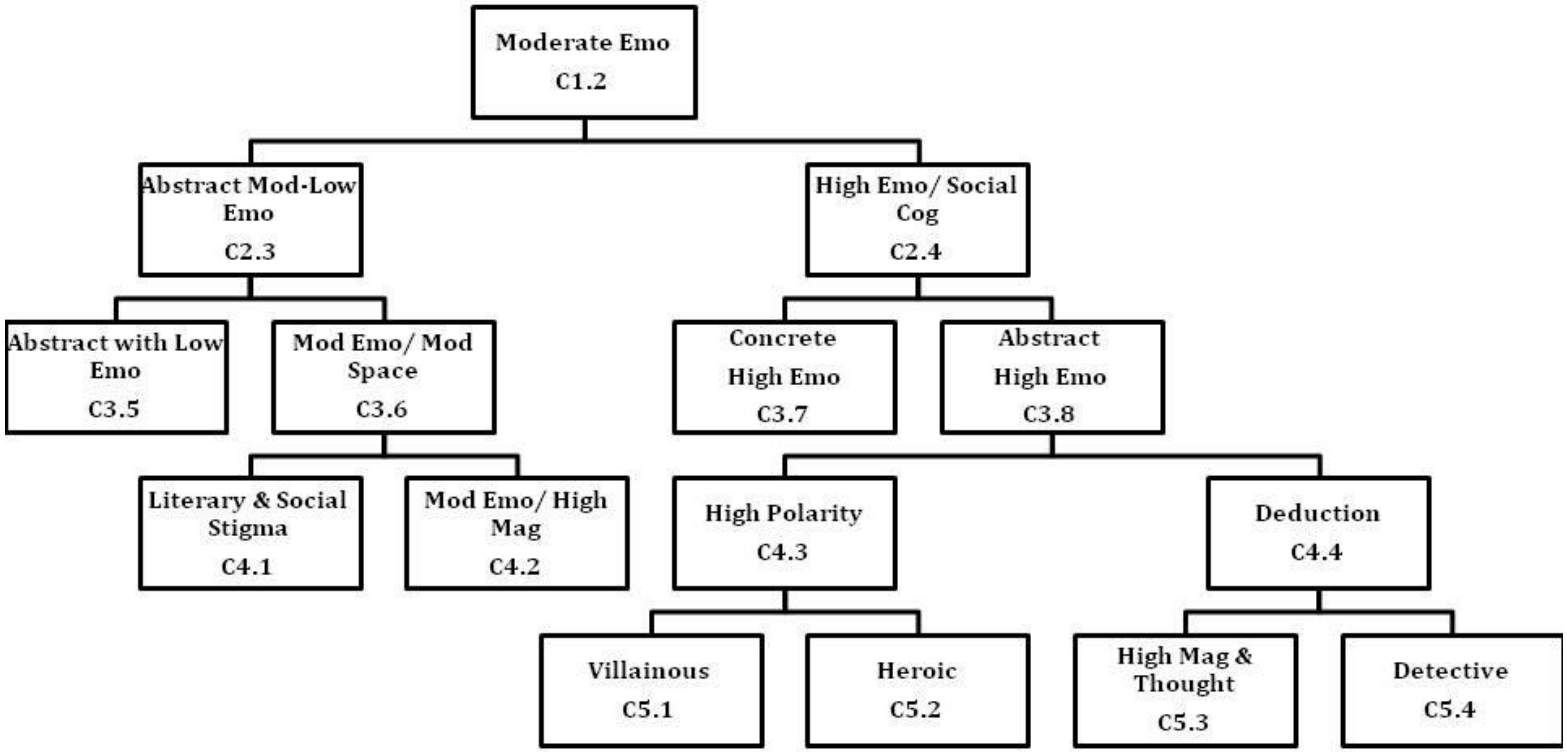


Figure 3-4. Right side of the hierarchical cluster analysis with cluster descriptions and numbers

Table 3-3. Means and mean differences of clusters

	C1.1	C1.2	MD	C2.1	C2.2	MD	C2.3	C2.4	MD	C3.1	C3.2	MD
Imag	600.12	349.54	250.58*	598.92	601.87	2.95	300.18	392.05	91.87*	595.54	618.53	22.99
AOA	279.68	461.80	182.12*	274.19	286.06	11.87	501.44	425.47	75.97*	280.07	249.86	30.21
Frqy	33.49	37.68	4.19	19.80	53.54	33.74*	7.72	64.84	57.12*	14.05	53.98	39.93*
CNC	594.72	337.55	257.17*	599.72	587.46	12.26*	308.19	361.11	52.92*	598.67	605.60	6.93
Fam	536.10	518.45	17.65*	526.10	550.58	24.48*	492.15	540.32	48.17*	519.33	564.40	45.07*
Emo	-0.74	0.58	1.32	-0.78	-0.72	0.06	-0.09	1.18	1.27	-0.86	-0.15	0.71
Cnc/Tch	0.69	-0.54	1.23	0.64	0.76	0.12	-1.21	0.07	1.28	0.54	1.25	0.71
Mag	-0.01	0.01	0.02	-0.81	1.78	2.59	-0.20	0.19	0.39	-0.85	-0.55	0.30

