

# Semantic Categorisation and Verbal Fluency Performance in a Community Population in Hong Kong: a Preliminary Report

RCK Chan, M Wong, EYH Chen, LCW Lam

## Abstract

**Objective:** Category fluency tests are important cognitive and clinical neuropsychological assessments. The lack of Chinese norms suggests the need for well-validated normative data for Hong Kong Chinese people.

**Patients and Methods:** This study aimed to provide preliminary normative data for healthy Hong Kong Chinese adults, aged from 16 to 65 years, for 4 commonly used measures of category fluency — ‘animal’, ‘means of transport’, ‘food’, and ‘furniture’. 100 healthy people (42 men and 58 women) were recruited in the community.

**Results:** The mean age and educational level of the group was 32 years (standard deviation, 11.76 years) and 11.31 years (standard deviation, 3.64 years), respectively. The findings indicate that the categories of food and animal had the highest mean number of citations ( $21.52 \pm 7.14$  for food and  $20.07 \pm 5.84$  for animal), whereas the categories of furniture and means of transport had the lowest mean score ( $14.24 \pm 4.79$  for furniture and  $15 \pm 3.86$  for means of transport).

**Conclusion:** The implication of applying these preliminary norms in Hong Kong Chinese and psychiatry research is discussed. These findings may give clinicians an alternative to screen and assess such groups in their communities.

*Key words:* Category, Chinese, Hong Kong, Norms

## Introduction

Studies of categorisation arise in psychological research with the aim of understanding how an infinite number of discriminably different objects, events, and experience in the real world are internally organised. The ability to categorise enables us to interact with our environment without becoming overwhelmed by its complexity. Previous studies suggest that categories are organised in a hierarchical order by means of class inclusion.<sup>1</sup> According to Rosch et al, there are 3 levels of hierarchy for categories.<sup>1</sup> The superordinate categories (such as musical instrument)

contain the basic-level categories (such as drum), which in turn contain the subordinate categories (such as bass drum). It is suggested that the basic level of categories carries the most information, possesses the highest category cue validity, and is therefore the most differentiated from 1 category to another.<sup>1</sup>

Many researchers of cognitive psychology, on the other hand, are interested in how instances within a category are structured. There are 2 main ways to measure this internal category structure. The first one is the associate frequency, which refers to the measure of the probability of a person producing an item when asked to generate members of a particular category.<sup>2</sup> Associate frequency is based on the network-search models of semantic memory, which suggests that the internal structure of a semantic category is best measured by the strength and search order of pathways linking the category node to its subordinate item nodes.<sup>2</sup> The higher the probability of a particular item elicited by participants and the earlier in the order of presentation of that item indicates that the particular item is a higher representation of the category name, e.g. orange of the category ‘fruit’.

The second way to investigate the internal category structure utilises the concept of typicality.<sup>3</sup> According to Rosch, typicality is measured by asking participants to rate the extent to which an item represented the idea or image of

---

*Dr RCK Chan, Department of Psychology, Sun Yat Sen University, Guangzhou, China, and Department of Psychiatry, The University of Hong Kong, Hong Kong.*

*Dr M Wong, Department of Clinical Psychology, Kwai Chung Hospital, Hong Kong.*

*Dr EYH Chen, Department of Psychiatry, The University of Hong Kong, Hong Kong.*

*Dr LCW Lam, Department of Psychiatry, The Chinese University of Hong Kong, Hong Kong.*

**Address for correspondence:** Dr RCK Chan, Department of Psychology, Sun Yat Sen University, Guangzhou 51027, Guangzhou, China.

Tel: (86 20) 8411 4267

Fax: (86 20) 8411 5600

E-mail: [ilto:rckchan2003@yahoo.com.hk](mailto:ilto:rckchan2003@yahoo.com.hk) or [rckchan@hkucc.hku.hk](mailto:rckchan@hkucc.hku.hk)

**Submitted:** 8 October 2003; **Accepted:** 7 January 2004

a particular category.<sup>3</sup> This has been shown to correlate with measures of feature overlap, and typicality effects are assumed to be due to the feature similarity among category members.

