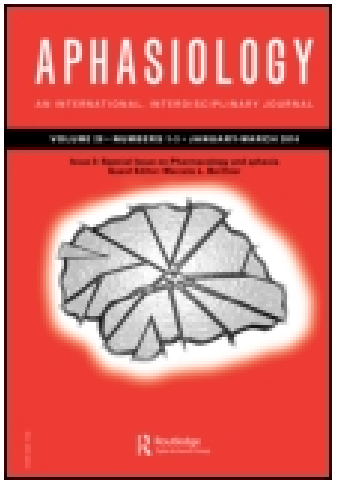

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Effects of context and word class on lexical retrieval in Chinese speakers with anomic aphasia

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Effects of context and word class on lexical retrieval in Chinese speakers with anomic aphasia

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Background: Differences in processing nouns and verbs have been investigated intensely in psycholinguistics and neuropsychology in past decades. However, the majority of studies examining retrieval of these word classes have involved tasks of single-word stimuli or responses. Although the results have provided rich information for addressing issues about grammatical class distinctions, it is unclear whether they have adequate ecological validity for understanding lexical retrieval in connected speech that characterises daily verbal communication. Previous investigations comparing retrieval of nouns and verbs in single-word production and connected speech have reported either discrepant performance between the two contexts with presence of word class dissociation in picture naming but absence in connected speech, or null effects of word class. In addition, word finding difficulties have been found to be less severe in connected speech than picture naming. However, these studies have failed to match target stimuli of the two word classes and between tasks on psycholinguistic variables known to affect performance in response latency and/or accuracy.

Aims: The present study compared lexical retrieval of nouns and verbs in picture naming and connected speech from picture description, procedural description, and storytelling among 19 Chinese speakers with anomic aphasia and their age, gender, and education matched healthy controls, to understand the influence of grammatical class on word production across speech contexts when target items were balanced for confounding variables between word classes and tasks.

Methods & Procedures: Elicitation of responses followed the protocol of the AphasiaBank consortium (http://talkbank.org/AphasiaBank). Target words for confrontation naming were based on well-established naming tests, whereas those for narrative were drawn from a large database of normal speakers. Selected nouns and verbs in the two contexts were matched for age-of-acquisition (AoA) and familiarity. Influence of imageability was removed through statistical control.

Outcomes & Results: When AoA and familiarity were balanced, nouns were retrieved better than verbs, and performance was higher in picture naming than connected speech. When imageability was further controlled for, only the effect of task remained significant.

Conclusions: The absence of word class effects when confounding variables are controlled for is similar to many previous reports; however, the pattern of better word retrieval in naming is rare but compatible with the account that processing demands are higher in narrative than naming. The overall findings have strongly suggested the importance of including connected speech tasks in any language assessment and evaluation of language rehabilitation of individuals with aphasia.

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Keywords: Chinese; word class dissociation; picture naming; connected speech

Introduction

Nouns and verbs are major word classes that exist in virtually all human languages. They arguably carry the core information in any verbal communication. These two grammatical classes differ at the semantic, syntactic, morphological, and pragmatic/discourse levels. Their fundamental differences are reflected not only in behavioural measures of response latency with a noun advantage among healthy individuals in lexical processing tasks (see Kauschke & Stenneken, 2008, for a review) but also in patterns of language impairment exhibited by individuals with aphasia as a result of brain damage. The first observation of noun–verb dissociation among language-impaired individuals was reported in Goodglass, Klein, Carey, and Jones (1966). Applying a discriminant analysis on multiple task performances of 72 speakers with aphasia, including 37 with Broca's aphasia and 35 speakers of fluent aphasia types, they found that individuals with Broca's aphasia showed impaired action naming, whereas fluent aphasic speakers had deficits in object naming. Subsequently, studies reporting double dissociation between deficits of nouns and verbs among individuals with aphasia at different processing levels were available (e.g., semantic level: Caramazza & Hillis, 1991; Damasio & Tranel, 1993; Daniele, Giustolisi, Silveri, Colosimo, & Gainotti, 1994; McCarthy & Warrington, 1985; Miceli, Silveri, Nocentini, & Caramazza, 1988; Warrington & McCarthy, 1983; Zingeser & Berndt, 1988; lexical form: Baxter & Warrington, 1985; Caramazza & Hillis, 1991; morphosyntactic level: Miceli & Caramazza, 1988; Shapiro & Caramazza, 2003; Shapiro, Shelton, & Caramazza, 2000; Tsapkini, Jarema, & Kehayia, 2002).

Although verb-specific and noun-specific impairments have been documented, it is well recognised that their prevalence rates are far from balanced. Mätzig, Druks, Masterson, and Vigliocco (2009) reviewed 38 papers published during 1984–2005 on picture naming of nouns and verbs in 280 individuals with various types of aphasia and found that 75% of them showed selective impairment to naming verbs. Compared with speakers with aphasia exhibiting greater disruption to nouns, individuals with verb impairments presented more diverse clinical profiles (associated with different aphasia types, Mätzig et al., 2009) and lesion sites (e.g., Gainotti, Silveri, Daniel, & Giustolisi, 1995). The bias toward occurrence of verb impairments may be due to inherent linguistic and psycholinguistic differences between nouns and verbs, confounding factors or a combination of both.

The majority of studies examining word class effects employed confrontation naming of picturable objects and actions. Pictured objects are invariably rated to be more imageable and have higher naming agreement than pictured actions (e.g., Bird, Howard, & Franklin, 2000; Masterson & Druks, 1998; Snodgrass & Vanderwart, 1980; Szekely et al., 2005). Furthermore, word class effects exhibited in a picture-naming task are restricted to concrete nouns and verbs, which have been proposed to differ along a sensory–functional semantic feature continuum (e.g., Bird et al., 2000; Warrington & Shallice, 1984), with animate objects on the sensory end, actions on the functional end, and inanimate objects in between. A few studies circumvented these confounding variables and observed selective disruption to verbs. Berndt, Haendiges, Burton, and Mitchum (2002) used abstract nouns and verbs matched in imageability in a sentence completion task and found verb-specific impairment in three participants with aphasia. Word class dissociation was also observed in Byng, Nickels, and Black (1994) and Marshall, Pring, and Chiat

(1998), in which participants with aphasia named pictures of homophonic nouns and verbs that were similar in meaning, for example, brush.