	C3.3	C3.4	MD	C3.5	C3.6	MD	C3.7	C3.8	MD	C4.1	C4.2	MD
Imag	587.05	608.22	21.17	340.81	283.56	57.25*	563.09	345.76	217.33*	240.38	289.52	49.14
AOA	311.50	270.00	41.5	500.53	501.92	1.39	221.00	466.36	245.36*	617.00	495.15	121.85*
Frqy	38.85	59.71	20.86	6.14	8.49	2.35	223.05	26.53	196.52*	1.48	9.37	7.89
CNC	585.65	588.21	2.56	326.73	299.42	27.31*	574.48	305.10	269.38*	285.67	301.10	15.43
Fam	534.70	557.06	22.36	485.19	495.28	10.09	584.95	528.60	56.35*	424.43	505.00	80.57*
Emo	-0.88	-0.65	0.23	-0.80	0.25	1.05	1.23	1.17	0.06	-0.34	0.33	0.67
Cnc/Tch	0.68	0.80	0.12	-1.59	-1.02	0.57	1.69	-0.32	2.01	-1.59	-0.95	0.64
Mag	2.55	0.60	1.95	0.54	-0.56	1.10	-0.30	0.31	0.61	-1.48	-0.45	1.03

	C4.3	C4.4	MD	C5.1	C5.2	MD	C5.3	C5.4	MD
Imag	380.10	327.04	53.06*	370.13	383.73	13.60	362.67	309.70	52.97*
AOA	474.94	461.94	13	512.50	463.38	49.12	442.67	478.00	35.33
Frqy	19.70	30.35	10.65	7.40	23.50	16.10	45.46	22.97	22.49
CNC	294.80	311.28	16.48	272.25	303.00	30.75	312.53	310.64	1.89
Fam	512.30	538.38	26.08*	465.63	529.27	63.64*	557.59	528.48	29.11*
Emo	1.59	0.94	0.65	1.34	1.67	0.33	1.62	0.60	1.02
Cnc/Tch	-0.12	-0.43	0.31	-0.45	-0.02	0.43	0.05	-0.67	0.72
Mag	-0.50	0.76	1.26	-1.60	-0.17	1.43	0.99	0.65	0.34

Note: Imag=Imageability, AOA=Age of Acquisition, Frqy=Frequency, CNC=concreteness, Fam=Familiarity, Emo=Emotion/Social Cognition Cnc/Tch=Concreteness/Ease of Teaching, Mag=Magnitude, MD=Mean Difference, *=p<.05

CHAPTER 4
DISCUSSION

General Discussion

Much remains to be learned about the linguistic and neurological representation of abstract words. Advances in this domain can be aided by a vast body of research on the hierarchical representation of concrete words. We investigated clustering and conceptual features of abstract words. In order to determine if abstract concepts displayed a hierarchical organization it was necessary to determine the features of abstract concepts. Concrete concepts have salient sensorimotor features which aid in their hierarchical organization while abstract concepts do not. It was, therefore, necessary to expand our search beyond sensorimotor features to include a range of alternate cognitive domains.

The 12 parameters we chose, which represented several broad cognitive domains, were found to represent three distinct latent factors: emotion/social cognition, concreteness, and magnitude. These new factors were then input into our model to determine if abstract concepts displayed a hierarchical organization. It was revealed that abstract concepts do display a hierarchical organization.

A level by level analysis of the hierarchy revealed several findings. At the most superordinate level the nouns separated into two clusters (C1.1 & C1.2). Essentially these two clusters were concrete nouns (C1.1) and abstract nouns (C1.2). There were also comparable differences in the level of emotion/social cognition of the clusters with nouns low in emotion/social cognition being represented in C1.1 and nouns moderate to high in emotion/social cognition being represented in C1.2. While it is unsurprising that

the nouns would cluster based on concreteness, it is unexpected that nouns would cluster relative to emotion/social cognition at the most superordinate level.

The role of emotional valence in the organization of concepts is a fairly recent development. Altarriba and colleagues (1999) have argued that highly emotionally valent concepts should occupy their own place in the semantic space separate from concrete and abstract concepts. More recently Kousta and colleagues (2011) have argued for an embodied theory of semantic memory, that unlike other embodied theories includes abstract concepts. Unlike Altarriba and colleagues, Kousta and colleagues argue that highly emotionally valent words should not occupy their own space, but that valence is an important factor in the organization of abstract concepts.