The verbal fluency test, a widely employed test in neuropsychological assessment, is based on the network search models of semantic memory. There are 2 types of verbal fluency test. The first is the letter fluency test, e.g. the FAS test. However, this test does not address the semantic dimension directly. The second type is the category fluency or category naming test, in which the participant is required to produce as many exemplars of a given category (e.g. animal, food, and vegetables) as possible.

The category fluency tests provide useful qualitative and quantitative data for detecting cognitive defects in patients across a wide range of psychiatric disorders. The performance of category fluency tests depends on sustained attention, verbal intelligence, efficiency of semantic process, and the integration of the lexical system.<sup>4</sup> Similarly, impairment in category fluency tests may involve different neural systems and is found in patients with various psychiatric disorders such as Alzheimer's disease, Parkinson's disease, Huntington's disease, schizophrenia, Korsakoff's syndrome, frontal lobe lesions, temporal lobe lesions, and attention deficit and hyperactivity disorders.<sup>4-8</sup>

The results of some studies indicate that the verbal fluency test is sensitive to cerebral lesions, especially the left frontal lobe.<sup>9</sup> Differential patterns of performance in verbal fluency tests in different patient groups have provided important information in the neural process of verbal fluency and semantic memory. It was found that in Alzheimer's disease, category fluency is disproportionately affected compared with letter fluency, whereas both letter and category fluency tests are equally impaired in Huntington's and Parkinson's diseases.<sup>8</sup>

It has been suggested that the impairment of verbal fluency in Alzheimer's disease is related to the structure of the semantic store, while that in Huntington's and Parkinson's disease is due to the problem of accessing the store.<sup>8</sup> However, equivocal findings on the pattern of impairment in patients with schizophrenia suggested that poor verbal fluency performance may be partly due to inefficient access to semantic store,<sup>10</sup> reduction in semantic store,<sup>11</sup> or both.<sup>12</sup> Generally speaking, however, the verbal fluency test seems to be a brief and efficient screening tool in neuropsychological assessment applicable to a wide range of people, including the elderly.<sup>6</sup>

Despite the potential usefulness in the clinical and research setting, the verbal fluency norms for Chinese people — in particular Hong Kong Chinese people — are scarce. A literature search indicates that there are only 4 studies concerning the category fluency test in Chinese people.<sup>6,13-15</sup> Jeng et al established the category norms from university students in Taiwan.<sup>15</sup> However, these norms are not applicable to Hong Kong due to linguistic and cultural differences between the 2 locations. It is especially true that the dominant dialect between the Taiwanese (Mandarin) and

Hong Kong Chinese (Cantonese) people is different. In addition, Jeng et al's norms were limited to high function participants, i.e. university students, and thus were limited in their representativeness.<sup>15</sup>

In Chiu et al's study, the authors tested for the usefulness of the category fluency task as a satisfactory screening instrument for differentiating patients with dementia from normal elderly Chinese people in Hong Kong.<sup>6</sup> The categories employed were 'animal', 'fruit', and 'vegetable'. It was found that, with a cut-off score of 19 in combined total scores of the 3 categories, a sensitivity of 80.0% and a specificity of 88.7% were yielded in differentiating demented and cognitively intact elderly people. Despite the relevancy of the Hong Kong Chinese norms in Chiu et al's study, their norms were limited to the elderly population.<sup>6</sup>

Chen et al compared the verbal fluency performance between patients with schizophrenia and healthy controls and found that category fluency exhibited a robust correlation with negative symptoms of schizophrenia in the Hong Kong Chinese setting.<sup>14</sup> These researchers suggested a partial overlap between the neural mechanisms underlying negative symptoms and verbal fluency in these patients. However, they did not provide the normative scores for the participants.

