

# Alexithymia, Interhemispheric Transfer, and Right Hemispheric Specialization: A Critical Review

Golnaz Tabibnia Eran Zaidel

Department of Psychology, University of California, Los Angeles, Calif., USA

© Free Author  
Copy - for per-  
sonal use only

ANY DISTRIBUTION OF THIS  
ARTICLE WITHOUT WRITTEN  
CONSENT FROM S. KARGER  
AG, BASEL IS A VIOLATION  
OF THE COPYRIGHT.

Written permission to distri-  
bute the PDF will be granted  
against payment of a per-  
mission fee, which is based  
on the number of accesses  
required. Please contact  
permission@karger.ch

## Key Words

Alexithymia · Interhemispheric transfer · Hemispheric specialization · Corpus callosum · Laterality · Affect

## Abstract

**Background:** One neural model of alexithymia relates the condition to poor interhemispheric transfer, while another model associates it with a disturbance in right hemisphere activity. **Methods:** The available empirical evidence directly relating alexithymia to a deficit in interhemispheric transfer and/or in right hemisphere activity is critically reviewed. **Results:** The interhemispheric transfer studies have related alexithymia to a deficit in transfer, but the nature and directionality of the transfer deficit have yet to be determined. Many of the hemispheric specialization studies do not relate alexithymia to a right hemisphere dysfunction. Shortcomings of these studies are reviewed. **Conclusions:** The hypothesis that alexithymia is related to a deficit in the right-to-left transfer of emotional information and to a right hemisphere impairment in emotion processing remains to be tested directly and definitively. Suggestions for future research are made.

Copyright © 2005 S. Karger AG, Basel

The term ‘alexithymia’, meaning ‘no words for feelings’, was first published in *Psychotherapy and Psychosomatics* 30 years ago by Sifneos [1] to refer to the condition in which a person has difficulty identifying and describing his or her feelings. Other core characteristics are paucity of fantasy and tendency toward action-oriented or ‘operational’ thinking [2]. The condition of alexithymia is of particular interest to clinicians because of its possible neurological basis and its high prevalence in patients with certain medical illnesses, including hypertension (a classic psychosomatic disease), functional gastrointestinal disorders, substance use disorders, and some anxiety disorders [3]. Identification of reliable neural correlates of alexithymia could not only aid the diagnostic process but could also influence treatment of these associated disorders. The neurophysiological basis of alexithymia is still unknown, but one model relates the condition to a poor transfer of emotional information from where it purportedly originates in the right hemisphere (RH) to the language areas of the left hemisphere (LH) [4]. Another model suggests that alexithymia is associated with a disturbance in RH functioning, presumably in the processing of emotions [5, 6].

While it is well-established that speech production is a ‘LH task’ in most people, the lateralization of emotion

## KARGER

Fax +41 61 306 12 34  
E-Mail karger@karger.ch  
www.karger.com

© 2005 S. Karger AG, Basel

Accessible online at:  
www.karger.com/ppa

Eran Zaidel  
University of California, Psychology Department, 1285 Franz Hall  
PO Box 951563  
Los Angeles, CA 90095-1563 (USA)  
Tel. +1 310 825 4343, Fax +1 310 206 3655, E-Mail ezaidel@psych.ucla.edu

processing is less clear [7]. However, there seems to be a general trend in support of a right hemisphere advantage (RHA) for emotion perception [8], particularly for negative emotions [9]. Given the LH advantage for speech production and the RHA for the processing of affective information, it seems plausible to expect that an efficient connection between the two hemispheres [i.e., a healthy corpus callosum (CC)] is necessary for the ability to talk about feelings. Similarly, a breakdown in the ability of the RH to process emotions should also lead to problems in emotional speech.

According to the interhemispheric deficit model, emotionally laden material becomes cut off from the verbally expressive LH, and is instead expressed only via RH-controlled physiological channels, such as corticotropic and autonomic effectors. Thus, anxiety and negative emotions find outlet in bodily symptoms, one of the main characteristics of alexithymia [2, 10]. Similarly, the RH deficit model suggests a dysfunction in the RH-dominated control of these stress-related responses. Additionally, the unique role of RH in the control of oxytocin-mediated affiliative behavior [11] and the enduring detrimental effects of early relational trauma on RH function [12] may further explain the clinical presentations of alexithymia. Indeed, avoiding close interpersonal relationships has been rated as 'extremely characteristic' of alexithymia by expert raters [10]. Given the well-known protective effect of social support against illness [13], the putative failure of the RH to form social bonds may contribute to the medical conditions that are comorbid with alexithymia. Thus, the hemispheric models of alexithymia may explain the clinical nature of alexithymia in terms of abnormal RH control of the stress response and affiliative behavior, leading to or exacerbating various medical conditions. However, it should be noted that deficits in interhemispheric communication or in one hemisphere alone may not be the sole neural explanation of alexithymia. Another plausible model, relating alexithymia to anterior cingulate dysfunction and therefore to a functional disconnection between neocortical and limbic regions, has also been postulated by Lane et al. [14]. The current paper focuses on the hemispheric models.

The aim of this paper was twofold: (1) suggesting a new and comprehensive behavioral approach for investigating the role of RH and callosal dysfunction in alexithymia, and (2) using that approach to review and critique empirical studies that directly test these two neurophysiological models of alexithymia.

## A Novel Approach

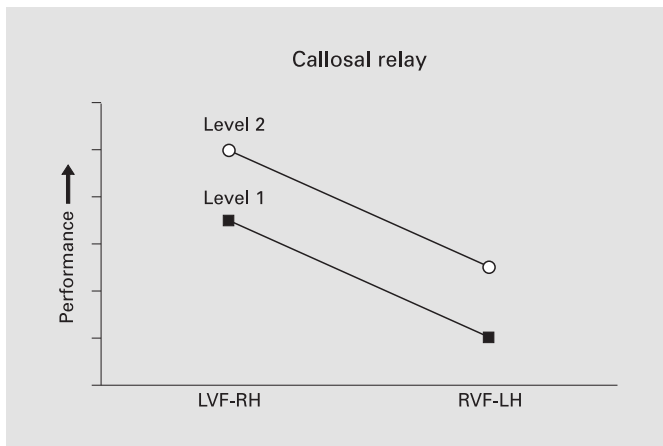
To date, empirical evidence that directly associates alexithymia with poor RH processing and/or with poor interhemispheric transfer of emotional information has been scarce. What few studies exist have various methodological shortcomings, including weak measures of hemispheric specialization and of callosal function.