Our findings support Kousta and colleagues' assertion, as the emotion/social cognition factor was found to be an organizing factor at the superordinate levels of the hierarchy. In addition, our findings suggest that valence not only aids in the organization of abstract concepts but also provides an organizational structure to concrete concepts. In Figure 3-4, take note of Cluster C3.7, which is comprised of predominately concrete nouns but is nested on the abstractly dense side of the hierarchy. This cluster, however, unlike the other clusters of concrete nouns, contains concrete nouns high in emotion/ social cognition (e.g., father and chocolate). According to this hierarchy, therefore, this cluster of nouns aligns closer to abstract concepts such as cowardice and freedom than other concrete concepts such as fisherman and corn.

One of the most novel findings of this study came from examination of the magnitude factor. To date, no studies have examined a magnitude factor as a possible factor of importance in the organization of concepts. Our study revealed, however, that

the magnitude factor does have a role in the organization of concepts, at the most subordinate levels of the hierarchy. It is important to note that this factor was not found to correlate with any of the psycholinguistic variables including imageability and concreteness. These findings demonstrate that the magnitude factor can be differentiated from concreteness; as it could be assumed that as a factor of orientation and size, this factor would be related to concreteness. The lack of correlation with concreteness may be due to space and quantity being part of what Walsh (2003) theorized as a distinct magnitude system in the brain. Walsh, however, grouped time in with space and quantity, which was not supported by our data. Some models of the factor analysis did place the time factor with the space and quantity factor, but these models were not the best-fit model and were therefore not applied. The fact that time was not grouped with space and quantity may have been due to our attempts to simplify parameters in order to facilitate understanding in participants.

A number of caveats should be noted when considering the findings in this current study. One concern relates to the specificity of the domains being tested. The rating labels and descriptions presented to participants (e.g. ‘Sensation’, ‘Time’) were deliberately broad and non-technical in order to ensure that participants had a clear understanding of and confidence in the judgments they were being asked to make. Using such lay terminology inevitably leads to uncontrolled variation in rating specificity. For example, ratings for ‘Social interaction’ could potentially be influenced by many different social cognitive processes such as mental state attribution or empathy. A second but related point concerns the number of rating variables selected. The list of broad cognitive domains selected was by no means exhaustive, and some domains

could have been fractionated into multiple domains. For example, the ‘Sensation’ variable could have been subdivided into separate ratings for vision, audition, gustation, olfaction and different types of somatosensory information. Such a division might provide much richer feature ratings particularly for concrete items, but these modalities were combined so as to limit the number of different ratings requested from each participant, and because the focus of the study was upon the conceptual structure of abstract words and the contribution of non-sensorimotor domains.

Conclusion

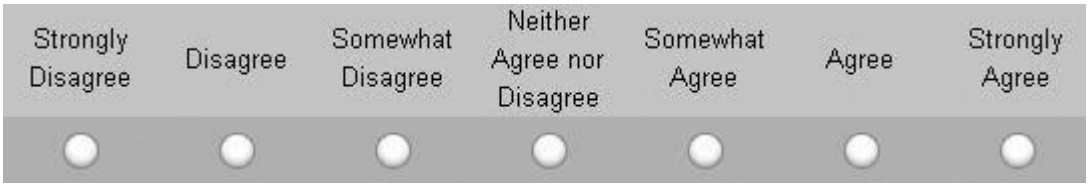
Our findings demonstrate that abstract concepts, like concrete concepts, exhibit a hierarchical organization. We also confirmed the important role of emotion/social cognition in the organization of concepts. In addition, the distinct domain of magnitude was discovered to serve a purpose in the organization of concepts. These findings display a departure from widely held theories of abstract concepts such as the dual coding theory and context availability model. These theories contend that abstract and concrete concepts are qualitatively different. It is also possible to infer that these theories would suggest that abstract concepts would not display a hierarchical organization. Our findings, however, suggest that differences between abstract and concrete concepts may be more indicative of the types of information that support the concept (e.g. valence, magnitude) rather than the strength or availability of information as suggested in previous theories. These findings also suggest that the structure and organization of concrete concepts and abstract concepts may display more similarities than differences, which is a separation from previous thought on abstract concept structure. Our results also suggest the possibility of new neuroanatomical correlates for abstract concepts, although our study cannot directly speak to this assertion.

Overall, we contend that these findings represent a new approach to the understanding of abstract concepts. Although these findings are a promising foundation for a new theory of abstract concept structure and organization, there remain too many unanswered questions to be able to consider the theory complete. As previously stated, the list of cognitive domains tested was not exhaustive, and further research is necessary to determine the presence of additional factors that aid in the organization of abstract concepts. While our findings support the presence of a hierarchical organization of abstract concepts, questions remain as to whether abstract concepts also display an embodied organization. Future research will investigate abstract concept structure through the effects of priming in both healthy and diseased populations as well as exploring lesion models such as Parkinson's disease (PD; difficulties with emotion) and corticobasal degeneration (CBD; visual spatial difficulties).