The final study was conducted by Chan and Poon in a group of healthy Hong Kong Chinese people.<sup>13</sup> While these authors provided very useful and relevant local category norms for Hong Kong Chinese people, they limited their local norms to 2 categories of animal and means of transport. Although the inclusion of living things (animal) and non-living thing (means of transport) may provide a sensitive yardstick for detecting category-specific semantic impairments in neuropathological change in the brain,<sup>16-18</sup> the discrepancy in these findings may be due to task difficulty rather than the true difference between groups.<sup>19</sup> Moreover, there seem to be a limited number of items within the category means of transport, making it easier to reach the ceiling effect for the healthy population. Therefore, inclusion of a non-living thing category with a wider range of items or increasing the number of non-living thing categories in the data collection may supplement and strengthen the normative data of the category fluency test in the Hong Kong Chinese setting.

In general, however, most of the aforementioned studies tended to use and emphasise a simple quantitative fluency score (number of items cited within a particular time period). The study of frequency and probability of items, as mentioned above, would supplement quantitative information relevant to the internal categorical structure.<sup>20</sup> Therefore, the present study aimed to provide the preliminary verbal fluency norms of 4 categories — 'animal', 'food', 'furniture', and 'means of transport'. It also aimed to supplement previous Chinese normative studies on more category fluency scores by providing detailed information on the frequency and ranking score of the 4 categories. This information is particularly important and relevant to the understanding of the underlying semantic network in local clinical samples.

## Patients and Methods

### Patients

100 healthy people, including 42 men and 58 women, were recruited in the community after screening with a questionnaire. The participants had a mean age of 32 years (standard deviation [SD], 11.76 years; range, 16 to 65 years), and a mean education level of 11.31 years (SD, 3.64 years). The participants did not have a past history of central nervous system disease and mental illness. Potential participants were further excluded if they were chronic drinkers, smokers, or drug addicts; had visual and hearing difficulties; had speech and motor impairments that may hinder the running of the tests; or were taking medication known to affect cognitive function. These exclusion criteria were established to make sure the participants were representative of a non-clinical sample and to ensure that they could understand all the procedures and participate meaningfully in the study. Participation was on a voluntary basis. Written consent was obtained from all the participants preceding the assessment.

### Materials

In this study, 4 categories were selected: ‘animal’, ‘means of transport’, ‘food’, and ‘furniture’. The categories were selected from a unit of categories used in Battig and Montague<sup>21</sup> and Jeng et al’s<sup>15</sup> studies. The exception was

‘means of transport’ which was modified from ‘vehicle’ in Battig and Montague<sup>21</sup> and Jeng et al’s<sup>15</sup> studies, as more exemplars could be included in the category.

### Procedures

The data were collected by trained research assistants and audiotaped. Participants were requested to provide as many exemplars from the target categories as they could within the time limit of 1 minute. The administrators later transcribed the responses in the exact order in spreadsheets. Repeated responses were excluded from the participant’s response list. The spreadsheet consisted of 2 columns: the name of the exemplar and the rank order of the response.

### Data Analysis

The data were analysed using the Statistical Package for Social Sciences (version 10.0). Mean scores for each category were computed. Multivariate analysis of variance (MANOVA) was conducted to examine the main effects and interaction effects of age, education, and gender. Individual response items were then presented in descending order of total frequency for each category in terms of ‘rank first’ and ‘mean rank’. Frequency is the number of the occasions in which an item was produced amongst the 100 participants. The rank first data are the number of times the item was produced as the first response.

**Table 1. Category fluency scores in Hong Kong Chinese people.**

Variable	Animal (standard deviation)	Food (standard deviation)	Furniture (standard deviation)	Means of transport (standard deviation)
Age (years)				
16-26 (n = 45)	21.68 (5.90)	22.09 (7.83)	14.86 (4.77)	15.18 (4.59)
27-46 (n = 42)	19.62 (5.61)	21.48 (6.97)	13.98 (5.15)	15.50 (3.01)
47-65 (n = 13)	16.15 (4.71)	19.77 (5.53)	13.08 (3.73)	13.00 (3.21)
Education (years)				
0-9 (n = 25)	16.16 (5.68)	19.48 (6.38)	13.08 (5.38)	12.80 (3.16)
10-13 (n = 45)	21.00 (4.73)	21.18 (7.57)	14.64 (4.29)	15.40 (3.64)
14-18 (n = 30)	22.03 (6.22)	23.83 (6.77)	14.66 (5.07)	16.38 (4.05)
Gender				
Male (n = 42)	20.83 (6.25)	19.62 (7.50)*	12.60 (4.33) <sup>†</sup>	15.36 (3.86)
Female (n = 58)	19.53 (5.56)	22.93 (6.66)*	15.47 (4.83) <sup>†</sup>	14.49 (3.89)

\*  $p < 0.05$ .

