Ninety-three pictures and 108 questions for the elicitation of homophones

VICTOR S. FERREIRA and J. COOPER CUTTING

University of Illinois at Urbana-Champaign, Urbana, Illinois

Homographs and homophones have interesting linguistic properties that make them useful in many experiments involving language. To assist researchers in the elicitation of homophones, this paper presents a set of 93 line-drawn pictures of objects with homophonic names and a set of 108 questions with homophonic answers. Statistics are also included for each picture and question: Picture statistics include name-agreement percentages, dominance, and frequency statistics of depicted referents, and picture-naming latencies both with and without study of the picture names. For questions, statistics include answer-agreement percentages, difficulty ratings, dominance, frequency statistics, and naming latencies for 60 of the most consistently answered questions.

Homophones are words such as (river-) *bank* and (money-) *bank* that have different meanings but have identical pronunciations.¹ Homophonic stimuli have been widely used in psychological experiments, because homophone pairs are a sort of natural experiment (by controlling form while varying meaning) and they pose interesting processing and ambiguity resolution issues for psycholinguistic systems. Experiments employing homophones have been influential in the study of lexical access in word recognition (e.g., Simpson & Krueger, 1991; Swinney, 1979; Tanenhaus, Leiman, & Seidenberg, 1979), lexical frequency in language comprehension (e.g., McRae, Jared, & Seidenberg, 1990), lexical frequency in language production (e.g., Dell, 1990; Griffin, 1995; Jescheniak & Levelt, 1994), language acquisition (e.g., Doctor & Coltheart, 1980), transsaccadic integration (Pollatsek, Lesch, Morris, & Rayner, 1992), aging (Balota & Duchek, 1991), psychological disorders (e.g., Clare, McKenna, Mortimer, & Baddeley, 1993; Waters, Caplan, & Leonard, 1992) and have been used to control phonological factors (e.g., Wheeldon & Monsell, 1994). In

short, homophones are very useful for studies involving language.

When designing experiments using homophones, an important methodological question concerns how homophones should be elicited from subjects. For experiments investigating homophone processing as an ambiguity-resolution problem, the ambiguous word forms (e.g., “bank”) can easily be used as stimuli. This report will make two alternative methods of homophone elicitation available to researchers. One method elicits homophone responses with picture stimuli; the other method uses questions. These methods are particularly useful when the use of ambiguous word-form stimuli may be ill suited for a particular investigation.

Eliciting homophones with pictures or questions can be especially useful for two reasons. First, eliciting homophones from meaning determines a particular meaning to elicit, in contrast to printed or spoken homophone stimuli. For example, if a subject says “bank” in response to reading *bank*, the response may be based on the side-of-the-river meaning, the financial institution meaning, neither, or both (although nonhomographic homophones like *weak* and *week* can be unambiguously presented by using printed word stimuli). Furthermore, investigations using printed stimuli have shown that under certain circumstances, reading homophones in a constraining sentence context (e.g., “I deposited my check in the *bank*”) at least partially evokes multiple meanings of the homophone (e.g., Swinney, 1979, but see Simpson & Krueger, 1991). Hence, to elicit a specific or individual homophone meaning, meaning-based methods such as picture naming or questioning must be used.

Second, eliciting homophones with pictures or questions is much like natural word production, and thus tasks with pictures or questions can reveal characteristics of the language-production system (Bock, 1996). This is in contrast to reading or repeating tasks, which involve a strong comprehension component, and are unlikely to involve the crucial formulation processes involved in production.

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Thus, for language production or production-related investigations, where natural production processes are at issue, or for investigations into language-disordered populations, where comprehension and production processes often dissociate, a more meaning-based methodology for eliciting homophones is necessary.

This report includes 93 line-drawn pictures of objects with homophonic (noun) names, and 108 questions, the answers to which are homophonic nouns. Whether pictures or questions should be preferred for a particular investigation will depend on the nature of that investigation, but the needs of a wide range of experiments should be accommodated using one method or the other.

Appendix A contains 93 pictures of objects with homophonic names. To assist researchers in choosing stimuli, the pictures are accompanied by statistical information about relevant properties of the pictures and their names. The appendix includes agreement of name information, dominance of meaning statistics (how dominant the depicted meaning is relative to other meanings of the homophone; Twilley, Dixon, Taylor, & Clark, 1994), printed word frequency (Francis & Kučera, 1982), and mean picture-naming latencies. Naming latencies were collected both without study and when subjects studied the picture stimuli with each intended name. For many experimental purposes, studying the picture names beforehand does not compromise the dependent measure, but does increase the range of pictures that can be productively used.

Presenting homophones as pictures permits an unambiguous homophone referent to be identified, and, being a production task, allows language-production issues to be investigated (Bock, 1996). There are drawbacks to using picture presentation, however. Objects in pictures are necessarily highly imageable, so any homophone that is abstract (e.g., *deed*, as in accomplishment) or difficult to picture (e.g., *ball*, as in formal dance) will be poorly elicited with a picture stimulus. As a consequence of this, it is difficult to construct a set of picturable homophone pairs. Of the 93 pictures included in this set, only 12 (6 pairs) consist of paired homophones.

For investigations that require two members of a homophonic set to be elicited, this report makes available a second method of presentation. Appendix B includes 54 pairs of questions, the correct answers to which are homophones. Agreement, difficulty, dominance, and frequency statistics are included for all 54 questions, and response latencies are included for 30 of the most consistently answered question pairs.

