SESSION 6 TOOLS FOR COGNITIVE ANALYSIS

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Semantic Analyzer of Schemata Organization (SASO)

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A menu-driven software system was developed to implement schemata organization in a constraint-satisfaction neural network. The current neural-net model presents several advantages and modifications over previous related models. On the one hand, the schemata behavior shown by the present model is based on conceptual definitions and ratings obtained empirically from human subjects rather than on the idiosyncratic knowledge database of a single programmer. On the other hand, this property is most valuable to experimental research in which the current knowledge status of the subjects is critical for the experiments (e.g., word-recognition experiments).

The present paper describes a menu-driven software system called Semantic Analyzer of Schemata Organization (SASO). This program was developed to implement schemata organization in a constraint-satisfaction neural network similar to the connectionist model for schemata postulated by Rumelhart, Smolensky, McClelland, and Hinton in 1986. However, the current neural-net model presents several advantages and modifications over previous related models. First, the schemata behavior shown by the present neural net is based on conceptual definitions and ratings obtained empirically from human subjects rather than on the idiosyncratic knowledge database of a single programmer. This property is especially well suited to experimental research in which the knowledge status of the subjects is critical for the experiments (e.g., word-recognition experiments). Second, SASO provides the user with a set of utilities to process raw data generated by the subjects. It also automatically sets up the weight-connectivity matrix among concepts and generates the interface data files needed to run schemata simulations on the constraint-satisfaction neural-net program provided by McClelland and Rumelhart in 1988.

A psychological experiment and computer neural-net simulations were carried out to test schemata organization

in the current neural-net model. Furthermore, some statistical analysis was performed on the weight-connectivity matrix of the neural net. The advantages of using the current model as a computational tool for psychological experiments will be argued elsewhere in this paper.

ANALYSIS AND SCALING OF CONCEPTUAL DEFINITIONS

The first part of the study obtained the empirical data that were used in the neural-network simulations. The schema of *room* and related schemata were chosen for this experiment in order to work with some of the same schemata that Rumelhart et al. (1986) used in their simulations and thus be able to compare results. Rumelhart et al. (1986) chose *a priori* the descriptor concepts implemented in their network. By contrast, in the present study, a technique to obtain semantic networks from subjects was used to obtain the concepts of the neural network. Thus, the current schemata simulations are based on the information generated from the memories of a sample of 24 undergraduate students. The technique to obtain conceptual definitions is illustrated in the Method section of the experiment and was used empirically to obtain the concepts of the neural network and to estimate the values needed to compute the connection strength among the neural-net concepts. This technique has been experimentally contrasted against conceptual definitions generated by free-association techniques and has been shown to produce conceptual definitions of abstract and concrete concepts based on their meaning rather than on

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free associations or pure semantic category membership (Figuerola, Gonzalez, & Solis, 1976, 1981).

Method

Subjects. For this part of the experiment, 24 undergraduates from the University of Wisconsin-Madison participated as subjects. All were enrolled in an introductory psychology course, were native speakers of standard American English, and received course credit for their participation.

Procedure. Each person was given a booklet with a complete set of instructions and 20 concepts to define (target concepts). Each target concept was typed on a separate page and in a different random order for each subject. The only restriction to this randomization was that across all 24 subjects, each concept should appear as the first one in the sequence of presentation for at least one subject and also as the last one in the sequence for at least one subject. The subjects were asked to define the 20 target concepts, one by one, using other single-word concepts as definers. The definers could be any noun (e.g., *animal*, *quadruped*), adjective (e.g., *small*, *intelligent*), or verb (e.g., *runs*, *barks*). However, the definers could not be complete phrases (e.g., *a dog is an animal*), pronouns (e.g., *my*, *she*), articles (e.g., *the*, *an*), prepositions (e.g., *of*, *with*), or conjunctions (e.g., *and*, *but*).

After the subjects had finished writing down the definers for one concept and before going to the definition of the next concept, they were instructed to rate each produced definer for the current concept with a number between 1 and 10 according to its relevance to the target concept. The subjects were instructed that the number 10 should correspond to the best definer(s), 9 to the next best definer(s), and so on. In the rating phase of the experiment, the subjects were allowed to use the same rating number for different definers and to skip any number if they wanted to do so. The subjects were required to give the definitions and ratings for each of the following 20 concepts: ROOM, LIVING ROOM, BEDROOM, BATHROOM, DINING ROOM, KITCHEN, HOUSE, BASEMENT, GARAGE, OFFICE, APARTMENT, CLASSROOM, SCHOOL, BUILDING, LIBRARY, LABORATORY, RESTAURANT, THEATER, STORE, and GYMNASIUM. The maximum time allowed for the production of definers for each concept was 60 sec; 30 sec was allowed for the rating of the definers given for each concept. The subjects were given one solved example and one practice trial with totally unrelated target concepts (*dog* and *apple*, respectively) at the beginning of the experimental session to make sure that they understood the task.

