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The relationship between affective word ratings and lexico-semantic properties in

Chinese words rated by Mandarin speakers

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Abstract

This study investigated the relationship between lexical-semantic features: age of acquisition, familiarity, subjective frequency and imageability and affective features: emotional valence and arousal of Chinese words for native Mandarin speakers. Lexical items from the Object and Action Naming Battery (Druks & Masterson, 2000) were selected. One hundred and seventy monosyllables produced by native Mandarin speakers with high naming agreement were used. Eighty participants were recruited to rate items on lexical and affective features. The results showed that all features were highly correlated. Ratings of word imageability and frequency significantly predicted ratings of emotional arousal and frequency significantly predicted ratings of emotional valence. The results can be used to develop standardized object and action naming tests to assess aphasia in Mandarin-speaking patients. The results can also guide choice of target stimuli for rehabilitation of Mandarin-speaking patients with aphasia.

Introduction

The motivation for this study is to investigate the associations between lexical-semantic (cold) features and affective (warm) features of words for Mandarin speakers. Cold features refer to the lexico-semantic properties of words, including the age of acquisition (AoA), familiarity, frequency and imageability. AoA refers to the estimated age that a word is learned by an adult speaker. Familiarity is the subjective frequency of exposure to a word by an adult speaker. Frequency refers to the occurrence of a word in daily communication. Imageability is defined as the ease with which a word induces a sensory mental image. Studies show these variables have an impact on lexical processing in normal and impaired Mandarin speakers (Weekes, Shu, Hao, Liu, & Tan, 2007). However, it is an open question whether the variables are related to emotion. Warm features refer to properties related to emotional characteristics. Emotional valence and arousal are two dimensions that characterize emotion. Valence shows the extent to which an emotion is positive or negative, while arousal represents the intensity of emotion (Citron, Weekes, & Ferstl, 2010). Such features have correlated in English and German. One hypothesis is that cold feature ratings will be related to warm feature ratings in Mandarin but no study has tested this question. Mandarin is the standardized form of modern spoken Chinese in Mainland China and Taiwan (Fung, 2009). There are seven geographical dialect groups in China but Mandarin is the largest with over 870 million Mandarin speakers (Fung, 2009). Hence, the results from such a study can be applied to a very large population.

Effect of cold features in word recognition

Studies of alphabetic languages show that age-of-acquisition (AoA), familiarity, frequency and imageability all predict oral reading (Balota, Cortese, Sergent-Marshall, Spieler, & Yap 2004) and object naming (Poncelet, Majerus, Raman, Warginaire, & Weekes, 2007). Some lexico-semantic features have also been found to affect word processing in word and picture naming in Chinese. For example, highly familiar, frequent and early acquired words take less time to name in picture naming by normal Mandarin speakers (Weekes et al, 2007).

Relationship within cold features in word recognition

Studies of English speakers reported a positive correlation between familiarity, frequency and AoA (Bird, Franklin & Howard, 2001; Citron et al., 2010). Similar findings were reported for Mandarin speakers. For example, Chan (2011) found strong positive correlations between familiarity and frequency ratings in Mandarin speakers. One reason may be more frequently used words will have higher familiarity, so they are perceived as more familiar. It has also been found that imageability is a reliable predictor of AoA in Chinese for nouns and verbs in native Chinese speaking children (Ma, Golinkoff, Hirsh-Pasek, McDonough & Tardif, 2009).

AoA, familiarity and frequency are highly correlated, and AoA is correlated with imageability, causing a problem of multi-collinearity in psycholinguistic research (Cutler, 1981). Therefore, based on previous studies, it is expected that cold features including AoA,

familiarity, frequency and imageability will be highly correlated in Mandarin speakers.

Effect of warm features in word recognition

Previous studies show that emotional valence and arousal activate different parts of the brain (Lewis, Critchley, Rotshtein, & Dolan, 2007). Therefore, it is possible that these two affective features will have independent effects on word recognition. It is quite reasonable to believe that words with high emotional valence and words with high arousal will be faster to process. However in English, emotional valence and arousal have an interactive effect on word recognition (Citron et al., 2010). Highly negative words are more arousing than highly positive words. Therefore, a more negatively valenced word could lead to a faster response than a highly positive word. This can be explained by the threatening nature of negatively valenced words, which may initiate faster response due to avoidance behaviour (Chan, 2011).

Relationship within warm features in word recognition

Recent studies on English words report a high correlation between emotional valence and arousal (Citron et al., 2010). However, this was characterized by a nonlinear relationship in the form of a U-shaped curve when doing correlation analyses. This means that more positive and negative valance words are also high in arousal. Similar findings were found in a study of Mandarin speakers (Chan, 2011), words with both positive and negative valence were rated higher in arousal compared to neutral words (Bradley & Lang, as cited in Citron et al., 2010). Therefore, it is hypothesized that there will be a non-linear correlation U-shaped correlation

between warm feature (valence and arousal) ratings in native Mandarin speakers.

Relationship between cold and warm features in word recognition

Studies with English and German words found a high correlation between rated imageability and arousal, as well as familiarity and valence (Citron et al., 2010). However, imageability did not predict arousal ratings in a Mandarin speaking group (Chan, 2011). This could be a result of small sample size in Chan's study, so that the results might not show a correlation between imageability and emotional arousal. Chan (2011) suggested a larger sample might find a significant correlation. Chan also reported that the lexical-semantic features, frequency of use and imageability significantly predict emotional valence. This finding was compatible with research using English words (Bird et al., 2001) including a study showing high correlation between warm features and rated imageability (Citron et al., 2010).

Research gap

Previous studies reported similarities in the relationships between cold and warm features in English and German words (Citron et al., 2010). However both of these are Indo-European languages using an alphabetic script. Few studies have investigated the relationship between cold features and warm features and the effect of emotion properties on word processing in Chinese, which is Sino-Tibetan using a non-alphabetic script. The patterns of correlation between cold and warm features may vary across language groups because of linguistic

differences. Moreover, ratings of object and action words that are highly reported in English

(Druks & Masterson, 2000) are not available for young and elderly native Mandarin speakers.

Purpose of current study

The primary aim is to investigate the relationship between cold features (lexico-semantic

properties: AoA of acquisition, familiarity, frequency and imageability) and warm features

(affective features: arousal and valence) for Mandarin speakers. If a high correlation is found,

this can guide the choice of stimuli for the rehabilitation of Mandarin-speaking patients with

aphasia. For example, stimuli with high emotional valence and arousal could be chosen to

enhance word processing of patients whereas neutral words with low arousal may be trained

at a later stage. A standardized test of object and action naming similar to Object and Action

Naming Battery (Druks & Masterson, 2000) can also be developed to test hypotheses about

the effect of grammatical class on word retrieval in aphasia by matching correlated variables.

Based on findings, controlled list of nouns and verbs for Mandarin patients can be developed

for research into the dissociations between processing of actions and objects in aphasia as

reported in numerous studies (see Bird et al. 2001; Druks & Masterson, 2000).

Method

Preparatory Study

To examine differences between action and object naming in native Mandarin speakers, it

is necessary to identify words that are unambiguously objects (nouns) and verbs (actions).

This is a problem in Chinese languages because of the large degree of compounding in most words. Five native Mandarin speakers were recruited to name all the stimuli in Object and Action Naming Battery (Druks & Masterson, 2000) containing black and white line drawings of 162 objects and 100 actions. Participants were asked to use a monosyllabic word if possible. The specific instruction for naming objects was "Please name this picture using a single syllable""请用一个中文字命名图中的物件", and the specific instruction for actions was "Please describe the actions in the drawings using a single syllable"" 请用一个中文字形容图中的动作". Naming agreement of the pictures was obtained. Items with satisfactory naming agreement of 80% or more were chosen as stimuli for the rating experiment. The standard consent form used throughout all stages of the study can be found in Appendix A.