Eliciting homophones by asking questions of subjects suffers because a question unfolds in time, and thus reaction-time statistics to questions are relatively noisy and difficult to interpret. (Note, though, that we attempted to design the questions so as to load critical information near the end of the question, so that subjects would not determine the correct answer too early during presentation.) However, questions are relatively easy to present and unambiguously determine a particular homophonic

referent to be identified. Furthermore, the answers to questions do not need to be imageable (like pictures), so fewer restrictions apply to which homophones can be tested with this method of elicitation. For this reason, this report is able to include 108 questions that elicit 54 different pairs of homophones.

The methods used to collect agreement and naming-latency information are described in Study 1 for picture stimuli and in Study 2 for question stimuli. The Results section of each study includes frequency distributions that summarize the agreement statistics for the pictures and questions, means and standard errors, and a summary of the correlations among all the measures. Appendixes A and B include the actual picture and question stimuli, as well as average statistics for each of the measures collected for each stimulus.

STUDY 1

Pictures

Method

Subjects

For the agreement statistics, 33 students enrolled in an introductory psychology class at the University of Illinois participated for class credit. The norming of these stimuli was part of a larger norming session. The naming latencies (with and without study of picture names) were collected in two other experimental sessions; 20 different speakers participated in each session. These 40 subjects were members of the University of Illinois community; some participated for class credit in introductory psychology, while others were paid for participation.

Materials

Of the 93 pictures, 49 were taken from the Snodgrass and Vanderwart (1980) set, 39 were drawn by the second author, 3 were taken from the Philadelphia Comprehension Battery (Saffran, Schwartz, Linebarger, Martin, & Bochetto, 1988), and 2 were taken from clip-art libraries. The source of each picture is indicated in Appendix A.

Procedure

Agreement session. Subjects were given a stapled booklet containing the 93 pictures, 6 per page, with a numbered line under each picture. Subjects were instructed to write down the first one-word name that came to mind for each picture, to not skip any pictures, and to guess at pictures that they did not know. Subjects were free to complete these booklets at their own pace. All subjects received the stimuli in the same order. Pictures of homophone pairs (e.g., *bat* and *bat*) appeared at least 23 pictures apart.

Naming session. Subjects sat in front of a Quadra 800 computer, with a 17-in. color monitor and an external speaker, or a Power Macintosh 7100/80, with an audiovisual monitor. Voice responses were collected by a Shure unidirectional head-worn microphone. The experiment was implemented using the PsyScope experimental software (Cohen, MacWhinney, Flatt, & Provost, 1993), and latencies were measured with a PsyScope millisecond timer. At the beginning of each trial, the subjects saw a fixation point (an asterisk) for 200 msec, followed by a 500-msec delay. The picture was then presented and remained on the screen until the voice key registered a response (no time-out criterion was imposed). Subjects who did not study the picture names were asked to say as quickly as possible the first one-word name they felt described the picture; subjects who did study the picture names were asked to use the name that they had studied for each picture.

Each subject named all 93 homophone picture stimuli. In the non-study session, the subjects named an additional 122 filler pictures; in the study session, the subjects named an additional 75 filler pictures (the number of fillers was reduced in the study session so that the subjects would have fewer pictures to study). All naming sessions began with 13 separate lead-in pictures. The 20 subjects in each session received different random orderings of the 215 and 168 homophone and filler pictures, although the same random orderings were used for the study and nonstudy sessions.

Prior to naming the pictures, subjects in the study session were shown each picture on the computer screen with its intended name printed, entirely in lowercase letters, below the picture. The subjects were asked to study the pictures and names long enough so that they could correctly name the pictures during the experiment. They pressed the space bar when they felt they had sufficiently studied the picture. The duration of study was recorded by the experimental software and is reported in Appendix A along with each picture. Nonstudy subjects did not see the pictures and names before the naming-latency trials.

Dominance and frequency statistics. Dominance statistics were calculated on the basis of University of Alberta norms of relative meaning frequencies (Twilley et al., 1994), except for *plug*, the dominance of which was estimated on the basis of figures reported by Gilhooly and Logie (1980).² In the University of Alberta norms, the subjects generated associates to printed homographs, and the number of responses associated with particular meanings of a homograph are summed. For our picture stimuli, we report from these norms the proportion of all responses for a particular homograph that were categorized as associates of our depicted meaning.

Frequency statistics are taken from Francis and Kučera (1982). This corpus reports the estimated frequency of the printed form of English words in occurrences per million, broken down by form class. These frequencies therefore do not discriminate among the meanings of a homophone (except when meanings can be fully distinguished by form class), but they do provide an indication of how commonly a word is used in the language. Also, the overall printed form frequency can be multiplied by the dominance of the meaning (from the Twilley et al., 1994, norms) to gain a rough estimate of the frequency of a particular meaning (Griffin, 1995). Comparison of the frequency estimate based on dominance to a more direct estimate of spoken frequency of particular meanings (Griffin, 1996) shows the dominance estimate to be a reasonable measure of meaning frequency.

Results and Discussion

Agreement Statistics

Agreement percentages were calculated by totalling the number of subjects who identified each picture with its intended name, and dividing by the total number of subjects (and multiplying by 100). Across all 93 pictures, the mean agreement percentage was 82.9 (standard error of 2.1). Figure 1 shows the distribution of agreement percentages of each picture. The figure shows that most pictures had quite high agreement percentages: Of the 93 pictures, 51 had agreement percentages over 89%. Other pictures, however, had quite low agreement percentages, with the lowest percentage being at 15.2%. All statistics reported in this Results section are reported for each individual picture in Appendix A.