<sup>†</sup>  $p < 0.005$ .

**Table 2. Category scores in Hong Kong Chinese people by gender and age and by gender and education.**

Category	Men (standard deviation)			Women (standard deviation)		
	16-26 (n = 16)	27-46 (n = 22)	47-65 (n = 4)	16-26 (n = 20)	27-46 (n = 20)	47-65 (n = 9)
Age (years)						
Animal	21.50 (7.74)	20.82 (5.47)	18.25 (3.69)	21.79 (4.71)	18.30 (5.60)	15.22 (4.99)
Food	20.00 (9.00)	19.05 (7.01)	21.25 (3.50)	23.29 (6.96)	24.15 (6.03)	19.11 (6.29)
Means of transport	12.56 (4.50)	12.18 (4.49)	15.00 (2.16)	16.18 (4.48)	15.95 (5.22)	12.22 (4.06)
Furniture	14.38 (4.88)	15.91 (3.22)	16.25 (1.71)	15.64 (4.44)	15.05 (2.76)	11.56 (2.60)
Education (years)						
Animal	17.00 (5.89)	20.44 (5.77)	23.60 (6.02)	15.69 (5.69)	21.37 (3.97)	20.36 (6.21)
Food	17.33 (7.38)	18.50 (8.97)	22.33 (4.79)	20.69 (5.64)	22.96 (6.02)	25.43 (8.29)
Means of transport	12.44 (5.46)	12.44 (4.45)	12.87 (3.70)	13.44 (5.49)	16.11 (3.56)	16.57 (5.75)
Furniture	13.22 (3.56)	14.94 (3.89)	17.13 (3.38)	12.56 (3.01)	15.70 (3.51)	15.57 (4.65)

The mean rank data are the total of the rank of that response divided by its total frequency. Finally, a series of stepwise linear regression analyses were conducted to examine the relative contribution of age, education, and gender on different category fluency scores. This approach allowed inclusion of all the data into the analysis with a relatively lower impact of small cell sizes in the analysis of variance model.

## Results

### Verbal Fluency Scores

The mean scores for the categories of animal, food, means of transport, and furniture for the whole sample were 20.07 (SD, 5.84), 21.52 (SD, 7.14), 15 (SD, 3.86), and 14.24 (SD, 4.79), respectively. One-way ANOVA indicated that significant differences were found between the categories of food and means of transport ( $p < 0.0001$ ), food and furniture ( $p < 0.0001$ ), animal and means of transport ( $p < 0.0001$ ), and animal and furniture ( $p < 0.0001$ ). The category mean scores did not differ between animal and food ( $p = 0.079$ ) and means of transport and furniture ( $p = 0.326$ ).

Category scores are summarised in Table 1. MANOVA was conducted to examine the main effects and interaction terms on the 4 category scores and the total fluency score. There were no significant 3-way interaction effects on the category scores. However, there was a 2-way age-education interaction on the fluency scores [ $F(4, 82) = 2.577$ ;  $p = 0.044$ ]. Gender was found to be the only main effect on the category scores [ $F(4, 44) = 5.567$ ;  $p = 0.002$ ].

A series of post-hoc analyses were also conducted to further examine the differential category scores found between men and women. Men generated significantly fewer categories scores in food [ $F(1, 98) = 5.373$ ;  $p = 0.023$ ] and furniture [ $F(1, 98) = 9.378$ ;  $p = 0.003$ ] than women. Men did not differ from women in terms of animal [ $F(1, 98) = 1.201$ ;  $p = 0.276$ ] and means of transport [ $F(1, 98) = 0.519$ ;  $p = 0.473$ ]. Table 2 further summarises the corresponding scores of different categories by gender and age as well as by gender and education.