Besides differences in lexico-semantics, nouns and verbs also differ in the complexity of morphosyntax in languages rich in inflectional morphology. Cross-linguistically, verbal conjugation tends to have greater paradigmatic complexity than nominal declension. In a study using functional magnetic resonance imaging (fMRI), Longe, Randall, Stamatakis, and Tyler (2007) asked English-speaking healthy individuals to make valence judgements (pleasant/not pleasant) of uninflected and inflected abstract and concrete nouns and verbs matched in imageability. They found no brain regions differentially activated for uninflected nouns and verbs, but greater activation for inflected verbs in the left inferior frontal gyrus (LIFG) and left middle temporal gyrus. This raises the question of whether word class effects could be reduced to a difference in processing demand associated with morphosyntactic operations of nouns and verbs (see Vigliocco, Vinson, Druks, Barber, & Cappa, 2011, for a review). This view seems to be consistent with the case reports of selective verb impairment in speakers with aphasia during production of nouns and verbs in a sentence context (Berndt et al., 2002). It also finds support in Siri et al. (2008) in which healthy Italian-speaking participants named pictures depicting events using infinitive verbs, inflected verbs, and action nouns. Activation in the LIFG was significantly stronger for action nouns than uninflected and inflected verbs, while the last two conditions did not differ. The researchers argued that production of action nouns was more demanding because they are not the preferred responses to pictured actions, learned later in life, and morphologically derived from inflected verbs (see a similar account in Yu, Bi, Han, Law, and Law (2013) for explaining the neural correlates of verbal and nominal grammatical morpheme processing in Chinese using fMRI). Nonetheless, separate neural regions activated for inflected verb versus noun production have been reported (Shapiro, Moo, & Caramazza, 2006; Shapiro, Pascual-Leone, Mottaghy, Gangitano, & Caramazza, 2001; Shapiro et al., 2005), suggesting grammatical class distinction at the morphosyntactic level.

The foregoing cursory review of previous investigations in word class dissociation or distinction illustrates that the observations were largely based on performance on tasks involving single-word production or stimuli, that is, picture naming, operations of inflectional morphology, judgement of semantic feature, and sentence completion. The ecological validity of single-word production has, however, been questioned by some when it comes to understanding daily verbal communication of normal speakers as well as speakers with aphasia in rehabilitation (e.g., Carragher, Conroy, Sage, & Wilkinson, 2012; Carragher, Sage, & Conroy, 2013; Crepaldi et al., 2011). As such, there have been attempts to examine grammatical class effects in the contexts of single-word production as well as connected speech. Yet an in-depth comparison of the effect across contexts has proven to be methodologically challenging. Although most studies employed picture naming to evaluate lexical production, a variety of tasks were used to assess connected speech, including conversation with or without pre-selected topics (e.g., Crepaldi et al., 2011; Mayer & Murray, 2003), story retelling (e.g., Gordon, 2007), picture description (e.g., Basso, Razzano, Faglioni, & Zanobio, 1990; Gordon, 2007; Mayer & Murray, 2003), and video narration (e.g., Pashek & Tompkins, 2002). These connected speech tasks vary in familiarity of content matters and presence of visual stimuli, among others. More crucially, target nouns and verbs were often not matched on relevant psycholinguistic variables within the same task (e.g., Hadar, Jones, & Mate-Kole, 1987; Miceli, Silveri, Villa, & Caramazza, 1984; Zingeser & Berndt, 1988). Some studies selected noun and verb stimuli balanced for word frequency, familiarity, and perhaps word length (e.g., Mayer & Murray, 2003; Pashek & Tompkins, 2002) but not for age-of-acquisition (AoA) and imageability, two variables

that have been shown to influence lexical processing performance (e.g., Bird, Howard, & Franklin, 2003; Cuetos, Aguado, Izura, & Ellis, 2002; Law, Weekes, Yeung, & Chiu, 2009; Weekes, Shu, Hao, Liu, & Tan, 2007). In addition, target stimuli across tasks were rarely matched. Although the same nouns and verbs were used in picture naming and video narration in Pashek and Tompkins (2002), it was not clear whether AoA and imageability were balanced for the two-word classes. Further difficulty in comparing performance between word classes and across contexts is the scoring of responses. As pointed out by Pashek and Tompkins (2002), there tend to be more acceptable alternatives to target verbs than nouns, particularly in connected speech.

Notwithstanding the concerns about comparability of target noun and verb stimuli within and between tasks, previous investigations generally found a lack of correlation in performance between picture naming and connected speech especially for speakers with a mild degree of aphasia, such as anomic aphasia (Mayer & Murray, 2003; Pashek & Tompkins, 2002; Williams & Canter, 1982, 1987). Word class dissociation demonstrated in picture naming might disappear in connected speech (e.g., Crepaldi et al., 2011; Mayer & Murray, 2003), or word finding difficulty may be less severe in narrative than picture naming (e.g., Breen & Warrington, 1994; Hadar et al., 1987; Pashek & Tompkins, 2002; Zingeser & Berndt, 1988; see Basso et al. (1990) for null effects of context on word retrieval). The apparently greater ease of word access in conversation and narrative has been explained in terms of richer contextual cues, compared with picture naming, available in the communication context and the syntactic frame of the sentence to be produced, resulting in stronger activation from the modality-independent lexical representations (or lemmas in Levelt, Roelofs, & Meyer, 1999) to the corresponding phonological forms (or lexemes) for output (Crepaldi et al., 2006, 2011).