APPENDIX A
PARAMETER DESCRIPTION

Parameter	Definition
Polarity	I relate this word to positive or negative feelings in myself.
Sensation	I relate this word to physical feelings like vision, hearing, smelling, etc.
Action	I relate this word to actions, doing, performing and influencing.
Thought	I relate this word to mental activity, ideas, opinions, and judgments.
Emotion	I relate this word with human emotion.
Social interaction	I relate this word with relationships between people.
Time	I relate this word with time, order, or duration.
Space	I relate this word to position, place or direction.
Quantity	I relate this word to size, amount or scope.
Morality	I relate this word to morality, rules or any thing that governs my behavior.
Ease of modifying	I can easily choose an adjective for this word (the ugly truth, whole truth, etc.)
Ease of teaching/learning	This word could be easily taught to a person who does not speak English.

APPENDIX B
LIKERT SCALE ANCHOR POINTS



APPENDIX C
CLUSTER MEMBERSHIP

Word	1st Level	2nd Level	3rd Level	4th Level	5th Level
Abundance	C1.2	C2.4	C3.8	C4.4	C5.4
Ambition	C1.2	C2.4	C3.8	C4.4	C5.4
Arrangement	C1.2	C2.4	C3.8	C4.4	C5.4
Attention	C1.2	C2.4	C3.8	C4.4	C5.4
Awareness	C1.2	C2.4	C3.8	C4.4	C5.4
Comparison	C1.2	C2.4	C3.8	C4.4	C5.4
Competence	C1.2	C2.4	C3.8	C4.4	C5.4
Comprehension	C1.2	C2.4	C3.8	C4.4	C5.4
Conclusion	C1.2	C2.4	C3.8	C4.4	C5.4
Consequence	C1.2	C2.4	C3.8	C4.4	C5.4
Corporation	C1.2	C2.4	C3.8	C4.4	C5.4
Debt	C1.2	C2.4	C3.8	C4.4	C5.4
Decision	C1.2	C2.4	C3.8	C4.4	C5.4
Democracy	C1.2	C2.4	C3.8	C4.4	C5.4
Determination	C1.2	C2.4	C3.8	C4.4	C5.4
Disaster	C1.2	C2.4	C3.8	C4.4	C5.4
Economy	C1.2	C2.4	C3.8	C4.4	C5.4
Event	C1.2	C2.4	C3.8	C4.4	C5.4
Evidence	C1.2	C2.4	C3.8	C4.4	C5.4
Fact	C1.2	C2.4	C3.8	C4.4	C5.4
Importance	C1.2	C2.4	C3.8	C4.4	C5.4
Incentive	C1.2	C2.4	C3.8	C4.4	C5.4
Intention	C1.2	C2.4	C3.8	C4.4	C5.4
Introduction	C1.2	C2.4	C3.8	C4.4	C5.4
Logic	C1.2	C2.4	C3.8	C4.4	C5.4
Miracle	C1.2	C2.4	C3.8	C4.4	C5.4
Moment	C1.2	C2.4	C3.8	C4.4	C5.4
Occupation	C1.2	C2.4	C3.8	C4.4	C5.4
Outcome	C1.2	C2.4	C3.8	C4.4	C5.4
Ownership	C1.2	C2.4	C3.8	C4.4	C5.4
Perception	C1.2	C2.4	C3.8	C4.4	C5.4
Possibility	C1.2	C2.4	C3.8	C4.4	C5.4
Prediction	C1.2	C2.4	C3.8	C4.4	C5.4
Presence	C1.2	C2.4	C3.8	C4.4	C5.4
Production	C1.2	C2.4	C3.8	C4.4	C5.4
Promotion	C1.2	C2.4	C3.8	C4.4	C5.4
Proof	C1.2	C2.4	C3.8	C4.4	C5.4
Quality	C1.2	C2.4	C3.8	C4.4	C5.4
Reality	C1.2	C2.4	C3.8	C4.4	C5.4