Experimental Stage

Participants

Ninety native Mandarin speakers were recruited through personal contact and email alert. Fifty participants were young adults (17 males and 33 females) who were aged 18 years old or older and 40 of them were elders (10 males and 30 females) who were aged 50 years old or older who provided informed consent and ratings data for the study on a voluntary basis.

Material

Word selection

Names of actions and objects with naming agreement above 80% in the preparatory study

were chosen for the experiment proper. A total of 62 actions and 108 objects with a naming agreement of 80% or above were selected. Therefore, a total of 170 words were chosen as the stimuli for the rating study. In addition to these stimuli, 10% of words were chosen randomly to appear twice in the test as a check on the intra-rater reliability. As some of the items such as 画 and 梳 can be a verb or a noun simultaneously, quotation marks specifying their lexical features were added e.g. 画 (名詞), 梳 (名詞).

The questionnaire

Online questionnaires were created using the online survey software called *Survey Monkey*. Action names and object names were presented as Chinese characters in simplified font. The questionnaires requested subjective ratings of the cold features (lexico-semantic properties: AoA, familiarity, frequency of use and imageability) and warm features (affective features: arousal and valence) of selected items. Stimuli were the 170 words with naming agreement above 80% and 17 repeated words for intra-rater reliability. Subjective ratings on the six features of the 187 Chinese characters were obtained. Eight sets of online questionnaires were prepared to randomize the order of feature ratings. Each set was further divided into two parts. The first part consisted of seven web pages, with a consent form (Appendix B) attached, an introduction page, a demographic page, and three pages for subjective ratings of three features and an intermission page. The second part consisted of five web-pages, with one intermission page, three pages for subjective ratings of another three features and one page

for leaving contact.

A definition of each feature was given in the questionnaire (Appendix C). All the stimuli on each web page were randomized to make sure they had equal chance to appear in different orders. Participants were asked to use a 7-point scale to rate the features: arousal, familiarity, frequency and imageability, from 1 (the least) to 7 (the most). They were asked to rate valence with 1 as most negative, 4 as neutral and 7 as the most positive. For AoA, values 1 to 7 were labeled as age ranges 0-2, 3-4, 5-6, 7-8, 9-10, 11-12 and 13 or above, with each point representing a two-year age band. An option of "unknown word" (不認識此字) was provided beside the 7-point scale of each stimulus.

Based on the methods reported by Druks and Masterson (2000), instructions for AoA and familiarity ratings were adopted and translated from Gilhooly and Logie (1980), while that of imageability were adopted and translated from Paivio, Yuille and Madigan (1968). Instructions of frequency, arousal and valence were adopted and amended from Chan (2011). All written instructions were provided using simplified characters. (Appendix C)

As use of the internet is not familiar to the elderly group, hard copies of the questionnaires were made. It was identical to the online version except it did not have an intermission page. There were also totally eight sets of questionnaires to randomize the features, the words were also randomized. It consisted of 8 pages including a consent form, a demographic page and 6 pages for subjective ratings of six features. The questionnaires were also self-paced and the

participants were advised to take a rest when they felt tired so as to prevent fatigue.

Procedure

For online questionnaires, web links to the online questionnaires were sent to volunteer participants. They were allowed to choose randomly from the eight sets of questionnaires. Hard copies of questionnaires were distributed randomly to elderly participants. Participants were asked to give ratings of the 6 features for 187 Chinese characters on a 7-point scale. To prevent fatigue, participants were permitted to complete the questionnaire after rest periods.

Results

Descriptive Statistics

Demographic information

Demographic information including gender, education level and place of living of the two age groups, participants aged 18 or above (n=50) and those aged 50 or above (n=40), are summarized in Table 1. The majority of participants were female. Almost all participants (98%) had Secondary education or more. Overall, most participants lived in Hong Kong, but for the younger group an equal number of participants lived in Hong Kong and the Mainland.

Table 1

Descriptive statistics of the participants' Demographic

	Total sample (N=90)	Aged 18 or above (n=50)	Aged 50 or above (n=40)
Gender			
Male	27(30%)	17	10
Female	63(70%)	33	30
Education Level			
Primary or below	2 (2%)	0	2
Secondary School	51 (57%)	19	32
Undergraduate	32 (36%)	27	5
Postgraduate or above	5 (6%)	4	1
Place of Living			
Hong Kong	59 (66%)	23	36
Mainland	29 (32%)	25	4
Others	2 (2%)	2	0

Word ratings

Descriptive statistics including means and standard deviations of the ratings for each word

for cold features and warm features were obtained (Appendix D). The descriptive statistics of

the features including AoA, familiarity, frequency, imageability, emotional arousal are shown

in Table 2 for the three valence categories (positive, neutral and negative). Means of valence

ratings were categorized as negative (between 1.00 and 3.29) neutral (between 3.30 and 4.70),

and positive (between 4.71 and 7.00) as recommended by Citron et al. (2010). According to this categorization, out of 170 stimuli, 1 word was negative, 143 words were neutral and 26 words were positive. The mean of AoA was lowest for positively valenced words.

Table 2

Descriptive statistics of rated features in the positive, neutral and negative valence categories

| | Valence Categories | | | | | | | | | | |
| | Positive (26 words) | | | | Neutral (143words) | | | | Negative (1 word) | | |
Features	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	Min	Max
AoA	4.01	0.27	3.58	4.80	4.32	0.34	3.53	5.15	4.11	4.11	4.11
Familiarity	5.24	0.36	4.16	5.81	4.86	0.40	3.67	5.76	4.50	4.50	4.50
Frequency	4.60	0.39	3.81	5.37	4.07	0.45	3.12	5.32	3.48	3.48	3.48
Imageability	5.03	0.32	4.38	5.67	4.74	0.26	4.14	5.28	4.76	4.76	4.76
Arousal	3.87	0.37	3.32	4.88	3.57	0.26	2.84	4.23	4.00	4.00	4.00

Developing a test of action and object naming

Based on the descriptive statistics for the features including AoA, familiarity, frequency, imageability, emotional arousal and valence for all items, a test of action and a object pictures with pairwise matched ratings for all six features was developed (Appendix E) containing 20 nouns and 20 verbs.

Correlation Analyses

Reliability analyses

Ten percent of stimuli were randomly selected (17 words out of 170) to check intra-rater reliability. Correlation analyses compared first and second word ratings by each participant. The intra-rater reliability on all rated features is presented in Table 3. The values range from 0.89 to 0.98 for features of seventeen words. Intra-rater reliability was therefore acceptable.

Table 3

Intra-rater reliability in all features

Features	Correlation between the repeated words
Age-of-acquisition	0.98
Familiarity	0.94
Frequency	0.93
Imageability	0.91
Arousal	0.95
Emotional Valence	0.89

Relationship among variables

Correlation analyses were performed to determine the relationship among ratings. Pearson correlations were used to analyze the correlations among emotional valence, arousal, AoA, familiarity, frequency and imageability. A significance level of $p= .05$ was used. Correlations between all features are shown in Table 4. All features were significantly correlated $p < .01$.

Correlation among cold features

Correlations between cold features (AoA, familiarity, frequency and imageability) can be seen in Table 4. All features were positively correlated except AoA which was negatively correlated with the other variables. This is because the earlier the age of acquisition (a smaller AoA value), would predict higher rating of other features.

Table 4

Correlation among all features (N=90)

Features	Arousal	Valence	AoA	Familiarity	Frequency	Imageability
Arousal	1					
Valence	.281**	1				
AoA	-.469**	-.355**	1			
Familiarity	.535**	.496**	-.640**	1		
Frequency	.596**	.531**	-.659**	.807**	1	
Imageability	.576**	.367**	-.561**	.694**	.534**	1

Note. **= $p < .01$.