### *Relative vs. Exclusive Hemispheric Specialization*

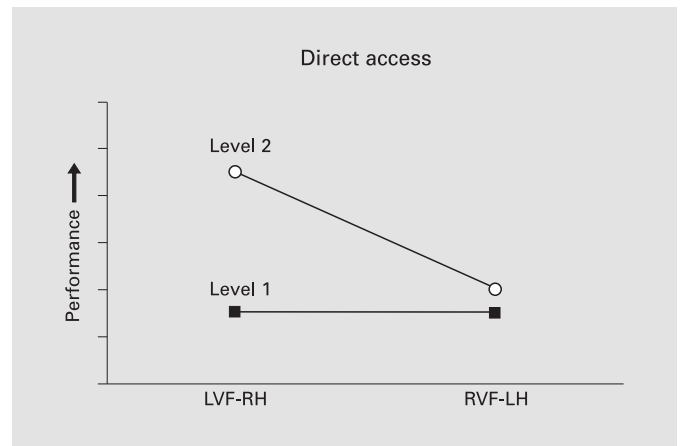
Behavioral laterality tests often fail to distinguish between relative and exclusive specialization. In the case of exclusive specialization, only one hemisphere can accomplish the task. In these situations, also referred to as 'callosal relay', if the information reaches the incompetent hemisphere, it will have to be relayed through the CC to the specialized hemisphere to be processed. In relative specialization, on the other hand, both hemispheres can accomplish the task, but one may be better or faster, or the two hemispheres may use different strategies. In these situations, also referred to as 'direct access', information can be processed by either hemisphere independently and immediately, without callosal transfer [15–17].

The distinction between relative and exclusive specialization is particularly important in alexithymia. Assuming a general callosal dysfunction in alexithymia, different predictions would follow depending on the type of specialization. If emotion perception is exclusively specialized in the RH (callosal relay), then we may expect *stronger* laterality for it in alexithymic individuals than in controls. This is because if emotional stimuli enter the LH of an alexithymic [e.g., when an emotional face is presented to the right visual field (RVF)], they would be processed poorly or not at all because the LH cannot do the task and because of the defective relay from the LH to the competent RH. This prediction would be true unless the alexithymic individuals have RH dysfunction above and beyond the callosal dysfunction, such that the RH is rendered almost as incompetent as the LH; in this case, very low performance scores would be expected in both visual fields (VFs) on emotion perception. If, on the other hand, emotion perception is not exclusively specialized in the RH and is processed in a direct access fashion, then the efficacy of callosal function should not affect laterality, because in both groups, each hemisphere would be capable of doing the task independently of the other.

In sum, whether emotion perception is callosal relay or direct access, callosal dysfunction alone would not lead to the purported RH incompetence in alexithymia. In fact, if emotion perception is callosal relay, then the CC dysfunc-



**Fig. 1.** Example of the absence of a VF × Y interaction in a callosal relay task.



**Fig. 2.** Example of a VF × Y interaction in a direct access task.

tion would predict an *increased* RHA. Thus, observing both an RH deficit and a transfer deficit in alexithymia would suggest that the two deficits are independent. For example, the transfer problem may be in that of processed and abstract emotional information, while the lowered RH competence may be in earlier sensory perception. To help elucidate the relationship between callosal transfer and RH competence in alexithymia, the same experimental paradigms should ideally measure both laterality and transfer at different processing stages (e.g. higher abstract vs. lower sensory) and should distinguish between relative and exclusive specialization.

#### *Tools to Distinguish between Relative and Exclusive Specialization*

A set of behavioral measures has been developed to determine the level of specialization of a given task in normal subjects. For simplicity's sake, this paper will consider only the two limit cases of exclusive specialization (callosal relay) and relative specialization without transfer (direct access). However, undoubtedly many specialized tasks may involve cooperation between the two hemispheres such that they will fit neither the direct access nor the callosal relay model completely. (For a more detailed discussion, see Zaidel [15, 18], and Zaidel et al. [17].)

A procedure for determining the type of specialization involves an analysis of the interaction between hemifield of presentation (i.e., VF) and another experimental parameter, Y (e.g. emotional valence of the stimulus), say with two levels, 1 and 2. In our discussion, let us suppose that the task is a two-choice decision paradigm, involves hemifield tachistoscopic presentations and unimanual re-

sponses, emphasizes both accuracy and reaction time, and shows a left visual field advantage (LVFA). If the task is exclusively specialized, there will be an LVFA and the difference in performance between level 1 and level 2 will be the same in the two VFs (fig. 1), suggesting that the stimuli are processed in the same manner whether presented to the RVF or LVF, and, hence, possibly processed by the same neural structures. If, on the other hand, the VF × Y interaction is significant, the task must be direct access because each VF processes the stimuli differently (fig. 2). An illustration of the application of these procedures and a demonstration that cognitive tasks fitting the callosal relay or direct access models do exist have been presented elsewhere [15, 19].

#### *Direction of Callosal Transfer*

As with the RH model of alexithymia, the literature supporting the transfer model tends to lack specificity on the nature of the callosal dysfunction. This is because the bulk of the evidence comes from neuropsychological studies of callosotomy patients, rather than from behavioral studies of subjects without neurological insult. The neuropsychological studies simply report higher alexithymia scores in patients who have a surgically severed CC, or split-brain patients, compared to other populations [20]. Based on these studies, we cannot conclude that the problem in alexithymia is simply in the right-to-left transfer of processed emotion information.

If the underlying problem is in the right-to-left transfer of processed or abstract emotional information, then we would expect the alexithymic to have difficulty with tasks that require bifield comparison of emotions expressed

through facial expressions or through photographs of emotional scenes. If the problem is in the back-and-forth transfer of initial and less processed information, then bi-field comparison of less complex or less abstract stimuli should also prove difficult for the alexithymic. Therefore, both complex emotional and simple sensory stimuli should be used to elucidate the nature of the transfer problem, and transfer should be analyzed in both directions. Note that under the exclusive RH specialization hypothesis for emotion processing, a deficit in LH-to-RH sensory transfer would result in an increased LVFA, whereas a deficit in RH-to-LH transfer of cognitive information would not affect the LVFA. To date, only one behavioral transfer study of alexithymia has used affect-laden stimuli [21], while most have used simple sensory material.