Naming and Study Latencies

Mean naming latencies for the pictures were calculated first by removing any latency more than 2.5 standard de-

viations above or below the overall mean for that picture or for that subject. Any observation where subjects did not use the intended name or where the voice key mistriggered was excluded from latency analysis (although correctly named trials where the voice key mistriggered are still considered correct in the *number correct* column in Appendix A, as were inflectionally incorrect items [e.g., plurals] or phrasal responses [e.g., "the ball"]). When subjects did not study the pictures and intended names, the mean naming latency across all pictures was 933 msec, with a standard error of 7.3 msec. With study, the mean naming latency was 901 msec with a standard error of 12.6 msec. The distributions of the number of pictures correctly identified in the two study conditions are shown in Figure 1.

Outliers for study latencies were determined on the basis of the 2.5 standard deviation cutoff, as with the naming latencies. The mean study latency across all pictures was 1,162 msec, with a standard error of 23.2 msec. The mean study latencies are included with each picture in Appendix A.

Dominance and Frequency Statistics

Dominance statistics come from studies that measure the proportion of responses that are an associate of the depicted meaning of the homophone. The mean dominance of the 93 pictures is .62, with a range of .00–.98. The set represents a wide range of dominances, although there are more high-dominance items than low-dominance ones (perhaps because subjects in the Twilley et al., 1994, study used imaging as a strategy for generating associates).

The printed frequencies of the names of the 93 pictures represent a wide range of frequencies, with a median frequency of 51 occurrences per million and a range of 2–906 occurrences per million. The dominance of the picture meaning and frequency of the picture name are reported for each picture in Appendix A.

Correlations

The correlations among the picture and name measures are shown in Table 1. Unsurprisingly, the behavioral measures (percent agreement, naming latencies, and number correct) all correlate reliably with one another, such that the agreement and number-correct measures increase together, and the latency measures decrease together with increasing agreement and number correct. These correlations suggest that general difficulty in picture naming can manifest both as increased naming times and as decreased number correct. Study-time measures also show a predictable pattern: As study time increases, so do naming latencies, while percent agreement and number correct decrease. This suggests that subjects study the more difficult to name pictures longer.

The only reliable correlations with the item measures (dominance and frequency) occur between the dominance of the picture meanings and the latency and number correct without study. As dominance increases, so does unstudied number correct, while unstudied naming latency

Figure 1. Distribution of name-agreement percentages (top panel) and number of pictures correctly named without study (middle panel) and with study (bottom panel) for all 93 pictures.

decreases. This suggests that at least with respect to unstudied picture naming, pictures of more dominant meanings are easier to name. However, given that dominance is ultimately a homophone-specific relative measure (it is the frequency of a meaning of a sound form, compared with other meanings of *that* sound form), why such correlations should appear (and why the correlations appear only without study) is unclear. A possible explanation is that the dominance measure itself is a reflection of an imagery-based strategy on the part of the subjects who provided those dominance measures, so that homophone meanings that are more imageable (and therefore easier to name as pictures) received higher dominance values.

STUDY 2

Questions

Method

Subjects

Agreement norms for the 54 pairs of questions were obtained from 40 University of Illinois undergraduates participating for class credit. Thirty-four different subjects, participating for class credit, provided the question-answering latencies for 30 of the most consistent question pairs.

Materials

All questions, reported in Appendix B, were designed by the authors. The wording of each question was chosen so as to select the intended word as uniquely as possible, and meaningful words were

Table 1
Correlations Among Picture/Name Measures

	Unstudied		Studied			Dominance	Log ₁₀ Freq.
	Latency	Number Correct	Latency	Number Correct	Study Time		
Percent agreement	-.602	.768	-.551	.573	-.362	.260	-.026
Unstudied							
Latency		-.641	.675	-.458	.595	-.420	-.150
Number Correct			-.667	.705	-.442	.291	.154
Studied							
Latency				-.662	.547	-.188	-.103
Number Correct					-.327	.105	.233
Study Time						-.243	-.064
Dominance							.036

Note—Boldface correlation values are reliable at the .01 level or better.

placed as close as possible to the end of the question so that the subjects would not ascertain the answer too early during the question. All stimuli were interrogative questions rather than fill-in-the-blank cloze items. For the collection of latencies, the questions were recorded on a Macintosh computer at a normal speaking rate, at a sampling rate of 22 kHz.

Procedure

Agreement statistics. Subjects were given a booklet of numbered questions. Each question was followed by a large and small blank. Subjects were asked to write in the large blank the first single-word answer that came to mind for each question. In the small blank, subjects rated how difficult the answer for that question was to think of, on a 1–7 scale (1 labeled *Occurred immediately* and 7 labeled *Couldn't think of it*). The subjects answered each question at their own pace. There were two different lists, each consisting of 54 questions, with only 1 question from each homophone pair on a particular list. Thus, the subjects did not give more than one meaning of a homophone as an answer, to make it less likely that they would realize that the questions were asking for homophones. Twenty subjects completed each list.