Correlation between warm features

Correlations between warm features, emotional arousal and valence are presented in Figure 1. A U-shaped curve was obtained. This showed that both positively and negatively valenced words were rated higher in arousal than more neutral words as reported in studied of English and German words (Bradley & Lang, as cited in Citron et al., 2010).
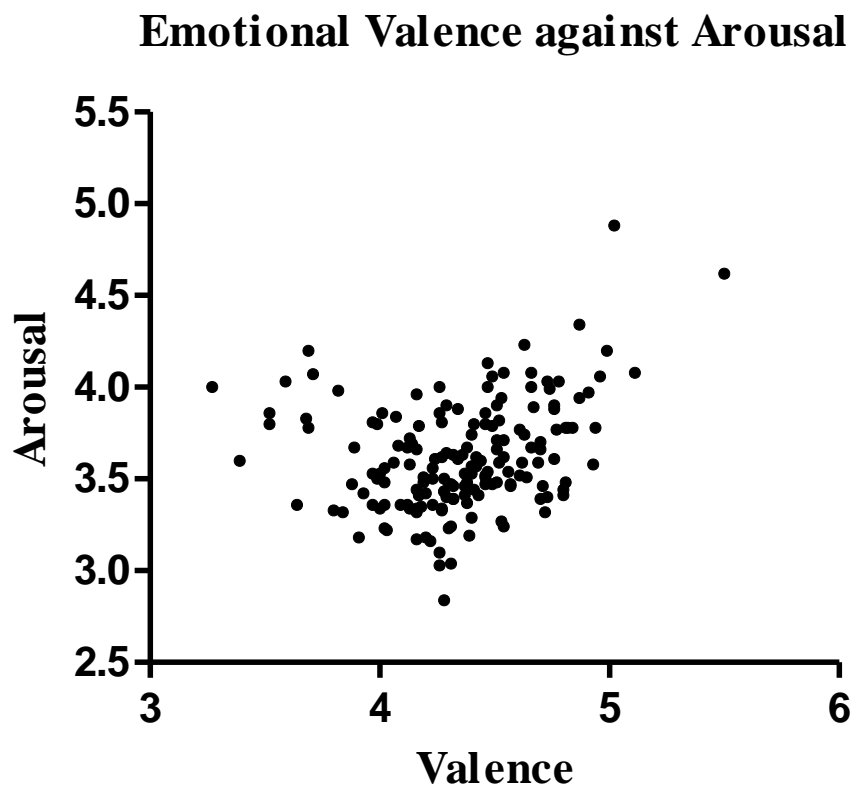
Emotional Valence against Arousal

Figure 1. Emotional valence ratings plotted with emotional arousal ratings

Correlation between cold and warm features

The high correlations between ratings for action and object words reflect multi-colinearity. It is therefore not certain whether each of the cold and warm features are related as suggested or whether each feature appears to be related because of the large degree of shared variance with another variable. Multiple regression was therefore used to analyze the data to determine which independent variables significantly predict word ratings (the dependent variable) when all variables are considered. The independent variables entered into the equation were rated AoA, familiarity, frequency and imageability. The dependent variables entered were ratings of emotional valence and arousal. A significance level of $p= .05$ was applied for all analyses.

Emotional arousal

The stepwise regression results for predictor variables of emotional arousal are shown in Table 5. The results showed that frequency and imageability ratings significantly predicted emotional arousal.

Table 5

Regression results for predictor variables of emotional arousal in Mandarin

Variables	Adjusted R square	t	Standardized Coefficientsβ
Frequency	.349	8.496***	.622
Imageability	.444	5.427***	.371

Note: ***= $p < 0.001$

Emotional Valence

Results from stepwise regression for emotional valence are shown in Table 6. The results showed that frequency ratings significantly predicted emotional valence.

Table 6

Regression results for predictor variables of valence in Mandarin

Variables	Adjusted R square	t	Standardized Coefficientsβ
Frequency	.275	6.909***	.564

Note: ***= $p < 0.001$

Comparison between the results of young adults and elders

The ratings made by different age groups showed different patterns. Pearson correlations were used to analyze the correlations among emotional valence, arousal, AoA, familiarity, frequency and imageability for the young adults aged 18 or above and old adults aged 50 or above. A significance level of $p= .05$ was used. Correlations between all features for young adults are shown in Table 7, while that of the elders are shown in Table 8. The results showed that all six features are significantly correlated $p < .01$ for the young adult group. However, for the elder group, arousal is not correlated with AoA and imageability and valence is not correlated with AoA. Other features were significantly correlated but the coefficients were not as high as those observed in the young adult group.

Table 7

Correlation among all features for young adults who aged 18 or above (N=50)

Features	Arousal	Valence	AoA	Familiarity	Frequency	Imageability
Arousal	1					
Valence	.326**	1				
AoA	-.595**	-.447**	1			
Familiarity	.703**	.499**	-.823**	1		
Frequency	.689**	.532**	-.788**	.912**	1	
Imageability	.518**	.286**	-.481**	.442**	.420**	1

*Note. **= p < .01.*

Table 8

Correlation among all features for elders who aged 50 or above (N=40)

Features	Arousal	Valence	AoA	Familiarity	Frequency	Imageability
Arousal	1					
Valence	.151*	1				
AoA	-.124	-.102	1			
Familiarity	.159*	.350**	-.217**	1		
Frequency	.247**	.438**	-.297**	.381**	1	
Imageability	.136	.224**	-.182*	.570**	.153*	1

Note. = p < .05, **= p < .01.*

Discussion

The motivation for this study was to investigate the pattern of relationships between the cold features (lexico-semantic properties: AoA, familiarity, frequency and imageability) and warm features (affective properties: emotional arousal and valence) for Mandarin speakers. It was predicted that there would be significant correlations among the ratings of cold features and warm features for Mandarin speakers as in English and German. The results support this hypothesis, although only frequency predicted the ratings for arousal and valence when the colinearity with other variables was controlled in the multiple regression analyses. Overall, the more frequent a word the more arousing it is for both age groups. More frequent words are also viewed as more positive. More imageable words are also considered more arousing by the younger group but not by the elder group.

The descriptive statistics of the features AoA, familiarity, frequency, imageability, and emotional arousal were reported for the three valence categories (positive, neutral and negative). According to classification proposed by Citron et al. (2010), most words are rated as neutral. This might due to the fact that the stimuli in this study were all nouns and verbs from the Object and Action Naming Battery (Druks & Masterson, 2000). This contrasts with studies by Chan (2011) and by Citron et al. (2010) that included nouns, verbs and adjectives with approximately 1/3 positive, 1/3 neutral and 1/3 neutral items in their corpora.

Despite the uneven number of words with positive, neutral and negative emotional valence,

we still observed a trend. Words with positive emotional valence were usually perceived to be of higher familiarity, frequency, imageability and arousal. They were also perceived to be earlier in their age of acquisition.

The results show that all features are correlated. This confirms the prediction that the cold features including AoA, familiarity, frequency and imageability are correlated in Mandarin speakers as reported by Chan (2011) and is compatible with the results from English (Bird, Franklin & Howard, 2001; Citron et al., 2010). Also as predicted from previous studies, a U-shaped curve was obtained when plotting the scatter graph of arousal against valence. This means words with positive emotional valence and words with negative valence were rated higher in arousal than neutral words (Bradley & Lang, as cited in Citron et al., 2010). This was inline with the results of Citron et al. (2010) in English and of Chan (2011) in Mandarin. The non-linear relationships reported in these studies support the view that these variables are independent at least in terms of the ratings given for emotional arousal and valence.

Step-wise regression found that frequency and imageability ratings significantly predicted ratings of emotional arousal. Frequency ratings also significantly predicted emotional valence. Therefore, frequency is the variable that predicts warm features (both valence and arousal).

