

Supplemental Online Materials

Experimental Study 1: Visual Object Recognition, Linguistic Processing, and Visual Long-term Memory Encoding.

Visual Object Recognition

Task 1: Motion Perception

Methods and Materials. To investigate whether Case AA had any difficulties processing biological motion, Case AA was asked to decide if a human figure comprised of dot configurations (biomotionlab.ca) was moving to the left or to the right of the center of the screen. The dot configurations were presented at systematically manipulated eccentricities from the center, varying up to 90 degrees to the left and right, respectively; eccentricity was randomized. The first time the motion perception task was administered Case AA was below control range (45/50, 90%, $p < .01$), however Case AA was at ceiling when the test was administered later in the investigation (50/50, 100%, $p = .66$).

Task 2: Color Identification

Methods and Materials. Case AA was asked to identify the color of a centrally presented colored square. The stimuli consisted of nine colors: gray, pink, green, red, purple, orange, brown, blue, black. Color perception performance when first tested (6/9, 66%, $p = 0.19$), and when subsequently tested several weeks later (7/9, 78%, $p = 0.58$) color perception was not different from controls.

Task 3: Object Decision

Methods and Materials. Case AA was asked to make reality judgments over 160 line drawings of common objects. Real images were presented in their canonical form or manipulated such that their appearance was “not real” (e.g., a frog with a mouse’s tail; for

original materials see Barbarotto, Laiacona, Macchi, & Capitani, 2002). Case AA was within control range for living (74/80, 93%, $p = .18$) and nonliving (77/80, 97%, $p = .27$) stimuli.

Task 4: Letter Identification

Methods and Materials. Case AA's ability to read letters was assessed both with in-house tests and letter identification tests from the Psycholinguistic Assessment of Language Processing in Aphasia (PALPA) battery (Kay, Lesser, & Coltheart, 1992). Letter identification was examined in a naming test where Case AA was required to name the letters of the alphabet in their lower case and upper case forms (PALPA Test 22). Case AA was successful in naming each letter of the alphabet in upper and lower case form (104/104). Case AA was also successful in matching letters presented in their normal or reversed upper case and lower case form (PALPA Test 18; average = 36/36), matching upper case letters with their lower case form (PALPA Test 19, average = 26/26), and deciding if the letters in words (words or nonwords), presented in upper case and lower case form, were the same or different (PALPA Test 21, average = 60/60). Additionally, Case AA was successful in matching an auditorily presented letter with one of five visually presented lower case letters (PALPA Test 23, average = 26/26; see Supplemental Table 1 for the results).

Task 5: Number Identification

Methods and Materials. Case AA was asked to identify a centrally presented number. Numbers varied from one digit to three digits, and number identification was at ceiling for one and two digits, however, number identification for 3 digits was different

than controls (8/10, 80%, $p < .05$); analysis of his naming errors (2/10) revealed phonological-like errors (e.g., 954 → 945).

Task 6: Overlapping Figures Discrimination

Methods and Materials. To test for impairments associated with parietal lobe damage (i.e., simultanagnosia), Case AA was asked to make decisions about overlapping figures. On each trial Case AA was presented with a target image of two overlapping figures (e.g., square and triangle overlapping) and two images below the target (e.g., square and diamond) presented to the left and to the right of fixation; Case AA was asked to decide which of the two images below the target was presented in the target. His performance was worse than controls (9/12, 80%, $p < .05$).

Task 7: Birmingham Object Recognition Battery (BORB)

Methods and Materials. To investigate Case AA's mid- and high-level visual processing, the Birmingham Object Recognition Battery was administered (BORB; Riddoch and Humphreys, 1992). Case AA's hemiplegic impairment to the right side of his body left him with an impoverished writing and drawing capacity with his non-dominant left hand. All tests from the BORB were administered except drawing from memory, copying, and the overlapping figures test. Case AA was within control range for matching line length (25/30, 83%, $p = .17$), size length (26/30, 87%, $p = .62$), orientation of lines (25/30, 83%, $p = 1$), and positions of gaps in circles (34/40, 85%, $p = .77$); furthermore, his performance when matching objects with minimal features and foreshortened view was at ceiling. When making object decisions Case AA was within control range, or better than controls with 'hard' (Version A: 29/32, 91%, $p = .35$; Version B: 31/32, 97%, $p = .09$) and 'easy' (Version A: 30/32, 94%, $p = .32$; Version B:

30/32, 94%, $p = .32$) trials; in addition, his performance on the item match task (32/32, 100%, $p = .40$) and associative match task (25/30, 83%, $p = .29$) was not different than controls.

Picture naming for Case AA was also similar to controls. When administered the short version ($N = 15$), Case AA was similar to controls (13/15, 87%, $p = .90$). The long version of the picture naming experiment was also similar to controls (65/76, 86%, $p = .12$).

Visual Object Recognition Results

Case AA's ability to make decisions about visual stimuli along color, motion, and real/unreal dimensions was similar to control participants. Case AA was also similar to control participants when asked to make mid- and higher-level visual discrimination decisions in the BORB, and was flawless when matching letters that had been mirror reversed, or presented in uppercase and lowercase form; in addition, Case AA was able to match a spoken letter with its written letter. Case AA was significantly different than control when asked to make motion discriminations the first time he was given the Motion Perception test, however, he was administered the test a week later as performed at ceiling. Case AA was also impaired on the Overlapping Figure Discrimination test: he committed several errors when he was shown a triad of three objects and was asked to choose which of the two lower objects matched one of two overlapping figures in the target object. This may be due to symptoms of simultanagnosia, a deficit in perceiving portions of overlapping visual stimuli that typically accompanies parietal lobe damage; however, his performance on the BORB rules out any visual deficiency as a cause of the principal impairments of the neuropsychological evaluation.

Linguistic Processing

On all word reading tasks Case AA was asked to name a visually presented word. All words were presented for 10 seconds, and all tasks were adapted from the PALPA.

Task 1: PALPA Test 36—Nonword Reading

Methods and Materials. Case AA was asked to name 24 three-, four-, five-, or six-character monosyllabic nonwords. His performance for reading three-character (4/6, 67%, $p = .69$), five-character (5/6, 83%, $p = .69$), and six-character (3/6, 50%, $p = .19$) nonwords was within control range; when asked to read four-character nonwords Case AA was different than controls (3/6, 50%, $p < .05$; see Supplemental Table 2 for all results).

Task 2: PALPA Test 35—Spelling-Sound Regularity Reading

Methods and Materials. To investigate Case AA's ability to read words with varying spelling-sound regularities, he was asked to read regular and exceptionally spelled words. Case AA performed similarly to controls when reading regular (29/30, 97%, $p = 1$) and exception words (28/30, 93%, $p = .80$).

Task 3: PALPA Test 32—Grammatical Class Reading

Methods and Materials. Twenty adjectives, functors, nouns, and verbs, respectively, were visually randomly presented for Case AA to read aloud. Reading adjectives (19/20, 95%, $p = .66$), functors (18/20, 90%, $p = .17$), nouns (20/20, $p = .62$), and verbs (20/20, $p = .66$) was similar to controls.

Task 4: PALPA Test 33—Grammatical Class & Imageability

Methods and Materials. Twenty respective nouns and functors were visually presented for Case AA to read; all words were equally imageable. Reading of functors

(19/20, 95%, $p = .83$) and nouns (16/20, 80%, $p = .12$) was within range of control participants.

Task 5: PALPA Test 31—Imageability & Frequency

Methods and Materials. Eighty visually presented words were manipulated to test for the interactions between imageability and lexical frequency of words. Case AA was at ceiling for reading high frequency words (40/40, 100%, $p = .66$) and high imageability words (40/40, 100%, $p = .40$). Low frequency word reading (38/40, 95%, $p = .40$) and low imageability word reading (38/40, 95%, $p = .12$) was within range of controls. Case AA was also at ceiling when reading high imageability/high frequency, high imageability/low frequency, and low imageability/high frequency words (20/20, respectively); reading low imageability/low frequency words was impaired (18/20, 90%, $p < .01$).

Task 6: Chiarello et al. Noun and Verb Reading

Methods and Materials. Grammatical class reading was further probed with an oral reading task of 190 nouns and verbs, respectively (for materials see Chiarello, Shears, & Lund, 1999), and Case AA's performance was not modulated by grammatical class (nouns, 163/190, 86%; verbs, 169/190, 89%; $\chi^2 < 1$).

Linguistic Processing Results

While Case AA's performance for reading nonwords across all word lengths was less accurate than controls, his reading of nonwords with four characters was the only portion significantly different from controls ($t(5) = 2.78$, $p < .05$). Case AA's difficulty with nonword reading extended to repetition as well, where his ability to repeat nonwords was affected (PALPA Test 8, 25/30, 83%). Case AA's reading was not affected by

spelling-sound regularity/irregularity; when asked to name spelling-sound regular and spelling-sound exception words, he was similar to controls. Case AA was at ceiling or similar to controls when reading words from different grammatical classes; such was the case when he was asked to read equally imageable words from different grammatical classes.

Both low and high frequency and imageable words were within control range. Interactions between the two factors largely yielded normal performance: Case AA was within control range for high imageable/high frequency, low imageable/high frequency, and low imageable/high frequency words, but his naming of low imageable/low frequency words was impaired ($t(5) = -4.17, p < .01$). In an extended grammatical class word reading task (Chiarello Noun Verb readings), Case AA showed similar performance when reading nouns and verbs (see Supplemental Table 2 for all results).

Visual Long-term Memory Encoding and Retrieval.

Task 1: Picture Memory Test.

Methods and Materials. To investigate visual long-term memory, Case AA was asked to identify repeated images embedded within the presentation of 216 images (adapted from Brady, Konkle, Alvarez, and Oliva, 2008). On each trial, a picture (e.g., tools, animals, kitchen appliances, medical equipment, foods) was presented for 3 seconds. Case AA and controls were asked to hit the space bar if the image being presented was a repeat (i.e., had been presented beforehand). There were a total of 40 repeated images, and the number of trials between repeats varied from 3 to 16 trials. Participants were given feedback: If a repeat was correctly identified the central fixation cross (presented after each trial) turned green, and if the participant incorrectly identified

an image as a repeat (i.e., a false alarm), the fixation cross turned red. There was no feedback for misses or correct rejections. Case AA was at ceiling (40/40, 100%, $p = .27$; see Supplemental Table 3).

Task 2: Picture Repeat. In a follow-up experiment, two images were presented per trial, one image to the left, and one to the right of fixation. Of the two images presented, one was from the Picture Repeat Test while the other was a foil. The foil was one of three identities: a novel foil (e.g., the correct object was a piece of bread, and the foil was a ball), an exemplar foil (e.g., the correct object was a black calculator and the foil was a white calculator), or a state foil (e.g., the correct object was doll in an upright position while the foil was the same doll in a downward position). Case AA and controls were asked to identify which object was one of the repeated images from the prior experiment. Case AA was within control range (39/40, 98%, $p = .56$; see Supplemental Table 3).

Short-term Memory: Digit Span.

Digit Span. Case AA was asked to repeat auditorily presented digits forwards and backwards; the digits ranged in value from 1 to 9, were binned in intervals from 1 to 9, were randomly presented, and did not repeat with an interval (e.g., 2-1-4-3-6-4). Case AA was asked to repeat the digits as quickly and accurately as possible. Within each interval Case AA was given three opportunities to correctly repeat the digits; if he made three errors in a row the experiment ended. Case AA successfully repeated digits forward and backward (see Supplemental Table 4).

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Table S1A. Visual Object Recognition

	<i>Control Sample</i>			<i>Case AA's score</i>		<i>Significance test</i>			
	<i>n</i>	<i>Mean</i>	<i>SD</i>	<i>S1</i>	<i>S2</i>	<i>t</i>		<i>p</i>	
						<i>S1</i>	<i>S2</i>	<i>S1</i>	<i>S2</i>
Motion Perception	6	.99	.02	.9	1	-4.17	.46	.01	.66
Color Identification	6	.85	.11	.66	.78	-1.52	-.59	.19	.58
Object Decision									
Living	6	.87	.03	.93		1.54		.18	
Nonliving	6	.92	.03	.97		1.23		.27	
Letter Identification									
Letter Naming and Sounding	–	–	–	1					
Mirror Reversal	–	–	–	1					
Upper Case - Lower Case Letter Matching	–	–	–	1					
Letter Discrimination: Letters in Words and Nonwords	–	–	–	1					
Spoken Letter - Written Letter Matching	–	–	–	1					
Number Identification									
One digit	6	1	–	1		0		–	
Two digits	6	.99	.03	1		.31		.77	
Three digits	6	.97	.05	.8		-3.15		.03	
Overlapping Figure Discrimination	6	.92	.05	.75		-3.15		.03	
BORB									
Length Match Task	39	.9	.05	.83		-1.38		.17	
Size Match Task	39	.91	.08	.87		-.49		.62	
Orientation Match Task	39	.83	.09	.83		0		1	
Position of Gap Match Task	39	.88	.11	.85		-.30		.77	
Minimal Feature View Task	30	.93	.07	1		1		.33	
Foreshortened View Task	30	.86	.09	1		1.53		.14	

Object Decision A: Hard	14	.84	.07	.91	.96	.35
Object Decision B: Easy	13	.95	.04	.94	-.24	.81
Object Decision A: Easy	14	.9	.08	.94	.48	.32
Object Decision B: Hard	32	.79	.10	.97	1.77	.09
Item Match Task	34	.93	.07	1	.85	.40
Associative Match Task	15	.92	.08	.83	-1.09	.29
Picture Naming (Short Version)	34	.85	.15	.87	.13	.90
Picture Naming (Long Version)	11	.93	.04	.86	-1.68	.12

Table S1B. Visual Object Recognition

	<i>Estimated percentage of the control sample obtaining a lower score than Case AA</i>				<i>Estimated effect size (Z_{CC})</i>			
	<i>Point</i>		<i>(95% CI)</i>		<i>Point</i>		<i>(95% CI)</i>	
	<i>S1</i>	<i>S2</i>	<i>S1</i>	<i>S2</i>	<i>S1</i>	<i>S2</i>	<i>S1</i>	<i>S2</i>
Motion Perception	.44	66.87	(.00 to 4.50)	(35.34 to 90.89)	-4.50	.50	(-7.31 to -1.70)	(-.38 to 1.33)
Color Identification	9.51	29.07	(.20 to 36.65)	(6.69 to 60.86)	-1.64	-.64	(-2.88 to -.34)	(-1.50 to -.28)
Object Decision								
Living	90.83		(63.98 to 99.83)		1.67		(.36 to 2.92)	
Nonliving	86.41		(56.78 to 99.26)		1.33		(.17 to 2.44)	
Number Identification								
One Digit	–		(– to –)		–		(– to –)	
Two Digits	61.50		(30.61 to 87.35)		.33		(-.51 to 1.14)	
Three Digits	1.27		(.00 to 11.40)		-3.40		(-5.58 to -1.21)	
Overlapping Figure Discrimination	1.27		(.00 to 11.40)		-3.40		(-5.58 to -1.21)	
BORB								
Length Match Task	8.75		(3.30 to 17.07)		-1.40		(-1.84 to -.95)	
Size Match Task	31.22		(20.32 to 43.49)		-.50		(-.83 to -.16)	
Orientation Match Task	50.00		(37.68 to 62.32)		0		(-.31 to .31)	

Position of Gap Match Task	38.43	(26.79 to 50.91)	-.30	(-.62 to .02)
Minimal Feature View Task	83.33	(71.03 to 92.43)	1.00	(.55 to 1.43)
Foreshortened View Task	93.16	(84.47 to 98.15)	1.56	(1.01 to 2.09)
Object Decision A: Hard	82.29	(62.33 to 95.14)	1.00	(.31 to 1.66)
Object Decision B: Easy	40.68	(21.26 to 62.08)	-.25	(-.79 to .31)
Object Decision A: Easy	68.15	(47.38 to 85.29)	.50	(-.07 to 1.05)
Object Decision B: Hard	95.69	(89.06 to 99.08)	1.8	(1.23 to 2.36)
Item Match Task	79.78	(67.66 to 89.37)	.86	(.46 to 1.25)
Associative Match Task	14.72	(3.87 to 32.27)	-1.13	(-1.77 to -.46)
Picture Naming (Short Version)	55.18	(41.87 to 68.08)	.13	(-.21 to .47)
Picture Naming (Long Version)	6.23	(.35 to 21.92)	-1.75	(-2.69 to -.78)