Significance	C1.2	C2.4	C3.8	C4.4	C5.4
Vocabulary	C1.2	C2.4	C3.8	C4.4	C5.4
Ability	C1.2	C2.4	C3.8	C4.4	C5.3
Accomplishment	C1.2	C2.4	C3.8	C4.4	C5.3
Belief	C1.2	C2.4	C3.8	C4.4	C5.3
Brain	C1.2	C2.4	C3.8	C4.4	C5.3
Faith	C1.2	C2.4	C3.8	C4.4	C5.3
Freedom	C1.2	C2.4	C3.8	C4.4	C5.3
Holiday	C1.2	C2.4	C3.8	C4.4	C5.3
Idea	C1.2	C2.4	C3.8	C4.4	C5.3
Improvement	C1.2	C2.4	C3.8	C4.4	C5.3
Information	C1.2	C2.4	C3.8	C4.4	C5.3
Intelligence	C1.2	C2.4	C3.8	C4.4	C5.3
Justice	C1.2	C2.4	C3.8	C4.4	C5.3
Knowledge	C1.2	C2.4	C3.8	C4.4	C5.3
Leadership	C1.2	C2.4	C3.8	C4.4	C5.3
Memory	C1.2	C2.4	C3.8	C4.4	C5.3
Opportunity	C1.2	C2.4	C3.8	C4.4	C5.3
Reputation	C1.2	C2.4	C3.8	C4.4	C5.3
Responsibility	C1.2	C2.4	C3.8	C4.4	C5.3
Skill	C1.2	C2.4	C3.8	C4.4	C5.3
Wisdom	C1.2	C2.4	C3.8	C4.4	C5.3
Admiration	C1.2	C2.4	C3.8	C4.3	C5.2
Attitude	C1.2	C2.4	C3.8	C4.3	C5.2
Behavior	C1.2	C2.4	C3.8	C4.3	C5.2
Benefactor	C1.2	C2.4	C3.8	C4.3	C5.2
Character	C1.2	C2.4	C3.8	C4.3	C5.2
Charity	C1.2	C2.4	C3.8	C4.3	C5.2
Confidence	C1.2	C2.4	C3.8	C4.3	C5.2
Crisis	C1.2	C2.4	C3.8	C4.3	C5.2
Danger	C1.2	C2.4	C3.8	C4.3	C5.2
Duty	C1.2	C2.4	C3.8	C4.3	C5.2
Equality	C1.2	C2.4	C3.8	C4.3	C5.2
Expression	C1.2	C2.4	C3.8	C4.3	C5.2
Fantasy	C1.2	C2.4	C3.8	C4.3	C5.2
Honesty	C1.2	C2.4	C3.8	C4.3	C5.2
Identity	C1.2	C2.4	C3.8	C4.3	C5.2
Independence	C1.2	C2.4	C3.8	C4.3	C5.2
Insight	C1.2	C2.4	C3.8	C4.3	C5.2
Instinct	C1.2	C2.4	C3.8	C4.3	C5.2
Integrity	C1.2	C2.4	C3.8	C4.3	C5.2
Interaction	C1.2	C2.4	C3.8	C4.3	C5.2
Kindness	C1.2	C2.4	C3.8	C4.3	C5.2

Opinion	C1.2	C2.4	C3.8	C4.3	C5.2
Purpose	C1.2	C2.4	C3.8	C4.3	C5.2
Satisfaction	C1.2	C2.4	C3.8	C4.3	C5.2
Tradition	C1.2	C2.4	C3.8	C4.3	C5.2
Truth	C1.2	C2.4	C3.8	C4.3	C5.2
Cowardice	C1.2	C2.4	C3.8	C4.3	C5.1
Criticism	C1.2	C2.4	C3.8	C4.3	C5.1
Deceit	C1.2	C2.4	C3.8	C4.3	C5.1
Disagreement	C1.2	C2.4	C3.8	C4.3	C5.1
Hatred	C1.2	C2.4	C3.8	C4.3	C5.1
Malice	C1.2	C2.4	C3.8	C4.3	C5.1
Mercy	C1.2	C2.4	C3.8	C4.3	C5.1
Revenge	C1.2	C2.4	C3.8	C4.3	C5.1
Artist	C1.2	C2.4	C3.7		
Baby	C1.2	C2.4	C3.7		
Body	C1.2	C2.4	C3.7		
Boy	C1.2	C2.4	C3.7		
Cat	C1.2	C2.4	C3.7		
Child	C1.2	C2.4	C3.7		
Chocolate	C1.2	C2.4	C3.7		
Christmas	C1.2	C2.4	C3.7		
Dad	C1.2	C2.4	C3.7		
Doctor	C1.2	C2.4	C3.7		
Father	C1.2	C2.4	C3.7		
Food	C1.2	C2.4	C3.7		
Girl	C1.2	C2.4	C3.7		
Grandmother	C1.2	C2.4	C3.7		
Heart	C1.2	C2.4	C3.7		
Kitten	C1.2	C2.4	C3.7		
Laughter	C1.2	C2.4	C3.7		
Mother	C1.2	C2.4	C3.7		
Photo	C1.2	C2.4	C3.7		
Puppy	C1.2	C2.4	C3.7		
Sister	C1.2	C2.4	C3.7		
Television	C1.2	C2.4	C3.7		
Woman	C1.2	C2.4	C3.7		
Advantage	C1.2	C2.3	C3.6	C4.2	
Adversity	C1.2	C2.3	C3.6	C4.2	
Announcement	C1.2	C2.3	C3.6	C4.2	
Assistance	C1.2	C2.3	C3.6	C4.2	
Assumption	C1.2	C2.3	C3.6	C4.2	
Circumstance	C1.2	C2.3	C3.6	C4.2	
Cognition	C1.2	C2.3	C3.6	C4.2	