Chan (2011) found that the perception of self-reference was the only common predictor of emotional arousal and valence for a native Mandarin speaking group. This factor was not measured in the present study. Frequency was not found to be a predicting factor of the warm

features by Chan (2011). Imageability also had no predictive value in arousal in the Mandarin speaking group (Chan, 2011). The present results show that with a larger sample size, there is a correlation between imageability and emotional arousal at least for action and object names.

Limitation and possible modifications of the present study

Fifty participants were aged 18 or above while only forty participants were aged 50 or above. More young participants were tested due to two reasons. First, there were more young adults in my social circle. Second, use of internet was not common in adults aged above 50. Distributing the questionnaires in hard copies was much harder and slower than spreading the links online. The majority of the participants were female as they had higher response rate for the questionnaires. Most participants aged 50 or above live in Hong Kong creating a distinct sample. This was due to the geographical limitation of administering the hard copies.

Most of the stimuli were rated as neutral because they were verbs and nouns extracted from the Object and Action Naming Battery (Druks & Masterson, 2000). Unlike adjectives, objects and actions are usually more neutral in nature in the fact that they seldom arouse any emotions. Therefore, the stimuli in this study are not ideal for studying warm features such as emotional valence and arousal. However, the present results will allow us to exclude effects of emotional variables on any observed dissociations between action and noun naming given that stimuli can now be matched for differences in emotion variables that have independent effects of brain activation. More critically the present study produced a set of monosyllabic

action and object names that have wide application in aphasia and in cognitive neuroscience.

The present results allow more than one standardized word list to be used from the corpus. If warm features were the focus of a study, it would be best to choose more arousing words with more variety in terms of emotional valence. Subjects can be recruited to rate emotional valence of the words so as to categorize the words into negative, neutral and positive.

Only two dimensions of emotion: emotional valence and arousal were studied. A study on Chinese affective words suggested that more emotional factors including pleasure (valence), excitement (arousal), dominance and familiarity should be investigated in order to reveal a more complete picture of Chinese words (Wang, Zhou, & Luo, 2008). In future studies, these factors may be added to investigate the effects of the affective properties of words more fully.

Mandarin speakers were recruited based on the requirement that Mandarin was their main language with native proficiency. However, participants were not required to be monolingual speakers of Mandarin. As well as Mandarin, they can speak other dialects such as Cantonese or Kejia etc. Knowledge of other dialects might affect ratings of word features in Mandarin. For example, a person who can speak both Mandarin and Cantonese, the word kettle "壺" is more frequently used in Mandarin but if it is replaced by "煲" in Cantonese, then perception of the frequency of using "壺" may be lower than for a person who can only speak Mandarin.

In addition to the dialects spoken by participants, place of living might affect their ratings. For example, the word spoon "勺", is frequently used for places which use Mandarin as the

dialect of daily communication. However, the same word is seldom used in Cantonese and is replaced by "羹". Thus a participant may have different perception depends on the place of residence when rating the word. It would be better to recruit participants who live in the same place using Mandarin as the spoken dialect of daily communication and Mandarin is the only dialect known. Beijing would be an ideal place to fulfill such criteria. In that case, these two factors can be more easily controlled.

Another methodological weakness of the study is that male: female ratio was not controlled. The male to female was of 1:2. If males and females perceive features of words differently especially warm features that are related to emotion then imbalances could cause misleading results. Therefore, if possible, it would be better to keep same number of male and female participants equivalent in future studies. The majority of participants received secondary school education. More participants with lower education level could be recruited so that perception of the features could be studied in a broader context. It is quite reasonable to assume that different levels of education will affect ratings. For example, people with higher education may be more familiar with less frequent words and they may use less imageable words more frequently.

Clinical implication

The high correlations among features could guide the choice of stimuli in the rehabilitation of Mandarin-speaking patients with aphasia. For example, as frequency and imageability

significantly predict emotional arousal, we would expect words with high frequency and imageability to induce high intensity of emotion. Then these words would probably enhance learning, and so might be chosen as stimuli at the beginning stages of rehabilitation.

The results also contribute to the development of a standardized test of object and action naming similar to the established Object and Action Naming Battery (Druks & Masterson, 2000) for Mandarin speaking patients with aphasia. The words with similar ratings for all six features can be matched to form a word list that can be used to assess naming abilities of the patients (see Appendix E). The results from the elder group can develop the normative data for this word list.

Conclusion

Lexico-semantic and affective properties of Chinese verbs and nouns are highly correlated in Mandarin speakers. Imageability was found to be a predictive factor of rated arousal while frequency was found to be a predictive factor for both emotional valence and arousal. As most of the words in this study are perceived as neutral, there was a limited number of words with positive or negative valence. Modifications will be needed to prepare stimuli with larger variety of warm features in future studies. Then we can have more insight on the relationship between the cold features and warm features in Chinese word recognition. Stricter inclusive criteria can also be set to reduce the confounding factors. Besides subjective ratings, previous studies show that emotional valence and arousal activate different parts of the brain (Lewis, Critchley, Rotshtein & Dolan, 2007). Therefore, in addition to behavioral studies such as the present study, further imaging investigations with fMRI and event-related potentials (ERP) studies should be performed to investigate mechanisms of word recognition.

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Acknowledgement

Appendix A- Consent form for the preparatory study

参 加 者 须 知 及 同意书

<div align="center">中文字的语义及词汇特性与情绪特性的关系</div>

本人是香港大学教育学院語言语及听觉科学部四年级学生。现诚意邀请阁下参与一项有关中文字的研究。

研究目的
研究旨在探讨中文字的语义及词汇特性与情绪特性的关系。

研究过程
在参与研究过程中，您将被邀请命名一些图画，共有一百六十二张物件及一百个动作。您可选择您喜欢或方便您的地方进行研究。这过程旨在筛选适当的项目，作下一阶段制作问卷之用。整个过程需时约少于半小时。您的回应将被笔录然，后储存于电脑中，再存到光盘中。有关数据最多会被储存五年，然后销毁。

风险
研究过程并没有风险。

利益
是次研究并未为阁下提供直接利益，但研究员将非常感激阁下之参与。而阁下之参与将会提供宝贵资料，这对中文词汇的研究有极大的贡献。

个人私隐保障
有关你的个人资料，只供研究人员作参考之用而不会用作其它用途。参加者的身份亦不会被公开。一切参与，均属自愿性质。

参与及退出研究
阁下参与本研究是出于自愿，并可于研究的任何时候退出，所有记录的资料将被销毁。阁下不会因此承受任何负面后果，亦无需提供理由。

在此多谢您的参与！

查询
如有任何查询，请与郭逸云小姐联络(电话 :(852) 9302 0092；电邮: cherrynice@hotmail.com)或导师 Professor Brendan Weekes (电邮: weekes@hku.hk)。如想知道更多有关研究参与者的权益，请联络香港大学非临床研究操守委员会 (2241-5267)。

签署
我 _____ (参加者姓名) 明白此项研究的目的及程序，
并同意/ 不同意，参加此项研究。

_____   _____

参加者签署   日期

Appendix B- Consent form for the questionnaire

参 加 者 须 知 及 同意书

<div align="center">中文字的语义及词汇特性与情绪特性的关系</div>

本人是香港大学教育学院言语及听觉科学部四年级学生。现诚意邀请阁下参与一项有关中文字的研究。

研究目的
研究旨在探讨中文字的语义及词汇特性与情绪特性的关系。

研究过程
在参与研究过程中，您需要填写一份网上问卷。您可选择您喜欢或方便您的地方利用电脑上网进行研究，问卷将会要求您对字的六种特性用一个评级尺度作出判断。问卷的每一部份均有详尽的讲解和指示。您可选择分两段完成问卷。每段需时约三十分钟。您的回应将被储存于电脑中，再存到光盘中。有关数据最多会被储存五年，然后销毁。