Given the methodological shortcomings of previous comparisons of retrieval of nouns and verbs between contexts, the findings of facilitative effects in connected speech over picture naming are questionable. Although it seems reasonable to suggest that sentential and discourse cues characterising connected speech would facilitate word retrieval, an alternative view has also been put forth. Ilshire and McCarthy (2002) have proposed that processing demands for lexical retrieval may be different in picture naming and connected speech. In the former, the target word, noun or verb, is clearly the preferred choice for production; in the latter, several semantically related alternatives to the target may be comparatively acceptable, rendering a higher number of candidates competing for selection for output. This proposal makes the prediction that word-finding difficulty would be greater in connected speech than picture naming.

The present study investigated the production of nouns and verbs in picture naming and connected speech, including picture description, procedural description, and story-telling, in a group of Chinese-speaking individuals with anomic aphasia and their age-, gender-, and education-matched controls. Target stimuli were selected from sizeable databases while taking into consideration familiarity, imageability, and AoA, such that the targets were matched on these parameters between word classes and tasks as much as possible. As anomic aphasia represents the mildest form of language impairment and the most prevalent aphasia type, data from these speakers would allow us to compare word retrieval between confrontation naming and connected speech without the concern of concomitant syntactic deficits, and the observations would have broad implications for assessment and rehabilitation. Finally, there is one advantage of studying the production of nouns and verbs using Chinese speakers with aphasia. The Chinese language is well-known for its paucity of inflectional morphology; hence, the effect of grammatical class would be minimally confounded with different demands in morphosyntactic

processes associated with noun and verb production (Yu, Bi, Han, Zhu, & Law, 2012; Yu, Law, Han, Zhu, & Bi, 2011). Nonetheless, one must also bear in mind a feature of the Chinese language when directly contrasting performances on nouns and verbs. Compounding is highly productive in Chinese word formation. Many verbal compounds have the structure of V-N, for example, 打字 "to type" literally *hit-word*, 開刀 "to operate" *open-knife*; that is, a complex word belonging to the grammatical class of verb may contain a lexical component of the other form class. The same is true of compound nouns, for example, 開關 "a switch" *open-close*, 思想 "thought" *think-think*, 飛機 "airplane" *fly-machine*. Therefore, any interpretation of word class effects in retrieval of Chinese words needs to consider the presence of such compound words in the stimulus list.

Method

Ethics statement

Informed written consent was obtained from all participants before the study began. The tasks were performed in accordance with the Declaration of Helsinki with approval of the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster.

Data corpora

Data of picture naming and connected speech elicited from various narrative tasks of native speakers of Cantonese were drawn from two databases, one consisting of language samples from 120 neurologically unimpaired male and female speakers of varied ages and education levels and the other from 52 speakers of different aphasia types who suffered a single stroke as verified through neuroimaging or a clear medical diagnosis (Kong, Law, & Lee, 2009). The corpora form a component of the AphasiaBank consortium (MacWhinney, Holland, Forbes, Spector, & Fromm, 2008, http://talkbank.org/AphasiaBank). Data collection followed the AphasiaBank protocol but with adaptation to the local Chinese culture. Participants were asked to (1) narrate an important event in their life, (2) describe a picture—Cat Rescue, a photo—Flood, and two picture sequences—Broken Window and Refused Umbrella, (3) tell two highly familiar stories—"The Hare and the Tortoise" and "The Boy who Cried Wolf"—with picture cues, and (4) describe the procedure of making a ham and egg sandwich. The picture-naming task consisted of 60 line drawings of objects from the Boston Naming Test (BNT; Kaplan, Goodglass, & Weintraub, 2001) and 50 line drawings of actions from the Verb Naming Test of the Northwestern Assessment of Verbs and Sentences (NAVS; Thompson, 2011).

The language samples were transcribed by two linguistically trained research assistants, including author CL, orthographically and phonetically in case of speech errors. Interrater reliability of orthographic transcription was computed by randomly selecting 10% of the samples, which were double-checked against the audio recordings by authors SPL and AK, and was found to have an agreement of greater than 99%. Transcripts of the narrative tasks were formatted using the Codes for the Human Analysis of Transcripts (CHAT; MacWhinney, 2000) and annotated for parts of speech.

Participants

Inclusion criteria for individuals with aphasia were (1) a single stroke resulting in left cortical or subcortical lesion(s), (2) post-onset for at least 9 months, (3) premorbidly right-handed, and (4) Cantonese as first or most often used language. Exclusion criteria included (1) second stroke, (2) severe problems with articulation/oro-motor control/voice production/swallowing, (3) dementia/brain trauma/brain tumour, and (4) a history of drug abuse/alcoholism or mental disease. A total of 19 participants with aphasia [17 males; mean age (in year) ± *SD*: 55 ± 11, range: 41–85; post-onset period: 9–189 months] and 19 age-, gender- and education level-matched controls (17 males; mean age ± *SD*: 53 ± 10, range: 40–77) were selected from the Cantonese AphasiaBank databases (Kong et al., 2009). All the chosen participants with aphasia were diagnosed with anomic aphasia according to the Cantonese version of the Western Aphasia Battery (CAB; Yiu, 1992). The background information on the participants with aphasia and their controls is given in Table 1. With respect to language background, 15 of the participants with anomic aphasia were monolingual; the other four learned English as a second language (L2). Ten of the control participants were monolingual. For the others, seven learned English as L2 and one as L3, and two spoke Mandarin as L2.

In addition, a group of 30 native Cantonese speakers (15 males; mean age ± *SD*: 25 ± 3, range: 21–30) naïve to the purpose of the investigation was recruited to provide ratings of AoA, familiarity, and imageability of potential stimuli in the present study.