#### *Tool to Infer Direction of Transfer*

For determination of the specific direction of transfer, an interhemispheric priming paradigm similar to the lateralized lexical decision task [19] may be utilized. In this paradigm, subjects have to determine whether an underlined letter string in one VF is a word or nonword, while ignoring a distractor letter string in the other VF. It has been shown that the lexicality (wordness) of the distractor affects the decision of the target. Performance improves if target and distractor are both words compared to if one is a word and one a nonword, particularly targets in the LVF [19]. In order for priming to occur, the information from one hemisphere must cross the CC and reach the other hemisphere [22]. If the task is direct access, we may assume that the hemisphere that initially receives the input does most of the processing; therefore, the hemisphere that receives the distractor is most likely the one that relays the information across [18, 22]. Thus, when RVF distractors prime LVF targets, the interhemispheric transfer is most likely left-to-right. Conversely, when LVF distractors prime RVF targets, the callosal transfer is right-to-left. The emotion version of this lexicality priming task could involve photos of facial expressions instead of letter strings, and the task could be to determine whether or not the boxed face in one VF is expressing a negative emotion, while ignoring a distractor face in the other VF.

Of course, the example above involves implicit priming of an emotionality judgment by an emotional distractor in the other hemisphere. It is possible that alexithymia involves a deficit in explicit, rather than implicit, transfer of emotional information. This could be tested in a task requiring matching emotional stimuli between hemispheres.

In what follows, we provide a critical review, from the perspective of the preceding analysis, of the extant empirical reports on the two hemispheric models of alexithymia. Each study is reviewed separately.

### **Patient Studies of the Transfer Model**

A series of studies by Hoppe and Bogen [20] and TenHouten et al. [23–27] has shown that callosotomy patients score highly on alexithymia schedules. The first of these investigations was conducted by Hoppe and Bogen [20], who studied 12 patients with complete commissurotomy. These patients had their CC, hippocampal commissure, and anterior commissure surgically disconnected in order to control intractable epilepsy. All except 1 of the patients were right-handed. To measure alexithymia, Hoppe and Bogen independently rated each patient using the Beth Israel Psychosomatic Questionnaire (BIQ). The BIQ is an observer-rated questionnaire containing 8 items that measure Sifneos' [1] construct of alexithymia. Results indicated that the 12 commissurotomy patients had higher mean alexithymia scores than the psychosomatic patients in the Sifneos study.

The study by Hoppe and Bogen was seminal in that it pioneered scientific inquiry into the relation between alexithymia and interhemispheric connection. Nonetheless, some limitations of the study must be kept in mind. Most prominent is the lack of preoperative data, as well as the lack of a true control group or normative data against which to compare the alexithymia scores of the commissurotomy patients. Furthermore, although the BIQ was the most commonly used measure of alexithymia at the time, its use as such a measure was flawed. Of the 8 items in the questionnaire, only 5 yielded concordance in rating. Indeed, the original BIQ seems to have fallen out of favor since the development of the self-report Toronto Alexithymia Scale (TAS), which has shown high internal consistency, good test-retest reliability, and both construct and criterion validity [28].

Seven years after their original study in 1977, Hoppe and Bogen joined the sociologist TenHouten in further investigating alexithymia in split-brain patients. Together they published a series of papers based on experiments in which they showed a 3-min silent film about death to 8 right-handed split-brain patients. Six of these patients had complete commissurotomy, while 2 had the posterior portion of their CC (i.e., the splenium) spared. After viewing the emotional film, each subject was asked to (1) verbally express his or her general impression of the film; (2) write

4 sentences about the film; (3) answer a series of questions about the symbols in the film, and (4) verbally express his or her feelings about the film. Subjects' verbal and written responses were transcribed, and content analysis was performed on the transcriptions.

The results of the content analysis were published in the first three papers of the series [23–25]. The emotional content of the subjects' responses was coded on three different levels – lexical, sentential, and global – and factor analysis was used to derive indices of alexithymia. Using subjective ratings and relatively complex statistical analyses, all three studies associated commissurotomy with alexithymia. As the authors themselves point out, lack of intercoder reliability limits the conclusions that can be drawn from these studies.

TenHouten et al. [26, 27] also report results of electroencephalographic recordings that were obtained while the 8 split-brain patients and the 8 controls watched the short film. In one paper [26], interhemispheric coherence of alpha-band activity between three pairs of electrodes placed at three different homologous sites on the left and right was used as an indirect measure of interhemispheric communication. Path and covariance structure analyses related interhemispheric coherence measures to indices of alexithymia that were derived from factor analysis measures in previous studies. In the other paper [27], they used regression analysis to relate an index of alexithymia to alpha-band coherence averages. They associated alexithymia with poor interhemispheric communication, because alexithymic individuals showed no left-right coherence between homologous frontal, temporal, and parietal electrode pairs, while expressive (or nonalexithymic) individuals did between all three pairs. However, the authors also reported coherence between left parietal and right frontal electrodes in the alexithymic; this finding actually contradicts the interhemispheric transfer hypothesis of alexithymia.

In addition to split-brain patients, patients with agenesis of the CC have been reported to be alexithymic [5, 29]. In the first study, Buchanan et al. [5] report that Mr. H., a 37-year-old man born without a CC and showing normal verbal intelligence, received an alexithymic score for all 8 items of the BIQ from both physicians who rated him. Clinical observation confirmed his 'incapacity to label or differentiate affect'. Mr. H. had no past history of medical problems or cerebral malformations related to callosal agenesis. In the more recent callosal agenesis study, Ernst et al. [29] describe patient L.B., a 15-year-old woman who received a score of 71 on the TAS-20, the most recent version of the TAS [30]; this score is well above the suggested

cutoff of 61 for alexithymia. Clinical observations also confirmed her 'flat affect', 'restricted fantasy life', and an '[inability] to recall dreams'. These findings should be interpreted with caution, however, because L.B. had multiple medical problems, including spina bifida, hydrocephalus, sleep apnea, and endocrine dysfunction [29].

In a unique experiment, Habib et al. [21] related callosal size and alexithymia by scanning the brains of patients with multiple sclerosis (MS), since callosal degeneration is a prominent feature of this disease. Based on scores on the TAS and on one of their own instruments named the Parallel Visual Information Processing Test, 14 of the 20 MS patients were found to be alexithymic. Nineteen were right-handed. MRI scans of the CC indicated a negative correlation between alexithymia score and callosal area, especially the posterior region and especially with the TAS. To our knowledge, this is the only imaging study relating the size of the CC to alexithymia. Although a direct relationship between callosal size and callosal function may be questioned, Habib et al. [21] have supporting data.