Coincidence	C1.2	C2.3	C3.6	C4.2
Complication	C1.2	C2.3	C3.6	C4.2
Consideration	C1.2	C2.3	C3.6	C4.2
Consistency	C1.2	C2.3	C3.6	C4.2
Context	C1.2	C2.3	C3.6	C4.2
Definition	C1.2	C2.3	C3.6	C4.2
Denial	C1.2	C2.3	C3.6	C4.2
Description	C1.2	C2.3	C3.6	C4.2
Destiny	C1.2	C2.3	C3.6	C4.2
Development	C1.2	C2.3	C3.6	C4.2
Difference	C1.2	C2.3	C3.6	C4.2
Dilemma	C1.2	C2.3	C3.6	C4.2
Distraction	C1.2	C2.3	C3.6	C4.2
Diversity	C1.2	C2.3	C3.6	C4.2
Error	C1.2	C2.3	C3.6	C4.2
Example	C1.2	C2.3	C3.6	C4.2
Exception	C1.2	C2.3	C3.6	C4.2
Explanation	C1.2	C2.3	C3.6	C4.2
Gender	C1.2	C2.3	C3.6	C4.2
Identification	C1.2	C2.3	C3.6	C4.2
Ignorance	C1.2	C2.3	C3.6	C4.2
Immortality	C1.2	C2.3	C3.6	C4.2
Impairment	C1.2	C2.3	C3.6	C4.2
Incident	C1.2	C2.3	C3.6	C4.2
Interruption	C1.2	C2.3	C3.6	C4.2
Legality	C1.2	C2.3	C3.6	C4.2
Limitation	C1.2	C2.3	C3.6	C4.2
Mastery	C1.2	C2.3	C3.6	C4.2
Method	C1.2	C2.3	C3.6	C4.2
Mystery	C1.2	C2.3	C3.6	C4.2
Myth	C1.2	C2.3	C3.6	C4.2
Necessity	C1.2	C2.3	C3.6	C4.2
Opposition	C1.2	C2.3	C3.6	C4.2
Originality	C1.2	C2.3	C3.6	C4.2
Permission	C1.2	C2.3	C3.6	C4.2
Phenomenon	C1.2	C2.3	C3.6	C4.2
Philosophy	C1.2	C2.3	C3.6	C4.2
Preference	C1.2	C2.3	C3.6	C4.2
Preparation	C1.2	C2.3	C3.6	C4.2
Recognition	C1.2	C2.3	C3.6	C4.2
Regulation	C1.2	C2.3	C3.6	C4.2
Reinforcement	C1.2	C2.3	C3.6	C4.2
Replacement	C1.2	C2.3	C3.6	C4.2

Requirement	C1.2	C2.3	C3.6	C4.2
Response	C1.2	C2.3	C3.6	C4.2
Selection	C1.2	C2.3	C3.6	C4.2
Separation	C1.2	C2.3	C3.6	C4.2
Situation	C1.2	C2.3	C3.6	C4.2
Stimulus	C1.2	C2.3	C3.6	C4.2
Stupidity	C1.2	C2.3	C3.6	C4.2
Tendency	C1.2	C2.3	C3.6	C4.2
Theory	C1.2	C2.3	C3.6	C4.2
Topic	C1.2	C2.3	C3.6	C4.2
Translation	C1.2	C2.3	C3.6	C4.2
Uncertainty	C1.2	C2.3	C3.6	C4.2
Unity	C1.2	C2.3	C3.6	C4.2
Willingness	C1.2	C2.3	C3.6	C4.2
Exclusion	C1.2	C2.3	C3.6	C4.1
Fallacy	C1.2	C2.3	C3.6	C4.1
Heresy	C1.2	C2.3	C3.6	C4.1
Idiom	C1.2	C2.3	C3.6	C4.1
Impossibility	C1.2	C2.3	C3.6	C4.1
Irony	C1.2	C2.3	C3.6	C4.1
Metaphor	C1.2	C2.3	C3.6	C4.1
Pretense	C1.2	C2.3	C3.6	C4.1
Accumulation	C1.2	C2.3	C3.5	
Acquisition	C1.2	C2.3	C3.5	
Addition	C1.2	C2.3	C3.5	
Amplitude	C1.2	C2.3	C3.5	
Appointment	C1.2	C2.3	C3.5	
Aspect	C1.2	C2.3	C3.5	
Availability	C1.2	C2.3	C3.5	
Brevity	C1.2	C2.3	C3.5	
Calculation	C1.2	C2.3	C3.5	
Capacity	C1.2	C2.3	C3.5	
Category	C1.2	C2.3	C3.5	
Clearance	C1.2	C2.3	C3.5	
Combination	C1.2	C2.3	C3.5	
Convergence	C1.2	C2.3	C3.5	
Deduction	C1.2	C2.3	C3.5	
Dimension	C1.2	C2.3	C3.5	
Distribution	C1.2	C2.3	C3.5	
Duration	C1.2	C2.3	C3.5	
Dynasty	C1.2	C2.3	C3.5	
Emergence	C1.2	C2.3	C3.5	
Episode	C1.2	C2.3	C3.5	