### Category Normative Data

In addition to fluency score, data were also analysed to provide local category norms. Items are listed only when their total frequency is larger than 10, and the rank first and mean rank data are presented only when its total frequency was equal to or greater than 10 (Tables 3, 4, 5, and 6).

### Linear Regression Analyses

A series of stepwise linear regression analyses were further conducted to examine the relative contribution of age, education, and gender on category fluency scores. A dummy was created for gender (0 for men; 1 for women) and a backward regression was performed.

For the category of animal, age and education accounted for a total of 16.2% of the corresponding variance [ $F(3, 96)$

**Table 3. Frequency and ranking of individual items within the category of animal.**

Item	Frequency	Mean rank
Tiger (老虎)	85	7.76
Dog (狗)*	85	6.27
Lion (獅子)	78	7.24
Cat (貓)*	74	6.69
Goat (山羊)	71	9.56
Elephant (象)	62	9.23
Mouse (老鼠)	59	9.83
Chicken (雞)	58	9.98
Monkey (馬騮)	57	10.53
Pig (豬)*	57	6.54
Cow (牛)*	55	6.95
Rabbit (白兔)	52	9.35
Duck (鴨)	42	13.10
Snake (蛇)	41	11.63
Leopard (豹)	38	11.53
Horse (馬)	36	8.47
Goose (鵝)*	36	3.67
Giraffe (長頸鹿)	32	9.25
Tortoise (烏龜)	26	13.46
Whale (鯨魚)	26	14.00
Crocodile (鱷魚)	26	12.81
Fish (魚)	25	14.00
Gorilla (猩猩)	25	13.28
Human (人)	24	7.79
Seal (海豹)	23	17.74
Bird (雀仔)	22	12.10
Hippopotamus (河馬)	20	12.10
Dolphin (海豚)	20	13.25
Deer (鹿)	19	13.37
Rhinoceros (犀牛)	18	11.44
Cockroach (蟑螂)	17	13.76
Kangaroo (袋鼠)	16	16.13
Panda (熊貓)	16	9.00
Camel (駱駝)	16	10.31
Bird (雀鳥)	15	13.40
Zebra (斑馬)	15	10.67
Shark (鯊魚)	15	16.00
Parrot (鸚鵡)	15	12.67
Wolf (狼)	14	13.43
Frog (青蛙)	13	15.77
Squirrel (松鼠)	13	14.54
Lizard (蜥蜴)	13	15.15
Penguin (企鵝)	12	16.50
Sea lion (海獅)	12	18.33
Bear (熊)	12	9.58
Dragon (龍)	12	11.33
Ant (蟻)	12	11.00
Goldfish (金魚)	11	15.73
Eagle (鷹)	10	14.20

\* The top 5 mean rank animals.

= 7.019;  $p = 0.0005$ ] (Table 7). Younger age and higher educational level better predict the category score of animal. For the categories food, means of transport, and furniture, education and gender were found to be the significant predictors of performance, explaining 11.6% [ $F(3, 96) = 4.924$ ;  $p = 0.003$ ], 12.2% [ $F(3, 96) = 5.191$ ;  $p = 0.001$ ], and 12.3% [ $F(3, 96) = 4.401$ ;  $p = 0.006$ ] of variances, respectively. Higher educational level and being female were associated with higher mean scores of food, means of transport, and furniture.