Question-answering latencies. The subjects sat in front of a Macintosh IIfx computer with an 11-in. monochrome monitor, external speaker, PsyScope button box, and keyboard. Voice responses were collected by a Realistic highball microphone that sat on a stand directly in front of the monitor. The subjects began each trial by pressing the space bar; this was followed by a 500-msec delay. The phrase "Get Ready" was then presented on the screen for 1,000 msec, and was immediately followed by auditory presentation of the question through the external speaker. After the offset of the question, a question mark appeared in the center of the screen, and remained there until the subject responded. As soon as the question mark disappeared, a sentence asking the subject to rate the difficulty of the question on a 1–7 scale (1 labeled *easy*, and 7, *hard*) appeared, along with a representation of the scale. This scale remained on the screen until the subject pressed an appropriate number key on the keyboard. A dash then appeared on the screen until the experimenter pressed a key on the button box, coding the accuracy of the subject's answer.

The subjects were instructed to answer each question with the first one-word answer that came to mind. They were asked to answer as quickly as possible after the question mark appeared. If the voice key registered a response prior to the question mark's being presented, the phrase "Too quick!" was printed in the center of the screen as the screen reversed colors.

The 60 questions for which latencies were collected were taken from the entire list of 108 questions for which agreement statistics were collected. Again, each question of a pair was answered by different subjects, so that the homophone status of the answers would

not be readily apparent. The questions were presented in random order for each subject.

Dominance and frequency statistics. Dominance and frequency statistics were collected and calculated as in Study 1. In Study 2, two dominance statistics are reported. First, the *absolute* dominance, or the proportion of respondents in the Twilley et al. (1994) study who gave associates to the questioned meaning of a homophone, is reported. Second, the *relative* dominance, which measures the dominance of a meaning of a homophone relative to the other meaning of that homophone *in this question set*, is reported. Thus, the relative dominances of both items of a homophone pair will always add to 1. The relative dominance was calculated by dividing the absolute dominance of one questioned meaning of the homophone by the sum of the absolute dominances of both questioned meanings of that homophone.

Results and Discussion

Agreement Statistics

An answer to a question was considered correct if a subject provided the intended answer, regardless of inflectional morphology (i.e., singular or plural). Agreement percentages were then calculated as in Study 1. The distribution of agreement percentages is shown in Figure 2. The figure shows that agreement percentages were in general quite high; the mean agreement percentage across all questions was 79.0 (with a standard error of 2.16), and of the 108 questions, 57 had agreements over 90% and 70 had agreements over 80%. Some questions had agreement percentages as low as 15%. All statistics reported in this results section, along with the accompanying difficulty ratings when appropriate, are included with each question in Appendix B.

Question-Answering Latencies

Question-answering latency outliers were determined as in Study 1, as were errors and voice-key mistriggerings. After excluding outliers, the mean question-answering latency for the 60 measured questions was 662 msec with a standard error of 22.7. As expected, the questions show a wide range of answering latencies; since questions unfold in time, the time to answer a question can be largely dependent on that question's wording. Nevertheless, answering-latency statistics can be useful for controlling particular aspects of question presentation, and

Figure 2. Distribution of answer-agreement percentages for all 108 questions.

so mean latencies (along with standard deviations, numbers correct, and mean difficulty ratings) are included in Appendix B.

Dominance and Frequency Statistics

The mean absolute dominance of the answers is .43, with a range of .00–.93. The median Francis and Kučera (1982) frequency is 46 occurrences per million, with a range of 6–506 occurrences per million. The absolute and relative dominances and the frequency of each question answer is presented for each question in Appendix B.

Correlations

The correlations among the question-and-answer measures are shown in Table 2. As was the case with the picture measures, the correlations reveal that the behavioral measures are generally correlated: The proportion-correct measures increase together, while the latency- and difficulty-rating measures (generally) decrease together with increasing proportion correct. As with the pictures, these correlations suggest that the difficulty of the questions manifest in accuracy, answering time, and difficulty rating. Unsurprisingly, absolute and relative dominance are highly correlated. The only other correlation of note is between frequency and off-line difficulty rating, such that higher frequency words are reported as less difficult. Such

a correlation should be interpreted cautiously, however, given that frequency did not correlate reliably with any other behavioral measure.

CONCLUSIONS

Due to their unique linguistic properties, ambiguous words like homographs and homophones have been used in hundreds of psycholinguistic experiments. In this report, we have provided researchers with the means necessary to elicit homographs and homophones with pictures and questions. Using pictures, researchers can have subjects name objects with homophonic names relatively reliably and with consistent naming latencies. Using questions, a wide variety of homophone answers can be elicited, so that issues involving pairs or sets of homophones can be addressed. Both sets can be used in production tasks, and thus permit investigation of production issues with homophones. For example, Cutting and Ferreira (1996) have used the homophone pictures to assess the effect of priming the nondepicted meaning of a homophone on production of the depicted meaning. In that experiment, subjects named homophone pictures while ignoring auditory distractor words that began 150 msec prior to picture onset. The distractor words were either related to the depicted meaning of the picture (e.g., the distractor “game” with a

Table 2
Correlations Among Question/Answer Measures

	Off Line		On Line		Abs. Dom.	Rel. Dom.	Log ₁₀ Freq.
	Difference Rating	Latency	Number Correct	Difference Rating			
Off Line							
Percent Correct	-.836	-.401	.392	-.340	.006	.012	.133
Difficulty rating		.190	-.242	.353	-.088	-.106	-.282
On Line							
Latency			-.512	.398	-.061	-.057	-.003
Number Correct				-.428	.077	.061	.003
Difficulty rating					-.141	-.159	-.037
Abs. Dominance						.962	-.055
Rel. Dominance							.000

Note—Boldface correlation values are reliable at the .01 level or better.

picture of a toy ball) or the nondepicted meaning of the name of the picture (e.g., the distractor "dance" with a picture of a toy ball). The results showed that depicted meaning distractors slow picture naming (compared with an unrelated control condition), while nondepicted meaning distractors speeded picture naming, suggesting that lexical access during word production was nonstaged or "cascaded" (McClelland, 1979).