Establishment	C1.2	C2.3	C3.5
Extent	C1.2	C2.3	C3.5
Hierarchy	C1.2	C2.3	C3.5
Magnitude	C1.2	C2.3	C3.5
Majority	C1.2	C2.3	C3.5
Midnight	C1.2	C2.3	C3.5
Occasion	C1.2	C2.3	C3.5
Origin	C1.2	C2.3	C3.5
Paradigm	C1.2	C2.3	C3.5
Proportion	C1.2	C2.3	C3.5
Reduction	C1.2	C2.3	C3.5
Retention	C1.2	C2.3	C3.5
Unit	C1.2	C2.3	C3.5
Variety	C1.2	C2.3	C3.5
Autumn	C1.1	C2.2	C3.4
Ball	C1.1	C2.2	C3.4
Bed	C1.1	C2.2	C3.4
Beverage	C1.1	C2.2	C3.4
Boat	C1.1	C2.2	C3.4
Bottle	C1.1	C2.2	C3.4
Boulder	C1.1	C2.2	C3.4
Cake	C1.1	C2.2	C3.4
Calendar	C1.1	C2.2	C3.4
Car	C1.1	C2.2	C3.4
Ceiling	C1.1	C2.2	C3.4
Chair	C1.1	C2.2	C3.4
Church	C1.1	C2.2	C3.4
Clothing	C1.1	C2.2	C3.4
Cottage	C1.1	C2.2	C3.4
Desk	C1.1	C2.2	C3.4
Diamond	C1.1	C2.2	C3.4
Door	C1.1	C2.2	C3.4
Elephant	C1.1	C2.2	C3.4
Factory	C1.1	C2.2	C3.4
Fireplace	C1.1	C2.2	C3.4
Fog	C1.1	C2.2	C3.4
Fountain	C1.1	C2.2	C3.4
Grass	C1.1	C2.2	C3.4
Hat	C1.1	C2.2	C3.4
Hospital	C1.1	C2.2	C3.4
Hurricane	C1.1	C2.2	C3.4
Jacket	C1.1	C2.2	C3.4
Lightning	C1.1	C2.2	C3.4

Mattress	C1.1	C2.2	C3.4
Menu	C1.1	C2.2	C3.4
Money	C1.1	C2.2	C3.4
Moonlight	C1.1	C2.2	C3.4
Neck	C1.1	C2.2	C3.4
Orchestra	C1.1	C2.2	C3.4
Oven	C1.1	C2.2	C3.4
Pie	C1.1	C2.2	C3.4
Rainbow	C1.1	C2.2	C3.4
Refrigerator	C1.1	C2.2	C3.4
Rocket	C1.1	C2.2	C3.4
Roof	C1.1	C2.2	C3.4
Saloon	C1.1	C2.2	C3.4
Shirt	C1.1	C2.2	C3.4
Snow	C1.1	C2.2	C3.4
Sofa	C1.1	C2.2	C3.4
Tree	C1.1	C2.2	C3.4
Truck	C1.1	C2.2	C3.4
Wallet	C1.1	C2.2	C3.4
Window	C1.1	C2.2	C3.4
Winter	C1.1	C2.2	C3.4
Bridge	C1.1	C2.2	C3.3
City	C1.1	C2.2	C3.3
Cliff	C1.1	C2.2	C3.3
Forest	C1.1	C2.2	C3.3
Hotel	C1.1	C2.2	C3.3
Island	C1.1	C2.2	C3.3
Lake	C1.1	C2.2	C3.3
Landscape	C1.1	C2.2	C3.3
Location	C1.1	C2.2	C3.3
Mansion	C1.1	C2.2	C3.3
Mountain	C1.1	C2.2	C3.3
Ocean	C1.1	C2.2	C3.3
Palace	C1.1	C2.2	C3.3
Pond	C1.1	C2.2	C3.3
Pyramid	C1.1	C2.2	C3.3
River	C1.1	C2.2	C3.3
Road	C1.1	C2.2	C3.3
Sky	C1.1	C2.2	C3.3
University	C1.1	C2.2	C3.3
Volcano	C1.1	C2.2	C3.3
Zoo	C1.1	C2.2	C3.3
Apple	C1.1	C2.1	C3.2