**Table 4. Frequency and ranking of individual items within the category of food.**

Item	Frequency	Mean rank
Beef (牛肉)	59	9.71
Pork (豬肉)	53	9.92
Chicken (雞)	47	10.00
Apple (蘋果)*	44	7.95
Fish (魚)	43	10.28
Orange (橙)*	42	7.88
Lamb (羊肉)	39	9.28
Banana (香蕉)*	32	7.91
Vegetable (菜)	30	10.43
Steamed rice (飯)	24	9.79
Lettuce (生菜)	23	12.52
Tomato (番茄)	23	13.26
Spanish (菠菜)	22	13.55
Pear (梨)	22	10.95
Egg (蛋)	22	11.09
Bread (麵包)	22	8.09
Watermelon (西瓜)	21	9.19
Papaya (木瓜)	19	12.11
Grape (提子)	19	9.53
Potato (薯仔)	18	14.06
Noodle (麵)	18	12.61
Mango (芒果)	17	9.76
Duck (鴨)	17	9.94
Pak choy (白菜)	16	14.25
Pineapple (菠蘿)	16	8.00
Pork chop (豬扒)	16	11.38
Strawberry (士多啤梨)	15	12.73
Choy sum (菜心)	15	11.13
Hamburger (漢堡飽)	15	8.73
Carrot (紅蘿蔔)	14	15.00
Ham (火腿)	14	13.50
Soft drink (汽水)	14	9.79
Chinese pear (雪梨)	14	8.00
Beef steak (牛扒)	13	11.46
Fruit (生果)*	13	6.54
Rice (米)*	13	7.54
Honeydew melon (蜜瓜)	13	10.08
Ice cream (雪糕)	13	12.54
Biscuit (餅乾)	13	9.00
Tongho (唐蒿)	12	14.75
Turnip (蘿蔔)	12	12.58
Sausage (香腸)	11	14.18
Lychee (荔枝)	11	11.09
Congee (粥)	11	11.64
Durian (榴槤)	11	10.82
Goose (鵝)	11	9.82
French fries (薯條)	10	9.90

\* The top five mean rank food.

## Discussion

The present study provides normative data from a group of healthy Hong Kong Chinese people for a category fluency test frequently encountered in cognitive and clinical neuropsychology. The present findings indicate that education and gender are the strongest predictors of the 4 category scores. Having higher educational level and being female are associated with a better performance in generating more category scores of food, means of transport, and furniture but not animal. These findings are generally

**Table 5. Frequency and ranking of individual items within the category of means of transport.**

Item	Frequency	Mean rank
Bus (巴士)*	87	3.80
Aeroplane (飛機)	76	7.20
Taxi (的士)*	71	5.61
Mass transit railway (地下鐵)	69	6.36
Bicycle (單車)	68	9.02
Ship (船)	66	7.86
Tram (電車)*	63	5.25
Train (火車)	62	6.68
Public light bus (小巴)*	50	5.32
Car (私家車)	50	7.70
Tram (電車)	41	8.69
Ferry (渡海小輪)	39	8.95
Light railway (輕便鐵路)	33	7.55
Rickshaw (黃包車)	32	10.41
Lorry (貨車)	29	10.13
Jetfoil (飛翔船)	26	10.50
Motorcycle (電單車)	26	8.38
Tank (坦克車)	23	11.86
Helicopter (直升機)	23	11.70
Hydrofoil (飛翼船)	21	11.71
Cruiser (旅遊船)	21	9.48
Sampan (舢舨)	20	11.65
Rocket (火箭)	20	10.40
Container truck (貨櫃車)	18	9.56
Vehicle (車)*	17	2.82
Motor boat (汽船)	15	11.13
Submarine (潛水艇)	13	13.62
Handcart (手推車)	12	10.67
Cart (馬車)	11	12.08
Light vehicle (小型貨車)	11	5.64
Space shuttle (穿梭機)	11	10.27
Maxicab (專線小巴)	10	4.80

\* The top five mean rank means of transport.

consistent with both western-based studies<sup>22,23</sup> and Chinese-based studies.<sup>6,15</sup>

The lack of gender effect on animal may be due to the fact that animal is a more familiar category than most other concepts. Previous studies of healthy participants also found that the category of animal was the one that generated more items than other categories.<sup>21,24</sup> Further research can be done to confirm such a hypothesis by checking with the familiarity rating on items generated by participants.

Unlike other studies, we found that age was only associated with the category of animal. Being younger significantly predicts a higher score. This is inconsistent with previous studies that reported that age is strongly associated with total fluency scores in both English- and Chinese-speaking groups.<sup>6,13</sup> This discrepancy may be due to the different samples.

First, the previous studies tended to recruit more elderly participants, whereas the present study attempted to recruit a wide range of participants from young adolescents to people in their early sixties. It is postulated that the recruitment of participants of an older age may add another confounding variable to the degeneration of mental processing.