Furthermore, any experimental issue that requires elicitation of particular homophone meanings can achieve that goal with these stimuli. For example, a memory task could assess the effect of eliciting one meaning of a homophone on memory for the other meaning.³ Overall, the pictures and questions included here should provide researchers with the tools necessary to design experiments that broaden the range of empirical issues that can be addressed with homophones.

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NOTES

1. Strictly speaking, homophones can have different spellings (e.g., *weak* and *week*), but this set includes only homographic, as opposed to heterographic, homophones.
2. The items *player*, *plug*, and *tank* were not present in the Twilley et al. (1994) norms, and *player* and *tank* were not present in any published set of norms we could find. The latter two dominances have been left missing.
3. We thank Gary Dell for suggesting this idea.

APPENDIX A
Pictures of Objects With Homophonic Names and Statistics

APPENDIX A (Continued)

<p>cabinet</p>	<p>cane</p>	<p>cast</p>
<p>cell</p>	<p>chain</p>	<p>check</p>
<p>chest</p>	<p>chest2</p>
<p>clip</p>	<p>coat</p>	<p>comb</p>
<p>corn</p>	<p>deck</p>	<p>diamond</p>
<p>diamond2</p>	<p>dress</p>	<p>drill</p>

APPENDIX A (Continued)

APPENDIX A (Continued)

letter	light	log

match	mug	nail

note	organ	palm

pen	pick	pipe

pitcher	player	plug

plug2	poker	pool

APPENDIX A (Continued)

APPENDIX A (Continued)

Picture Name	% Agreement	Unstudied			Studied				Dominance	Freq.	Source
		Latency		Number Correct	Latency		Number Correct	Study Time			
		M	SD		M	SD					
arm	78.8	732	64	20	749	107	19	1,008	0.91	278	SV
ball	100.0	749	98	20	737	76	20	954	0.92	125	SV
band	93.9	863	123	18	795	160	20	1,096	0.63	67	JCC
bar	84.8	1,128	215	20	899	119	20	1,221	0.79	133	JCC
bat	100.0	713	72	20	719	114	20	920	0.34	41	JCC
bat2	97.0	766	85	20	706	70	20	1,112	0.53	41	SV
belt	90.9	900	244	16	821	185	20	1,941	0.85	39	SV
block	75.8	939	111	17	904	228	20	1,188	0.45	118	JCC
board	63.6	1,131	365	4	1,034	224	16	1,400	0.70	300	JCC
boot	93.9	768	130	18	884	233	20	978	0.59	34	SV
bow	90.9	920	325	18	807	194	16	1,207	0.26	26	SV
bow1	100.0	935	248	17	903	253	19	1,116	0.64	26	SV
box	100.0	899	255	20	869	228	20	1,094	0.75	84	SV
brush	100.0	781	137	19	873	186	20	1,268	0.92	74	SV
bulb	60.6	817	191	3	928	289	13	1,088	0.86	10	SV
cabinet	63.6	1,075	302	4	1,109	273	12	1,523	0.79	22	Clip
cane	93.9	826	83	20	896	221	19	1,145	0.69	13	Phil
cast	97.0	1,073	97	15	932	147	20	1,209	0.34	54	JCC
cell	48.5	1,197	186	3	1,016	161	19	1,451	0.48	146	JCC
chain	84.8	984	200	16	846	128	19	1,047	0.78	60	SV
check	100.0	954	122	19	860	150	20	1,087	0.31	141	JCC
chest	66.7	1,006	145	20	851	247	20	1,171	0.27	57	JCC
chest2	90.9	1,074	215	14	1,005	251	17	1,122	0.51	57	JCC
clip	78.8	1,190	247	5	968	270	18	957	0.70	11	JCC
coat	69.7	1,020	256	14	1,146	373	14	1,116	0.89	58	SV
comb	100.0	801	152	20	788	144	19	1,069	0.98	11	SV
corn	81.8	981	276	20	831	155	20	1,158	0.94	38	SV

APPENDIX A (Continued)