Bird	C1.1	C2.1	C3.2
Blood	C1.1	C2.1	C3.2
Butterfly	C1.1	C2.1	C3.2
Candy	C1.1	C2.1	C3.2
Coffee	C1.1	C2.1	C3.2
Dentist	C1.1	C2.1	C3.2
Eagle	C1.1	C2.1	C3.2
Gun	C1.1	C2.1	C3.2
Lip	C1.1	C2.1	C3.2
Pillow	C1.1	C2.1	C3.2
Policeman	C1.1	C2.1	C3.2
Salad	C1.1	C2.1	C3.2
Skin	C1.1	C2.1	C3.2
Sugar	C1.1	C2.1	C3.2
Alligator	C1.1	C2.1	C3.1
Ambulance	C1.1	C2.1	C3.1
Ankle	C1.1	C2.1	C3.1
Arrow	C1.1	C2.1	C3.1
Banana	C1.1	C2.1	C3.1
Beaver	C1.1	C2.1	C3.1
Beetle	C1.1	C2.1	C3.1
Bell	C1.1	C2.1	C3.1
Blade	C1.1	C2.1	C3.1
Bracelet	C1.1	C2.1	C3.1
Bubble	C1.1	C2.1	C3.1
Bullet	C1.1	C2.1	C3.1
Butter	C1.1	C2.1	C3.1
Caterpillar	C1.1	C2.1	C3.1
Chicken	C1.1	C2.1	C3.1
Chipmunk	C1.1	C2.1	C3.1
Cocktail	C1.1	C2.1	C3.1
Coffin	C1.1	C2.1	C3.1
Corn	C1.1	C2.1	C3.1
Corpse	C1.1	C2.1	C3.1
Coupon	C1.1	C2.1	C3.1
Cow	C1.1	C2.1	C3.1
Cranberry	C1.1	C2.1	C3.1
Crocodile	C1.1	C2.1	C3.1
Crown	C1.1	C2.1	C3.1
Cucumber	C1.1	C2.1	C3.1
Cup	C1.1	C2.1	C3.1
Darkness	C1.1	C2.1	C3.1
Dove	C1.1	C2.1	C3.1

Drum	C1.1	C2.1	C3.1
Eyeball	C1.1	C2.1	C3.1
Fisherman	C1.1	C2.1	C3.1
Flask	C1.1	C2.1	C3.1
Football	C1.1	C2.1	C3.1
Frog	C1.1	C2.1	C3.1
Gorilla	C1.1	C2.1	C3.1
Grasshopper	C1.1	C2.1	C3.1
Helmet	C1.1	C2.1	C3.1
Horse	C1.1	C2.1	C3.1
Item	C1.1	C2.1	C3.1
Jewel	C1.1	C2.1	C3.1
Key	C1.1	C2.1	C3.1
Kite	C1.1	C2.1	C3.1
Lamb	C1.1	C2.1	C3.1
Lamp	C1.1	C2.1	C3.1
Laundry	C1.1	C2.1	C3.1
Lemon	C1.1	C2.1	C3.1
Leopard	C1.1	C2.1	C3.1
Lettuce	C1.1	C2.1	C3.1
Lion	C1.1	C2.1	C3.1
Lizard	C1.1	C2.1	C3.1
Lobster	C1.1	C2.1	C3.1
Macaroni	C1.1	C2.1	C3.1
Microscope	C1.1	C2.1	C3.1
Missile	C1.1	C2.1	C3.1
Mosquito	C1.1	C2.1	C3.1
Mustard	C1.1	C2.1	C3.1
Necklace	C1.1	C2.1	C3.1
Newspaper	C1.1	C2.1	C3.1
Onion	C1.1	C2.1	C3.1
Opera	C1.1	C2.1	C3.1
Orchid	C1.1	C2.1	C3.1
Peach	C1.1	C2.1	C3.1
Pig	C1.1	C2.1	C3.1
Pigeon	C1.1	C2.1	C3.1
Pimple	C1.1	C2.1	C3.1
Potato	C1.1	C2.1	C3.1
Propeller	C1.1	C2.1	C3.1
Queen	C1.1	C2.1	C3.1
Rabbit	C1.1	C2.1	C3.1
Raspberry	C1.1	C2.1	C3.1
Robin	C1.1	C2.1	C3.1

Sandal	C1.1	C2.1	C3.1
Shark	C1.1	C2.1	C3.1
Shrimp	C1.1	C2.1	C3.1
Skull	C1.1	C2.1	C3.1
Skunk	C1.1	C2.1	C3.1
Snake	C1.1	C2.1	C3.1
Spider	C1.1	C2.1	C3.1
Stapler	C1.1	C2.1	C3.1
Tennis	C1.1	C2.1	C3.1
Thorn	C1.1	C2.1	C3.1
Toilet	C1.1	C2.1	C3.1
Tomato	C1.1	C2.1	C3.1
Tongue	C1.1	C2.1	C3.1
Tool	C1.1	C2.1	C3.1
Towel	C1.1	C2.1	C3.1
Typewriter	C1.1	C2.1	C3.1
Wolf	C1.1	C2.1	C3.1

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BIOGRAPHICAL SKETCH

Joshua Troche graduated in 2009 from the University of Florida with a Bachelor of Science in psychology and minor in religion and classical studies. In 2009, he began a combined Master of Arts/Doctor of Philosophy program in the Department of Speech, Language and Hearing Sciences. His research interests include semantic memory, dementia, and cognitive rehabilitation.