Data Processing

For each of the 20 target concepts, the following values were computed:

1. *J* value: Total number of definers. This is a measure of the richness of the target concept.

2. *M* value: The sum of the ranks assigned by all the subjects to each definer concept. This is a measure of the relevance of each concept as a definer of the target concept.

3. SAM (semantic analysis of *M* value) group: The basic group of 10 definers with the highest *M* values for the target concept, from which further values are computed. This is the set of 10 definers that construct most of the meaning of the target concept in a network.

4. FMG value: The percentage rank corresponding to the *M* value of each of the definers in the SAM group, with respect to the highest *M* value in the group. To com-

pute the FMG value for each definer in each SAM group, the definer having the highest *M* value of the SAM group always corresponds to 100%; therefore, $FMG1 = 100$. The FMG value for the definer having the second highest *M* value (*M*2) of a SAM group is computed by the following formula: $FMG2 = M2 \cdot 100/M1$. The FMG value for the definer having the third highest *M* value (*M*3) was computed by $FMG3 = M3 \cdot 100/M1$, and so on. These percentage values were used to compute one of the four values needed to set up the weight connections between concepts in the PDP network.

5. *G* value: The difference between the lowest and the highest *M* values in the SAM group divided by 9, that is, divided by the number of definers in the SAM group minus 1. This is a measure of the closeness of the 10 *M* values in each of the SAM groups. Small numbers indicate dense groupings, and large numbers indicate widely spread out groups of definers.

Appendix A lists the 20 SAM groups, one for each target concept, and their respective semantic values. To carry out these computations with the raw data obtained from the empirical definition and ranking tasks, a menu-driven computer program with editing and simple graphics capabilities was developed. This program constitutes the SASO's editor. This computer program was also needed to encode the data into a format that is compatible with that of a second program developed in PROLOG to produce the matrix of weight connections for the neural net.

In short, the number of definers generated for each of the 20 target concepts (*J* value) as well as the densities of the SAM group of each concept (*G* value) were more or less homogeneous. However, the most important result for the present work was the fact that, as can be seen in Appendix A, the subjects used some common definer concepts to define several target concepts. Therefore, the total number of different definers given for the 20 target concepts in the 20 SAM groups was 141, and not 200 (20×10) as would have been expected if definers had not been repeated. These common definers are very useful for setting up the connections between the SAM groups of the different target concepts. Such was the case for the definers *desk*, *room*, *small*, *food*, *table*, *chair*, *people*, and some other, less common, definers. The number of common definers will depend on the knowledge domain.

NEURAL-NETWORK COMPUTER SIMULATIONS

This part of the paper describes how the target concepts and the definer concepts obtained in the experiment of this study were implemented as schemata on a constraint-satisfaction neural network. However, for our current purposes, only the results of 2 simulations from a total of 60 computer simulations are used to show the basic behavior of the implemented neural net.

Network Implementation

In a constraint-satisfaction neural network like the one used by Rumelhart et al. (1986), the weight of the connection between two concepts is computed by the following derivative of the Bayesian formula:

$$w_{ij} = -\ln\{[p(X = 0 + Y = 1)p(X = 1 + Y = 0)] \\ \times [p(X = 1 + Y = 1)p(X = 0 + Y = 0)]^{-1}\},$$