In sum, the majority of the patient studies of callosal function have associated alexithymia with CC dysfunction. A potential problem with studies involving patients with a reduced or absent CC is that the conclusions may not account for cortical reorganization. More importantly, these studies may not provide information about the specific callosal channels (i.e., posterior or sensory vs. anterior or abstract information) or the directionality of transfer that may be compromised in alexithymia. In order to hypothesize about the specific callosal channels or sectors involved, we first need to determine whether the code that transfers from the RH to the LH is an 'emotional code' or a 'linguistic code'. Nonetheless, we may speculate that the anterior CC is particularly involved because of its connection to Broca's area [32]. The specific callosal channels involved in emotional expressiveness is currently best explored in behavioral paradigms.

### **Behavioral Studies of the Transfer Model**

More informative are the handful of behavioral studies with normal subjects that have related alexithymia to interhemispheric transfer [21, 33–36]. One advantage of these studies is that their design allows for laterality measures as well. Three of these studies [33–35] found a deficit in transfer of tactile information, another in transfer of nonemotional visuospatial information [36], and yet another in transfer of auditory linguistic information [21].

The laterality findings from these studies will be reviewed in a later section.

In the study by Zeitlin et al. [33], 15 Vietnam veterans with posttraumatic stress disorder (PTSD) and with alexithymia were compared to 7 veterans with PTSD but without alexithymia. There was also a control group of 10 subjects with neither PTSD nor alexithymia. All subjects were right-handed men. Alexithymia scores were obtained from the TAS. Interhemispheric transfer was measured using a finger localization task. In each trial, the experimenter lightly touched one or several of the subject's fingers sequentially. The subject's task was to indicate which fingers were touched by touching those fingers with the thumb of the same hand (uncrossed condition) or the corresponding fingers on the other hand with the other thumb (crossed condition). Interhemispheric transfer scores were recorded as the percent correct difference between the uncrossed and crossed conditions; the higher the score, the greater the transfer deficit. Multiple regression analysis indicated that transfer deficit scores were highly and positively correlated with alexithymia scores, independent of PTSD severity. Furthermore, the alexithymic PTSD subjects had higher transfer deficit scores than the nonalexithymic PTSD or the control subjects. This interhemispheric transfer deficit in the alexithymic individuals was bidirectional (left-to-right and right-to-left). These findings suggest that there may be a general transfer deficit in alexithymia. However, alexithymic subjects without concurrent psychiatric or neurological diagnoses would be better subjects.

Parker et al. [34] at Toronto replicated the findings of Zeitlin et al. [33] with a group of 29 healthy right-handed men, 14 of whom scored within the alexithymic range on the TAS-20. The alexithymic group made significantly more errors in the crossed condition than the control group. Planned comparisons showed that the transfer deficit is bidirectional. Although these findings support the transfer deficit hypothesis of alexithymia, the extent to which they can be generalized is limited. As the authors point out, since sex is related to interhemispheric connectivity and to hemispheric specialization, women should also be studied. Furthermore, as the authors point out, such transfer deficits in finger localization tasks are not unique to alexithymic individuals, but have also been found in dyslexics with low phonological ability.

A third finger localization study of alexithymia, conducted by Lumley and Sielky [35], involved 47 male and 58 female college students. Alexithymia was measured by two subscales of the TAS-20, i.e. the 'difficulty identifying feelings' and the 'difficulty describing feelings' subscales

(henceforth referred to as the identifying and describing subscales, respectively, for short), measuring the ability to identify one's own feelings and the ability to communicate them, respectively. Among the men, TAS-20 scores correlated with the 'crossing index' (percentage of errors during all crossed trials minus the percentage of errors during all uncrossed trials), relating increasing level of alexithymia with poorer interhemispheric transfer. Post hoc tests indicated that the transfer deficit is bidirectional. Among the women, alexithymia was unrelated to the crossing index. The findings of this study are consistent with the other two finger localization studies in terms of the bidirectional transfer deficit among males.

All three finger localization studies [33–35] reported bidirectional deficit in transfer of simple sensory stimuli. Thus, one possible reason we find alexithymia in people with callosal dysfunction may be that verbal emotional expression involves back-and-forth transfer of information. However, interpreting performance in a crossed hand condition as a reflection of transfer in one direction assumes a direct access model of information processing. Although the direct access model may well represent the processing of simple sensory stimuli, the nature of hemispheric specialization for emotional processes remains to be elucidated. Thus, as Parker et al. [34] mention, the literature would be well-served by transfer specialization studies using affect-laden stimuli.

To test the transfer hypothesis of alexithymia in a non-clinical population using nontactile stimuli, Dewaraja and Sasaki [36] administered a lateralized visual matching task, using words (linguistic task) and line drawings of objects (nonlinguistic task), to right-handed Japanese undergraduates. Over 700 subjects were screened with the self-report Schalling-Sifneos Personality Scale (SSPS) and the Minnesota Multiphasic Personality Inventory Alexithymia Scale. Neither scale is now regarded highly for the assessment of alexithymia, due to low reliability and validity [28]. Based on their scores on both scales, the 27 most alexithymic and the 26 least alexithymic students were chosen as subjects. In each trial, a centrally presented set of 3 words or of 3 drawings was followed by 1 lateralized word or drawing, respectively. The subjects' task was to determine whether the lateralized stimulus had appeared in the centrally presented set. Congruity of response hand with VF was used to distinguish between interhemispheric (crossed) and intrahemispheric (uncrossed) tasks. Response times in crossed conditions were used as a measure of relative callosal transfer speed. Based on some complex and somewhat nonstandard analyses, the authors reported that the right-to-left interhemispher-

ic transfer in the nonlinguistic task was slower in alexithymic individuals than controls. The right-to-left transfer in the linguistic task did not differ between the two groups. Surprisingly, the left-to-right transfer of linguistic and nonlinguistic stimuli was not different from the uncrossed processing of the same task. The authors concluded that these findings are consistent with the hypothesis that alexithymia is related to a deficit in the right-to-left transfer of complex nonlinguistic stimuli.

Several cautionary notes must be considered, however, in interpreting the results of these four studies. One criticism of such crossed-uncrossed comparisons has been that ceiling effects in the uncrossed or floor effects in the crossed conditions would diminish the possibility of detecting a difference between the two conditions [37]. Since Dewaraja and Sasaki [36] did not report their means, we cannot discount this possibility. However, the means reported by Zeitlin et al. [33], Parker et al. [34], and Lumley and Sielky [35] were approximately in the 60th, 70th, and 80th percentiles, respectively (chance  $\leq 25\%$ ); these means do not indicate ceiling or floor effects. A more critical weakness in all four studies is the inference of transfer directionality based on the response hand by sensory field relationship. Such inference assumes relative specialization and resource-unlimited processing (between decision and response programming) [17], two untested assumptions in all four studies. Finally, and more generally, the validity of choice reaction times in crossed VF-response hand conditions as a measure of interhemispheric transfer time in the study by Dewaraja and Sasaki [36] is problematic [38].

In another experiment by Habib et al. [21], 20 MS patients and 20 matched controls, all right-handed, participated in a dichotic listening task. Recall that the patients in this study had reduced CC size and increased alexithymia scores, as measured by the TAS and the Parallel Visual Information Processing Test. Emotional and verbal transfer were assessed utilizing 4 different auditory nonword stimuli, each pronounced in 1 of 4 different emotional tones. In each trial, the subject heard 2 different nonwords, 1 in each ear, each pronounced in a different emotional tone. In the emotion task, the subjects had to detect a target emotion, while in the verbal task, they had to detect a target nonword. Results indicated better right ear (RE) performance in the emotion task and better left ear (LE) performance in the verbal task in controls compared to patients. Habib et al. [21] interpreted the poor RE performance in the patients in the emotion task as a deficit in left-to-right interhemispheric transfer, supposedly because the hemisphere that initially receives the

emotion information must transfer it to the specialized hemisphere to be processed. Similarly, they interpreted the poor LE performance in the patients in the verbal task as a deficit in right-to-left interhemispheric transfer of verbal information. Furthermore, LE accuracy of verbal information, a supposed measure of right-to-left transfer, was negatively correlated with alexithymia. Thus, the authors concluded that the transfer hypothesis of alexithymia is supported to the extent of a right-to-left transfer deficit of verbal information. However, their measures of verbal and emotional transfer rely on the assumptions that the LH is exclusively specialized for phoneme detection and the RH is exclusively specialized for emotional prosody detection, respectively. The authors' interpretation also presupposes that dichotic pairs create complete ipsilateral suppression so that the LE-to-LH and RE-to-RH signals are inhibited. Although the authors do report an overall RE advantage in the verbal and LE advantage in the emotional task across groups, the assumptions that specialization for these tasks is exclusive and that ipsilateral suppression is complete are not strongly supported by the data in split-brain patients or healthy participants [39, 40]. Therefore, it is important to determine the level of specialization in each experiment if inferences about transfer are to be drawn.

To summarize, behavioral studies supporting the transfer hypothesis of alexithymia have thus far been scarce. They have been more informative, however, than the patient studies, because they have also tested for laterality. More studies need to be conducted using emotional stimuli, especially in the auditory and visual domains, because both simple sensory information and abstract emotional information can be presented in these modalities. Furthermore, behavioral transfer paradigms that allow for measures of laterality should statistically test for the level of specialization (relative vs. exclusive).

### **Patient Studies of the RH Deficit Model**

Empirical evidence supporting RH dysfunction in alexithymia is equally scant. A few studies have reported poorer facial expression perception in alexithymic individuals than controls. These data have been used to infer RH dysfunction in alexithymia [41, 42], because facial expression perception has been attributed to the RH [43, 44]. In addition, clinical observations of behavioral similarities between RH-damaged patients and alexithymic individuals suggest RH dysfunction in alexithymia [45]. However, in order to directly relate alexithymia to RH

dysfunction, alexithymia must be measured either in RH- and LH-damaged patients and healthy controls or it must be measured in healthy subjects in a behavioral study comparing RH and LH performance, i.e., via presentation of lateralized stimuli.

To our knowledge, two studies have reported alexithymia in RH damage. The first, conducted by Fricchione and Horowitz [46], is a case history of a 61-year-old right-handed woman who suffered lesions in the right lenticular and right frontotemporal-parietal areas following two episodes of cerebrovascular accidents due to hypertension. In addition to motor aprosodia, she also exhibited alexithymic features, as measured by the 6 of 8 BIQ items used by Hoppe and Bogen [20]. As with many patient studies, one problem with this study is the lack of preinfarct data. Furthermore, as mentioned earlier, the BIQ is not a very reliable measure of alexithymia [28]. In a more rigorous study, by Spalletta et al. [47], 21 stroke patients with RH lesions and 27 with LH lesions filled out the TAS-20 and several other psychiatric measures. Location of lesion varied widely among patients, but there were no overall differences in lesion location between the two patient groups. After controlling for other psychiatric scores, the RH patients had a significantly higher mean alexithymia score (60.5) than the LH patients (54.8). Furthermore, a  $\chi^2$  analysis revealed that more RH patients than LH patients were alexithymic, while more LH patients than RH patients were nonalexithymic. The findings from this study strongly support the RH deficit model of alexithymia. As with other lesion studies, due to the possibility of compensatory dynamics and functional reorganization, results should be interpreted with caution. Furthermore, the authors of these two studies do not explicitly rule out anosognosia and anosodiaphoria, which often accompany RH damage, as possible confounds that may mimic certain alexithymic features [14].

### **Behavioral Studies of the RH Deficit Model**

Two behavioral studies using chimeric faces [41, 48] have related alexithymia to reduced leftward bias, and, therefore, to RH underactivation. A chimeric face is a conjoined pair of half-faces. In a common test, one half-face expresses an emotion (i.e., sad or happy), while the other is neutral. Even when viewed in free vision, subjects tend to rate chimeric faces with the emotional half on the left side (LVF-RH) as more emotional than the mirror image of the same chimeric face [49]. Such leftward biases have been interpreted as higher RH than LH activation.

In the study by Berenbaum and Prince [48], 137 right-handed university students were shown happy-neutral chimeric faces in free vision, and were instructed to indicate which of two chimeric photographs looked happier. Alexithymia was measured by the TAS-20 identifying and describing subscales. Subjects with scores at least one standard deviation above the mean were compared with the other subjects. Males with high scores on the identifying subscale had a lower leftward bias than other males, while females with high scores on the describing subscale had a lower leftward bias than other females. However, a correlation between hemispatial bias and alexithymia was not significant. Therefore, this study found only weak support for the RH model of alexithymia.

A problem with these findings of leftward bias is that we do not know whether they reflect higher RH activation for emotion processing per se or for visual processing in general. To address this issue, Jessimer and Markham [41] presented 5 types of stimuli: happy-neutral and sad-neutral chimeric photos, happy-neutral and sad-neutral chimeric cartoons, and nonemotion photos of asymmetrically distributed stars. Subjects, all right-handed, had to indicate which of two photos was more emotional or had more stars. Subjects with the highest and lowest 10% of scores on two components of the TAS-20 (identifying and describing) were assigned to the high- and low-alexithymic groups, respectively. Results indicated that high-alexithymic individuals were less leftward biased than low-alexithymic individuals, for the sad-neutral photos only. The RH hypothesis of alexithymia's neurological basis, which assumes RHA across all emotions, would predict group differences for all emotional chimeric tasks, if not for all chimeric tasks. Although the other four chimeric tasks showed group differences in the predicted direction, they did not reach significance. In contrast, Berenbaum and Prince [48] reported lower leftward bias for happy-neutral photos, albeit in a small subset of alexithymic subjects. Thus, the study by Jessimer and Markham [41] does not completely support the RH underactivation model of alexithymia either.

The two chimeric studies reviewed above report conflicting results and each study only partially supports the RH model. The inconsistency in the findings of these two studies suggests that photo chimeras yield unreliable results, which may disappear altogether when replaced by more systematic and consistent drawings. Indeed, the relation of arousal asymmetry, as measured by lateral chimeric bias, and hemispheric specialization remains controversial [50].

Two behavioral studies of conjugate lateral eye movements (CLEMs) addressed the relation of alexithymia to RH activation [51, 52]. CLEMs refer to the eye movements people make as they begin to think about something. It has been hypothesized that the predominance of CLEMs in one direction is indicative of higher activation in the contralateral hemisphere [53]. For example, people with predominant left CLEMs, or 'left movers', are considered to have a dominant RH. In the study by Cole and Bakan [51], 102 right-handed university students were asked 20 general knowledge questions that had been shown not to produce CLEMs in one consistent direction. The direction of the subjects' first eye movement was recorded after each question. At least 14 CLEMs had to be present to calculate the CLEM score (number of left CLEMs divided by total number of CLEMs). Thus, the higher the CLEM score, the higher the supposed RH activation. The SSPS was used to measure alexithymia. There was a significant positive correlation between CLEM scores and alexithymia scores, indicating *higher* RH activation in alexithymic individuals. This finding directly contradicts the RH underactivation hypothesis. Although the authors suggest theoretical implications of higher RH activation in alexithymia, another possibility is that their finding is spurious, given that the SSPS has been criticized for its low validity and reliability [28].

To address the methodological weaknesses of the study by Cole and Bakan [51], Parker et al. [52] replicated it using the TAS in addition to the SSPS, otherwise using the exact same methodology. Subjects were 60 right-handed university students. With the TAS as the dependent measure, there was a higher TAS score for right movers than left movers, suggesting higher alexithymia scores in those with higher LH activation compared to those with higher RH activation. With the SSPS as the dependent variable, there were no main effects or interactions. These findings support the RH underactivation hypothesis of alexithymia and suggest that the finding by Cole and Bakan [51] may be due to the low reliability of the SSPS. Nonetheless, as Parker et al. [52] point out, the validity of CLEMs as an index of hemisphericity is questionable, as results tend to vary with subtle differences in methodology. In addition to the variable task-specific effects, CLEM studies have also been criticized for failing to report consistent individual differences [54].

The report by Cole and Bakan [51] of increased RH activation in alexithymia is not alone in contradicting the RH underactivation hypothesis of alexithymia. The finger localization studies by Zeitlin et al. [33] and Parker et al. [34], as well as the visual matching study by Dewaraja

and Sasaki [36] all reported no difference between right and left sensory field performance in uncrossed conditions by the alexithymic subjects, suggesting equal activation of the hemispheres. However, the finger localization study by Lumley and Sielky [35] reported that alexithymia scores in men correlated with poorer RH performance compared to the LH. In addition, the study by Habib et al. [21] reported an impaired LE-RH performance in patients compared to controls, but only in phoneme detection; they also reported an impaired RE-LH performance in emotion detection. Therefore, the finding by Habib et al. [21] does not completely support the RH model either. The impaired RE-LH performance in emotion detection may be explained by the callosal dysfunction if the task is callosal relay [40]. However, as mentioned earlier, data supporting a callosal relay model of prosody perception are inconclusive. Finally, since three of these five behavioral studies reporting some sort of a transfer deficit in alexithymia found no hemispheric differences, the possible RH underactivation attributed to alexithymia is unlikely to be a simple epiphenomenon of the callosal dysfunction.

In conclusion, the behavioral data ascribing alexithymia to abnormal hemispheric specialization are inconclusive and may depend on task. A more direct measure of RH competence would be a lateralized perception task, such as the dichotic listening task by Habib et al. [21] or a lateralized facial emotion perception task. If alexithymic individuals show reduced or absent RH superiority compared to controls in a lateralized emotion perception task, only then can we suggest that alexithymia is related to lowered RH competence for emotion perception.

Besides lesion and behavioral methods, an alternate method of investigating the RH hypothesis is functional neuroimaging, such as functional MRI, positron emission tomography, and electroencephalography. In order to demonstrate a true hemispheric asymmetry in functional neuroimaging studies, a condition  $\times$  hemisphere or a group  $\times$  hemisphere interaction must be tested [55]; this interaction was referred to by Zaidel [15] as the 'processing dissociation'. However, since, to our knowledge, the extant functional neuroimaging studies of alexithymia do not report the processing dissociation test of hemispheric specialization, and since these studies have recently been reviewed in this journal [56], they will not be included in the current review.

**Table 1.** Summary of reviewed studies

	Used TAS	Method	Laterality deficit	Direction of transfer deficit	CR vs. DA	Emot stim	Other methodological limitations
Hoppe and Bogen [20]	no	split patients	not tested	NA	not tested	NA	
TenHouten et al. [23–25]	no	split patients	not tested	NA	not tested	NA	unreliable measures
TenHouten et al. [26, 27]	no	split patients	not tested	NA	not tested	NA	questionable measures
Buchanan et al. [5]	no	CC agenesis	not tested	NA	not tested	NA	
Ernst et al. [29]	yes	CC agenesis	not tested	NA	not tested	NA	
Habib et al. [21]	yes	MS patients, dichotic listening	RH verbal; LH emotion	inferred bidirectional; CR assumed	not tested	yes	
Zeitlin et al. [33]	yes	finger localization	none	inferred bidirectional; DA assumed	not tested	no	no women
Parker et al. [34]	yes	finger localization	none	inferred bidirectional; DA assumed	not tested	no	no women
Lumley and Sielky [35]	yes	finger localization	RH, men only	inferred bidirectional; DA assumed	not tested	no	
Dewaraja and Sasaki [36]	yes	lateralized visual match	none	inferred RH-to-LH; DA assumed	not tested	no	
Fricchione and Howanitz [46]	no	RH lesion	RH	NA	NA	NA	
Spalletta et al. [47]	yes	RH lesion	RH	NA	NA	NA	
Berenbaum and Prince [48]	yes	chimeric pictures	RH?	NA	NA	yes	unreliable measure (chimeras)
Jessimer and Markham [41]	yes	chimeric pictures	RH?	NA	NA	yes	unreliable measure (chimeras)
Cole and Bakan [51]	no	CLEMs	LH?	NA	NA	NA	questionable validity (CLEMs)
Parker et al. [52]	yes	CLEMs	RH?	NA	NA	NA	questionable validity (CLEMs)

CR = Callosal relay; DA = direct access; Emot stim = emotional stimuli; NA = not applicable.

## Conclusion

Table 1 summarizes the studies reviewed above. The hypothesis that alexithymia is related to an RH impairment in emotion processing and to a deficit in the right-to-left transfer of emotional information remains to be tested directly and definitively. Since hemispheric specialization may be related to callosal connectivity, future studies should test in a within-subject design both laterality and transfer of both higher-level emotional information and simple sensory stimuli. Furthermore, the level of hemispheric specialization should be determined by looking at sensory field and independent-variable interactions. In addition, the direction of transfer should be specified.

Further, we suggest that future studies use multiple paradigms, including hemifield tachistoscopes and dichotic listening, in order to test for callosal function in different sensory modalities. New studies should also recruit participants with no concurrent neurological or psychiatric conditions and utilize the TAS-20 as the measure of alexithymia. However, given that the TAS-20 is a self-report measure, it would best be utilized in conjunction

with an observer-rated scale, such as the Observer Alexithymia Scale or the modified version of the BIQ [57], in order to reduce bias.

Finally, some issues regarding the ecological validity of the experiments reviewed and proposed in this paper need to be addressed. First, although a difference of a few milliseconds in response time or a few percentage points in accuracy in such lateralized and interhemispheric tasks may seem too small to explain some of the clinical manifestations of alexithymia, these laterality and transfer paradigms reflect behavioral differences that are substantial in the 'real world'. For example, the fundamental language specialization in the LH is reflected in a small RVFA, typically of the order of 20–40 ms, in lateralized lexical decision tasks [19]. Nonetheless, these behavioral paradigms are best supplemented by other measures of hemispheric functioning, such as neuroimaging, in order to obtain convergent evidence. Furthermore, since a core deficit of alexithymia is a difficulty in labeling one's emotions, future studies may include tasks involving verbal labeling of emotion and utilize stimuli that actually evoke emotions, such as the graphic photographs in the International Affective Picture System [58]. Finally, the relation

between alexithymia on the one hand and social support and stress on the other should also be examined [59–61], given the purportedly unique involvement of the RH in affiliation and stress [11, 12]. Thus, in order to fully address the clinical realities of alexithymia in experimental settings, several different types of studies, each addressing a different aspect of the construct, should be conducted.

## Acknowledgments

This research was supported by an NSF Graduate Research Fellowship awarded to G.T. and by an NIH grant RO1 NS20187 awarded to E.Z.