风险
研究过程并没有风险。但部份参加者可能会因长时间作答问卷而感到疲倦，因此，您可把问卷分两次作答，以缩短阁下每次作答问卷的时间。

利益
是次研究并未为阁下提供直接利益，但研究员将非常感激阁下之参与。而阁下之参与将会提供宝贵资料，这对中文词汇的研究有极大的贡献。

个人私隐保障
有关你的个人资料，只供研究人员作参考之用而不会用作其它用途。参加者的身份亦不会被公开。一切参与，均属自愿性质。

参与及退出研究
阁下参与本研究是出于自愿，并可于研究的任何时候退出，所有记录的资料将被销毁。阁下不会因此承受任何负面后果，亦无需提供理由。

在此多谢您的参与！

查询 如有任何查询，请与郭逸云小姐联络(电话：(852) 9302 0092; 电邮: cherrynice@hotmail.com) 或导师 Professor Brendan Weekes (电邮: weekes@hku.hk)。如想知道更多有关研究参与者的权益，请联络香港大学非临床研究操守委员会 (2241-5267)。

签署
我 _____ (参加者姓名) 明白此项研究的目的及程序，
并同意/ 不同意参加此项研究。

_____   _____

参加者签署   日期

Appendix C- Instructions and definitions of the features in the questionnaire

Instructions and definitions of the warm features:

Emotional Arousal

Please rate each word as to the ease or difficulty with which it arouse emotion. Please give a high arousal rating (towards the number 7) to words which arouse high intensity of emotion. Words which arouse lower intensity of emotion should be given a low arousal rating (towards the number 1). Please use the full range of the scale.

情绪反应程度

请您根据每一个字所引起的情绪反应程度来评分。情绪反应程度是指接触一个字时所唤起的情绪的程度。如果那个字能唤起很大的情绪反应， 那请给它一个较高的情绪反应程度评分（偏向评定量表上的数字 7）；相反，如果那个字只能唤起很小的情绪反应，请给它较低的情绪反应程度评分（偏向评定量表上的数字 1）。请您使用整个评定量表的范围。评定量表的范围。如果你不懂得那个字，请选择「不认识此字」一栏。
[1 为极低，7 为极高]

Emotional Valence

Valence describes the extent to which an emotion is positive or negative. Please rate the words according the positivity or negativity of emotion. In this scale, 1 represents negative, 4 represents neutral and 7 represents positive. If the words arouse a positive emotion, then it should be rated as higher (From 5-7, the higher the more positive). If it does not arouse emotion, then it should be rated as 4. If it arouse a negative emotion, then it should be rated as low (From 1-3, the lower the more negative).

情绪正负面程度

请您根据每一个字所引起的情绪正负面程度来评分。情绪正面是指一个字能带出正面的情绪，情绪负面是指一个字能带出负面的情绪。在这量表，1 为极负面，4 为中性，7 为极正面。如果那个字唤起很正面的情绪，请给它较高的评分（偏向评定量表上的数字 7）；如果那个字并没有唤起任何情绪，请给之中性 4 分；如果那个字唤起很负面的情绪，那请给它一个较低的评分（偏向评定量表上的数字 1）。请您使用整个评定量表的范围。如果你不懂得那个字，请选择「不认识此字」一栏。[1 为极负面，7 为极正面]

Instructions and definitions of the cold features in the questionnaire:

Age-of-acquisition (adopted from Gilhooly & Logie, 1980)

Please select the age at which you learned each of the words. By "learning a word" it means the age at which you would have understood that word if somebody had used it in front of you, even if you did not use, read or write it at the time. Each number (1 to 7) on the scale spans the period of 2 years. Please use the full range of the scale.

学习每个字的年龄 (adopted and amended from Dai, 2011)

请选出您学习每一个字的年龄。「学习」 的意思是指在那个年龄，如果别人在您面前说出或写出这个字，尽管您还不懂得使用、阅读或书写这个字，您也能明白它的意思。每一个在量表上的数字（1 到 7）代表两年的岁数。请您使用整个量表的范围。

Familiarity (adopted from Gilhooly & Logie, 1980)

Please rate each word as to the number of times that you experienced it in daily life. If you have seen or heard or used the word nearly every day of your life, please give the word a higher familiarity rating (towards the number 7) whereas if you rarely have seen or heard or used the word, please give the word a lower familiarity rating (towards the number 1). Please use the full range of the scale.

对每个字的熟悉程度 (adopted and amended from Dai, 2011)

请您根据在日常生活中接触该事物或动作的频率来评定对每一个字的熟悉程度。如果您常常会看见，听见或使用到那个字，请给较高的熟悉程度评分（偏向评定量表上的数字7）；相反，如果您很少会见到，听到或用到它，请给那个字较低的熟悉程度评分（偏向评定量表上的数字 1）。请您使用整个评定量表的范围。如果你不懂得那个字，请选择「不认识此字」一栏。[1 为极低，7 为极高]

Frequency of Use

Please rate each word according to the frequency of use which depends on the relative frequency of a word is used during daily communication. If you use it very frequently, please give a higher rating (towards the number 7). If you use it very rarely, please give a lower rating (towards the number 1). Please use the full range of the scale.

用字频率

请填上每一个字的用字频率。用字频率是指你在日常生活中用那个字的次数。如果您常常会使用到那个字，请给较高的用字频率评分（偏向评定量表上的数字 7）；相反，如果您很少使用到那个字，请给那个字较低的用字頻率评分（偏向评定量表上的数字 1）。请您使用整个评定量表的范围。如果你不懂得那个字，请选择「不认识此字」一栏。
[1 为从不使用, 7 为经常使用]

Imageability (adopted from Paivio et al., 1968)

Please rate each word as to the ease or difficulty with which it arouse mental images (a mental picture, or sound, or other sensory experience). Please give a high imageability rating (towards the number 7) to words, in your estimation, arouse a mental image very quickly and easily whereas any word that arouses a mental image with difficulty should be given a low imagery rating (towards the number 1). Please use the full range of the scale.

此字的可想象性(adopted and amended from Dai, 2011)

请您根据每个字有多容易唤起脑海中的图像、声音或感官来评定它的可想象性。如果那个字很容易唤起相对的图像,声音或感官，请给它一个较高的可想象性评分（偏向评定量表上的数字 7）；相反，如果那字很难唤起相对的感官图像或声音，请给它一个较低的可想象性评分（偏向评定量表上的数字 1）。请您使用整个评定量表的范围。
如果你不懂得那个字，请选择「不认识此字」一栏。
[1 为极低，7 为极高]