Procedures for selection of materials

The stimuli used for comparing word retrieval between word classes and tasks were selected from the nouns and verbs in confrontation naming and the narrative tasks described earlier with the exception of "important event" from the healthy participants database. The exclusion of the "important event" was because there was little control over the content that the participants would produce, making it difficult to choose target items from the two-word classes for comparison across participants. Five nouns and three verbs from the naming tasks that were also target items in the narrative tasks were first chosen as stimuli. To select other noun and verb stimuli that would be matched on AoA, familiarity, and imageability, we then compiled a long list of words to be rated by the 30 normal participants. First included in this list were all the items in the naming tasks. We then looked for other potential stimuli from the narrative tasks. To do so, a frequency analysis using the function in the Computerized Language Analysis program (CLAN; MacWhinney, 2000) was conducted on the narrative transcripts of the 120 healthy participants in the database. Nouns and verbs with a frequency of mention greater than 120 were selected to ensure that they were produced by a significant number of speakers. Second, these words were input to the Powergrep program (Goyvaerts, 2013) to determine how many participants produced each of these words. Only lexical items that were used by more than 50% of the 120 healthy participants were selected as stimuli for rating. A total of 87 nouns (60 from BNT and 27 from narrative tasks) and 87 verbs (50 from VNT and 37 from narrative tasks) including the items common to both tasks comprised the list of items to be rated.

The group of 30 native Cantonese speakers rated the AoA, familiarity and imageability of the 174 words. The items were blocked in terms of word class and the psycholinguistic variable to be rated, resulting in six blocks. The order of these blocks was rotated across participants, who were required to rate (1) AoA using a 7-point scale with a 2-year age band

Table 1. Background information on aphasic and control participants.

Subject code	Group	Age	Gender	Education	Aphasia quotient based on CAB	Months post-onset	Lesion site
ANM01	Anomic aphasia	46;03	M	Junior High	94.8	131	Cerebellar
ANM02	Anomic aphasia	54;04	M	Matriculation	95.8	55	Cerebellar
ANM04	Anomic aphasia	45;03	M	Matriculation	90.4	119	Parietal
ANF01	Anomic aphasia	53;04	F	Primary	96.1	17	Parietal
ANM09	Anomic aphasia	41;04	M	Junior High	85	11	Intracerebral
ANF04	Anomic aphasia	61;06	F	Secondary School	88.1	12	Anterior
ANM10	Anomic aphasia	50;07	M	University	71.9	16	Intracerebral
ANM11	Anomic aphasia	72;05	M	Secondary School	91.9	102	N/A
ANM12	Anomic aphasia	51;05	M	Secondary School	99	13	Brainstem
ANM13	Anomic aphasia	43;08	M	Secondary School	87.7	151	Putamen
ANM16	Anomic aphasia	48;09	M	Secondary School	93.9	14	Anterior circulation
ANM17	Anomic aphasia	85;11	M	Matriculation	92.4	13	Thalamic
ANM18	Anomic aphasia	59;09	M	Junior High	93.1	9	Lobar
ANM21	Anomic aphasia	67;09	M	Secondary School	78	84	Partial anterior
ANM19	Anomic aphasia	59;09	M	Matriculation	95.9	189	N/A
ANM20	Anomic aphasia	46;10	M	University	77.1	9	Anterior
ANM22	Anomic aphasia	63;03	M	Junior High	95	67	Putaminal
ANM23	Anomic aphasia	49;00	M	Junior High	97.2	156	Subcortical
ANM24	Anomic aphasia	44;09	M	Junior High	86.9	144	N/A
Cont306	Control	46;08	M	Junior High			
Cont317	Control	50;01	M	University			
Cont305	Control	46;03	M	Secondary School			
Cont405	Control	50;03	F	Junior High			
Cont319	Control	40;00	M	Matriculation			
Cont620	Control	60;04	F	Secondary School			
Cont321	Control	53;07	M	University			
Cont503	Control	71;00	M	Matriculation			
Cont304	Control	51;10	M	Secondary School			
Cont309	Control	43;04	M	Junior High			

(*continued*)

Table 1. (*Continued*).

Subject code	Group	Age	Gender	Education	Aphasia quotient based on CAB	Months post-onset	Lesion site
Cont318	Control	47;06	M	University			
Cont528	Control	77;10	M	Junior High			
Cont303	Control	55;05	M	Junior High			
Cont529	Control	66;03	M	Junior High			
Cont301	Control	59;00	M	Primary			
Cont322	Control	47;02	M	University			
Cont521	Control	62;10	M	Secondary School			
Cont320	Control	48;05	M	University			
Cont316	Control	44;01	M	Matriculation			

Notes: N/A = not available. ANM11 and ANM19 were admitted to a hospital on mainland China and did not have discharge summary. ANM24 did not remember which hospital he was admitted to and had no family member to provide the relevant information.

on each point (from 0 to 13 years or above), (2) familiarity on a 5-point scale from 1 for unfamiliar [has never been in contact with the object/performed (or seen) the action] to 5 for extremely familiar [very often in contact with the object/carry out (or see) the action], and (3) imageability on a 7-point scale from 1 for not at all imageable to 7 for highly imageable (Law et al., 2009). Note that object/action familiarity ratings were used to represent word frequency, as many of the target nouns and verbs in Cantonese did not have norms in available frequency counts. Familiarity is often considered a measure of subjective frequency (e.g., Hirsh & Ellis, 1994; Nickels & Howard, 1995).

