Phonological mediation in language processing: An investigation into homophone effect on broad and specific (narrow) categorisation tasks

By

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ABSTRACT

The study investigated and compared homophone effect in a semantic categorisation task involving broad and specific categories. The Open University DD303 Psychology Course students were participants. Results confirmed Van Orden’s homophone effect on specific categories and more false positive errors on homophones. There was some interaction between homophony and category size. Homophone effect on specific category was due to priming. Longer response times confirmed the presence of homophone confusions caused by phonological mediation in language comprehension. Category size mediated homophone effect. Interaction between homophony and category size was limited to spelling controls. The more specific the category, the greater the homophone effect on language comprehension. Future studies could focus on homophone effect in categorisation tasks involving broad and specific categories controlled for frequency.

Keywords: homophone, category, language, semantic, specific categories, broad categories, phonological mediation, priming.

INTRODUCTION

Aims: Reading aloud required access to phonological representation of words. Does phonology play a role when the reader seeks to comprehend a given word? The project investigated homophone effect on comprehension of broad and specific categorisation tasks.

Objectives: Concepts and categories determined meaning accessed once a word is recognised. (Braisby, 2005). The study explored (a) homophone effect on semantic categorisation tasks, and (b) compared homophone effect on broad and specific categories.

Background and Rationale: In a study of phonology and language use Bybee (2001) concluded that language use played a role in shaping the form and content of sound systems. For example, the frequency with which individual words or sequences of words are used and the frequency with which certain patterns recur in a language affected the mental representation and in some cases the phonetic shape of words. This is because the ways in which the speakers and hearers experience language affected representation of phonology. In a similar study using 90 000 tokens of homophones in a switchboard Corpus of American English telephone conversations came to the conclusion that high frequency words such as ‘time’ were significantly shorter than low frequency homophones such as ‘thyme’, Gahl (2006). The findings have theoretical implications for the role of frequency information in linguistic competence and models of language production. For example, there is now a general agreement in psycho-linguistics literature that language production involves two levels of lexical information, comprising on the one hand the semantic and syntactic properties and phonological form on the other. (Bock, 1995; Dell, 1986; Levelt, 1989). Language processing was basic to comprehension.

Some theorists have advocated the dual route (orthography and phonology) for accessing meaning. (VH3)That is, one has to hear the sound of a word (phonology) and then see the spelling (orthography) in order to recognise and tell its meaning. (Gaskell, 2005; Gough, 1972; Rubenstein, Lewis & Rubenstein, 1971 in Wydell, Patterson & Humphreys, 1993) and others direct route. The latter states that phonology was adequate to understand a word, that is, by merely hearing the sound, one was able to comprehend its meaning. Use of homophones enabled distinguishing orthographic and phonological effects. Reading activated phonological codes of a word’s orthography thereby activating its meaning.

Participants made more false positive errors to homophones such as ROWS for category 'A FLOWER' than to spelling controls due to homophone confusion in semantic categorisation tasks. Results affirmed phonological mediation in accessing word meanings. (Bloomfield et al, in Wydell et al (1993); Coltheart (1991); Jared and Seidenberg (1991), Van Orden, Pennington and Hove (1990).

In a related decision task, participants found it difficult to reject homophones such as ROWS for the category A FLOWER. Incorrect responses suggested activation of homophone pronunciation causing homophone confusion. (Van Orden, 1987). Error rates to homophones indicated phonological effects on reading for comprehension hence the need for more research.

According to Rubenstein et al (1971) and Coltheart (1977) participants took longer to correctly reject pseudo-homophones (non-words) such as DYME than non-pseudo-homophones non-words. DYME activated phonological representation/DIME/ which activated the word DIME. Classification of the word DYME as a non-word became difficult. Results of phonological mediation such as these demonstrated the link between sound of non-words like roze to actual words, rose making it harder to classify roze as a non-word hence slower response time. However, pseudo-homophone effect was only evident when correct response was 'no.' Similarly, participants in categorisation studies took longer to correctly reject pseudo-homophones such as PAIR than non-pseudo-homophones TAIL (Meyer & Rudy, 1973; Meyer & Gustythera, 1975).

Lexical status influenced false error rates for non-word and homophone foils. Orthographic similarity of exemplars and spelling controls and specificity of category names influenced homophone effect. Category size had a significant impact on homophone effect. Van Orden (1987) used specific categories such as A PART OF A MOUNTAIN (PEAK; FOIL: PEEK). Results showed homophone effect on both high and low frequency word foils. Jared and Seidenberg (1991) used broad categories such as A LIVING THING which restricted homophone effect to low frequency words. The breadth of the category influenced priming of the relevant category producing a significant pre-target activation of few correct exemplars: (PEAK, SLOPE, BASE...). The target word: (PEEK) had phonological representation matching one already in the lexicon hence greater priming and homophone effect compared to large numbers of living things (broad category). Jared and Seidenberg argued that homophone effect was restricted to low frequency foils when broad and general semantic categories were used. The current study sought to extend Van Orden's study by investigating and comparing homophone effect on specific and broad categories in categorisation tasks.