where X represents one of the concepts of the pair of concepts to be associated and Y the other concept. In the present case, the joint probability value $p(X = 1 + Y = 0)$ was obtained by computing how many times the definer X of the current pair appeared in a SAM group in which Y did not appear. For example, if $p(X = 1 + Y = 0) = 1/5$, then the definer X appeared in 5 of the 20 available SAM groups and Y was only absent in one of those 5 SAM groups. The joint probability values for $p(X = 0 + Y = 1)$ and $p(X = 0 + Y = 0)$ for the weight connection of the current pair were obtained in a similar way. However, the term $p(X = 1 + Y = 1)$ was calculated in a more complex way. It represents the hierarchical modulation of the M values of the SAM groups and their interconnectivity into the computations of the neural net. The steps to compute this value are as follows. First, for each target concept, the semantic distance between each definer and the best definer of the SAM group was computed by subtracting their FMG values and then dividing the result by the G value of their SAM group. This was done to obtain a standardized variability score similar to the standard z score of statistics. Second, if the same pair of definers appeared in other SAM groups, then the semantic distance between them was computed for each SAM group in which they appeared and an average of these values was obtained. Since this last average was the most representative value of definer association through all the SAM groups, it was taken as the probability value for the term $p(X = 1 + Y = 1)$, by dividing the average by 100. A menu-driven PROLOG computer program with editing capabilities was developed to computer the 141×141 weight-connectivity matrix for all the definers and to produce automatically the five files of programming and data to interface with Rumelhart's constraint-satisfaction program, which included the network, weights, start up, template or screen, and pattern-presentation files (see McClelland & Rumelhart, 1988). This program constitutes SASO's interface. By using SASO's utilities, it takes from 2 to 3 days to go from processing raw data to running simulations, compared with the 1½ months that two persons would need if they did the analysis by hand.

Results: Network Simulations

The outputs of two simulations are presented in Appendix B. These simulations were obtained by using SASO's interface program and Rumelhart's constraint-satisfaction model (McClelland & Rumelhart, 1988). Each page shows

a screen with the 141 different definers obtained empirically in the experiment. The value to the left of each definer represents its node's input value, and the value to its right represents its node's output value. Both variables can take on values between 0 and 100. However, the number 100 for the input value is indicated by the sign **. Before running each simulation, the node corresponding to the best definer of the target concept (highest M value of the SAM group) was deterministically activated at its maximum of 100. Rumelhart et al. (1986) call this concept *clamping*. This clamping is signaled by a ** to the left of the node on the screen. Therefore, one screen presents the initially activated node and the resulting spontaneous activation generated in other nodes. It also presents the current target concept in the simulation on the upper left portion of the screen. The result for each clamped concept is obtained after 20 cycles of the simulation (the same number of cycles run by McClelland & Rumelhart, 1988). In the first screen, the clamped concept was *room*. Interestingly, even though *room* is the highest definer for the target concept BUILDING, the SAM group for this concept was not activated. Instead, a seemingly fuzzy categorical pattern of activation was obtained, since the SAM groups for the target concepts OFFICE (*desk, work, secretary, computer, business, telephone, boss, papers, chair*) and HOUSE (*family, home, live, bedroom, kitchen, building, garage, bathroom, living room*) were activated as well as particular definers such as *garage* and *rent* (for the target concept APARTMENT). Now, if instead of activating the *room* node (the highest definer for BUILDING), the node corresponding to the definer *brick* is activated (the third best definer for BUILDING), then the SAM group of BUILDING becomes activated (*room, window, construction, door, large, tall, cement, skyscraper, stair*). (This simulation was not included in Appendix B.) It is in this sense that the definer *room* was more generic to several SAM groups than it was specific to BUILDING.

Another example is shown in the second screen of Appendix B. Here, the node corresponding to the highest ranked definer of the target concept RESTAURANT was clamped, that is *waiter*. As a result, the SAM groups for RESTAURANT (*food, eat, menu, service, table, cook, chair, drink, money*), KITCHEN (*food, cook, refrigerator, stove, sink, dish, microwave, table, eat, oven*), and DINING ROOM (*table, eat, food, chair, dish, dinner, silverware, family, china, fancy*) were spontaneously activated. As can be seen, the words in the pair *waiter* and *microwave* are more related by the implicit interconnection between semantic groups than by some explicit association or conceptual category. Such is also the case for the word *brick* and *live* when the node *room* is activated.

A multidimensional scaling analysis was carried out on the weight-connectivity matrix of the definers belonging to 10 of the 20 target concepts. The 10 target concepts were the following: ROOM, KITCHEN, LIVING ROOM, BEDROOM, BATHROOM, OFFICE, DINING ROOM, APARTMENT,

Figure 1. A multidimensional scatterplot matrix graphic for the following target concepts: ROOM, APARTMENT, BATHROOM, BEDROOM, HOUSE, OFFICE, LIVING ROOM, DINING ROOM, and KITCHEN.