APPENDIX 1 (Continued)											
Picture Name	% Agreement	Unstudied			Studied			Study Time	Dominance	Freq.	Source
		Latency		Number Correct	Latency		Number Correct				
		M	SD		M	SD					
deck	33.3	870	134	2	969	197	17	958	0.19	30	JCC
diamond	78.8	1,004	355	19	716	57	20	943	0.04	15	JCC
diamond2	84.8	1,128	292	15	857	206	20	1,165	0.89	15	JCC
dress	90.9	840	184	20	870	190	20	1,099	0.88	130	SV
drill	45.5	1,510	606	8	1,145	280	16	1,331	0.59	51	Clip
drum	100.0	842	177	20	728	79	20	794	0.92	32	SV
duck	93.9	799	151	16	1,035	330	18	1,161	0.81	21	SV
ear	93.9	736	84	20	712	88	20	808	0.95	67	SV
fan	97.0	832	136	20	758	87	20	968	0.75	47	Phil
fan2	75.8	1,335	346	10	1,012	224	20	1,646	0.19	47	JCC
fence	93.9	822	186	19	778	105	20	1,060	0.83	50	SV
file	27.3	1,133	430	6	940	238	16	1,175	0.72	146	JCC
file2	15.2	1,635	41	3	1,078	293	14	1,500	0.19	146	SV
fly	75.8	1,024	320	13	877	155	19	1,164	0.34	115	SV
foot	93.9	775	139	20	776	136	20	818	0.93	363	SV
glass	84.8	765	158	14	919	204	20	1,300	0.29	128	SV
grave	100.0	961	239	17	880	148	19	1,208	0.88	39	JCC
hand	100.0	739	92	19	694	102	20	967	0.93	769	SV
harp	97.0	940	238	18	864	209	19	1,113	0.80	2	SV
horn	97.0	1,011	255	20	840	118	20	1,081	0.77	33	JCC
iron	100.0	806	121	19	797	196	20	1,067	0.47	57	SV
key	97.0	732	85	20	770	127	20	986	0.90	104	SV
leaf	100.0	770	177	20	786	152	19	1,027	0.89	34	SV
letter	93.9	905	128	18	938	167	20	1,102	0.68	262	SV
light	75.8	1,005	212	11	878	211	18	875	0.78	441	SV
log	87.9	807	143	15	880	184	17	1,088	0.80	25	JCC
match	78.8	1,040	279	16	1,032	327	20	1,194	0.58	101	JCC
mug	75.8	891	159	4	1,099	349	14	1,071	0.84	3	JCC
nail	100.0	894	204	16	887	200	16	1,096	0.58	32	SV
note	90.9	954	253	18	778	169	20	1,035	0.10	291	JCC
organ	90.9	1,085	327	13	834	143	18	1,159	0.47	26	JCC
palm	24.2	1,337	—	2	843	130	17	1,250	0.27	32	JCC
pen	100.0	772	112	20	825	120	20	949	0.91	23	SV
pick	60.6	1,196	440	9	1,101	486	17	1,875	0.14	148	JCC
pipe	97.0	872	125	19	764	101	20	1,081	0.51	32	Phil
pitcher	87.9	1,064	255	17	1,040	304	15	1,497	0.49	29	SV
player	45.5	—	—	0	1,039	210	15	1,361	—	54	SV
plug	90.9	1,365	431	12	1,022	255	18	1,974	0.36	29	SV
plug2	39.4	933	130	19	829	155	19	1,177	0.64	29	JCC
poker	57.6	1,668	404	3	1,127	282	10	1,409	0.09	6	JCC
pool	100.0	1,024	168	15	888	161	18	1,266	0.73	135	JCC
pot	57.6	1,079	290	10	1,056	268	15	1,185	0.70	37	SV
present	54.5	1,024	241	14	1,046	299	17	1,320	0.53	503	JCC
punch	72.7	1,545	416	7	1,030	285	18	1,549	0.23	8	JCC
queen	66.7	1,124	219	17	927	131	19	1,130	0.90	51	SV
record	81.8	1,078	408	16	1,058	285	19	1,149	0.84	288	JCC
ring	97.0	845	184	20	878	288	17	899	0.63	84	SV
ruler	100.0	841	174	20	841	238	18	1,179	0.75	13	SV
saw	100.0	903	196	20	851	171	19	880	0.66	17	SV
scale	51.5	1,232	458	14	1,082	341	18	1,207	0.77	66	JCC
seal	100.0	957	149	15	961	182	19	1,002	0.50	37	SV
shed	51.5	1,329	322	9	1,283	388	13	1,503	0.52	17	JCC
shower	93.9	1,115	258	19	933	148	20	1,368	0.65	23	JCC
sock	100.0	765	89	20	757	123	20	993	0.88	12	SV
spade	84.8	1,369	382	14	884	159	20	1,257	0.27	8	JCC
speaker	90.9	1,216	229	16	1,033	168	20	1,077	0.31	8	JCC
stamp	90.9	878	91	16	926	192	20	1,267	0.74	67	JCC
star	100.0	729	111	20	735	91	20	835	0.00	62	SV
suit	78.8	1,145	346	14	1,012	169	18	1,039	0.83	95	SV
tank	87.9	980	203	18	784	157	19	1,237	*	30	JCC
tie	87.9	864	179	20	789	157	18	930	0.51	77	SV
tire	93.9	980	285	18	907	242	18	1,230	0.87	77	JCC

APPENDIX A (Continued)

Picture Name	% Agreement	Unstudied			Studied				Dominance	Freq.	Source
		Latency		Number Correct	Latency		Number Correct	Study Time			
		M	SD		M	SD					
top	93.9	1,041	251	16	995	277	19	950	0.04	221	SV
train	93.9	1,068	161	19	845	154	19	1,330	0.82	216	SV
watch	100.0	798	185	20	793	114	20	1,002	0.66	240	SV
well	97.0	912	155	20	882	270	19	1,148	0.57	906	SV

Note—Latencies and study times are measured in milliseconds, and frequencies are measured in occurrences per million. *JCC* is picture drawn by the second author, *Phil* is picture from Saffran et al. (1988), and *SV* is picture from "A standardized set of 260 pictures: Norms for name agreement, image agreement, familiarity, and visual complexity," by J. G. Snodgrass and M. Vanderwart, 1980, *Journal of Experimental Psychology: Human Learning & Memory*, 6, pp. 197-204. Copyright 1980 by the American Psychological Association. Reprinted with permission.