Appendix D- Means and standard deviations of word list in all rated features

Stimuli	AoA		Frequency		Familiarity		Imageability		Arousal		Valence	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
开	3.60	1.47	5.06	1.81	5.11	2.11	4.73	2.09	4.13	1.98	4.47	1.82
走	3.56	1.45	5.32	1.77	5.30	2.05	5.03	2.05	3.90	1.95	4.51	1.44
腿	4.21	1.37	4.72	1.90	5.10	1.91	4.98	1.94	3.79	1.81	4.49	1.17
艇	4.81	1.43	3.81	2.01	4.28	1.84	4.74	1.77	3.24	1.94	4.54	1.35
叶	3.83	1.36	4.53	2.10	5.02	1.86	5.01	1.69	3.41	1.91	4.80	1.28
凳	4.44	1.50	3.94	1.63	5.06	1.80	5.07	1.89	3.41	1.76	4.37	1.51
蠋	4.92	1.53	3.21	1.79	4.24	1.83	4.43	2.00	3.23	1.70	4.30	1.53
梳	4.51	1.40	4.16	2.02	4.90	1.78	4.64	1.82	3.62	1.86	4.34	1.33
坐	3.88	1.51	4.98	1.91	5.47	1.85	4.76	1.94	3.94	1.93	4.53	1.19
猪	4.20	1.50	4.39	1.93	5.24	1.72	5.20	1.65	4.06	1.99	4.49	1.35
桌	4.13	1.42	4.39	1.95	5.46	1.53	5.00	1.73	3.79	2.03	4.17	1.66
跑	4.00	1.50	4.70	2.01	5.24	1.72	5.21	1.55	4.00	1.79	4.26	1.50
吠	4.56	1.36	3.54	1.90	4.33	2.00	4.99	1.68	3.80	1.81	3.52	1.46
轮	4.40	1.31	4.10	2.08	5.01	1.92	4.91	1.91	3.48	1.83	4.02	1.28
扣	4.29	1.38	3.84	1.89	4.67	1.69	4.52	1.72	3.36	1.95	3.97	1.28
叉	4.06	1.48	4.27	2.10	4.74	1.89	4.86	1.86	3.34	1.98	4.13	1.25
院	4.21	1.24	4.24	2.09	4.87	1.82	4.82	1.67	3.39	1.88	4.70	1.29
堡	4.80	1.34	3.81	2.09	4.16	2.02	4.38	1.76	3.32	1.77	4.72	1.53
耙	5.02	1.48	3.12	1.89	3.67	1.98	4.16	1.85	2.84	1.76	4.28	1.21
脑	4.29	1.38	4.60	1.82	5.09	1.73	4.98	1.77	3.59	1.94	4.69	1.30
跳	3.97	1.34	4.10	1.83	5.12	1.73	5.24	1.42	3.71	1.87	4.54	1.43
信	4.08	1.27	4.46	1.95	5.42	1.84	5.39	1.64	3.88	1.88	4.76	1.37
鸭	3.88	1.53	3.93	1.92	4.96	1.89	5.00	1.76	3.47	1.79	4.30	1.41
虎	4.03	1.36	4.07	2.16	4.74	2.03	5.14	1.65	3.84	1.97	4.07	1.39
栏	4.28	1.36	4.18	2.07	4.38	1.83	4.62	1.78	3.43	1.95	4.28	1.25
果	3.91	1.32	4.59	2.09	5.24	1.70	4.72	1.90	3.97	2.05	4.91	1.38
笑	3.82	1.40	4.67	2.06	5.30	1.99	5.22	1.92	4.62	1.97	5.50	1.47
锤	4.49	1.57	3.73	1.94	4.54	1.83	4.38	1.99	3.46	1.82	4.37	1.37
篮	4.29	1.46	3.74	2.16	4.82	1.61	4.69	1.84	3.41	1.77	4.17	1.21
靠	4.39	1.35	4.54	1.82	5.29	1.64	4.66	1.84	3.69	1.78	4.14	1.54
盒	4.14	1.28	4.49	1.75	5.00	1.68	4.61	1.87	3.53	1.90	4.00	1.44
鸟	3.96	1.42	4.12	1.99	5.30	1.83	5.23	1.86	3.80	2.07	4.41	1.33
冠	4.44	1.32	3.79	1.88	4.42	1.81	4.42	1.84	3.54	1.96	4.56	1.21
室	4.31	1.38	4.67	1.93	4.91	1.74	4.41	1.90	3.66	1.86	4.16	1.29

Stimuli	AoA		Frequency		Familiarity		Imageability		Arousal		Valence	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
箭	4.63	1.29	3.66	1.86	4.44	1.95	4.78	1.69	3.22	1.73	4.03	1.39
巫	4.74	1.37	3.20	2.19	4.24	2.08	4.20	1.97	3.36	1.76	3.64	1.75
椅	4.12	1.37	4.12	1.91	5.42	1.51	4.87	1.88	3.54	1.85	4.47	1.22
玩	4.00	1.45	4.56	1.97	5.38	1.81	5.01	1.93	4.20	1.94	4.99	1.43
钓	4.40	1.33	3.52	1.86	4.60	1.87	4.77	1.77	3.46	1.82	4.32	1.48
打	3.86	1.34	4.36	2.07	5.00	2.05	5.09	1.75	4.20	1.82	3.69	1.58
哨	4.57	1.27	3.18	2.00	4.24	1.93	4.28	1.83	3.34	1.78	4.16	1.07
摇	4.56	1.53	3.99	1.85	4.59	1.95	4.67	1.85	3.43	1.88	4.28	1.18
伞	4.29	1.50	4.24	1.89	4.93	1.75	4.69	1.95	3.53	1.74	4.40	1.34
化	4.22	1.42	4.16	1.94	4.58	1.89	4.50	1.90	3.39	1.92	4.32	1.28
蜂	4.63	1.41	3.88	2.12	4.64	1.96	4.94	1.82	3.34	1.83	4.27	1.34
剑	4.73	1.41	3.27	1.98	4.62	2.10	4.84	1.97	3.36	1.85	4.23	1.45
折	4.40	1.45	3.90	2.13	5.01	1.73	4.88	1.72	3.39	2.01	4.32	1.36
书	3.69	1.43	4.62	2.24	5.48	1.67	5.19	1.66	3.77	1.94	4.61	1.80
床	3.77	1.47	4.91	1.94	5.40	1.82	5.07	1.77	4.08	1.98	4.66	1.52
鱼	3.78	1.41	4.50	1.92	5.53	1.54	5.14	1.67	3.77	1.87	4.77	1.33
旗	4.36	1.37	3.91	1.98	4.51	2.15	4.48	2.12	3.47	1.75	4.49	1.21
指	4.08	1.42	4.67	2.03	5.08	1.86	4.58	1.89	3.61	1.75	4.24	1.17
射	4.37	1.38	3.96	2.01	4.69	1.91	4.63	1.76	3.56	1.77	4.02	1.32
脚	3.81	1.53	4.16	2.03	5.63	1.46	5.13	1.64	3.80	1.97	4.46	1.37
鞍	4.56	1.68	3.38	1.89	4.03	1.99	4.21	1.69	3.29	1.93	4.40	1.28
盘	4.58	1.41	3.79	1.95	4.76	1.76	4.53	1.79	3.27	1.89	4.53	1.37
马	3.98	1.46	3.82	2.30	5.22	1.94	5.24	1.79	3.40	1.83	4.29	1.45
根	4.23	1.44	3.44	2.08	4.60	1.98	4.43	1.81	3.50	1.94	3.99	1.53
烟	4.19	1.39	4.30	1.93	5.10	1.85	5.10	1.77	3.86	1.86	3.52	1.56
睡	4.12	1.63	4.69	2.04	5.24	1.92	4.93	1.87	4.23	1.92	4.63	1.43
舌	4.06	1.62	4.19	2.32	4.93	1.96	4.64	1.84	3.57	2.01	4.42	1.25
种	4.17	1.46	4.09	2.12	4.63	1.97	4.73	1.74	3.70	2.05	4.70	1.38
刷	4.31	1.49	3.80	1.86	5.03	1.78	4.93	1.65	3.47	1.89	4.57	1.32
接	4.38	1.35	4.34	1.89	5.16	1.73	4.76	1.83	3.59	1.84	4.52	0.99
称	4.64	1.34	4.01	1.81	4.97	1.73	4.44	1.81	3.04	1.70	4.31	1.36
唱	3.96	1.50	4.48	1.96	5.10	1.69	5.23	1.72	4.03	1.80	4.73	1.53
吃	3.62	1.40	5.09	1.93	5.47	2.03	5.06	2.00	4.34	1.90	4.87	1.46
剥	4.76	1.29	3.61	1.85	4.38	1.93	4.39	1.79	3.53	1.82	3.97	1.32
表	4.48	1.47	4.49	2.04	5.22	1.80	4.96	1.85	3.89	1.96	4.67	1.29

