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ANOMALOUS LATERAL DOMINANCE PATTERNS IN WOMEN WITH EATING DISORDERS: CLUES TO NEUROBIOLOGICAL BASES

ZOHAR EVIATAR

Institute of Information Processing and Decision Making
Haifa University, Israel
and
Psychology Department
Haifa University, Israel

YAEL LATZER

School of Social Work
Haifa University
and
Eating Disorders Clinic, Psychiatric Division, RAMBAM
Medical Center, Haifa, Israel

POLINA VICKSMAN

Psychology Department
Haifa University, Israel

Objectives: We tested the hypothesis that there is differential hemispheric functioning in women with eating disorders as compared to controls. **Method**: A divided visual field paradigm, with a language task [for which we assume left hemisphere (LH) specialization] and a spatial task [for which we assume right hemisphere (RH) specialization]. The participants were 20 healthy women, 17 women with anorexia nervosa (AN), and 18 women with bulimia nervosa (BN). **Results**: The groups did not differ in accuracy. The latency of responses

Address correspondence to Zohar Eviatar, Institute for Information Processing and Decision Making, And the Psychology Department, Haifa University, Mount Carmel Haifa, 31905 Israel. E-mail: zohare@research.haifa.ac.il

revealed different asymmetry patterns among the groups. The AN group was indistinguishable from the control group in the spatial task, and showed no evidence of LH specialization for the language task. The BN group revealed evidence for LH specialization in the language task, but no specialization in the spatial task. **Discussion**: Our results converge with other reports of asymmetric functional deficits in AN and BN, and support the hypothesis that AN involves specific LH dysfunction and BN involves specific RH dysfunction.

Keywords Hemispheric functioning, anorexia nervosa, bulimia nervosa, neurocognitive functioning, lateral dominance

INTRODUCTION

Eating disorders (ED) are common, demanding, and in many cases life-threatening diseases, which can be differentiated as anorexia nervosa (AN), bulimia nervosa (BN), and other related disorders (atypical ED or ED not otherwise specified (EDNOS)) (APA, 1994). AN and BN are characterized by attempts to control body weight, and evidence of semi-starvation is common to both disorders (Laesle et al., 1996). The etiology of eating disorders is still unclear. Polivy and Herman (2002) review a large amount of evidence suggesting that many kinds of factors may be involved, including sociocultural factors, family patterns, and psychological and physiological factors. Within the course of the diseases several changes in brain structure and function can be observed, but it is still unclear, whether this is due to a genetic predisposition, secondary to low body weight and starvation, or an interaction of both these factors.

Since the 1970s, associations between eating disorders and dysfunction of the central nervous system have been explored. The hypothesis that brain deficits in ED are related to lateralization anomalies has had a varied history. In general, behavioral studies using neuropsychological tests have reported equivocal findings in terms of differences between ED patients and control participants (Braun & Chouinard, 1992). Imaging studies, both structural and functional, have suggested a complex picture: Structural studies of AN indicate general brain atrophy, often identified as cerebral spinal fluid (CSF) spaces enlargement (Heinz et al., 1977; Kohlmeyer et al., 1983; Swayze et al., 1996), reduction in size of the pituitary gland (Doraiswamy et al., 1991; Kornreich et al., 1991), cerebellar atrophy (Addolorato et al., 1997), and subcortical hyperintense changes on T2 MRI images (Sieg et al., 1997), which only in part are reversible after weight restoration. Functional studies of AN (Frank et al., 2004), have suggested the involvement of every lobe of the cortex, with some studies finding differences between AN patients and controls mostly in the left hemisphere (LH) (e.g., Addolorato et al., 1997; Chowdhury et al., 2003), some in the right hemisphere (RH) (Miller et al., 2004), many revealing bilateral differences (e.g., Takano et al., 2001), and some showing interesting thalamic involvements (Dusior et al., 2005).

Structural studies of BN report cerebral atrophy and enlarged ventricles with loss of brain tissue water, potentially attributable to changes in vascular permeability secondary to release of vasopressin (Frank et al., 2000; Nishita et al., 1989). Functional studies in BN revealed increased cortical activity in BN patients before eating, especially in the left bilateral inferior frontal regions (Nozoe et al., 1995). Hirano et al. (1999) reported changes in CBF (cerebral blood flow) between binge eating and anorectic phases in BN, where global CBF during binge eating was higher than that during anorexia. In the anorectic state, the CBF in the temporal, parietal, and occipital lobes on the right side was lower than that on the left side. In the binge-eating state, a lack of laterality between the right and left cerebral hemispheres was found. This suggests differences in cerebral activity between the two phases, and that the asymmetry is related to the presence or absence of binge eating. Hagman et al. (1990) found that control subjects have higher metabolism (rCMRGlu) in the RH than in the LH, but that patients with BN have lost this normal right activation in some areas, whereas basal ganglia activity was maintained. This is in contrast to patients with depression, who retained normal right activation but had decreased rCMRGlu in the basal ganglia. Comparing PET scans of eight bulimics and eight controls, Wu et al. (1990) found that metabolic rate during the performance of a visual vigilance task was higher in the RH for controls, but not for bulimics. This suggests that bulimics fail to show the normal asymmetrical metabolic rate associated with vigilance, but they do not demonstrate changes in metabolism in basal ganglia associated with depression. The results indicate differential involvement of neuronal circuits associated with AN, BN, and depression. More specifically, they suggest differential hemispheric dysfunction in ED as compared to controls.

Thus, the hypothesis that ED involves anomalous hemispheric organization receives mixed support from studies using neuropsychological tests and from neuroimaging studies. However, two studies that have directly examined hemispheric functioning have reported somewhat tantalizing findings: In a comprehensive study that examined neuropsychological functions in AN adolescent women before and after weight gain, Bradley et al. (1997) used electrophysiological indexes (N400 and P300) to measure brain states while participants performed a verbal and a nonverbal task. The results suggest differences between AN participants and controls in both hemispheres. The latency of N400 showed a Group × Task interaction, with AN participants evincing longer latencies on the nonverbal task than on the verbal task, but not differing from the controls on the verbal task. For P300, the pattern was the opposite: latencies in the nonverbal task were the same in the two groups, but AN had significantly longer latencies in the verbal task. Thus, different aspects of the verbal and nonverbal tasks differed between the groups. Amplitude measures showed a Group × Task × Hemisphere interaction that was due to the controls showing larger amplitudes over the LH for the verbal task and larger amplitudes over the RH for the nonverbal task. The AN participants showed no significant differences between the hemispheres in either task, with the small differences they did evince going in the opposite direction. This study also reported a correlation between BMI (body mass index) and N400 amplitude in the LH for the verbal task, and between the BMI and P300 amplitude in the RH for the nonverbal task. Thus, nutritional state, lower BMI, was associated with lower LH response to the verbal task and lower RH response to the nonverbal task. In addition, the drive for thinness subscale on the EDI, and the measure of the depression, the BDI, correlated negatively with P300 amplitude over the LH for the nonverbal task—that is, higher scores in these tests were related to lower amplitudes in the hemisphere *not* specialized for the task. These results are especially interesting in the context of a network view of brain functioning. That is, even though they do not show an overall asymmetry, women with more severe symptoms evinced lower indexes of LH involvement in the nonverbal task, suggesting different functional architecture in the AN women than in the controls.

Smeets and Kosslyn (2001) explored the laterality of the distorted body image in AN women. They used a divided visual field paradigm in which AN women and thin healthy controls judged the fatness of distorted photographs of their own and of an actress's body. The dependent measure was the proportion on distorted images that the women judged as equal to their own body. The control participants had a bias (approximately 60%) to judge thinner stimuli as equal to their body representation, and showed the same bias to stimuli presented in both visual fields. The AN women showed a different pattern: to stimuli presented directly to the RH [in the left visual field (LVF)], they showed no bias, e.g., their errors were evenly distributed between fatter and thinner distortions of their own body. However, when stimuli were presented in the right visual field (RVF) (directly to the LH), they showed the opposite bias than the controls: approximately 70% of their errors were toward judging fatter distortions as equal to their own body. These errors were faster than the same errors in the LVF. Interestingly, this pattern was shown by women who had had AN in the past, and were in remission, the participants who were in the active stage of the disease showed this biased error pattern in both visual fields.

Both of these studies examined women only with AN. The study reported below examined performance asymmetries in a divided visual field paradigm in patients with both AN and BN. The nosology of eating disorders is in the process of being clarified (e.g., Williamson et al., 2005). One current issue is the question of whether AN and BN are different manifestations of the same underlying disorder, or they are distinct diagnostic categories. Individuals often cross over between AN and BN, and many personality characteristics are shared by patients with these diagnoses, however others are not. Anomalies of serotonin receptors have been reported in both disorders (Kaye et al., 2005), but recent multicenter genome-wide linkage analyses demonstrate links to different chromosomes for the two disorders (AN-susceptibility locus on chromosome 1p for the restricting subtype of AN (Bergen et al., 2003), and a link with chromosome 10 for bulimia with self-induced vomiting (Bulik et al., 2003)).

A variety of paradigms have suggested that cortical activation levels across the cerebral hemispheres may differ in patients with ED than in controls. We tested the hypothesis that these functional differences reflect differences in unilateral hemispheric functioning, and explored the differences in asymmetry patterns between women with AN and women with BN. In order to do this directly, we conducted a straightforward test of hemispheric function, by using two tasks that have been shown to result in predicted and interpretable performance asymmetries: a lexical decision task that reflects LH specialization for language, and a bar graphs task that reflects RH specialization for spatial processing (Boles, 1986; Eviatar, 1997).

The RH Task: The participants were required to make odd/even judgments on bar graph stimuli presented tachistoscopically in the peripheral visual fields (Boles, 1986). Bilateral displays with a central arrow indicating the visual field to which the subjects were to respond were used, as Boles (1990) has shown that this type of display results in larger visual field differences. Eviatar (1997) presented a meta-analysis of this task, and showed that all of the experiments revealed a left performance asymmetry suggesting an advantage for RH processing in this task (a left visual field advantage, LVFA). She also reported that Hebrew and Arabic speakers reveal an equivalent asymmetry to English speakers.

The LH Task: We used a lateralized bilateral lexical decision task. Lexical decision, in which participants are presented with strings of letters and have to decide if the string is a word or not have consistently revealed a performance asymmetry suggesting LH specialization for this linguistic task (a right visual field advantage, RVFA). Studies with speakers of Hebrew, Yiddish, and with vertically displayed stimuli have been used to show that the RVFA for verbal stimuli is truly a reflection of underlying hemispheric asymmetry for the tasks, not of scanning habits (see Eviatar, 1995 for review and discussion).

This type of investigation, with a focus on eating disorders, has not been undertaken before, to the best of our knowledge. Given that one of the characteristics of psychopathology in general is anomalous hemispheric patterns of activation, this information can be helpful to our attempts to understand the factors involved in the nosology and etiology of these diseases.

METHOD

Participants

The participants were three groups of women between the ages of 19 and 32: a group of 17 female patients suffering from AN (mean BMI = 18.46, SD = 1.96) and a group of 18 female patients suffering from BN (mean BMI = 23.71, SD = 4.75), who were in treatment at the outpatient Eating Disorders Clinic at the RAMBAM Medical Center in Haifa. The control group consisted of 20 undergraduates from the University of Haifa who had never been diagnosed as suffering from an eating disorder or any other psychiatric disorder (all were interviewed with the structured clinical interview for axis I DSM-IV disorders (Shalev et al., 1996)), and were chosen to match the experimental groups in age. All the participants were native Hebrew speakers, right handed, and without a previous history of neurological disorders. Participants signed an informed consent that was approved by the Hospital and Ministry of Health Helsinki committee.

Materials

Bar Graphs Task: The stimuli were six bar graphs representing whole numbers from 1 to 6. The bar graphs appeared as vertical rectangles against 3 horizontal reference lines at the 0, 4, and 8 levels. Each bar graph appeared 10 times in each visual field resulting in 120 experimental trials. The bar graphs subtend 1.8×5

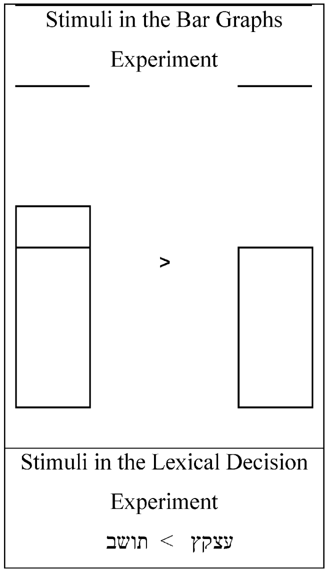

Figure 1. Stimuli in bar graphs task (top panel) and in the lexical decision task (bottom panel).

degrees of visual angle with the inner edge 2° off fixation. The center of the bar graphs was level with the fixation point. Each target bar graph was randomly paired with the others to form bilateral displays. A directional arrow appeared at fixation (< or >) and indicated to the subject which visual field contained the target stimulus on each trial, in a random sequence. Thus a stimulus display on each trial consisted of a directional arrow in the center, and two bar graphs, one in each visual field. The stimuli were composed of black lines on a gray background. An example is shown in the top panel of Figure 1.

Lexical Decision Task: The stimuli were 80 four-letter strings in unvoweled Hebrew,[1] half of which were concrete words and half pronounceable and orthographically regular psuedowords. Each target letter string appeared one time only in either the left or the right visual field and was randomly paired with one of the other strings to form bilateral displays. An arrow indicating the target was displayed simultaneously with the letter strings. The stimuli were presented with their inner edge 1.5° of visual angle offset from fixation, and subtended 2.5–3° of visual angle. Letter size was 0.5 × 0.5 degrees. The stimuli were presented as black letters on gray background. An example is shown in the lower panel of Figure 1.

Procedure

The participants were seated with their chin in a chin rest that held their eyes 57 cm from the screen. Instructions were read by the experimenter in Hebrew. Participants were shown examples of all of the stimuli and could study them for an unlimited time. In the bar graphs task the participants were asked to indicate whether the target bar graph represented an odd or even number, by pressing one of the two keys, the up arrow on the key pad to indicate ‘‘even’’ and the down arrow to indicate ‘‘odd’’. In the lexical decision task the participants were asked to indicate if the target letter string was a real word in Hebrew or not, by pressing one of two keys, the up arrow on the key pad to indicate ‘‘yes’’ and the down arrow to indicate ‘‘no’’. All responses were with the right hand. In both tasks, the participants first performed a practice set (24 trials in the bar graphs tasks and 20 trials in the lexical decision task), during which feedback was given about the correctness of the response (happy or sad face at fixation point). No feedback was given during the experimental trials. The participants were asked to respond as quickly and as accurately as possible. The sequence of events on each trial was as follows: The fixation cross was presented alone for 1 s, the screen was blank for another 100 ms, and immediately the stimuli were presented for 100 ms. The subject was given 3 s to respond, and the next trial began after 1 s. In the bar graphs task the 120 experimental trials were presented in four blocks of 30. In the lexical decision task the 80 trials were presented in two blocks of 40. Between the blocks the participants were allowed to rest. The length of these breaks was not controlled.

RESULTS

In both experiments the dependent factors were the percent errors and the median response times of correct responses in each condition. These data were analyzed using a mixed GLM procedure for unequal groups with Group (AN, BN, and controls) as a between-groups factor, and visual field as a within-groups factor. In the lexical decision task, lexicality (words vs. nonwords) was also a within-groups factor. The data are presented separately for each task, and then a combined analysis is presented.

Bar Graphs Task: In order to check for speed–accuracy tradeoffs, we computed the correlation between percent errors and median RT (respone time) for each group, in each visual field. None of these analyses resulted in a negative correlation, which would indicate a speed–accuracy tradeoff.

The analysis of the error scores revealed only a main effect of visual field, $F(1,52) = 6.77$, $p < .05$, with less errors in the LVF (7.59%) than in the RVF (8.53%). No other effects were significant.

Analysis of the RT data revealed a significant main effect of Group, $F(2,52) = 4.44$, $p < .05$, with the control group and the AN group not differing from each other (1075 ms vs. 1159 ms), and both responding significantly faster than the BN group (1372 ms, BN vs. controls: $F(1,52) = 8.49$, $p < .01$; BN vs. AN: $F(1,52) = 4.06$, $p < .05$). The Group by visual field interaction was also significant in the RT data, $F(2,52) = 6.67$, $p < .006$. Planned comparisons revealed that the simple main effect of visual field was significant for the AN ($F(1,16) = 16.81$, $p < .0001$;) and the control ($F(1,19) = 12.38$, $p < .001$) groups, but not for the BN group ($p > .1$,). These cell means are illustrated in Figure 2, and reveal that the AN and control groups evinced the expected advantage for stimuli presented in the LVF, and did not differ from each other. The BN group did not show this pattern, and actually responded somewhat faster in the RVF than in the LVF, although this difference was not significant. It can also be seen that the variance in the BN group was larger than in the other two groups.

Leaxical Decision Task: In order to check for speed–accuracy tradeoffs, we computed the correlation between percent errors and median RT for each group, in each visual field. None of these analyses resulted in a negative correlation, which would indicate a speed–accuracy tradeoff.

The errors and response times to words and nonwords in the two visual fields were analyzed with a GLM procedure. The analysis of error scores revealed an interaction of lexicality with visual field, $F(1,52) = 35.06$, $p < .0001$, showing the canonical pattern of a larger RVFA for words (25.04% in the LVF vs. 8.36% in the RVF) than for nonwords (19.82% in the LVF vs. 16.09% in the RVF). There was also a significant main effect of visual field, $F(1,52) = 37.30$, $p < .0001$, with more errors in the LVF (22.43%) than in the RVF (23.23%). No other effects were significant.

In the median RT scores the analysis revealed, as in the bar graphs task, a main effect of Group $F(2,52) = 5.64$, $p < .01$; however, the pattern here was different than in the bar graphs task, with responses of the AN and BN groups not differing from each other (1371 ms vs. 1377 ms), and both responding more slowly than the control group (1081 ms, AN vs. controls: $F(1,52) = 7.89$, $p < .01$; BN vs. controls: $F(1,52) = 8.70$, $p < .005$). The main effect of visual field was significant ($F(1,52) = 5.32$, $p < .05$), with faster (1237 ms) performance in the RVF than in the LVF (1297 ms). The main effect of lexicality (words vs.

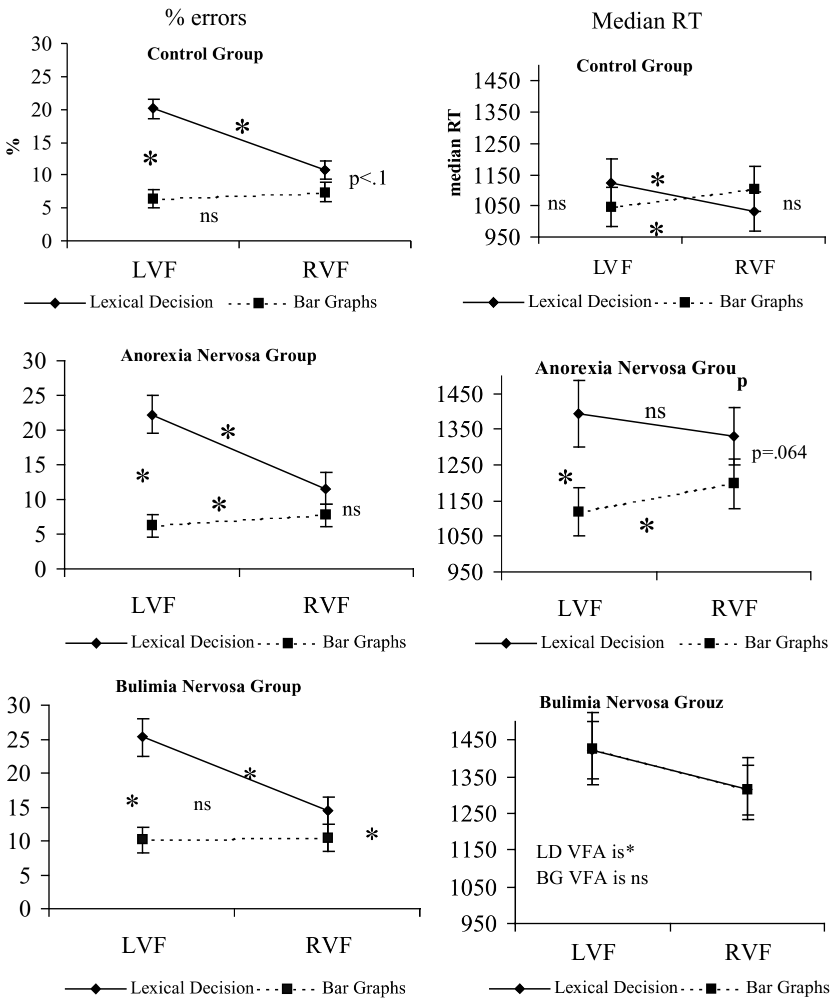

Figure 2. Accuracy and Median RT of each participants group in the two tasks (LVF, left visual field; RVF, right visual field; *, $p \leq .05$.)

nonwords) was significant, $F(1,52) = 59.93$, with responses to words (1167 ms) faster than responses to nonwords (1366 ms).

Combined Analyses: Given that lexicality did not interact with Group, we recomputed the error and RT scores in the lexical decision task without this factor, and performed an analysis with Task as an additional within-groups factor. This analysis yielded the effects presented in Table 1.

Table 1. Significant effects in percent errors and median RT in the GLM procedure with Group as a between-groups factor, and Task and visual field as within-groups factors

Effect	% errors	Median RT
Group	$F(2,52) = 2.56, p = .086$	$F(2,52) = 5.92, p < .005$
Task	$F(1,52) = 69.42,$ $p < .0001$	ns
Visual field	$F(1,52) = 27.83,$ $p < .0001$	$F(1,52) = 4.96, p < .05$
Task × Group	ns	ns
Visual field × Group	ns	$F(2,52) = 3.56, p < .05$
Visual field × Task	$F(1,52) = 44.95,$ $p < .0001$	$F(1,52) = 7.94, p < .01$
Visual field × Task × Group	ns	ns

Most importantly, we see an interaction between Group and visual field in RT but not in errors and an interaction of Task with visual field in both measures. The cell means contributing to these effects are illustrated in Figure 2. As can be seen in the first column of the figure, the groups reveal similar patterns in error scores, revealing a strong and significant RVFA for the lexical decision task, and a small, and mostly insignificant LVFA for the bar graphs task. However, it can be seen that in RT, the three groups show very different patterns. The control group shows the expected cross-over interaction, revealing a significant RVFA for the lexical decision task and a significant LVFA for the bar graphs task, $F(1,19) = 8.81$, $p < .01$. The Task × visual field interaction was also significant for the AN group, $F(1,16) = 8.13$, $p < .01$, but they show a different pattern, in which they are similar to the controls in the bar graphs task, but reveal no RVFA in the lexical decision task. In fact, in the RVF, their RT for the bar graphs task is faster than their RT for the lexical decision task. This is remarkable because the modal LH is purported to be specialized for language, not for spatial tasks. The BN group revealed yet a third pattern: They show only a main effect of visual field, $F(1,17) = 6.22$, $p < .05$, revealing the expected RVFA for the lexical decision task, but no performance asymmetry for the bar graphs task, and in fact, their pattern is opposite to the one that is shown by the other two groups, with slightly faster responses in the RVF than in the LVF.

In order to examine more closely the differential hemispheric effects, we performed planned comparisons on the median response times of the three groups for each task in each visual field separately. Figure 3 shows these comparisons. In the bar graphs task, we see different effects of Group in the two visual fields: In the LVF, the response times of the AN group (1120 ms) is not significantly different from the response times of the control group (1046 ms), whereas the response times of the BN group (1427 ms) is significantly slower than both of the other groups (BN vs. AN, $F(1,52) = 7.59$, $p < .01$; BN versus controls, $F(1,52) = 12.63$, $p < .0001$). In the RVF, the AN group (1198 ms) does not differ significantly from either the control group (1104 ms) or the BN group (1317). However, again, the BN group differs significantly from the control group, $F(1,52) = 4.2$, $p < .05$. Thus, the response times of the AN group in both visual fields were not significantly different from that of the control group, and the response times of the BN group in both visual fields were significantly slower than that of the control group.

In the lexical decision task we see a different pattern. In both visual fields, the two pathological groups responded more slowly than the control group, and did not differ significantly from each other. In the LVF, AN (1390 ms) versus controls (1129 ms), $F(1,52) = 4.8$, $p < .05$; BN (1398 ms) versus controls, $F(1,52) = 5.49$, $p < .05$. In the RVF, AN (1351 ms) versus controls (1032 ms), $F(1,52) = 10.95$, $p < .005$; BN (1357 ms) versus controls, $F(1,52) = 11.66$, $p < .005$. Thus, in this task, the participants with ED responded more slowly than the control groups in both visual fields, and did not differ from each other.

DISCUSSION

The results of this study are surprisingly clear: The control group revealed the expected performance asymmetries in both tasks: a significant RVFA for the language task and a significant LVFA for the bar graphs task. As shown diagrammatically in Figure 3, in general, the spatial task revealed different patterns in the three experimental groups, whereas the language task distinguished between the participants with ED and the controls. All our participants with ED were slower than the controls in the language task, and the BN participants were also slower in the spatial task. If we take asymmetry patterns into account, the picture becomes more interesting. The AN group was indistinguishable from the control group on the spatial task, but very different on the language task. Although they were not less accurate, their responses were much slower, and showed no advantage for the stimuli presented to the RVF, that is, directly to the LH. The BN group was significantly slower than the control group in both tasks, but showed a right visual field advantage in the

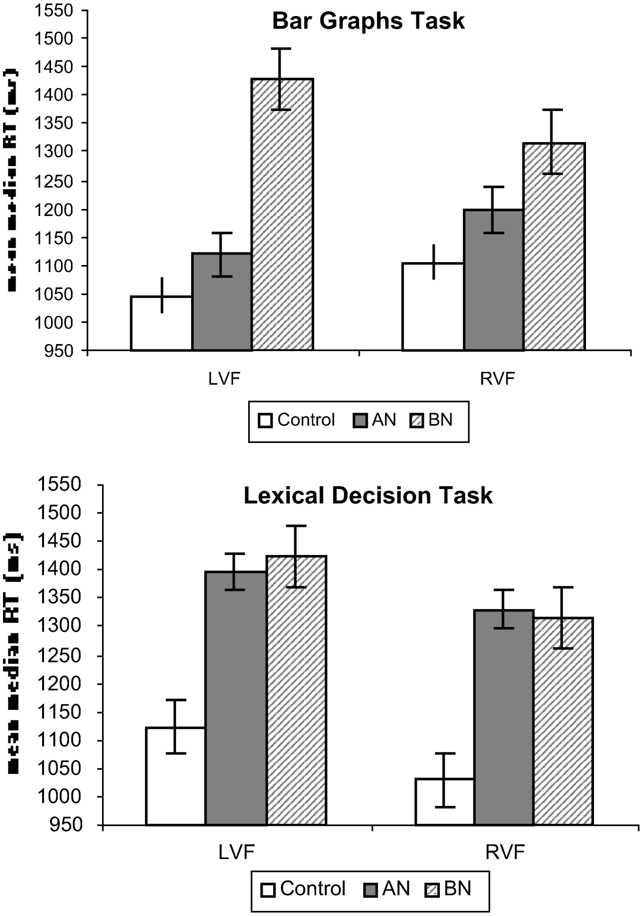

Figure 3. Mean median RTs for each experimental group in the two visual fields. Note that the AN group patterns with the control group in the bar graphs task, and with the BN group in the lexical decision task.

language task, and no visual field advantage in the spatial task. That is, they did not show RH specialization for the spatial task.

These patterns were apparent in the response time data. It is important to note that the three groups did not differ in the error data. All three groups revealed the expected LH specialization for the lexical decision task in errors, and a trend (significant in the case of the AN group) in the opposite direction for the bar graphs. In our view, this equivalence in accuracy emphasizes the possible importance of the differences in response times between the groups. It may be the case that this dissociation between accuracy and latency of responses is relevant to the inconsistency of results in neuropsychological testing of these populations. That is, our patients did not differ from the controls in the level of responses that was indexed by accuracy scores, but did differ from the controls in latency, that indexes the processes involved in performance of the tasks. Thus, our patients performed as well as the controls in terms of accuracy, but may have used different neuropsychological mechanisms to achieve this performance level. Figure 2 shows that women with AN do not show a significant RVFA for the language task, but do show a significant LVFA for the spatial task. That is, in the task for which we assume dominance for the LH (the language task), they do not show an advantage for response times in the RVF. Thus, although they make fewer errors in the RVF in the language task (similarly to the control group), they do not respond more quickly in the RVF (here they are different from the control group). Most tellingly, in the task for which we assume dominance for the RH (the spatial task), they also show slower LH processing. This pattern suggests that we may be seeing a specific LH deficit in this group. Our results converge with the two studies that examined hemispheric functions mentioned in the introduction: the electrophysiological data presented by Bradley et al. (1997), where severity of symptoms correlated with lower LH indexes and the behavioral data of Smeets and Kosslyn (2001), where AN women in remission showed abnormal patterns in the RVF, not in the LVF.

The BN group shows us a different pattern. Although all of their responses are slower than those of the control group, they do show the expected RVFA in the language task. Thus, in the task for which we assume LH dominance, the participants in the BN group show the same pattern as the control group in both errors and response times. However, in the spatial task, for which we assume RH dominance, the visual field difference for this group is not significant in either errors or response times, and actually, in the latter measure, is in the opposite direction. Thus, this pattern may be interpreted as reflecting a specific RH deficit in BN.

One interesting point about the behavior of the BN patients is the fact that we do not see indication of impulsivity. That is, they were not less accurate, and in fact, responded more slowly than the other groups. Given that the impulsive behavior is one of the characteristics of the BN syndrome (Collier & Treasure, 2004) that differentiates it from the AN syndrome, it is interesting to note its absence in the context of these emotionally neutral stimuli, in both a language and a spatial task. It may be the case that impulsivity in BN is specific to emotional stimulation, rather than a general characteristic.

Limitations: We did not take depression into account, and given the higher prevalence of depression in BN patients and their relatives, and the implication of RH dysfunction in depression, it may be a confounding factor. In addition, we did not subdivide our pathological groups into subtypes according to the DSM-IV (APA, 1994). That is, within the AN group, we did not differentiate between AN-restricting type vs. AN-binge-purge type, and within the BN group, between BN-purging type vs. BN-nonpurging type. This may be crucial, as both pharmacological and clinical evidence has suggested that the bingeing behavior is the discriminating factor (Polivy & Herman, 2002). Thus, it may be that AN-binge-purge type will be more similar to the BN patients. On the other hand, it has also been suggested that restricting behavior may be the discriminating factor, and in that case, AN-restricting type may be similar to BN-nonpurging type, who binge, and compensate with restrained eating rather than with purging.

We are now in the process of using these tasks, together with lateralized versions of face identification and an emotion identification tasks, on carefully selected groups of patients, which we will categorize according to the criteria described above. In addition, we are examining the relationship of comorbidity factors such as anxiety, depression, obsessive–compulsive disorders, alexithymia, and impulse control with performance asymmetries in these divided visual field paradigms.

NOTES

1. Hebrew orthography is a consonantal alphabet, with vowels signified by diacritics above and below the letters. Vowels are used only in children's books, liturgical texts, and poetry. All other materials are unvoweled.

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