APPENDIX B

Questions With Homophonic Answers and Statistics

Question	Answer	Off Line		On Line				Abs. Dominance	Rel. Dominance	Freq.
		Percent Agreement	Difficulty	Latency		Number Correct	Difficulty			
				M	SD					
At what event did Cinderella lose her slipper?	ball	100	1.4	579	293	15	1.4	0.02	0.02	125
What do kids throw when they play catch?		90	1.8	523	194	16	1.4	0.92	0.98	
What do you call the place where you keep your savings?	bank	95	1.2	729	375	6	2.3	0.54	1.00	117
What do you call the land at the side of a river?		85	2.1	607	210	15	2.0	0.00	0.00	
What would you do a chin up on?	bar	80	2.7	848	397	14	2.2	0.07	0.08	133
What type of establishment is the setting for Cheers?		100	1.1	574	183	16	1.7	0.79	0.92	
What do you call the sound made by dogs?	bark	85	1.4	598	239	14	1.3	0.68	0.72	14
What is the rough substance that coats trees?		95	1.3	662	270	16	1.8	0.26	0.28	
With what would you hit a home run?	bat	90	1.4	761	414	14	1.3	0.53	0.61	41
What animal sleeps in caves hanging upside down?		95	1.4	417	118	15	1.4	0.34	0.39	
What do you call a concentrated stream of light?	beam	45	3.5					0.61	0.73	39
What does a gymnast balance on?		95	1.6					0.23	0.27	
What do you call a duck's beak?	bill	60	4.1					0.03	0.06	136
What do you get from the phone company once a month?		100	1.1					0.50	0.94	
What do you call the back of your leg below your knee?	calf	90	2.3	597	231	8	1.9	0.11	0.12	17
What do you call a young cow?		90	1.6	667	296	15	2.0	0.81	0.88	
What do you call the mysteries that detectives solve?	case	30	4.3					0.47	0.55	506
What do you carry a guitar in?		100	1.4					0.38	0.45	
What do you call the collection of players in a movie?	cast	40	3.8	832	328	9	2.9	0.27	0.44	54
What does a doctor put on a broken leg?		80	1.7	677	259	15	1.7	0.34	0.56	
What do you call a prisoner's quarters?	cell	75	2.0					0.48	0.55	146
What biological structure are plants and animals made of?		65	3.0					0.40	0.45	
On what part of his body did Superman sport a big 'S'?	chest	95	1.4	517	212	11	1.5	0.51	0.65	57
What container do pirates bury their treasure in?		95	2.2	615	231	14	1.7	0.27	0.35	
In terms of population, what is the biggest country in the world?	china	65	2.7					0.36	0.41	6
What do you call fine porcelain dishware?		85	1.9					0.51	0.59	
What fur garment would you wear when it's cold out?	coat	50	2.2					0.89	0.95	58
What do you call a layer of paint?		70	3.5					0.05	0.05	

APPENDIX B (Continued)

Question	Answer	Off Line		On Line				Abs. Dominance	Rel. Dominance	Freq.
		Percent Agreement	Difficulty	Latency		Number Correct	Difficulty			
				M	SD					
What do you call the number of balls and strikes against a batter?	count	60	3.1					0.71	0.77	96
What noble title could be applied to Dracula?		75	2.5					0.21	0.23	
What does a sailor swab?	deck	35	4.6					0.63	0.77	30
What do fifty-two cards make up?		100	1.4					0.19	0.23	
What good thing must a Boy Scout do each day?	deed	25	4.3					0.61	0.69	16
What legal document do you get when you buy a house?		20	4.2					0.28	0.31	
What kind of stone does an engagement ring usually have?	diamond	100	1.6	509	232	14	1.5	0.89	0.96	15
What is the shape of a baseball infield?		100	1.5	1,035	311	13	2.5	0.04	0.04	
What power tool do you use to make holes with?	drill	90	2.0					0.59	0.69	51
What do you call an exercise that sergeants lead their troops through?		70	3.0					0.26	0.31	
What hangs from a ceiling and cools you down?	fan	95	1.8	467	264	15	1.7	0.75	0.80	47
What do you call an avid follower of a team?		95	2.6	864	227	13	2.1	0.19	0.20	
On what part of your body do you wear a shoe?	foot	85	1.1	1,145	708	13	1.9	0.93	0.98	363
What distance does 12 inches make up?		100	1.1	582	243	13	1.5	0.02	0.02	
What do you call the fuel that runs your car?	gas	80	1.1	885	579	5	1.6	0.80	0.96	111
What is the state of a substance that is neither solid nor liquid?		90	2.0	527	209	13	1.5	0.03	0.04	
When driving, what do you use to audibly warn someone?	horn	90	1.5	747	422	11	1.7	0.77	0.82	33
What is on the head of a unicorn?		90	2.2	815	326	10	2.2	0.17	0.18	
With what do you remove wrinkles from clothes?	iron	95	1.4	604	292	14	1.8	0.47	0.49	57
What are heavy frying pans made from?		60	2.2	884	344	8	3.5	0.49	0.51	
Where do children sit when talking to Santa Claus?	lap	100	1.3	429	187	11	1.5	0.54	0.81	25
What do you call the full distance around a track?		60	3.2	746	424	11	2.1	0.13	0.19	
What does the alphabet consist of?	letter	100	1.3	647	271	14	1.1	0.07	0.09	262
What would you write to friends and send in the mail?		90	1.2	544	136	14	1.6	0.68	0.91	
What do you call the group of babies that an animal has?	litter	75	3.0					0.11	0.16	11
What do you call the garbage along the side of the road?		55	3.3					0.56	0.84	
What do you call the place where they make coins?	mint	55	4.4					0.12	0.12	7
What is the common flavor of after-dinner chocolates?		95	1.9					0.85	0.88	
What grows on old cheese?	mold	100	1.1					0.67	0.71	72
What do you pour Jello into to give it a shape?		65	1.6					0.27	0.29	
What do you call a single musical tone?	note	80	1.8	900	404	8	2.3	0.10	0.11	291
What would a schoolchild write and pass around?		100	1.4	415	169	13	1.8	0.84	0.89	
What piano-like instrument would you hear at church?	organ	95	1.7	539	265	16	1.4	0.47	0.48	26
What is your heart, liver, or kidney an example of?		100	1.1	586	255	16	2.4	0.50	0.52	
What do you call the tall trees that line the streets of Hawaii?	palm	95	2.2	536	241	15	1.4	0.27	0.31	32
What part of the hand does a fortune teller read?		100	1.1	843	458	7	2.3	0.59	0.69	
What is a pig kept in?	pen	70	1.8	1,124	976	9	1.3	0.04	0.04	23
With what do you use to write in ink?		100	1.0	646	191	15	1.5	0.91	0.96	
What would you call a bottomless hole?	pit	60	4.2					0.74	0.80	18
What do you call the stone or seed of a peach?		80	3.0					0.19	0.20	
What glass container do you pour water from?	pitcher	85	2.2	560	231	12	1.4	0.48	0.49	29