**Table 6. Frequency and ranking of individual items within the category of furniture.**

Item	Frequency	Mean rank
Chair (椅)*	73	3.78
Sofa (梳化)*	70	5.04
Bed (床)	67	6.67
Table (枱)*	66	2.97
Wardrobe (衣櫃)	43	7.44
Desk (書枱)	37	7.81
Dining table (飯枱)	36	7.92
Cabinet (櫃)*	36	6.06
Coffee table (茶几)	29	8.86
Cupboard (廚櫃)	25	9.56
Armchair (椅)*	20	4.85
Shoe shelf (鞋櫃)	20	8.60
Television (電視)	20	10.70
Bunkbed (碌架床)	19	11.63
Bookshelf (書櫃)	18	10.11
Refrigerator (雪櫃)	18	9.94
Lamp (燈)	17	9.59
Dressing table (化妝枱)	17	8.82
Single bed (單人床)	14	10.79
Double bed (雙人床)	14	10.43
Carpet (地氈)	13	7.85
Rocking chair (安樂椅)	13	13.08
Sideboard (地櫃)	12	7.42
Reading lamp (枱燈)	12	9.58
Stool (凳仔)	12	9.08
Bedside cabinet (床頭櫃)	11	7.00
Washing machine (洗衣機)	10	10.40

\* The top five mean rank furniture.

Second, the present studies only adopted 4 categories for testing, whereas Jeng et al adopted 56 categories for Taiwanese participants.<sup>15</sup> A sum of the different categories might inflate subtle differences.

Third, Jeng et al asked their participants to write down the names within 30 seconds,<sup>15</sup> whereas the present study requested the participants to verbalise their answers within 1 minute, opening the possibility that writing speed was a potentially limiting factor more susceptible to the effects of age.

In addition to the provision of normative mean scores of the 4 categories of animal, food, means of transport, and furniture, the present study further provides the frequency

and mean rank score of the corresponding categories. This information is relevant to the qualitative understanding of the underlying semantic network in clinical groups. The frequency and ranking of different individual items help to examine whether clinical groups such as those with schizophrenia and dementia may generate other unusual items compared with healthy people in addition to the deviation from the mean category score.

In the present group, it is observed that participants generated more category scores in animal and food than those of means of transport and furniture. These findings were similar to Battig and Montague's findings that it was easier for healthy participants to generate more examples of animal than that of means of transport — a distinction between living and non-living thing categories.<sup>21</sup> These 2 cluster scores — the combination of animal and food versus that of means of transport and furniture — may serve as another yardstick similar to the distinction of living and non-living thing categories in detecting any differential patterns in neuropathological change in the brain.

The present study also provides a more detailed category fluency score compared with previous similar Chinese normative studies. Given the general impact of education and gender across the 4-category scores and the specific impact of age on the animal category, it is hoped that the provision of normative data by age, education, and gender may facilitate a more accurate screening of impaired performance in category fluency in clinical practice.

Finally, the present study was limited by the relatively small sample size and the non-random nature of the sampling method. Therefore, in relation to 'normative data' in healthy community participants, the present findings could only be considered to be the preliminary community norms. However, the provision of Hong Kong Chinese norms may also apply to other Cantonese-speaking groups. There is an increasing trend for Hong Kong Chinese to migrate to other countries such as the USA, Canada, and Australia. The present findings may give clinicians an alternative to screen and assess such groups in their communities.

**Table 7. Estimates of backward regression analysis for category fluency scores.**

Category	Standardised coefficient	t Value	p Value	Adjusted R <sup>2</sup>	F value (3, 96)
Animal					
Education	0.280	2.638	0.01	0.162	7.019
Age	-0.209	-1.966	0.05		
Food					
Education	0.293	3.015	0.003	0.116	4.924
Gender	0.292	3.004	0.03		
Means of transport					
Education	0.232	2.398	0.018	0.122	5.191
Gender	0.347	3.578	0.001		
Furniture					
Education	0.351	3.696	0.0005	0.123	4.401
Gender	0.120	1.113	0.05		