Research Questions and Hypotheses: A relationship existed between concepts and words. Words used can be real (correctly spelled) or homophones. Things belonged to categories because they possessed certain properties in common. (Braisby, 2005; Gaskell, 2005; Pike & Brace, 2005). The study investigated the following hypotheses:

Hypothesis 1: Response times (RT) for specific categories will be shorter than for broad categories.
Hypothesis 2: Response times for spelling controls will be shorter than for homophones.
Hypothesis 3: There will be more false positive errors for homophones than spelling controls.
Hypothesis 4: There will be more false positive errors for specific than broad categories
Hypothesis 5: There will be an interaction between breadth of category and homophony.

METHOD:

a. Participants: Thirty two Open University DD303 Psychology undergraduate students participated as part of their course requirements. All except two were native English language speakers. The two were however, competent in both written and spoken English. They all had normal or corrected-to-normal vision.

b. Design

This was a 2x2 within-participant research design to explore Van Orden’s homophone effect on semantic categorisation tasks using specific and broad categories. There were two independent (IV) (homophone v spelling controls). Response time and accuracy for target word were the dependent variables (DV).

c. Apparatus/Materials

A Personal Computer (PC) with a keyboard, E-Prime and SPSS software and stimuli consisting of 100 target words and categories. Of these 50 were homophone foils, 50 spelling controls, 50 specific and broad categories each. Half the target words required ‘yes’ or ‘no’ responses each. There were ten additional practice items.
Homophones and spelling controls were similar in word size and sound (five letters each) and spelling differing in one letter only such as SCULL/SKULL for HEAD BONE. Van Orden used specific categories, similar and dissimilar words only while this experiment used both specific and broad categories for comparison. Homophones and spelling controls were obtained from a homophone list on website: www.vifooest.demon.co.uk/misc/homophones-list.html with nested category exemplars formulated on each word. They were not controlled for frequency.

PROCEDURE:

Participants sat in front of a PC and tested individually. Information on ethics was explained to every participant: They were free to participate or withdraw at any point during the experiment. Their responses were confidential and would be used solely for the purpose of the OU Project whose tutors were the only other people to have sight of the data. Participants were presented with a category name such as animal, dress etc. (broad or specific) in red colour, followed by a fixation point (+) marking the location of the target word in black to follow. The category name and target word were displayed for 1 500 and 3 000 milliseconds respectively. Participants responded ‘yes’ by pressing the letter ‘Z’ on the keyboard if the target word correctly represented the category name and ‘no’ by pressing letter ‘M’ if it was incorrect. Response times for each were recorded by E-Prime, a computer software but participants had no access to it. Participants did ten practice items before the actual experiment of 100 words and category names (See Appendix B). The experiment lasted between seven and ten minutes per participant. Responses were processed statistically for the time it took to say a word. Statistical analysis was carried out to answer research questions and hypotheses as outlined above. The means were computed to determine the average time it took to decide on the meaning. The mean was an estimate of the time it took the participant to decide on the correct word. The longer it took to decide, the more difficult the word was. This was the case with low frequency words which took longer (larger mean) than high frequency word such as ‘time,’ which took less time. This was followed by statistical analysis for significance using the Statistical Package for Social Scientists (SPSS) to determine whether the differences in time taken were due to chance or the result of the homophone effect. If the latter was the case, then results were described as statistically significant. The latter was yet another way of describing and explaining the results of the experiment to answer the research question such as: ‘The response times (Time taken to comprehend a word) would be shorter for specific compared to broad categories.’ If statistical evidence was significant, then one would go on to find out the variables responsible for the differences by carrying out the analysis of variance (ANOVA). This would reveal variables or factors responsible for the differences in comprehension as shown by response times. Overall this would show homophony effect on comprehension. No significant differences would suggest homophony had no influence and that any differences registered would be by chance. The experiment did not control for frequency hence the outcome should be viewed with caution. Participants were debriefed at the end of the experiment. Participants did not get feedback on response accuracy.

RESULTS

Data was collected to test homophone effect on broad and specific categories. SPSS generated descriptive statistics such as means and graphs. ANOVA tested whether differences were due to chance or manipulations done to the experiment (inclusion of homophones, spelling controls, broad and specific categories). Results are summarised below.