The noun and verb items in the naming task were then sorted separately in terms of ratings of AoA, familiarity and imageability. Items in the two-word classes that had roughly similar ratings along these parameters were then selected. The same procedure applied to lexical items in the narrative task. In the end, 29 nouns and 21 verbs in confrontation naming as well as 31 nouns and 21 verbs in the narrative tasks (i.e., picture description, procedural description, and storytelling), including the identical items between tasks, were selected as stimuli for contrasts between tasks and word classes (see Table 2 for descriptive statistics). Independent *t*-tests were employed to assess the comparability of stimuli in the different conditions for AoA, familiarity, and imageability. There was no significant difference in AoA and familiarity between nouns and verbs in picture naming ($p > .60$) and in narrative ($p > .30$). Neither was there reliable difference between tasks for each of the word classes for these variables ($p > .40$). In contrast, imageability ratings were significantly lower for verbs than nouns in picture naming [$t(48) = 3.76$, $p < .001$] and in narrative [$t(50) = 4.74$, $p < .001$], and lower in narrative than picture naming for nouns [$t(58) = 2.89$, $p < .01$] and for verbs [$t(40) = 3.66$, $p < .005$]. In short, while AoA and familiarity were matched across word class and task conditions, imageability was not. Note that two nouns and nine verbs in the naming task were compounds and contained a component of the other grammatical class, whereas none of the compound nouns and only two compound verbs in the narrative task have such a characteristic.

Scoring of responses

In picture naming, the participant was given a maximum of 30 s to name each object or action. The last (self-corrected) response was scored for accuracy. Interrater reliability between authors LL and CL was computed for four (roughly 10%) randomly selected subjects, including two participants with anomic aphasia and two control participants. The point-by-point agreement reached 95.5%. In the narrative tasks, production of target nouns and verbs in the same tasks as those found based on the data of normal controls

Table 2. Ratings of AoA, familiarity, and imageability [mean (*SD*)] of stimuli in different conditions.

	AoA (7-point scale)	Familiarity (5-point scale)	Imageability (7-point scale)
Nouns in picture naming	2.40 (.56)	3.79 (.72)	6.53 (.18)
Verbs in picture naming	2.41 (.57)	3.97 (.83)	6.15 (.54)
Nouns in narrative	2.38 (.61)	3.83 (.77)	6.19 (.54)
Verbs in narrative	2.43 (.55)	4.24 (.54)	4.96 (1.05)

would be considered successful word retrieval. Alternative responses considered acceptable with consensus among authors LL, AK, and SPL were also scored as correct. Acceptable alternatives for the stimuli in the narrative tasks are given in the Appendix.

Statistical analyses

A three-way mixed-design analysis of variance (ANOVA) was performed to evaluate the effects of word class and task on word retrieval. There was one between-subjects variable of "group" (aphasic vs. control) and two within-subjects variables of "task" (confrontation naming vs. connected speech) and "word class" (noun vs. verb). Post hoc analyses using two-way ANOVA and *t*-test were conducted in case of any significant two-way or three-way interaction effects.

As imageability was not matched across word class and task, to eliminate its possible influence on performance, hierarchical multiple regression analyses were carried out for the two participant groups separately. Imageability, word class, and task were entered as predictor variables in successive steps with average accuracy of each target item as the predicted variable.

Results

The participants' performance as a function of word class and task is given in Table 3. The three-way ANOVA revealed significant main effects of participant group [$F(1, 36) = 16.25$, $p < .001$], task [$F(1, 36) = 60.56$, $p < .001$], and word class [$F(1, 36) = 45.68$, $p < .001$]. Control participants retrieved words better than speakers with anomic aphasia; more accurate performance was observed in picture naming than connected speech and for nouns than verbs. There was a significant interaction between task and word class [$F(1, 36) = 8.59$, $p < .01$], and none of the other two-way interactions were significant ($p > .10$). Paired *t*-tests showed that the difference in naming accuracy between nouns and verbs was greater in picture naming than narrative [$t(37) = 2.841$, $p < .01$], and the difference between the two tasks was greater for nouns than verbs [$t(37) = 2.841$, $p < .01$].

The three-way interaction was marginally significant [$F(1, 36) = 3.40$, $p = .074$]. Two-way repeated measure ANOVAs were carried out for each speaker group. The results showed a significant interaction effect between word class and task in the aphasic group [$F(1, 18) = 8.13$, $p < .025$] but not in the control group ($p > .30$). Paired *t*-tests were subsequently performed on naming accuracy in the aphasic group with a significance threshold of .0125 adjusted for multiple comparisons. Participants with anomic aphasia retrieved significantly more nouns than verbs in picture naming [$t(18) = 4.40$, $p < .001$] but not in connected speech ($p > .04$). They also showed better performance in picture naming than connected speech for both nouns [$t(18) = 5.85$, $p < .001$] and verbs [$t(18) = 2.81$, $p < .0125$].

Since imageability could not be matched across conditions, hierarchical multiple regressions were performed to investigate the effects of word class and task after controlling for the influence of imageability. "Imageability", "word class", and "task" were entered in three steps and in that order. The results are provided in Table 4a for the participants with anomic aphasia and Table 4b for the control group. Table 4a shows that imageability accounted for 15.7% of the variance in word retrieval performance of the aphasic group ($p < .001$). Word class only minimally explained .3% of the variance ($p > .50$). When task was entered last in the regression, an additional 6.5% of the

Table 3. Word retrieval performance (in proportion correct) in different word class and task conditions.

	Picture naming		Narrative		Difference between word class (noun–verb)		Difference between task (picture naming–narrative)	
Subject	Noun	Verb	Noun	Verb	Picture naming	Narrative	Noun	Verb
ANM01	.97	1.00	.81	.81	−.03	.00	.16	.19
ANM02	.83	.57	.81	.76	.26	.04	.02	−.19
ANM04	.90	.67	.58	.62	.23	−.04	.32	.05
ANF01	.93	.67	.81	.71	.26	.09	.12	−.05
ANM09	.93	.62	.48	.43	.31	.06	.45	.19
ANF04	.79	.71	.45	.48	.08	−.02	.34	.24
ANM10	.66	.29	.48	.29	.37	.20	.17	.00
ANM11	.79	.62	.58	.71	.17	−.13	.21	−.10
ANM12	.93	.95	.87	.81	−.02	.06	.06	.14
ANM13	.90	.62	.48	.43	.28	.06	.41	.19
ANM16	.86	.71	.87	.81	.15	.06	−.01	−.10
ANM17	.83	.52	.45	.52	.30	−.07	.38	.00
ANM18	.93	.90	.84	.71	.03	.12	.09	.19
ANM21	.83	.71	.77	.67	.11	.11	.05	.05
ANM19	.90	.76	.65	.71	.13	−.07	.25	.05
ANM20	.86	.38	.39	.19	.48	.20	.47	.19
ANM22	1.00	.95	.84	.81	.05	.03	.16	.14
ANM23	.97	1.00	.87	.86	−.03	.01	.09	.14
ANM24	.90	1.00	.81	.62	−.10	.19	.09	.38
Mean (*SD*)	.88 (.08)	.72 (.21)	.68 (.18)	.63 (.19)				
Cont301	1.00	.71	.87	.76	.29	.11	.13	−.05
Cont303	1.00	1.00	.87	.71	.00	.16	.13	.29
Cont304	.93	.86	.81	.81	.07	.00	.12	.05
Cont305	1.00	1.00	.94	.90	.00	.03	.06	.10
Cont306	1.00	.90	.71	.86	.10	−.15	.29	.05
Cont309	1.00	1.00	.97	.90	.00	.06	.03	.10
Cont316	1.00	.76	.90	.81	.24	.09	.10	−.05
Cont317	.93	.90	.84	.76	.03	.08	.09	.14
Cont318	1.00	.86	.77	.57	.14	.20	.23	.29
Cont319	1.00	.95	.94	.81	.05	.13	.06	.14
Cont320	1.00	.86	.90	.71	.14	.19	.10	.14
Cont321	1.00	.81	.74	.57	.19	.17	.26	.24
Cont322	.93	.90	.87	.90	.03	−.03	.06	.00
Cont405	1.00	.90	.94	.86	.10	.08	.06	.05
Cont503	.93	.86	.71	.71	.07	.00	.22	.14
Cont521	1.00	.95	.87	.67	.05	.20	.13	.29
Cont528	.86	.71	.87	.90	.15	−.03	−.01	−.19
Cont529	.97	.86	.74	.67	.11	.08	.22	.19
Cont620	1.00	.95	.81	.86	.05	−.05	.19	.10
Mean (*SD*)	.98 (.04)	.88 (.09)	.85 (.08)	.78 (.11)				

variance was accounted for, and hence it was a significant predictor ($p < .01$). A similar pattern was found for the control group. Imageability explained 22.5% of the variance ($p < .001$); word class and task accounted for an additional .3% and 7.1% of the variance, respectively. Only imageability and task were significant predictors ($p < .005$).

Table 4. Results of hierarchical multiple regression.

	B	*SE B*	*β*	*t*	*p*
a. Participants with anomic aphasia					
Step 1					
Constant	.053	.158			
Imageability	.111	.026	.396	4.319	.000
Step 2					
Constant	.138	.215			
Imageability	.104	.029	.369	3.556	.001
Word class	−.026	.045	−.061	−.585	.560
Step 3					
Constant	.579	.259			
Imageability	.067	.031	.239	2.176	.032
Word class	−.054	.044	−.125	−1.216	.227
Task	−.119	.042	−.279	−2.860	.005
Note: R^2 = .157 for Step 1; ΔR^2 = .003 for Step 2 ($p > .5$); ΔR^2 = .065 for Step 3 ($p < .01$).					
	B	*SE B*	*β*	*t*	*p*
b. Control participants					
Step 1					
Constant	.313	.106			
Imageability	.092	.017	.474	5.382	.000
Step 2					
Constant	.369	.143			
Imageability	.087	.019	.447	4.497	.000
Word class	−.018	.030	−.058	−.587	.559
Step 3					
Constant	.690	.171			
Imageability	.061	.020	.311	2.979	.004
Word class	−.038	.029	−.125	−1.286	.202
Task	−.087	.027	−.293	−3.152	.002

Note: R^2 = .225 for Step 1; ΔR^2 = .003 for Step 2 ($p > .5$); ΔR^2 = .071 for Step 3 ($p < .005$).

Discussion

The present study examined the effects of word class in picture naming and connected speech of individuals with anomic aphasia and their controls. Word retrieval in different contexts was elicited following the AphasiaBank protocol. Candidates for target items in confrontation naming were from well-established naming assessment tools, whereas those for narrative were first identified based on output from a large number of healthy participants of different ages and education levels. Items that were matched for AoA and familiarity across word classes and tasks according to subjective ratings of a group of native speakers of Cantonese were then selected as target stimuli. As expected, participants with aphasia showed greater word finding difficulty than control participants. Their performance was affected by both word class and task when only AoA and familiarity were balanced. Across all experimental conditions, participants performed best when retrieving nouns in picture naming. More interestingly, the contrast in performance between word classes differed across tasks only for the anomic aphasic group, that is, more successful in retrieving nouns than verbs in picture naming but not connected speech. The finding cannot simply be attributed to word length as measured in number

of syllable, since there was no difference in this parameter between the names of pictured objects and actions ($p = .823$), albeit target verbs were significantly shorter than nouns in narrative ($U = 126.00$, $p < .001$). At the individual level, six participants with anomic aphasia (ANF01, ANM09, ANM10, ANM13, ANM17 and ANM20) and two control subjects (Cont301 and Cont316) demonstrated a significant dissociation between nouns and verbs in picture naming ($p < .03$) but not in narrative ($p > .20$) based on the Fisher's exact test. This observation of a discrepancy between the occurrence of word class dissociation in picture naming and its absence in connected speech is similar to Crepaldi et al. (2011) and Mayer and Murray (2003), although in those studies production of nouns and verbs was measured from relatively free conversations. Interestingly, we noted earlier that there was an apparent imbalance of compound words in the naming task, but not in the narrative task, with nine verbal compounds containing a nominal component versus two nominal compounds containing a verbal element. In such a case, one would expect a reduced word class difference in confrontation naming if the imbalance had any influence at all, but the results showed otherwise.