HOUSE, and BUILDING. These definers, which constitute 50% of the matrix, are more stereotypical for the schema of ROOM than the rest of the target concepts and give a good hint of what is going on in the organization of the conceptual definitions. Figure 1 shows a graph of the multidimensional scaling's final configuration of the above target-concept definitions after 28 iterations using the Kruskal method. The final stress value for two dimensions was .31. By increasing the number of dimensions, no stress value below .24 could be obtained. Since the stress is so high, the spatial configuration of points could not be interpreted by using both dimensions. However, as the scatterplot matrix (SPLOM) shows, a well-defined spatial configuration is visible. The points at the center represent the definers for the target concept HOUSE. These definers are nothing more than common definers for the surrounding target-concept definitions (the outmost circle of dots). Except for the definers of the target concepts ROOM and OFFICE, all the rest of the surrounding definers

were spatially grouped according to their SAM groups. Interestingly, the definers of ROOM were distributed around the surrounding circle of definers and also at the center of the distribution. Since OFFICE did not have common definers with the definers of HOUSE, it was divided and segregated into two subsets at opposite sites of the surrounding circle of definers. In short, what the SPLOM shows is the schema of HOUSE. This is interesting, since all the target concepts (including the target concepts of the other 50% of the matrix that are not related to house) were presented randomly to the subjects. Therefore, the subjects implicitly defined the schema of HOUSE, and the neural net was sensitive to this. The cases of the target concepts STORE and THEATER of the other 50% of the matrix were also interesting. It seems that the network excluded the definers of these target concepts from the general schemata of ROOM even when there were definers from these SAM groups common to other SAM groups.

The two simulations in Appendix B gave us some additional information. The final output configuration of this neural-net model after 20 cycles was based on "all or none" output values (100 or 0) rather than graduated output values between 1 and 100. The main reason for this was that the interconnectivity among SAM groups through common definers was not very high. As a consequence of this, most of the matrix does not compete for the final solution. Therefore, further developments are needed to increase interconnectivity. One way to do this is to require subjects to generate conceptual definitions for *definers* of previous target concepts until a sufficient set of common definers is achieved for the current schema.

DISCUSSION

The use of ratings as a measure of semantic association among definers deserves a more thorough discussion than any we could possibly present here. At present, experimental research is being conducted in our laboratory to test the validity of these ratings as an indicator of a semantic scale. On the one hand, the technique of Figueroa et al. (1976, 1981) can be translated into Thurstone's general judgment model since both analyses share similar processing of the rating judgments. The goal is to obtain a distribution of rating scores according to the law of categorical judgment (see Torgerson, 1958). On

the other hand, if the schemata behavior shown by the current model truly represents a psychological "reality," the schemata-related pairs of words like *microwave-restaurant* or *brick-building* should have a semantic priming effect on human subjects based on schemata properties rather than on categorical or associative properties. This possibility is also being tested. A main goal is to develop SASO's capabilities up to the point where its predictions can be useful for psychological research.

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APPENDIX A

<u>ROOM</u>			<u>KITCHEN</u>		
	M	FMG		M	FMG
Wall	111	100	Food	174	100
Space	81	72	Cook	151	86
Ceiling	78	70	Refrigerator	142	96
Floor	77	69	Stove	137	78
Square	47	42	Sink	91	52
Place	47	42	Dish	87	50
Door	44	42	Microwave	67	67
House	34	39	Table	64	35
Small	33	30	Oven	63	36
Bed	32	29	Eat	63	36
J= 56	G= 9		J= 55	G= 12	

<u>LIVING ROOM</u>			<u>BEDROOM</u>		
	M	FMG		M	FMG
Couch	167	100	Bed	162	100
Television	111	66	Sleep	144	88
Chair	90	53	Dresser	87	53
Family	67	40	Private	52	32
Relax	54	32	Desk	47	29
Stereo	47	28	Personal	34	20
Lamp	36	21	Window	28	17
Fireplace	36	21	Room	25	15
Room	34	20	Clock	24	14
Piano	31	18	Small	24	14
J= 52	G= 15		J= 61	G= 15	

APPENDIX A (Continued)

BATHROOM

	M	FMG
Toilet	159	100
Sink	145	91
Shower	135	84
Bathtub	89	55
Mirror	84	52
Clean	50	31
Soap	44	27
Wash	35	22
Water	33	20
Towel	33	20

J= 58 G= 14

OFFICE

	M	FMG
Desk	136	100
Work	118	86
Secretary	104	76
Computer	75	72
Business	65	47
Telephone	63	46
Boss	50	36
Papers	46	33
Room	43	31
Chair	33	24

J= 56 G= 11

DINING ROOM

	M	FMG
Table	145	100
Eat	140	96
Food	118	81
Chair	92	63
Dish	60	41
Dinner	55	44
Silverware	50	34
China	43	29
Family	43	29
Fancy	42	28