APPENDIX B (Continued)

Question	Answer	Off Line		On Line				Abs. Dominance	Rel. Dominance	Freq.
		Percent Agreement	Difficulty	Latency		Number Correct	Difficulty			
				M	SD					
In baseball, who tries to throw strikes?		100	1.8	801	272	11	1.5	0.49	0.51	
In what game is a full house a good hand?	poker	90	2.5					0.09	0.09	6
What do you call a sharp fireplace tool?		45	4.6					0.87	0.91	
What do you call a gift received on your birthday?	present	95	2.0	538	161	13	1.7	0.53	0.69	503
What do you call the time that is neither the future nor the past?		95	1.2	360	157	17	1.6	0.24	0.31	
What fruit drink is served from a large bowl?	punch	65	3.5	642	229	13	1.6	0.70	0.75	8
What do you call a hit with a closed fist?		95	2.0	463	160	14	1.7	0.23	0.25	
What do you call the black part of your eye?	pupil	65	3.0					0.33	0.33	45
What do you call the student of a tutor?		15	3.5					0.67	0.67	
What do you call someone who pretends to be a doctor?	quack	35	4.1					0.23	0.24	19
What is the sound made by a duck?		100	1.1					0.71	0.76	
What type of jewelry is worn on the finger?	ring	100	1.1	583	251	15	1.3	0.63	0.68	84
When someone calls, what sound does your telephone make?		90	1.1	501	222	16	1.8	0.30	0.32	
What do you stand on and weigh yourself with?	scale	95	1.6					0.77	0.96	64
What part of a map tells you the inch-to-mile conversion?		15	4.2					0.03	0.04	
On medication, what do you call the plastic used to prevent tampering?	seal	35	3.9					0.40	0.44	37
What animal claps and balances a ball on its nose?		80	2.7					0.50	0.56	
What is a group of words that starts with a capital letter and ends with a period?	sentence	75	2.7					0.72	0.77	56
After a criminal is found guilty, what does she or he receive?		90	2.2					0.21	0.23	
In cards, what is the black suit that's not clubs?	spade	95	2.3					0.27	0.29	8
What do you call the pointed shovel you dig holes with?		55	4.9					0.66	0.71	
What do you call a guest invited to talk to an audience?	speaker	90	1.8	677	226	8	2.6	0.58	0.65	67
What do you call the part of the radio that makes the sound?		90	1.7	863	365	13	2.3	0.31	0.35	
What season occurs after winter?	spring	95	2.2	1,020	371	12	1.7	0.57	0.79	168
What do you call the metal coil found in mattresses?		90	2.5	589	196	14	2.1	0.15	0.21	
What are scarecrows usually made out of?	straw	85	2.3	729	425	10	1.9	0.61	0.66	18
What do you drink a milkshake through?		95	1.2	567	139	15	1.7	0.31	0.34	
What do you file against someone you wish to take to court?	suit	40	2.8					0.02	0.02	95
What type of clothing would a man wear to church?		80	2.0					0.83	0.98	
Besides fleas, what does a collar protect your dog from?	tick	25	4.8					0.47	0.55	8
What do you call the sounds that come from a watch?		95	1.5					0.39	0.45	
What might a man wear around his neck?	tie	55	1.7	800	613	12	1.1	0.51	0.96	77
What do you call it when two teams have the same score?		100	1.2	457	186	15	1.4	0.02	0.04	
What do you call the point of a felt pen?	tip	75	3.5	613	395	11	2.0	0.46	0.61	40
What do you give a waiter or waitress for good service?		100	1.1	429	157	15	1.5	0.29	0.39	
Where in a car do you keep the spare tire?	trunk	95	1.5	700	313	14	1.7	0.66	0.84	13
What do you call the nose of an elephant?		95	1.5	621	182	15	2.1	0.13	0.16	
What distance does three feet make up?	yard	70	2.4					0.29	0.32	100
What is the enclosed area behind a house?		65	1.5					0.63	0.68	

Note—Latencies are measured in milliseconds, and frequencies in occurrences per million.

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