As ratings of imageability were higher for nouns than verbs and in picture naming than narrative tasks, its influence on word finding was then statistically controlled for. The results showed that only task, not word class, was significantly predictive of performance; this held for both participant groups. Although null effects of word class in connected speech were repeatedly observed (e.g., Crepaldi et al., 2011; Mayer & Murray, 2003), better performance in picture naming than narrative was rarely reported. On the contrary, all studies previously reviewed found either greater ease in word finding in connected speech than picture naming (e.g., Breen & Warrington, 1994; Hadar et al., 1987; Pashek & Tompkins, 2002; Zingeser & Berndt, 1988) or an absence of context effects (e.g., Basso et al., 1990). A difference in scoring target responses in single word production and narrative cannot easily explain the current findings. Pashek and Tompkins (2002) have suggested that there tend to be more acceptable alternatives to verbs than nouns, particularly in connected speech. Although this seems to characterise our somewhat more lenient scoring criterion of output in narrative, the comparison between the numbers of acceptable alternatives to target nouns and those of target verbs as listed in the Appendix was not significantly different ($p > .70$). If the scoring procedure was indeed more lenient in narrative than picture naming, one would expect higher performance in the former than the latter. In fact, the Appendix reveals that for many target items, the alternatives are often more specific in meaning and longer than the targets, for example, egg yolk/egg white/scrambled egg/sunny-side-up for the item "egg", egg sandwich/ham and egg sandwich for the item "sandwich".

Divergent views exist concerning whether cues in the communication context and syntactic frame may or may not be facilitative to word retrieval. We questioned earlier the validity of previous results of greater facilitation in connected speech than picture naming given the lack of matching between target words across tasks. The present findings are consistent with Ilshire and McCarthy (2002), who have suggested that there are likely to be more lexical candidates competing for selection in connected speech than confrontation naming, resulting in higher processing demand in narrative than picture naming. We are aware that our results may be relevant primarily to anomic aphasia or to individuals with mild aphasia. It is nonetheless interesting to recall the absence of correlation between naming and connected speech performance among speakers with this type of aphasia described in some previous works (Mayer & Murray, 2003; Pashek & Tompkins, 2002; Williams & Canter, 1982, 1987). We suggest that our data offer a more fine-grained depiction of the situation. The participants with anomic aphasia in this study demonstrated

a strong correlation between their overall accuracy of lexical retrieval in picture naming and narrative, Pearson's $r = .75$ ($p < .01$); however, the differences in accuracy between noun and verb items in the two task conditions were not related, $r = .13$ ($p > .1$).

Our main findings highlight the importance of detailed analyses of connected speech as part of any language assessment protocol. This is particularly the case for evaluating treatment effectiveness. It is commonly recognised that studies of anomia therapies have rarely examined treatment generalisation to connected speech. In a comprehensive review of naming disorder therapy for individuals with aphasia, Nickels (2002) singled out Hickin, Herbert, Best, Howard, and Osborne (2006) as one of the few studies to measure generalisation of treatment gains to connected speech and conversation. In a more recent review of remediation of word production in aphasia (Snella, Sage, & Lambon Ralph, 2010), connected speech was assessed in the studies considered using the Cookie Theft picture (Goodglass, Kaplan, & Barresi, 2001); however, only a rough measure of total number of words per minute was used, and there was no clear indication of whether a pre- and post-treatment comparison was routinely carried out.

In contrast, treatment focusing on retrieval of spoken verbs, particularly among non-fluent agrammatic speakers, has more frequently included sentence production, elicited connected speech, and/or conversation as outcome measures (see Carragher et al. (2012) and Webster and Whitworth (2012) for review), for the obvious reason that verb sub-categorisation specifies the syntactic frame of the clause or sentence in which a verb appears. Moreover, a relationship between extent of verb deficits and disruption to sentence production was observed among speakers with aphasia (e.g., Berndt, Haendiges, Mitchum, & Sandson, 1997; Berndt, Mitchum, Haendiges, & Sandson, 1997). Of the 26 treatment studies reviewed in Webster and Whitworth (2012), 19 assessed changes in sentence production and/or connected speech including picture description, narrative production and conversation before and after therapy. The authors recognised the methodological challenges of measuring changes in production of sentences and discourse reliably. Although some studies focused on constrained sentence production employing trained and untrained items, others used more general comparisons such as the number of grammatical sentences in connected speech (e.g., Edward & Tucker, 2006).

Since it is arguable that conversation as an outcome measure has greater ecological validity compared with other connected speech tasks, Carragher et al. (2012) critically reviewed five impairment-focused studies of aphasia that examined changes in performance in conversations. Despite that various measures were adopted, lexical retrieval of nouns and in particular verbs were consistently evaluated for documenting treatment generalisation (see also Carragher et al., 2013). Although we agree that positive changes in conversation should be an important goal of any language rehabilitation, further insights into the nature of changes in language performance of individuals with aphasia can only be gained if psycholinguistic properties, for example, AoA, familiarity/frequency, of the lexical items produced are provided in addition to reporting the rates of occurrence of different word classes, as long as lexical production is the key measure for reflecting changes. Moreover, samples of connected speech were essentially taken from free conversations in most previous therapy studies to demonstrate "specific" treatment effects, we argue that it is necessary to include a placebo condition to show that any improvement in conversation is attributable to the particular intervention under examination and not simply due to more language stimulation during the study period.