Mean response times to spelling controls and specific categories were shorter than homophones supporting hypotheses 1, 2, 3 and 4. (See Table 1).

| Table 1: Response Times by Category and Target Word |
|---------------------------------|-----------------|-----------------|
| Category                        | Homophone       | Control         |
| Broad category                  | 758.84msecs     | 695.49msecs     |
| Specific/narrow category        | 717.64msecs     | 672.99msecs     |

ANOVA revealed statistically significant differences in mean response times by category size $F(1, 31) = 6.352$, $p<0.05$ while those for homophones were not (See Appendix B for individual means). There was some interaction between homophony and breadth because graph lines were not parallel but it was not statistically significant suggesting that there was less interaction between homophony and breadth of category. (See Table 2; Figures: 1 & 2). Error bars describe how confident we are about the mean representing the homophone effect show marked deviation above and below the mean suggesting from the mean does not represent a significant impact of homophony on time taken to comprehend a word. The error bars (Figure: 3) confirmed low homophony effect thereby confirming results shown in tables 2, 3 and figures 1 &2. Further studies need to be carried out to confirm the results.
Table 2: Test of Within-Participant effect using ANOVA

<table>
<thead>
<tr>
<th>Source</th>
<th>F-ratio</th>
<th>df</th>
<th>Error df</th>
<th>Significance</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homophony</td>
<td>2.521</td>
<td>1.000</td>
<td>31.000</td>
<td>0.123</td>
<td>p&gt;0.05</td>
</tr>
<tr>
<td>Breadth</td>
<td>6.352</td>
<td>1.000</td>
<td>31.000</td>
<td>0.017</td>
<td>p&lt;0.05*</td>
</tr>
<tr>
<td>Homophony*Breadth</td>
<td>0.031</td>
<td>1.000</td>
<td>31.000</td>
<td>0.861</td>
<td>p&gt;0.05</td>
</tr>
</tbody>
</table>

Participants made more false positive errors for homophones to specific categories (18%) compared with 6% for controls in the same category. For broad categories this was 14% and 7% for homophones and controls respectively. (See Table, 3). Detailed data analysis can be found in Appendix C.

Table 3: False Positive Errors

<table>
<thead>
<tr>
<th>Category</th>
<th>Homophone</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broad category</td>
<td>14%</td>
<td>7%</td>
</tr>
<tr>
<td>Specific/Narrow category</td>
<td>18% (18.5%)</td>
<td>6% (3%)</td>
</tr>
</tbody>
</table>

(18.5)= Van Orden's False Positive Error Rate: Rates outside brackets are for the current experiment.

Figure 1: Interaction (with outliers)

Figure 2: Interaction (without outliers)
Mean Response times (RTs) for specific categories such as HEAD BONE were shorter as predicted. Results confirmed findings by Van Orden (1987) and Jared and Seidenberg (1991) in their study on word identification in reading: ‘proceeding from spelling to sound to meaning.’ Pre-activation or priming of the target word was responsible for quicker responses to specific categories. Thus, category size influenced homophone effect on comprehension in a categorisation task.

As expected RTs for controls were shorter than for homophones. Homophones for HEAD BONE (SCULL and control SKULL) took longer to reject due to sound alike and similar spelling interference. Similarity of the homophone and controls caused some confusion leading to more time taken to reject SCULL than SKULL as an exemplar for category HEAD BONE. The result supported Van Orden (1987); Wydell, Patterson and Humphreys (1993); Jared and Seidenberg (1991); Coltheart (1978, 1980 1985) on phonological mediation and dual route in accessing meaning of an exemplar category. Longer response times reflected difficulty participants experienced in rejecting homophones to a category member. It is unclear what effect the exclusion of frequency had on the results. The language phenomenon, especially, competence, usage and frequency which according to Bybee (2006) may have an effect on mental representations, and in some cases phonetic shape of words which can influence comprehension.

More false positive errors for homophones than controls confirmed homophone confusion as Van Orden (1987) did. False positive errors were higher for specific categories. The actual rate was almost the same as Van Orden’s using specific categories. Presentation of specific categories such as HEAD BONE produced significant pre-target activation of the few correct exemplars. Phonological representation already in the lexicon might have led to quick responses and more errors compared to broad categories where choice was broad with less priming. This increased homophone effect on the specific categories than the broad. Orthographic similarity between homophones and controls may have increased homophone confusion hence higher incidence of false positive errors. Thus, category size, lexical status and orthographic similarity may have had some influence on homophone effect in a language comprehension exercise.

Results revealed some interaction between category breadth and homophony. This is a new finding not previously investigated by Van Orden and others. Interaction was greater on the controls than homophones suggesting that homophone effect was more prominent when controls were used than homophones alone.

In conclusion, category breadth appeared to have some influence on homophone effect. Some interaction occurred between homophony and category breadth when controls and homophones were orthographically similar. The study established that category size mediated in homophone effect.

Future research could investigate a larger sample with stimuli controlled for frequency for broad and specific categories.
REFERENCES:


