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Identification of distinct and overlapping cortical areas for bilingual naming and reading using cortical stimulation

Case report

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✓A bilingual pediatric patient who underwent tumor resection was mapped extraoperatively using cortical stimulation to preserve English and Hebrew languages. The authors mapped both languages by using 4 tasks: 1) English visual naming, 2) Hebrew visual naming, 3) read English/respond Hebrew, and 4) Hebrew reading. Essential cortical sites for primary and secondary languages were compared, photographically recorded, and plotted onto a schematic brain of the patient. Three types of sites were found in this patient: 1) multiuse sites (multiple tasks, both languages) in frontal, temporal, and parietal areas; 2) single-task sites (1 task, both languages) in postcentral and parietal areas; and 3) single-use sites (1 task, 1 language) in frontal, temporal, and parietal areas. These results lend support to the concept that bilingual patients can have distinct cortical representations of each language and of different language tasks, in addition to overlapping or shared sites that support both languages and multiple tasks. *(DOI: 10.3171/PED/2008/1/3/247)*

Key Words • **bilingualism** • **cortical stimulation** • **language** • **naming** • **reading**

A compelling question regarding bilingualism has been whether overlapping or distinct cortical language areas represent each language. Data from a variety of neuroimaging techniques, cortical stimulation studies, and clinical findings have revealed several factors that are believed to influence the answer to this question, including the age of acquisition, the degree of fluency or proficiency, the type of script, and the tasks used to evaluate the languages in question. To date, study results have consistently demonstrated 1 of 2 views. The first view is that multiple languages are represented by common, overlapping language areas,[5,6,11,15,16,20,23–25] with investigators in initial studies asserting that an early age of acquisition and a high degree of fluency in each language were more likely to show overlapping cortical areas.[22] The second view is that multiple languages are represented by distinct cortical areas, usually in addition to overlapping areas.[8,22,26,34,37–40,42,45–47] Study results that support this "overlapping + distinct view" include some imaging studies but more often are cortical stimulation studies, which consistently show distinct cortical areas in addition to overlapping areas, even in early and proficient bilingual patients.

In this paper we report the case of a pediatric bilingual (English and Hebrew) patient who underwent neurosurgical resection of a left temporal anaplastic astrocytoma. Based on past cortical stimulation studies,[26,42,45,46] we made 2 hypotheses about this patient: 1) overlapping as well as distinct cortical areas representing this patient's 2 languages would be found; and 2) distinct areas would be found for the specific tasks administered, specifically that visual naming areas would be distinct from reading areas due to the different cognitive strategies involved with each task.

Cognitive theories of object identification propose that several stages of processing need to occur from the time the object is viewed until its verbal label is produced. These stages include early or low-level visual sensory processing[41] and matching of this encoded perceptual information to a multilevel memory system. The second stage (matching) involves accessing the stored structural description of the object, semantic descriptions (such as functional and associative properties) of the object, and phonological descriptions. Some models propose that a direct route exists from the structural code to the phonological code,[27] but a

Abbreviations used in this paper: DUMC = Duke University Medical Center; IFG = inferior frontal gyrus; MFG = middle frontal gyrus; MTG = middle temporal gyrus; SMG = supramarginal gyrus; STG = superior temporal gyrus.

more common view is that an abstract stage involving semantic access intervenes[53] and that retrieval of the phonological representation takes place subsequent to semantic access.[17,18] These strategies consistently activate the ventral stream of visual processing, including the inferior, middle temporal, and frontal gyri. Previous cortical stimulation studies using visual object naming have shown that sites are consistently found in frontal, temporal, and parietal areas,[34] and we expected to find a similar pattern in this study.

In contrast to visual object naming, a cognitive strategy for reading involves orthographic-to-phonological transformations. Evidence for the localization of these transformations in the SMG comes from both imaging[3,5,11,29,52] and cortical stimulation[42,45] studies. As such, we expected this general area to be identified during both English and Hebrew reading.

The read English/respond Hebrew task is a word-finding task using both languages in which the patient reads a sentence stem in English and fills in the blank with the appropriate Hebrew word. Generating the appropriate Hebrew word is dependent upon comprehension of the semantic material within the English sentence stem, similar to monolingual semantic priming tasks. Evidence suggests that semantic processing is affected by frontal lesions, especially in semantic priming tasks;[30,50] but because the read/respond task involves semantic priming with a strong reading component, we expected that errors would be induced by stimulation in both frontal as well as supramarginal areas.

Case Report

History and Neurological Examination. This 13-year-old right-handed male originally presented in 2001 at a different medical facility, showing intractable seizures as a result of a left temporal anaplastic astrocytoma. Extraoperative cortical stimulation had been performed at this outside facility to preserve English language areas, and a partial left temporal lobectomy was performed to remove the mass. This first resection removed the first 4 centimeters of the left superior and middle temporal lobe, and the patient received focal radiation therapy and chemotherapy following surgery.

After the first resection, no transient language deficit was noted for English, but he did have significant deficits in his Hebrew language skills, such that his scheduled Bar Mitzvah was cancelled. The patient underwent intensive Hebrew language skills training over the next 6 months and recovered most of his Hebrew language skills, to the point that he had a new Bar Mitzvah scheduled for 6 weeks after his second surgery. It was therefore an important requirement to obtain language maps for both Hebrew and English during the second resection procedure. Approximately 18 months following the first procedure, and while being treated with the antiepileptic levetiracetam, he presented at the DUMC with intractable grand mal seizures. Magnetic resonance imaging studies of his brain showed a postsurgical cavity in the first 4 centimeters of the left superior gyrus and MTG with an adjacent deep lesion, diagnosed as a recurrent anaplastic astrocytoma at the posterior superior margin of the resection cavity. The postsurgical cavity and recurrent tumor are outlined in Fig. 1 *left*.

Preoperative neurological examinations yielded normal findings with no focal deficits. It was noted that the patient was proficient in both English and Hebrew. According to the patient and his family, English and Hebrew were both spoken in the home since he was an infant and he was also engaged in Hebrew study as part of his Bar Mitzvah preparations at the time of his DUMC admission. English was spoken more frequently on a daily basis with the patient's friends and at school, however, and his Hebrew language skills were recovered through training following the first resection procedure. The patient reported mild difficulty in reading Hebrew text. For these reasons, English is referred to here as the primary language (L1) and Hebrew as the secondary (L2) language. Extensive preoperative language testing was performed in both languages. No impairments were found in reception, reading, or production for either language. A subdural grid was inserted during the craniotomy to map the location of each language for naming and reading as well as for word finding between languages using a bilingual read/response task. Postoperative language testing over the next 7 days showed hesitations for visual object naming in both English and Hebrew, whereas reading and read English/respond Hebrew showed mild production errors. These errors resolved within 3 months.

Language Mapping History. At the time of the first surgery at the outside center, only visual object naming in English was mapped in the dominant hemisphere. Generalized speech arrest was found in the IFG, whereas naming errors were found in the posterior portion of the SMG as well as the angular gyrus. These sites, the margins of the first resection, and the recurrent tumor are shown on a schematic diagram in Fig. 1 *right*.

Mapping of Language Function. Parental consent and child assent were obtained in accordance with the guidelines of the Internal Review Board of DUMC. Testing was performed in 2 sessions over 2 days. The area of exposure included frontal, temporal, and parietal areas. Twelve sites were tested on the 1st day; the patient experienced focal seizures but maintained intact visual and auditory naming, reading, and sentence completion in both languages. Seizures were resolved overnight, and 20 sites were tested on the 2nd day, avoiding the sites that led to seizure activity (Fig. 2).

The patient performed 4 tasks on the 2nd day of testing: 1) visual object naming in English; 2) visual object naming in Hebrew; 3) reading English sentences and completing them with Hebrew responses (read English/respond Hebrew); and 4) reading Hebrew sentences (see *Appendix* for stimuli). Baseline performance was measured by pretesting all tasks several days prior to grid placement. Only items that the patient successfully completed at least twice each at baseline during the testing were administered during cortical mapping.

To ensure that receptive language was not compromised during testing, stimulation was administered following presentation of the picture (naming) or written text (reading). Before each response, the patient spoke the carrier phrase "This is a . . ." (naming) or "This says . . ." (reading, read/response) to ensure that stimulation was not causing a general speech arrest. The presentation of the picture or written text was accompanied by an aural cue within the presentation software, alerting the neurosurgeon that the stimulus was on the screen. Stimulation was initiated immediately following this aural cue with a delay of approximately 1000

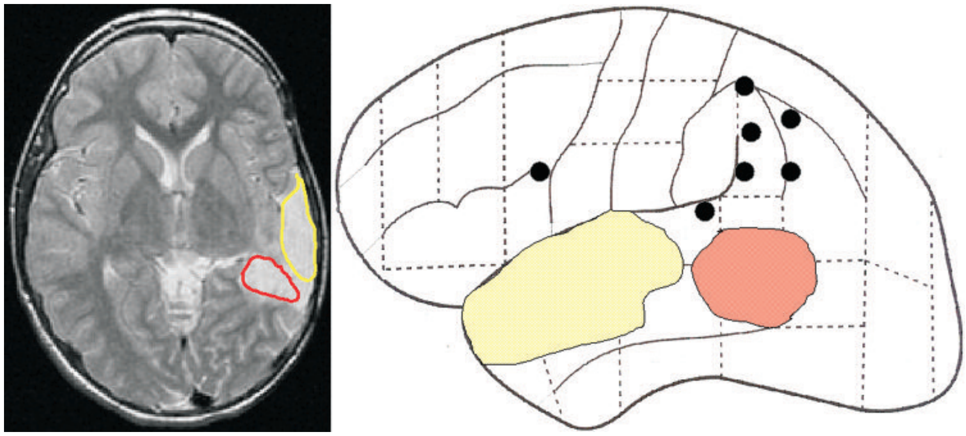


FIG. 1. Representative images of the patient's brain after the first resection procedure. *Left:* A T2-weighted spin echo axial magnetic resonance image of the resection cavity and recurrent tumor shows the resection of portions of the left STG and MTG *(yellow outline)* and recurrent tumor posterior to the cavity *(red outline)*. *Right:* Schematic illustration showing the approximate area of the resection area *(yellow)*, recurrent tumor *(red)*, and English visual naming sites *(black)*.

msec. This short delay allowed stimulation to proceed after the stimulus was on the screen but before the patient began his oral response of the carrier phrase and stimulus item/text.

The following error types[7] were noted: 1) semantic paraphasias (for example, substituting a semantically related item such as "cow" for "horse"); 2) phonological paraphasias (for example, clear substitution of 1 phoneme for another such as /f/ for /v/ or /tr/ for /dr/); 3) semantic/phonological blends (for example, substituting "train" for "plane"); 4) off-target responses, that is, those responses not semantically or phonologically related to the correct response (for example, substituting "tree" for "fork"); 5) no-target responses, that is, the patient correctly says the carrier phrase but is unable to give a response to the stimulus; 6) perseverations, in which the patient responds to a previous stimulus; 7) incorrect language, in which the patient names the object or responds in the wrong language; 8) apraxic errors such as a slur or stutter; and 9) phonological reduction, in which a syllable is dropped from a word (for example, responding with "can" instead of "candle").

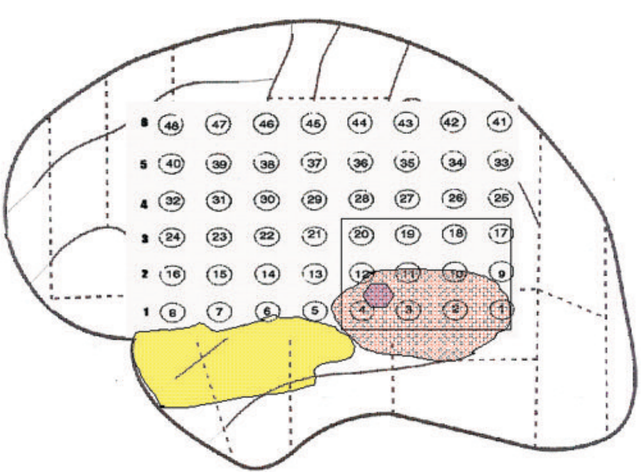


FIG. 2. Schematic illustration of the grid placement for cortical stimulation mapping. The first resection area is shown in *yellow*, the recurrent tumor in *red*, and the visible lesion in *purple*. The *boxed electrodes* in rows 1–3 (contacts 1–4, 9–12, 17–20) represent where a focal seizure was induced with 6 mA stimulation. Naming and reading in both languages remained intact.

In the read English/respond Hebrew task, the English reading portion of the trial was analyzed separately from the Hebrew word-finding part. Errors were classified in this task as either English only, Hebrew only, or mixed. The reliability of errors for each site in each task was calculated relative to the unstimulated baseline error rate using the Fisher exact test. Although probability values < 0.05 were considered statistically significant, values < 0.3 are included for purposes of a complete description. Probability values between 0.05 and 0.3 were considered weakly significant sites and are color-coded a lighter color than more robustly significant sites ($p < 0.05$) in corresponding figures.

Grid Mapping. Extraoperative mapping was performed using a 6×8-cm (48-contact) grid array, with 5-mm-diameter electrodes embedded in Silastic with center-to-center interelectrode distances of 1 cm. The grid was positioned over the frontoparietotemporal region. The exposed cortical surface and grid position were documented using digital photography and schematic diagrams. The amplitude of the current was progressively increased by 1 mA, beginning at 4 mA. We used a standard stimulation procedure[10] with biphasic square-wave pulses of 1 msec at 60 Hz, with a maximum train duration of 4 seconds until after discharge activity was evoked or maximum stimulation current reached 14 mA. Functional sites were marked with a sterile 5-mm^2 tag (Fig. 3 *upper*).

Outcome. Using extraoperative cortical stimulation mapping, we observed that rather than showing strictly overlapping areas for the 2 languages in this patient who was bilingual from an early age, the 2 languages were represented as a combination of overlapping and distinct sites in frontal, temporal, and parietal gyri. More specifically, we demonstrated 2 types of overlapping sites: 1) multiuse sites (several tasks, both languages), and 2) single-task sites (1 task, both languages) for naming as well as reading. Distinct single-use sites (1 task, 1 language) were found for visual nam-

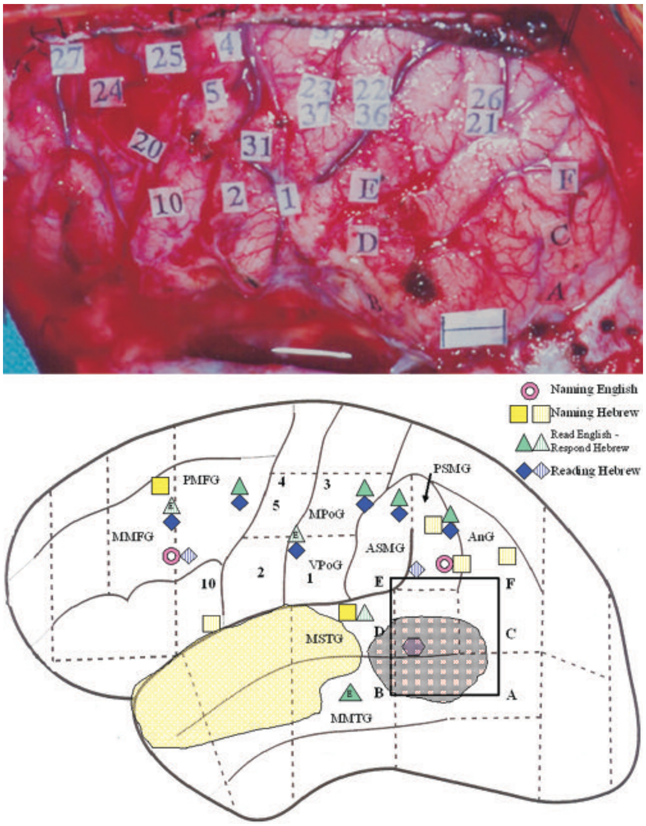


FIG. 3. Intraoperative photograph *(upper)* and schematic illustration *(lower)* of the cortical stimulation mapping sites. Letters A–F show stimulation-induced seizure activity. The numbers represent: 1 = tongue (sensory), 2 = mouth (motor), 3 = hand (sensory), 4 = thumb (motor), 5 = jaw movement, and 10 = speech arrest (counting). *Upper:* Tagged sites for visual naming, reading, and read/respond in English and Hebrew are shown. The paper at the bottom-right is a 1-cm measurement tag reference. *Lower:* Corresponding schematic map of English naming *(pink donut)*, Hebrew naming *(yellow squares)*, read English/respond Hebrew *(green triangles; E = English reading error only)*, and reading Hebrew *(blue diamonds)* essential sites. *Striped symbols (lighter colors)* represent p values between 0.05 and 0.3. AnG = angular gyrus; PoG = postcentral gyrus. Letters preceding abbreviations refer to posterior (P), middle (M), or ventral (V).

ing and reading in Hebrew and for English reading. No distinct site was found for visual naming in English.

A photograph of tagged sites and a schematic map of all tasks with significant error rates are included in Fig. 3 and described in Table 1. Reading was analyzed separately from responding for the read English/respond Hebrew task. Unless otherwise noted, errors were found both in English reading and in Hebrew responses within the same site; sites where errors were confined only to English reading are denoted by the letter “E” in Fig. 3 *lower* and by “E (R)” in Table 1.

As noted in Table 1, 3 types of sites were found. The first 2 types were overlapping, and the third type was distinct. Overlapping multiuse sites were significant for multiple tasks in both languages and were found in the MFG, STG, SMG, and postcentral gyrus. Overlapping, single-task sites were significant for a single task in both languages and were found in the MFG and postcentral gyrus. Distinct, sin-

TABLE 1

*Comparison of overlapping and distinct language and task sites in a bilingual patient**

		Overlapping		Distinct	
Location	Site (Tag No.)	Language	Task†	Language	Task
mid MFG	39–40 (24)	E (R), H	3‡,4§		
pst MFG	46–47 (25)	E, H	3‖,4§		
pst MFG	31–32 (20)	E, H	1‡,4‖		
vent PoG	29–30 (31)	E (R), H	3‖,4‖		
mid PoG	36–37 (23/37)	E, H	3‡,4‖		
pst SMG	34 (26/21)	E, H	2‖,3§,4‡		
ant SMG	35–36 (22/36)	E, H	3§,4§		
mid STG	13–14	E, H	2‡,3‖		
pst SMG	26–27	E, H	1§, 2‖		N
mid MTG	5–6		3‡	E	R
mid MFG	47–48 (27)		2‖	H	N
pst SMG	27–28		4‖	H	R
ang gyr	25–26		2‖	H	N
ant STG	15–16		2‖	H	N

* ang gyr = angular gyrus; ant = anterior; E = English; E (R) = English reading error only; H = Hebrew; mid = middle; N = naming; PoG = postcentral gyrus; pst = posterior; R = reading; vent = ventral.

† Task 1 = naming English; Task 2 = naming Hebrew; Task 3 = read English/respond Hebrew; Task 4 = reading Hebrew.

‡ $p < 0.05$.

§ $p < 0.01$.

‖ $p < 0.3$.

gle-use sites were found for Hebrew visual naming in the middle and inferior frontal gyri and angular gyrus, for Hebrew reading in the posterior SMG, and for English reading in the MTG.

Correspondence between the first and second English mapping sessions was moderate (Fig. 4). The first mapping showed a speech arrest site in the IFG that corresponded to speech arrest in the second mapping (tag 10 in Fig. 3 *lower*). Two sites in the inferior portion of the posterior SMG and angular gyrus from the first mapping were proximal to where we found errors for English visual naming (the *pink donut* in the posterior SMG in Fig. 3 *lower*). Two sites in a more superior portion of the posterior SMG and angular gyrus from the first mapping were proximal to a multiuse site for Hebrew naming, read English/respond Hebrew, and Hebrew reading in the posterior SMG. This multiuse site also showed 5 out of 16 errors for English naming in the second mapping, but this error rate did not reach a statistically significant level (p = 0.38). One site in the STG from the first mapping was near a site for Hebrew naming and read English/respond Hebrew, whereas 1 site in the superior part of the SMG from the first mapping appears more superior than the top edge of our grid placement.

Discussion

Bilingual language organization continues to be a source of debate. Several factors theoretically influence whether 2 languages are located in overlapping cortical areas or in distinct areas, including age of acquisition, proficiency in the second language, orthographic/script differences, and the tasks used to evaluate cortical representation of each language. Although a case study does not allow conclusions to be drawn about general factors that influence the distribution of 1 or more languages, these results are able to add evidence to existing views.

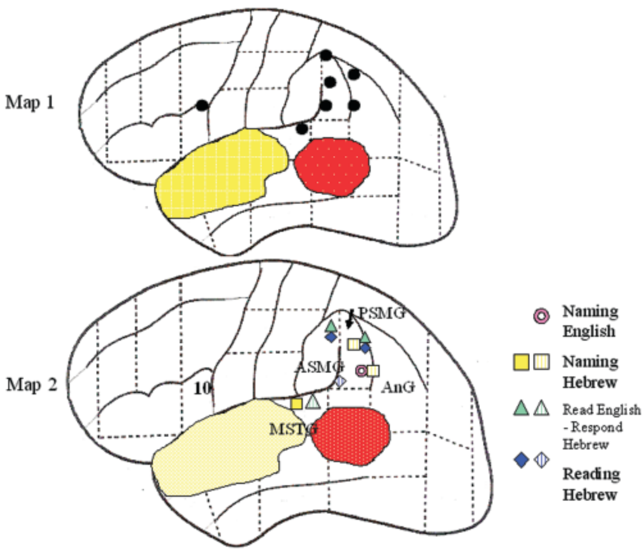


FIG. 4. Schematic illustrations showing the degree of correspondence between the first and second English mapping sessions. *Upper:* Map 1 shows the English visual naming sites *(black dots)* from the first resection. *Lower:* Map 2 shows the proximate sites from all tasks in the second resection. *Striped symbols (lighter colors)* represent p values between 0.05 and 0.3. Letters preceding the abbreviations refer to posterior (P), middle (M), or anterior (A). 10 = speech arrest (counting).

Overlapping areas of activation for bilingual patients are found in a wide range of circumstances. Whereas some authors of imaging studies hypothesized overlapping cortical areas in early and proficient bilingual patients,[5,15,16,22,23,25,31,39,57] other studies have called this view into question by showing overlapping areas in late bilingual patients, over a variety of second-language acquisition ages, and despite less fluency and different orthographic scripts in the secondary language.[5,6,11,20,24,31,56] Based on these studies, it seems generally established that 1 or more languages can share a cortical area under a variety of subject, task, and stimulus conditions, particularly in classic language areas.

More debatable is the issue of distinct cortical areas and which linguistic factors influence their detection.[8,22,38,39,57] Before adding this case study to the cortical stimulation evidence consistent with an "overlapping + distinct sites" bilingual map, the neurological history of this patient must be examined to determine whether the finding of distinct cortical areas could be due to language reorganization following the first resection. The structures involved in the first resection included the anterior portion of the left superior and middle temporal gyri. No transient language deficit was noted for English, but the patient had significant deficits in his Hebrew language skills. He underwent intensive retraining over a 6-month period and had recovered most of his Hebrew language skills when he underwent his second surgery. Most sites essential for naming and reading in both languages were located in the superior and anterior areas of the brain, away from the recurrent tumor and the resection cavity. The results of the first mapping of English language areas showed good consistency with our English mapping results. Taken together with the facts that the patient had no transient deficits and no need for speech rehabilitation in English, we suggest that the functional remapping of his English language skill was unlikely or minimal and that the distinct site for English reading was not due to reorganization.

In contrast, it is likely that his Hebrew language skill did undergo functional remapping. Over the course of 6 months, the patient recovered from significant deficits to a level of proficiency that allowed him to perform at his Bar Mitzvah approximately 6 weeks following his second surgery. It is unknown whether Hebrew was ever represented bilaterally—with the present left-lateralization indicating a shift to the left hemisphere during recovery—or whether Hebrew had previously been lateralized in the left hemisphere and was reorganized within the same hemisphere. Studies of children with extensive left hemisphere damage from perinatal strokes or other brain insults show that they are able to develop competent language skills in the healthy right hemisphere,[1,14,48] although the reorganization into the right hemisphere appears to be most common and language competence more likely if the injury is sustained before the age of 5 years.[12,28,43] In older children, insult to the dominant hemisphere in the form of refractory partial seizures is associated with a redistribution of language function within that hemisphere.[32] The recovery of perilesional tissue to support impaired language functions is also observed in adult aphasic stroke patients,[55] and several studies indicate that the recovery of perilesional tissue is associated with better verbal recovery and performance than increases in the right-sided homologue of language areas.[2,4,13,19,44,51,55] Language reorganization into areas adjacent to the first resection may account for the independent Hebrew naming site that was found in the IFG in this patient and possibly for joining a Hebrew naming site to what was already a multiuse site for read English/respond Hebrew in the middle portion of the STG. Both of these sites were found near the edges of the resected portions of the STG. Although the original extent of Hebrew lateralization is unknown, it appears likely that his Hebrew language underwent some functional reorganization within the left hemisphere concurrent with language recovery.

This functional reorganization of L2, however, still does not appear to account for all distinct Hebrew sites. It is important to note that distinct Hebrew naming and reading sites were also found in areas distant from his first resection, such as in the middle frontal and angular gyri for naming and the SMG for reading. These results suggest that the distinct sites found for L2 are not solely due to the functional reorganization of the secondary language but represent the detection of genuine distinct sites, a finding that is consistent with other cortical stimulation studies of bilingual patients.[26,34,42,45,46,54]

The multiuse sites for naming, reading, and read/respond tasks are comparable to previous cortical stimulation studies that show that different tasks can share a site. Verb generation and naming tasks, for example, were shown to share sites in frontal areas by Ojemann and colleagues,[35] as were naming and reading tasks in frontal and supramarginal areas in studies by Ojemann[33] and across languages in a study by Roux and associates.[45] It is unclear whether a site is able to sustain multiple tasks across languages because the site is able to sustain multiple cognitive strategies or because the tasks share common cognitive strategies that are performed by 1 site, such as phonological production for naming and reading.[45] In the case report described here, multiuse sites showed a variety of errors across tasks, including speech arrest, semantic paraphasias, phonological paraphasias, apraxic errors, and general anomia. From these data, the possibility is raised that a multiuse site is capable of sustaining a variety of language tasks even if those tasks employ different cognitive strategies, although this question needs to be examined on a much larger scale than a single case study.

Single-task sites are defined as those sites where 1 task is disrupted across both languages. These sites were found for both visual naming and for reading, suggesting a common cognitive strategy across languages was being disrupted for each task. The area of the single-task site found for reading in the MFG, for example, is often found as part of a network involved in semantic analyses of sentences[21,49] as well as during verbal working memory,[9] which could disrupt contextual cues needed to successfully read a given sentence in either language. Similarly, reading errors in the postcentral gyrus were always associated with apraxic or articulatory errors and were adjacent to an area identified as mouth motor and tongue movement (tag 1 in Fig. 3), which suggests that this area has more involvement with articulatory processes during reading, leading to disruptions across languages with stimulation.

Single-use sites, where only 1 task in 1 language is disrupted, were found for reading in L1 (English) in the MTG and for visual naming and reading in L2 (Hebrew) in both anterior and posterior regions. The distribution of L2 in anterior regions is inconsistent with the findings of Lucas et al.[26] who showed that distinct sites for L2 were located exclusively in the posterior temporal and parietal regions, whereas L1 and overlapping sites were found throughout the mapped area of the cortex. In contrast, we found L2 naming sites both in the MFG and in the anterior temporal gyrus and an L2 reading site in the MTG despite a similar region of exposed cortex. Because pediatric patients are believed to posses fewer language sites than adults and tend to gain sites with maturation,[36] the young age of this patient can probably be ruled out as a reason for the discrepancy. Distinct sites for L2 in the frontal lobe have also been reported in the cortical stimulation literature for both naming and counting,[45,46] making it unclear why such a discrepancy exists other than due to normal variability.

Conclusions

Cortical stimulation data from this bilingual pediatric patient showed distinct as well as overlapping sites for English and Hebrew, consistent with studies showing functional separation of languages. These data also showed distinct as well as overlapping cortical sites across and within different tasks, specifically visual naming, reading, and a bilingual read/response task. Multiuse sites for different languages and tasks were found in frontal, temporal, and parietal areas. Single-task (1 task, both languages) sites were found in frontal, temporal, postcentral, and parietal areas, whereas distinct, single-use (1 task, 1 language) sites were found in frontal, temporal, and parietal areas. Inconsistent with the data of Lucas and colleagues,[26] single-use sites in the secondary language in this study were not limited to posterior temporal or parietal areas. Further research is needed to determine if mapping and preserving essential areas for reading as well as naming in each language will improve the postoperative quality of life for the patient.

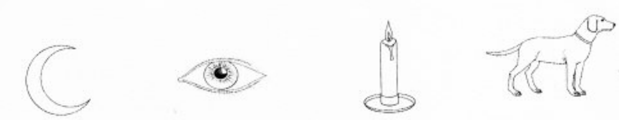
Appendix

STIMULI

Task 1 E: Visual Naming English
Task 2 H: Visual Naming Hebrew

E: Book / Heart / Mouth / Star
H: Sefer / Lev / Peh / Kochav

E: Fish / Hand / Mountain / Frog
H: Dag / Yad / Har / Tzsardaya



E: Moon / Eye / Candle / Dog
H: Yorayach / Ayin / Ner / Kelev

E: Box / Pig
H: Aron / Chazir

Task 3: Reading English with Hebrew response

1. On Pesach, we eat matzah.
2. On Rosh Hashana, we blow a shofar.
3. On Succos, we shake the lulav.
4. Before you put food in your mouth, you say a bracha.
5. Every morning you put on a white garment with strings called tzitzis.
6. On your head, you wear a yarmuka.
7. When you become Bar Mitzva, you wear tesilin.
8. When we walk through a doorpost, we kiss the mezuza.
9. The yom tov we stay up all night to learn is shavot.
10. Giving money to help a poor person is called giving tzedaka.
11. On Purim, we read the megilla.
12. On Chanukah, we light a menorah.
13. The blessing on an apple is boreh pri hoetz.
14. The blessing we say after going to the bathroom is asher yotzar.

Task 4: Reading Hebrew sentences

1. אז ישיר משה ובני ישראל את השירה הזאת לה' ויאמרו לאמר אשירה לה' כי גאה גאה סוס ורכבו רמה בים.
2. עזי וזמרת קה ויהי לי לישועה זה אלי ואנוהו אלקי אבי וארממנהו.
3. שמו 'איש מלחמה ה 'ה.
4. שלשיו טבעו בים סוףמרכבות פרעה וחילו ירה בים ומבחר.
5. תהמת יכסימו ירדו במצולת כמו אבן.
6. ימינך ה' נאדרי בכח ימינך ה' תרעץ אוי.
7. וברב גאונך תהרס קמיך תשלח חרנך יאכלמו כקש.
8. וברוח אפיך נארמו מים נצבו כמו נד נוזלים קפאו תהומות בלב ים.
9. ק חרבי תורישמו ידיאמר אויב ארדוף אשיג אחלק שלל תמלאמו נפשי ארי.
10. כסמו ים צללו כעופרת במים אדיריםנשפת ברוחך.
11. אשרי יושבי ביתך עוד יהללוך סלה.
12. אשרי העם שככה לו אשרי העם שה' אלוקיו.
13. תהלה לדוד ארוממך אלקי המלך ואברכה שמך לעולם ועד.
14. בכל יום אברכך ואהללה שמך לעולם ועד.
15. אד ולגדלתך אין חקר.גדול ה' ומהלל מ.
16. דור לדור ישבח מעשיך וגבורותיך יגידו.
17. הדר כבוד הודך ודברי נפלאותיך אשיחה.
18. ועזוז נוראותיך יאמרו וגדולתך אספרנה.
19. זכר רב טובך יביעו וצדקתך ירננו.
20. חנון ורחום ה' ארך אפים וגדל חסד.

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