Finally, the present study did not distinguish lexical production in different narrative tasks, although we are aware that processing demands may vary among picture

description, procedural description, and storytelling, arising from differences in participant's familiarity to content, presence or absence of visual cues and degree of constraint on the overall structure of the narrative, among others. It would be desirable for future investigation to consider how these factors may impact on word finding in connected speech. It is equally important to emphasise that even though our findings showed that grammatical class was not predictive of lexical retrieval performance of individuals with anomic aphasia, once the most common confounding psycholinguistic variables were controlled for, we are in no way casting doubt on all previous reports of word class dissociation per se. Strong evidence is available indicating that differential performance on production of nouns and verbs is genuine and frequently observed among speakers with non-fluent aphasia.

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Appendix

Targets and acceptable alternative responses in narrative tasks.

Noun target	Acceptable alternatives
人 "person"	大人, 成人, 成年人 "adults"; 人家 "other people"; 路人, 途人, 行人 "pedestrian"; 女人 "woman"
媽 "mother"	媽媽, 阿媽 "mother"
女仔 "girl"	女 "female"; 女孩, 細路女 "little girl"; 少女 "teenage girl"; 妹, 細妹 "younger sister"
雞蛋 "egg"	蛋 "egg"; 荷包蛋, 太陽蛋 "sunny-side-up"; 蛋黃 "egg yolk"; 蛋白 "egg white"; 滑蛋 "smooth egg"; 反蛋 "egg over easy"; 炒蛋 "scrambled egg"; 餐蛋 "egg (from set menu)"; 鵪鶉蛋 "quail egg"
雨 "rain"	雨水 "rain"; 風雨 "wind and rain"; 暴風雨, 暴雨 "storm and rain"
貓 "cat"	花貓, 貓咪, 喵喵 "cat"
屋企 "home"	家 "family"; 客廳 "sitting room"
麵包 "bread"	多士 "toast"; 麥包 "wheat bread"; 方包, 包 "bread"
男人 "man"	男 "male"; 爸爸, 爹哋, 老竇, 父親 "father"; 叔 "uncle"; 屋主, 主人, 戶主, 主人家 "host"; 鄰居, 隔壁鄰舍 "neighbour"; 成人, 成年人 "adult"
窗 "window"	窗戶, 窗門
身 "body"	身體 "body"; 頭 "head"; 頭髮 "hair"
小朋友 "kid"	細路, 細路哥, 孩子, 小童, 靚仔, 細蚊仔 "child"; 學童 "pupil"
動物 "animal"	野獸 "beast"
山 "hill"	山坡 "slope"; 山頂 "hilltop"; 村落, 村莊, 鄉村 "village"; 牧場,農場, 農村 "farm"; 草地, 草皮 "grass land"; 野外 "country side"
羊 "sheep"	羊咩咩, 綿羊, 羊咩 "sheep"; 山羊 "goat"; 羊群 "a herd of sheep"
兔仔 "rabbit"	兔, 白兔 "rabbit"
烏龜 "turtle"	龜, 龜仔 "turtle"
三文治 "sandwich"	蛋治 "egg sandwich"; 腿蛋治, 火腿蛋治 "ham and egg sandwich"
火腿 "ham"	午餐肉 "spam"; 煙肉 "bacon"
梯 "ladder"	雲梯, 消防梯 " fire ladder"
消防員 "fireman"	消防, 消防人員, 救火員 "fireman"
森林 "forest"	樹林 "forest"; 動物園 "zoo"; 草叢 "bush"
狼 "wolf"	野狼, 豺狼 "wolf"; 狼群 "a pack of wolves"
終點 "finishing point"	終點站 "destination"
村民 "villager"	樵夫,農夫, 農民 "farmer"; 牧民 "shepherd"; 民居, 市民, 居民 "resident"; 街坊 "neighbour"; 獵人 "hunter"
遮 "umbrella"	雨傘, 雨遮 "umbrella"
狗 "dog"	狗隻 "dog"; 狼狗 "German shepherd"; 臘腸狗 "dachshund"
波 "ball"	足球 "soccer"
玻璃 "glass"	NA
樹 "tree"	NA
屋 "house"	NA
Verb targets	
瞓 "sleep"	瞓低 "lie down"; 瞓醒, 瞌醒, 瞓醒覺 "wake up"; 瞓覺, 瞌著, 瞓著覺, 瞓著 "sleep"; 瞌眼瞓 "doze off"; 瞓唔著覺 "can't fall asleep"
講 "say/speak"	講笑 "to joke"; 講述 "narrate"; 話, 說 "speak"
玩 "play"	玩耍 "play"
見 "see"	睇見 "see"
來 "come"	嚟到, 嚟齊 "arrive"
帶 "bring"	帶齊, 攜帶, 拎, 攞 "bring"
嗌 "shout"	叫 "to call"; 叫醒, 嗌醒 "wake someone up"
驚 "scare"	怕, 害怕, 驚醒 "scare"

(*continued*)

(*Continued*).

Noun target	Acceptable alternatives
幫 “help”	幫手, 幫幫手, 幫忙, 幫助, 協助 “help/assist”
追 “chase”	超前, 扒頭, 超越, 超過 “overtake”; 追趕 “chase”; 趕上 “catch up”
贏 “win”	勝出 “win”; 成為冠軍, 攞到冠軍, 得到冠軍, 變咗冠軍 “become champion”
踢波 “play football”	打波 “play ball”
救 “save”	救人, 拯救, 搶救, 救濟, 救助, 攀救, 營救 “save”
諗住 “think/believe”	心諗, 以為, 諗 “think”
煎 “pan-fry”	煎好, 煎熟 “pan-fry until cooked”; 煎香 “pan-fry until fragrant”; 煎熱 “pan-fry until hot”; 煎兩煎 “pan-fry quickly”
食 “eat”	食飯, 喫飯, 吃, 喫 “eat”
爬 “crawl”	爬樹 “climb tree”; 爬行 “crawl”
畀 “give”	NA
做 “make”	NA
落雨 “rain”	NA
吠 “bark”	NA

Note: NA = no alternative response.