Stimuli	AoA		Frequency		Familiarity		Imageability		Arousal		Valence	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
鼠	4.71	1.70	3.72	1.95	4.60	1.99	4.83	1.79	4.07	1.83	3.71	1.78
敲	4.57	1.50	3.91	2.00	4.62	1.89	4.73	1.69	3.48	1.81	4.38	1.60
滴	4.42	1.44	3.82	1.90	4.60	1.93	4.78	1.70	3.18	1.71	4.20	1.29
圆	3.89	1.58	4.17	1.97	5.24	1.76	5.12	1.77	3.37	1.86	4.38	1.39
煮	4.70	1.55	4.47	1.96	5.50	1.75	5.03	1.86	3.59	2.01	4.62	1.44
梳	4.57	1.54	4.17	1.94	5.29	1.52	4.61	1.92	3.44	1.86	4.41	1.21
驼	4.86	1.50	3.38	1.92	4.58	2.17	4.49	2.17	3.10	1.68	4.26	1.34
钻	4.40	1.55	3.73	1.82	4.91	1.78	4.66	1.84	3.52	1.72	4.46	1.40
狮	4.67	1.51	3.48	1.94	4.43	1.99	4.71	1.89	3.63	1.89	4.32	1.53
塞	4.75	1.43	3.51	1.89	4.23	1.94	4.16	1.89	3.18	1.79	3.91	1.44
看	3.94	1.46	5.37	1.81	5.26	2.11	4.74	2.08	3.99	1.84	4.74	1.32
帐	4.70	1.34	4.17	2.13	4.99	1.89	4.99	1.99	3.53	1.89	4.37	1.19
飞	3.93	1.38	4.63	2.02	5.07	1.83	5.33	1.54	3.78	1.86	4.81	1.33
斗	4.03	1.49	3.87	2.08	4.17	2.16	4.28	1.94	3.33	1.82	4.27	1.44
斧	4.38	1.50	3.32	1.85	4.39	2.03	4.49	1.94	3.23	1.72	4.02	1.14
画	4.06	1.52	4.23	2.00	4.98	1.84	5.00	1.72	3.86	1.86	4.46	1.34
桶	4.31	1.35	4.06	1.84	5.13	1.68	4.82	1.80	3.42	1.79	3.93	1.53
心	3.80	1.37	4.84	2.12	5.31	1.73	5.12	1.76	4.03	1.97	4.78	1.38
弹	4.48	1.36	4.07	1.94	4.76	1.77	4.88	1.67	3.41	1.79	4.43	1.44
刮	4.47	1.31	4.01	1.96	4.44	1.81	4.44	1.64	3.36	1.75	4.12	1.67
锚	5.15	1.51	3.60	2.21	3.89	2.09	4.18	2.14	3.32	1.90	3.84	1.59
门	3.78	1.72	5.19	2.02	5.43	1.71	4.62	2.23	3.94	2.16	4.87	1.54
骑	4.13	1.63	3.70	2.06	4.88	1.99	4.83	1.81	3.56	1.88	4.23	1.27
爬	4.18	1.40	3.98	1.87	4.60	2.10	4.70	2.06	3.86	1.86	4.01	1.45
巢	4.71	1.53	3.33	2.04	4.24	2.05	4.36	1.89	3.36	1.87	4.09	1.38
猫	3.77	1.68	4.16	1.88	5.06	1.88	5.20	1.74	3.64	1.79	4.29	1.37
喝	4.12	1.41	5.09	1.73	5.68	1.51	5.19	1.66	4.06	1.73	4.96	1.45
滑	4.29	1.52	4.11	1.99	4.63	1.90	4.70	1.85	3.48	1.78	4.19	1.59
哭	3.90	1.64	4.52	2.13	4.92	2.08	5.28	1.79	4.03	1.96	3.59	1.76
树	4.04	1.48	4.58	2.02	5.18	1.81	4.83	1.78	3.40	2.02	4.73	1.33
桥	4.32	1.34	4.17	1.92	5.11	1.86	4.87	1.82	3.19	1.95	4.39	1.21
钱	4.33	1.55	5.31	1.73	5.79	1.64	5.67	1.54	4.88	1.97	5.02	1.45
莓	4.87	1.46	3.56	2.11	4.47	2.01	4.27	1.83	3.62	2.01	4.27	1.45
熨	5.02	1.42	3.41	1.87	4.47	2.03	4.58	1.84	3.90	2.07	4.29	1.46
鼓	4.27	1.48	3.63	1.97	4.82	1.84	4.71	1.76	3.80	1.82	3.99	1.50

Stimuli	AoA		Frequency		Familiarity		Imageability		Arousal		Valence	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
挥	4.25	1.23	3.99	1.89	4.87	1.92	4.50	1.68	3.32	1.64	4.16	1.29
沉	4.53	1.40	3.83	1.86	4.63	1.95	4.29	1.80	3.33	1.66	3.80	1.58
鞋	4.30	1.36	4.83	1.86	5.39	1.96	4.70	2.06	3.74	1.92	4.63	1.38
倒	4.23	1.36	4.19	2.07	5.10	1.74	4.81	1.87	3.68	1.85	4.08	1.72
响	4.47	1.42	4.37	2.08	5.10	1.77	4.74	1.80	3.86	1.73	4.26	1.25
肠	4.04	1.47	4.31	1.99	4.89	1.98	4.86	1.85	3.59	1.92	4.06	1.68
梦	4.59	1.59	4.52	1.92	5.22	1.73	4.52	1.93	3.66	1.88	4.51	1.45
牛	3.90	1.66	4.10	2.09	5.07	1.92	4.78	1.93	3.62	1.97	4.54	1.40
吼	4.53	1.58	3.35	1.95	4.43	2.16	4.84	1.57	3.60	1.82	3.39	1.69
浇	4.47	1.67	3.67	1.93	4.87	1.87	4.71	1.79	3.03	1.71	4.26	1.25
舔	4.55	1.89	3.46	1.87	4.47	2.03	4.71	1.83	3.47	1.73	3.88	1.44
方	3.53	1.36	4.31	2.05	5.38	1.81	4.69	1.84	3.36	1.82	4.02	1.35
剪	4.44	1.28	4.39	1.90	5.18	1.79	4.67	1.76	3.67	1.80	3.89	1.51
狗	3.73	1.36	4.48	1.98	5.49	1.64	5.03	1.81	3.88	1.99	4.34	1.58
鼻	4.18	1.49	4.61	2.00	5.32	1.79	4.53	2.04	3.50	2.05	4.28	1.36
指	4.19	1.36	4.43	1.97	5.09	1.84	4.64	1.80	3.16	1.97	4.22	1.33
蛙	4.10	1.48	3.74	2.00	4.46	2.02	4.66	1.80	3.17	1.77	4.16	1.40
门	3.86	1.70	5.08	1.94	5.64	1.66	4.84	1.91	3.51	1.98	4.64	1.52
铲	4.83	1.50	3.86	2.17	4.46	1.99	4.51	1.89	3.51	1.92	4.19	1.51
琴	4.38	1.36	4.01	2.05	5.13	1.76	4.78	2.09	3.90	1.99	4.76	1.46
洗	4.17	1.42	5.08	1.75	5.76	1.47	4.98	1.80	4.08	2.05	4.54	1.40
带	4.09	1.39	4.61	1.88	5.27	1.78	4.87	1.83	3.74	2.15	4.40	1.19
壶	4.13	1.66	4.08	2.03	4.83	1.76	4.77	1.76	3.24	1.84	4.31	1.26
写	3.54	1.42	4.86	1.89	5.58	1.43	5.04	1.76	3.63	1.87	4.36	1.35
梨	4.19	1.41	3.90	2.02	5.21	1.73	4.82	1.89	3.46	1.85	4.57	1.25
路	3.89	1.57	4.76	2.09	5.42	1.78	4.88	1.87	4.00	1.87	4.47	1.25
缝	5.02	1.40	3.69	1.98	5.04	1.95	4.64	1.70	3.58	1.80	4.13	1.28
结	4.44	1.36	3.99	2.07	5.01	1.74	4.53	1.82	3.50	1.96	4.23	1.37
踢	4.58	1.54	4.27	1.89	4.97	1.78	4.79	1.78	3.78	1.86	3.69	1.45
眼	3.58	1.61	4.67	2.01	5.20	1.99	5.01	1.95	3.82	2.05	4.52	1.68
骨	3.98	1.51	4.28	1.89	4.83	2.01	4.91	1.86	3.67	1.85	4.38	1.55
帽	3.99	1.43	4.26	1.93	5.06	1.79	5.22	1.77	3.44	1.76	4.80	1.28
笔	4.00	1.34	4.77	1.90	5.49	1.53	5.30	1.70	3.78	1.83	4.84	1.30
链	4.93	1.40	3.72	1.96	4.31	1.92	4.59	1.84	3.51	1.84	4.46	1.15
勺	4.48	1.63	4.26	2.07	4.59	1.91	4.49	1.95	3.46	2.02	4.71	1.27

Stimuli	AoA		Frequency		Familiarity		Imageability		Arousal		Valence	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
发	4.27	1.62	4.79	1.92	5.81	1.44	5.26	1.74	3.78	1.88	4.94	1.45
月	3.84	1.76	4.29	2.01	5.39	1.69	5.13	1.63	3.78	1.91	4.82	1.31
点	4.06	1.35	4.33	2.03	4.78	2.15	4.41	2.17	3.72	1.98	4.13	1.64
领	4.18	1.41	4.14	1.85	4.78	1.94	4.40	1.98	3.41	1.87	4.17	1.38
菇	4.43	1.49	3.73	1.85	4.14	1.95	4.39	1.88	3.42	1.76	4.20	1.20
窗	4.26	1.32	4.51	1.84	5.17	1.56	4.68	1.90	3.57	1.80	4.40	1.47
帘	4.88	1.41	3.93	1.82	4.93	1.71	4.64	1.83	3.48	1.82	4.51	1.28
吹	3.89	1.40	4.41	1.88	4.78	1.90	4.80	1.77	3.96	2.03	4.16	1.35
游	4.32	1.29	4.14	1.99	5.10	1.80	4.89	1.83	3.81	1.83	4.27	1.50
鬼	4.11	1.65	3.48	2.08	4.50	1.99	4.76	1.74	4.00	1.98	3.27	1.80
咬	4.26	1.50	3.88	2.07	4.51	2.01	4.92	1.62	3.98	1.89	3.82	1.55
象	4.38	1.39	3.68	2.03	4.56	1.99	4.53	1.90	3.67	2.01	4.12	1.32
跪	4.66	1.36	3.41	2.08	4.31	2.05	4.91	1.70	3.83	1.96	3.68	1.49
影	4.63	1.38	3.99	2.08	4.97	1.82	4.81	1.80	3.44	1.82	4.16	1.36
花	3.58	1.45	4.60	1.97	5.54	1.70	5.29	1.73	4.08	1.81	5.11	1.37
梯	4.14	1.55	4.37	1.93	5.10	1.81	5.10	1.87	3.48	1.83	4.81	1.35
画	4.00	1.55	4.48	2.05	5.07	1.71	5.17	1.61	3.58	1.89	4.93	1.24
酪	4.92	1.32	3.79	2.09	4.02	1.82	4.14	1.77	3.35	2.05	4.18	1.34
球	3.88	1.44	4.63	1.88	5.33	1.78	5.02	1.57	4.00	2.01	4.66	1.28
织	4.33	1.27	4.14	1.93	4.74	1.83	4.92	1.64	3.67	2.06	4.66	1.21
顶	4.28	1.27	4.01	2.00	4.69	1.94	4.46	1.80	3.60	1.88	4.44	1.29
王	3.89	1.46	4.11	2.13	4.84	2.00	4.47	2.00	3.61	1.97	4.76	1.57
缸	4.46	1.44	3.74	1.89	4.16	1.98	4.33	1.91	3.47	2.01	4.31	1.44
刷	4.30	1.46	4.26	1.89	4.93	1.67	4.94	1.68	3.61	1.89	4.34	1.38
推	4.19	1.33	4.23	1.90	4.98	1.74	4.86	1.63	3.81	2.01	3.97	1.30
蝶	4.46	1.37	3.74	1.83	4.51	1.97	4.66	1.82	3.71	2.22	4.51	1.34
塔	4.52	1.36	3.77	2.11	4.57	2.15	4.83	1.93	3.47	1.97	4.46	1.26
蕉	4.23	1.49	4.04	1.94	4.98	1.68	4.70	1.78	3.62	1.95	4.42	1.17
裤	4.30	1.46	4.80	1.93	5.44	1.54	4.87	1.68	3.52	2.00	4.61	1.29
羊	3.54	1.26	4.04	2.07	5.10	1.84	4.93	1.80	3.66	1.91	4.70	1.37
搅	4.65	1.55	3.77	1.84	4.72	1.92	4.72	1.90	3.34	1.65	4.00	1.32

Appendix E- Action and Object Naming Test- 20 matched pairs of verbs and nouns (Table showing means of all features for each word)

		AoA	Frequency	Familiarity	Imageability	Arousal	Valence		AoA	Frequency	Familiarity	Imageability	Arousal	Valence
1	敲	4.57	3.91	4.62	4.73	3.48	4.38	塔	4.52	3.77	4.57	4.83	3.47	4.46
2	画	4.00	4.48	5.07	5.17	3.58	4.93	梯	4.14	4.37	5.10	5.10	3.48	4.81
3	骑	4.13	3.70	4.88	4.83	3.56	4.23	篮	4.29	3.74	4.82	4.69	3.41	4.17
4	挥	4.25	3.99	4.87	4.50	3.32	4.16	领	4.18	4.14	4.78	4.40	3.41	4.17
5	带	4.09	4.61	5.27	4.87	3.74	4.40	腿	4.21	4.72	5.10	4.98	3.79	4.49
6	接	4.38	4.34	5.16	4.76	3.59	4.52	窗	4.26	4.51	5.17	4.68	3.57	4.40
7	跳	3.97	4.10	5.12	5.24	3.71	4.54	鸟	3.96	4.12	5.30	5.23	3.80	4.41
8	看	3.94	5.37	5.26	4.74	3.99	4.74	门	3.78	5.19	5.43	4.62	3.94	4.87
9	刮	4.47	4.01	4.44	4.44	3.36	4.12	栏	4.28	4.18	4.38	4.62	3.43	4.28
10	弹	4.48	4.07	4.76	4.88	3.41	4.43	伞	4.29	4.24	4.93	4.69	3.53	4.40
11	游	4.32	4.14	5.10	4.89	3.81	4.27	蕉	4.23	4.04	4.98	4.70	3.62	4.42
12	折	4.40	3.90	5.01	4.88	3.39	4.32	凳	4.44	3.94	5.06	5.07	3.41	4.37
13	射	4.37	3.96	4.69	4.63	3.56	4.02	扣	4.29	3.84	4.67	4.52	3.36	3.97
14	倒	4.23	4.19	5.10	4.81	3.68	4.08	轮	4.40	4.10	5.01	4.91	3.48	4.02
15	摇	4.56	3.99	4.59	4.67	3.43	4.28	旗	4.36	3.91	4.51	4.48	3.47	4.49
16	靠	4.39	4.54	5.29	4.66	3.69	4.14	鼻	4.18	4.61	5.32	4.53	3.50	4.28
17	滴	4.42	3.82	4.60	4.78	3.18	4.20	箭	4.63	3.66	4.44	4.78	3.22	4.03
18	坐	3.88	4.98	5.47	4.76	3.94	4.53	路	3.89	4.76	5.42	4.88	4.00	4.47
19	推	4.19	4.23	4.98	4.86	3.81	3.97	肠	4.04	4.31	4.89	4.86	3.59	4.06
20	点	4.06	4.33	4.78	4.41	3.72	4.13	盒	4.14	4.49	5.00	4.61	3.53	4.00