## References

1. Rosch E, Mervis CB, Gray WD, et al. Basic objects in natural categories. *Cognit Psychol* 1976;8:382-439.
2. Hampton JA, Gardiner MM. Measures of internal category structure: a correlational analysis of normative data. *Br J Psychol* 1983;74:491-516.
3. Rosch E. On the internal structure of perceptual and semantic categories. In: Moore TE, editor. *Cognitive development and the acquisition of language*. New York: Academic Press; 1973.
4. Joyce EM, Collinson SL, Crichton P. Verbal fluency in schizophrenia: relationship with executive function, semantic memory and clinical alogia. *Psychol Med* 1996;26:39-49.
5. Allen HA, Frith CD. Selective retrieval and free emission of category exemplars in schizophrenia. *Br J Psychol* 1983;74:481-490.
6. Chiu HF, Chan CK, Lam LC, et al. The modified Fuld Verbal Fluency Test: a validation study in Hong Kong. *J Gerontol B Psychol Sci Soc Sci* 1997;52:247-250.
7. Hart S, Smith CM, Swash M. Word fluency in patients with early dementia of Alzheimer type. *Br J Clin Psychol* 1988;27:115-124.
8. Hodges JR, Salmon DP, Butters N. Differential impairment of semantic and episodic memory in Alzheimer's and Huntington's diseases: a controlled prospective study. *J Neurol Neurosurg Psychiatry* 1990;53:1089-1095.
9. Janowsky JS, Shimamura AP, Kritchevsky M, et al. Cognitive impairment following frontal lobe damage and its relevance to human amnesia. *Behav Neurosci* 1989;103:548-560.
10. Allen HA, Frith CD, Liddle PF. Negative features, retrieval processes and verbal fluency in schizophrenia. *Br J Psychiatry* 1993;163:769-775.
11. Chen RYL, Chen EYH, Chan CKY, Lam LCW, Lieh-Mak F. Verbal fluency in schizophrenia: reduction in semantic store. *Aust NZ J Psychiatry* 2000;34:43-48.
12. Paulsen JS, Romero R, Chan A, et al. Impairment of the semantic network in schizophrenia. *Psychiatry Res* 1996;63:109-121.
13. Chan AS, Poon MW. Performance of 7- to 95-year-old individuals in a Chinese version of the category fluency test. *J Int Neuropsychol Soc* 1999;5:525-533.
14. Chen EYH, Lam LCW, Chen RYL, et al. Prefrontal neuropsychological impairment and illness duration in schizophrenia: a study of 204 patients in Hong Kong. *Acta Psychiatr Scand* 1996;93:144-150.
15. Jeng CI, Lai MW, Liu IM. Category norms in Chinese and English from bilingual subjects. *Acta Psychologica Tawanica* 1973;15:81-153.
16. Hillis A, Caramazza A. Category-specific naming and comprehension impairment: a double dissociation. *Brain* 1991;114:2081-2094.
17. Powell J, Davidoff J. Selective impairments of object knowledge in a case of acquired cortical blindness. *Memory* 1995;3:435-461.
18. Warrington EK, Shallice T. Category specific semantic impairments. *Brain* 1984;107:1273-1296.
19. Gaffan D, Heywood CA. A spurious category-specific visual agnosia for living things in normal human and nonhuman primates. *J Cognit Neurosci* 1993;5:118-128.
20. Rosch E. Principles of categorization. In: Rosch E, Lloyd BB, editors. *Cognition and categorization*. Hillsdale: Erlbaum; 1978.
21. Battig W, Montague W. Category norms of verbal items in 56 categories: a replication and extension of the Connecticut category norms. *J Exp Psychol Monograph* 1969;80:1-46.
22. Monsch AU, Bondi MW, Butters N, et al. Comparisons of verbal fluency tasks in the detection of dementia for the Alzheimer type. *Arch Neurol* 1992;49:1253-1258.
23. Lucas JA, Ivnik RJ, Smith GE, et al. Mayo's older American normative studies: category fluency norms. *J Clin Expt Neuropsychol* 1998;20:194-200.
24. Baldo JV, Shimamura AP. Letter and category fluency in patients with frontal lobe lesions. *Neuropsychology* 1998;12:259-267.