J= 55 G= 12

HOUSE

	M	FMG
Family	121	100
Home	98	80
Live	85	70
Room	75	61
Bedroom	46	38
Kitchen	41	33
Building	36	29
Garage	33	27
Bathroom	29	23
Living room	27	22

J= 85 G= 10

CLASSROOM

	M	FMG
Teacher	191	100
Desk	148	77
Learn	137	71
Student	131	68
Book	101	52
Blackboard	74	42
Teach	45	38
Chair	39	23
School	36	20
Chalk	36	20

J= 54 G= 17

SCHOOL

	M	FMG
Learn	179	100
Teacher	164	91
Student	132	73
Building	69	38
Book	68	37
Classroom	64	35
Study	62	34
Education	55	30
Desk	44	24
Exam	38	21

J= 55 G= 16

APARTMENT

	M	FMG
Small	64	100
Home	62	96
Live	58	90
Landlord	57	89
Kitchen	52	81
Bedroom	52	81
Rent	48	75
Bathroom	38	59
Living room	34	53
Room	32	50

J= 63 G= 4

BASEMENT

	M	FMG
Underground	125	100
Storage	107	85
Dark	99	79
Cement	91	72
Cold	83	66
Room	67	53
Laundry	30	24
Dusty	27	21
House	25	21
Humid	25	20

J= 40 G= 11

BUILDING

	M	FMG
Room	71	100
Window	65	91

GARAGE

	M	FMG
Car	180	100
Storage	123	68

APPENDIX A (Continued)

Brick	63	88	Door	68	37
Construction	44	61	Tools	65	36
Door	40	56	Lawnmower	45	25
Tall	35	49	Dirty	41	22
Large	35	49	Bike	45	25
Cement	33	46	Room	28	15
Skyscraper	32	45	Cold	26	14
Stair	30	42	Mechanics	13	13
J= 54	G= 5	J= 45	G= 17		

LABORATORY

	M	FMG
Experiments	163	100
Chemistry	80	49
Chemicals	77	47
Scientist	66	40
Test tubes	57	34
Research	54	33
Room	43	26
Learn	42	25
Science	41	25
Bunsen burner	34	22

J = 49 G= 14

LYBRARY

	M	FMG
Book	225	100
Quiet	162	72
Study	137	60
Librarian	97	43
Shelves	60	26
Card catalog	55	24
Magazine	54	24
Information	45	20
Table	43	19
Research	35	15

J= 53 G= 21

STORE

	M	FMG
Buy	86	100
Merchandise	72	83
Shopping	69	80
Money	63	73
Clothes	61	70
Grocery	49	56
Sell	47	54
Customer	36	41
People	32	37
Cash register	28	32

J= 48 G= 6

THEATER

	M	FMG
Movies	167	100
Actor	96	57
Chair	82	49
People	75	44
Popcorn	75	44
Plays	68	40
Entertainment	51	30
Ticket	49	29
Dark	45	26
Acting	38	22

J= 50 G= 14

RESTAURANT

	M	FMG
Food	197	100
Waiter	160	81
Service	79	40
Table	53	26
Cook	51	25
Eat	94	47
Menu	91	46
Money	45	22
Chair	46	23
Drink	45	22

J= 56 G= 17

GYMNASIUM

	M	FMG
Sports	94	100
Basketball	91	96
Exercise	66	70
Large	50	53
Athletes	43	45
Work	38	40
Floor	36	38
Athletics	31	32
Gymnastics	30	31
People	24	25

J= 68 G= 7

APPENDIX B
Two Simulation Screens

TARGET CONCEPT: BUILDING

0 chalk	0	0 family	0	0 research	0
0 school	0	0 exam	0	0 test-tubes	0
0 chairs	0	0 desk	0	0 scientist	0
0 teach	0	0 education	0	0 chemicals	0

APPENDIX B (Continued)

0 blackboard	0	0 classroom	0	0 chemist	0
0 square	0	0 building	0	0 experiment	0
0 place	0	0 student	0	0 cash register	0
0 ceiling	0	0 teacher	0	0 customer	0
0 space	0	0 liv.room	0	0 sell	0
0 wall	0	0 bathroom	0	0 grocery	0
0 oven	0	0 rent	100	0 clothes	0
0 microwave	0	0 kitchen	100	0 shopping	0
0 stove	0	0 bedroom	100	0 merchandise	0
0 refrig.	0	0 landlord	100	0 buy	0
0 piano	0	0 live	100	0 acting	0
0 lamp	0	0 home	100	0 dark	0
0 fireplace	0	0 small	100	0 ticket	0
0 stereo	0	0 house	0	0 entertainment	0
0 relax	0	0 humid	0	0 plays	0
0 television	0	0 dusty	0	0 people	0
0 couch	0	0 laundry	0	0 popcorn	0
0 clock	0	0 underground	0	0 actor	0
0 personal	0	0 stair	0	0 movies	0
0 private	0	0 skyscraper	0	0 money	0
0 dresser	0	0 cement	0	0 drink	0
0 sleep	0	0 tall	0	0 chair	0
0 bed	0	0 construction	0	0 cook	0
0 water	0	0 brick	0	0 table	0
0 towel	0	0 window	0	0 service	0
0 wash	0	0 mechanics	0	0 menu	0
0 soap	0	0 cold	0	0 eat	0
0 clean	0	0 dirty	0	0 waiter	0
0 mirror	0	0 lawnmower	0	0 food	0
0 bathtub	0	0 bike	0	0 gymnast	0
0 shower	0	0 tools	0	0 athleticism	0
0 sink	0	0 door	0	**room	100
0 toilet	0	0 storage	0	0 floor	0
0 papers	100	0 car	0	0 work	0
0 boss	100	0 information	0	0 athlete	0
0 telephone	100	0 magazine	0	0 large	0
0 business	100	0 card catalog	0	0 exercise	0
0 computer	100	0 shelves	0	0 basketball	0
0 secretary	100	0 library	0	0 sport	0
0 fancy	0	0 study	0		
0 china	0	0 quiet	0		
0 silverware	0	0 book	0		
0 dinner	0	0 burner	0		
0 dish	0	0 science	0		
0 garage	100	0 learn	0		

TARGET CONCEPT: RESTAURANT

0 chalk	0	0 family	0	0 research	0
0 school	0	0 exam	0	0 test-tubes	0
0 chairs	0	0 desk	0	0 scientist	0
0 teach	0	0 education	0	0 chemicals	0
0 blackboard	0	0 classroom	0	0 chemist	0
0 square	0	0 building	0	0 experiment	0
0 place	0	0 student	0	0 cash register	0
0 ceiling	0	0 teacher	0	0 customer	0
0 space	0	0 liv.room	0	0 sell	0
0 wall	0	0 bathroom	0	0 grocery	0
0 oven	100	0 rent	0	0 clothes	0
0 microwave	100	0 kitchen	0	0 shopping	0
0 stove	100	0 bedroom	0	0 merchandise	0
0 refrig.	100	0 landlord	0	0 buy	0
0 piano	0	0 live	0	0 acting	0
0 lamp	0	0 home	0	0 dark	0
0 fireplace	0	0 small	0	0 ticket	0
0 stereo	0	0 house	0	0 entertainment	0
0 relax	0	0 humid	0	0 plays	0
0 television	0	0 dusty	0	0 people	0
0 couch	0	0 laundry	0	0 popcorn	0
0 clock	0	0 underground	0	0 actor	0
0 personal	0	0 stair	0	0 movies	0
0 private	0	0 skyscraper	0	0 money	0
0 dresser	0	0 cement	0	0 drink	100
0 sleep	0	0 tall	0	0 chair	100

APPENDIX B (Continued)

0 bed	0	0 construction	0	0 cook	100
0 water	0	0 brick	0	0 table	100
0 towel	0	0 window	0	0 service	100
0 wash	0	0 mechanics	0	0 menu	100
0 soap	0	0 cold	0	0 eat	100
0 clean	0	0 dirty	0	**waiter	100
0 mirror	0	0 lawnmower	0	0 food	0
0 bathtub	0	0 bike	0	0 gymnast	0
0 shower	0	0 tools	0	0 athleticism	0
0 sink	100	0 door	0	0 room	0
0 toilet	0	0 storage	0	0 floor	0
0 papers	0	0 car	0	0 work	0
0 boss	0	0 information	0	0 athlete	0
0 telephone	0	0 magazine	0	0 large	0
0 business	0	0 card catalog	0	0 exercise	0
0 computer	0	0 shelves	0	0 basketball	0
0 secretary	0	0 library	0	0 sport	0
0 fancy	100	0 study	0		
0 china	100	0 quiet	0		
0 silverware	100	0 book	0		
0 dinner	100	0 burner	0		
0 dish	100	0 science	0		
0 garage	100	0 learn	0		