Table S2A. Linguistic Processing

	<i>Control Sample</i>			<i>Case AA's score</i>	<i>Significance test</i>	
	<i>n</i>	<i>Mean</i>	<i>SD</i>		<i>t</i>	<i>p</i>
Nonword Reading						
Three characters	6	.79	.22	.67	-.42	.69
Four characters	6	.92	.14	.5	-2.78	.04
Five characters	6	.91	.20	.83	-.42	.69
Six characters	6	.81	.19	.5	-1.51	.19
Spelling-Sound Regularity Reading						
Regular	6	.97	.05	.97	0	1
Exception	6	.95	.07	.93	-0.27	.80
Grammatical Class Reading						
Adjective	6	.97	.04	.95	-.46	.66
Functor	6	.97	.04	.9	-1.62	.17
Noun	6	.96	.07	1	.53	.62
Verb	6	.98	.04	1	.46	.66
Grammatical Class & Imageability						
Functors	6	.96	.04	.95	-.23	.83
Nouns	6	.96	.08	.80	-1.85	.12
Imageability & Frequency						
High Frequency	6	.99	.02	1	.46	.66
Low Frequency	6	.99	.02	.95	-1.85	.12
High Imageability	6	.99	.01	1	.93	.40
Low Imageability	6	.98	.03	.95	-.93	.40
High Image X High Frequency	6	1	–	1	–	–
High Image X Low Frequency	6	.99	.02	1	.46	.66
Low Image X High Frequency	6	.98	.04	1	.46	.66

Low Image X Low Frequency	6	.99	.02	.90	-4.17	.01
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PALPA Sentence Repetition	-	.94	1	-	-	-
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Table S2B. Linguistic Processing

	<i>Estimated percentage of the control sample obtaining a lower score than Case AA</i>		<i>Estimated effect size (Z_{CC})</i>	
	<i>Point</i>	<i>(95% CI)</i>	<i>Point</i>	<i>(95% CI)</i>
Nonword Reading				
Three characters	34.57	(10.01 to 65.94)	-.46	(-1.28 to .41)
Four characters	1.95	(.00 to 15.36)	-3.00	(-4.96 to -1.02)
Five characters	34.72	(10.10 to 66.07)	-.45	(-1.28 to .41)
Six characters	9.56	(.21 to 36.75)	-1.63	(-2.87 to -.34)
Spelling-Sound Regularity Reading				
Regular	78.08	(46.43 to 96.78)	.91	(-.09 to 1.85)
Exception	40.10	(13.76 to 70.75)	-.29	(-1.09 to .55)
Grammatical Class Reading				
Adjective	33.14	(9.11 to 64.66)	-.50	(-1.33 to .38)
Function	8.30	(.12 to 34.67)	-1.75	(-3.05 to -.40)
Noun	69.03	(37.34 to 92.21)	.57	(-.32 to 1.42)
Verb	66.86	(35.34 to 90.89)	.50	(-.38 to 1.33)
Grammatical Class & Imageability				
Functors	41.31	(14.63 to 71.77)	-.25	(-1.05 to .58)
Nouns	6.16	(.03 to 29.68)	-2.00	(-3.42 to -.53)
Imageability & Frequency				
High Frequency	66.86	(35.34 to 90.89)	.50	(-.38 to 1.33)
Low Frequency	6.16	(.03 to 29.68)	-2.00	(-3.42 to -.53)
High Imageability	80.15	(48.76 to 97.57)	1.00	(-.03 to 1.97)
Low Imageability	19.85	(2.43 to 51.24)	-1.00	(-1.97 to .03)
High Image X High Frequency	50.00	(21.18 to 78.82)	0	(-.80 to .80)
High Image X Low Frequency	66.86	(35.34 to 90.89)	.50	(-.38 to 1.33)
Low Image X High	66.86	(35.34 to 90.89)	.50	(-.38 to 1.33)

Frequency				
Low Image X Low Frequency	.43	(.00 to 4.50)	-4.50	(-7.31 to -1.70)

Table S3. Visual Long-term Memory Encoding and Retrieval

	<i>Control Participants</i>			<i>Case AA's score</i>	<i>Significant test</i>	
	<i>n</i>	<i>Mean</i>	<i>SD</i>		<i>t</i>	<i>p</i>
Picture Repeat Test	6	.96	.03	1	1.23	.27
Picture Identity Test	6	.96	.06	.98	.62	.56

Table S4. Short-term Memory: Digit Span

Digit Span	Case AA's Score	
	First Session	Second Session
Forward	6	8
Backward	2	3

Table S5. Action Recognition

	<i>Estimated percentage of the control sample obtaining a lower score than Case AA</i>		<i>Estimated effect size (Z_{CC})</i>	
	<i>Point</i>	<i>(95% CI)</i>	<i>Point</i>	<i>(95% CI)</i>
Action Decision	–	–	–	–
Pantomime Discrimination	11.18	(0.37 to 39.52)	-1.50	(-2.68 to -0.27)

Table S6. Action Production

	<i>Estimated percentage of the control sample obtaining a lower score than Case AA</i>		<i>Estimated effect size (Z_{CC})</i>	
	<i>Point</i>	<i>95% CI</i>	<i>Effect Size</i>	<i>95% CI</i>
Pantomime from Verbal Command:				
Transitive				
Content	50.00	(21.18 to 78.82)	.00	(-.80 to .80)
Spatial	.00	(.00 to .00)	-11.00	(-17.66 to -4.43)
Temporal	.70	(.00 to 7.01)	-4.00	(-6.52 to -1.48)
Other	.13	(.00 to .96)	-6.00	(-9.69 to -2.34)
Object Use	.01	(.00 to .00)	-11.00	(-17.66 to -4.43)
Pantomime Imitation:				
Transitive				
Content				
Spatial	.01	(.00 to .01)	-10.50	(-16.87 to -4.22)
Temporal	.70	(.00 to 7.01)	-4.00	(-6.52 to -1.48)
Other				
Object Use	.07	(.00 to .29)	-7.00	(-11.28 to -2.76)
Tactile Recognition, Object Use, and Knowledge of Object Function				
Content				
Spatial	.04	(.00 to .07)	-8.00	(-12.87 to -3.18)
Temporal				
Other				
Object Use	.28	(.00 to 2.79)	-5.00	(-8.10 to -1.91)
Object Identification	.07	(.00 to .29)	-7.00	(-11.28 to -2.76)
Identifies Function	.00	(.00 to .00)	-25.00	(-40.87 to -10.37)

Table S7. Action-related Object Knowledge

	<i>Estimated percentage of the control sample obtaining a lower score than Case AA</i>		<i>Estimated effect size (Z_{cc})</i>	
	<i>Point</i>	<i>(95% CI)</i>	<i>Effect Size</i>	<i>(95% CI)</i>
Matching by Function	40.10	(13.76 to 70.75)	-.29	(-1.09 to .55)
Matching by Identity	84.14	(53.67 to 98.77)	1.20	(.09 to 2.25)
Object Sound Decision	42.25	(15.31 to 72.56)	-.22	(-1.02 to .60)
Declarative Knowledge of Tools				
Precise Use	.04	(.00 to .12)	-7.67	(-12.34 to -3.04)
Motor Knowledge	.62	(.00 to 6.30)	-4.13	(-6.72 to -1.53)
Functional Use	–	–	–	–
Contextual Use	.96	(.00 to 9.24)	-3.67	(-6.00 to -1.33)

Table S8. Form-, and Color-related Object Knowledge

	<i>Estimated percentage of the control sample obtaining a lower score than Case AA</i>		<i>Estimated effect size (Z_{cc})</i>	
	<i>Point</i>	<i>(95% CI)</i>	<i>Effect Size</i>	<i>(95% CI)</i>
Object Size Judgment	19.85	(2.43 to 51.24)	-1.00	(-1.97 to .03)
Object Color Judgment	13.59	(.74 to 43.22)	-1.33	(-2.44 to -.17)
Definition Naming				
Animals	.07	(.00 to .37)	-6.80	(-10.96 to -2.68)
Body Parts	.07	(.00 to .29)	-7.00	(-11.30 to -2.76)
Fruits	92.34	(66.96 to 99.92)	1.82	(.44 to 3.15)
Furniture	2.58	(.00 to 18.32)	-2.75	(-4.57 to -.90)
Musical Instruments	.07	(.00 to .35)	-6.83	(-11.01 to -2.69)
Tools	.21	(.00 to 1.94)	-5.36	(-8.67 to -2.07)
Vegetables	77.27	(45.55 to 96.44)	.88	(-.11 to 1.81)
Vehicles	23.76	(4.01 to 55.55)	-.83	(-1.75 to .14)

Table S9. Naming and Matching Objects and Actions

Picture Naming	<i>Estimated percentage of the control sample obtaining a lower score than Case AA</i>		<i>Estimated effect size (Z_{CC})</i>	
	<i>Point</i>	<i>(95% CI)</i>	<i>Effect Size</i>	<i>(95% CI)</i>
Snodgrass Picture Naming				
Animals	38.42	(27.17 to 50.44)	-.30	(-.61 to .01)
Birds	12.12	(5.55 to 21.26)	-1.20	(-1.59 to -.80)
Body Parts	70.13	(58.38 to 80.50)	.54	(.21 to .86)
Clothing	38.95	(27.67 to 50.98)	-.29	(-.59 to .03)
Fruits	2.74	(.58 to 7.09)	-2.00	(-2.52 to -1.47)
Furniture	34.40	(23.52 to 46.35)	-.41	(-.72 to -.09)
Insects	3.10	(.71 to 7.78)	-1.94	(-2.45 to -1.42)
Kitchen	56.50	(44.48 to 68.09)	.17	(-.14 to .47)
Music	50.00	(38.12 to 61.88)	.00	(-.30 to .30)
Other	36.30	(25.23 to 48.28)	-.36	(-.67 to -.04)
Tools	34.13	(23.27 to 46.06)	-.42	(-.73 to -.10)
Vegetables	23.64	(14.21 to 34.88)	-.73	(-1.07 to -.39)
Vehicles	45.11	(33.44 to 57.12)	-.13	(-.43 to .18)
Action Naming	.00	(.00 to .00)	-9.80	(-11.52 to -8.07)
Matching Objects and Actions				
Picture-Word Matching: Objects	.70	(.00 to 7.01)	-4.00	(-6.52 to -1.48)
Picture-Word Matching: Actions	.02	(.00 to .12)	-3.80	(-4.55 to -3.04)
Kissing and Dancing	13.59	(.74 to 43.22)	-1.33	(-2.44 to -.17)
Pyramids and Palm Trees	6.16	(.03 to 29.68)	-2.00	(-3.42 to -.53)

Table S10. Attribute Knowledge of Actions

	<i>Estimated percentage of the control sample obtaining a lower score than Case AA</i>		<i>Estimated effect size (Z_{CC})</i>	
	<i>Point</i>	<i>(95% CI)</i>	<i>Effect Size</i>	<i>(95% CI)</i>
Word Attribute	.00	(.00 to .00)	-6.75	(-8.03 to -5.46)
Picture Attribute	.00	(.00 to .00)	-5.00	(-5.97 to -4.03)
Word Comparison	.00	(.00 to .00)	-5.25	(-6.26 to -4.24)
Picture Comparison	.00	(.00 to .00)	-6.50	(-7.74 to -5.26)

Table S11. Semantic Knowledge Tested from Non-linguistic Auditory Stimuli

	<i>Estimated percentage of the control sample obtaining a lower score than Case AA</i>		<i>Estimated effect size (Z_{cc})</i>	
	<i>Point</i>	<i>(95% CI)</i>	<i>Effect Size</i>	<i>(95% CI)</i>
Animal Sound Discrimination	8.67	(.13 to 35.07)	-1.71	(-2.99 to -.38)
Environmental Sound Discrimination	2.44	(.00 to 17.70)	-2.80	(-4.64 to -.93)
Limb- and Mouth-Related Sound Discrimination				
Limb Transitive	.18	(.00 to 1.50)	-5.60	(-9.05 to -2.17)
Limb Intransitive	6.64	(.04 to 30.81)	-1.94	(-3.33 to -.50)
Mouth Transitive	.18	(.00 to 1.50)	-5.60	(-9.05 to -2.17)
Mouth Intransitive	.21	(.00 to 1.86)	-5.40	(-8.74 to -2.08)
Animals	6.16	(.03 to 29.68)	-2.00	(-3.42 to -.53)