## References

- Sifneos PE: The prevalence of 'alexithymic' characteristics in psychosomatic patients. *Psychother Psychosom* 1973;22:255–262.
- Nemiah JC, Sifneos PE: Affect and fantasy in patients with psychosomatic disorders; in Hill OW (ed): *Modern Trends in Psychosomatic Medicine*. London, Butterworths, 1970, vol 2, pp 26–34.
- Taylor GJ, Bagby RM, Parker JDA: *Disorders of Affect Regulation: Alexithymia in Medical and Psychiatric Illness*. Cambridge, Cambridge University Press, 1999.
- Miller L: Is Alexithymia a disconnection syndrome? A neuropsychological perspective. *Int J Psychiatry Med* 1986–87;16:199–209.
- Buchanan DC, Waterhouse GJ, West SC Jr: A proposed neurophysiological basis of alexithymia. *Psychother Psychosom* 1980;34:248–255.
- Shipko S: Further reflections on Psychosomatic theory: Alexithymia and Interhemispheric specialization. *Psychother Psychosom* 1982;37:83–86.
- Hellige JB: Hemispheric asymmetry. *Annu Rev Psychol* 1990;41:55–80.
- Borod JC, Cicero BA, Obler LK, Welkowitz J, Erhan HM, Santschi C, Grunwald IS, Agosti RM, Whalen JR: Right hemisphere emotional perception: Evidence across multiple channels. *Neuropsychology* 1998;12:446–458.
- Davidson RJ: Cerebral asymmetry and emotion: A review. *Cogn Emotion* 1993;7:115–138.
- Haviland MG, Reise SP: A California Q-set alexithymia prototype and its relationship to ego-control and ego-resiliency. *J Psychosom Res* 1996;41:597–608.
- Henry JP: Psychological and physiological responses to stress: The right hemisphere and the hypothalamo-pituitary-adrenal axis: An inquiry into problems of human bonding. *Integr Physiol Behav Sci* 1993;28:369–387.
- Schore AN: The effect of early relational trauma on right brain development, affect regulation, and infant mental health. *Infant Ment Health J* 2001;22:201–269.
- House JS, Landis KR, Umberson D: Social relationships and health. *Science*. 1988;241:540–545.
- Lane RD, Ahern GL, Schwartz GE, Kaszniak AW: Is alexithymia the emotional equivalent of blindness? *Biol Psychiatry* 1997;42:834–844.
- Zaidel E: Disconnection syndrome as a model for laterality effects in the normal brain; in Hellige J (ed): *Cerebral Hemisphere Asymmetry: Method, Theory and Application*. New York, Praeger, 1983, pp 95–151.
- Zaidel E: Callosal dynamics and right hemisphere language; in Lepore F, Ptito M, Jasper HH (eds): *Two Hemispheres – One Brain: Functions of the corpus callosum*. New York, Praeger, 1986, pp 435–459.
- Zaidel E, Clarke J, Suyenobu B: Hemispheric independence: A paradigm case for cognitive neuroscience; in Scheibel AB, Wechsler AF (eds): *Neurobiology of Higher Cognitive Function*. New York, Guilford Press, 1990, pp 297–355.
- Zaidel E: Interhemispheric transfer in the split brain: Long-term status following complete cerebral commissurotomy; in Davidson RJ, Hugdahl K (eds): *Brain Asymmetry*. Cambridge, The MIT Press, 1995, pp 491–532.
- Iacoboni M, Zaidel E: Hemispheric independence in word recognition: Evidence from unilateral and bilateral presentations. *Brain Lang* 1996;53:121–140.
- Hoppe KD, Bogen JE: Alexithymia in twelve commissurotomy patients. *Psychother Psychosom* 1977;28:148–155.
- Habib M, Daquin G, Pelletier J, Montreuil M, Robichon F: Alexithymia as a consequence of impaired callosal function: Evidence from multiple sclerosis patients and normal individuals; in Zaidel E, Iacoboni M (eds): *The Parallel Brain: The Cognitive Neuroscience of the corpus callosum*. Cambridge, MIT Press, 2003, pp 415–422.
- Zaidel E, Iacoboni M, Laack KA, Crawford BT, Rayman J: Implicit interhemispheric lexicality priming in lateralized lexical decision. *Brain Lang* 1998;65:102–105.
- TenHouten WD, Hoppe KD, Bogen JE, Walter DO: Alexithymia and the split brain. 1. Lexical-level content analysis. *Psychother Psychosom* 1985;43:202–208.
- TenHouten WD, Hoppe KD, Bogen JE, Walter DO: Alexithymia and the split brain. 2. Sentential-level content analysis. *Psychother Psychosom* 1985;44:1–5.
- TenHouten WD, Hoppe KD, Bogen JE, Walter DO: Alexithymia and the split brain. 3. Global-level content analysis of fantasy and symbolization. *Psychother Psychosom* 1985;44:89–94.
- TenHouten WD, Hoppe KD, Bogen JE, Walter DO: Alexithymia and the split brain. 5. EEG alpha-band interhemispheric coherence analysis. *Psychother Psychosom* 1987;47:1–10.
- TenHouten WD, Hoppe KD, Bogen JE, Walter DO: Alexithymia and the split brain. 6. Electroencephalographic correlates of alexithymia. *Psychiatr Clin North Am* 1988;11:317–329.
- Taylor GJ, Bagby RM: Measurement of alexithymia: Recommendations for clinical practice and future research. *Psychiatr Clin North Am* 1988;11:351–366.
- Ernst H, Key JD, Koval MS: Alexithymia in an adolescent with agenesis of the corpus callosum and chronic pain. *J Am Acad Child Adolesc Psychiatry* 1999;38:1212–1213.
- Bagby RM, Parker JDA, Taylor GJ: The twenty-item Toronto Alexithymia Scale. 1. Item selection and cross-validation of the factor structure. *J Psychosom Res* 1994;38:23–32.
- Zaidel E, Iacoboni M, Zaidel DW, Bogen J: The callosal syndromes; in Heilman KM, Valenstein E (eds): *Clinical Neuropsychology*, ed 4. New York, Oxford University Press, 2003, pp 347–403.
- Clarke JM, Zaidel E: Anatomical-behavioral relationships: Corpus callosum morphometry and hemispheric specialization. *Behav Brain Res* 1994;64:185–202.
- Zeitlin SB, Lane RD, O'Leary DS, Schrift MJ: Interhemispheric transfer deficit and alexithymia. *Am J Psychiatry* 1989;146:1434–1439.
- Parker JDA, Keightley ML, Smith CT, Taylor GJ: Interhemispheric transfer deficit in alexithymia: An experimental study. *Psychosom Med* 1999;61:464–468.
- Lumley MA, Sielky K: Alexithymia, gender, and hemispheric functioning. *Compr Psychiatry* 2000;41:352–359.
- Dewaraja R, Sasaki Y: A left to right hemisphere callosal transfer deficit of nonlinguistic information in alexithymia. *Psychother Psychosom* 1990;54:201–207.
- Merriam AE, Wyszynski B: Interhemispheric transfer deficit in alexithymia. *Am J Psychiatry* 1990;147:955–956.

- 38 Zaidel E, Iacoboni M: Does the CUD in SRT measure IHTT? Or: Is the crossed-uncrossed difference in the simple reaction time task a pure measure of interhemispheric transfer time?; in Zaidel E, Iacoboni M (eds): *The Parallel Brain: The Cognitive Neuroscience of the corpus callosum*. Cambridge, MIT Press, 2003, pp 259–266.
- 39 Zaidel E, Iacoboni M: Current directions in clinical studies of callosal functions; in Zaidel E, Iacoboni M (eds): *The Parallel Brain: The Cognitive Neuroscience of the corpus callosum*. Cambridge, MIT Press, 2003, pp 453–457.
- 40 Grimshaw GM, Kwasny KM, Covell E, Johnson RA: The dynamic nature of language lateralization: Effects of lexical and prosodic factors. *Neuropsychologia* 2003;41:1008–1019.
- 41 Jessimer M, Markham R: Alexithymia: A right hemisphere dysfunction specific to recognition of certain facial expressions? *Brain Cogn* 1997; 34:246–258.
- 42 Mann LE, Wise TN, Trinidad A, Kohanski R: Alexithymia, affect recognition, and the five-factor model of personality in normal subjects. *Psychol Rep* 1994;74:563–567.
- 43 Blonder IX, Bowers D, Heilman KM: The role of the right hemisphere in emotional communication. *Brain* 1991;114:1115–1127.
- 44 Ley RG, Bryden MP: Hemispheric differences in processing emotions and faces. *Brain Lang* 1979;7:127–138.
- 45 Sifneos PE: Alexithymia and its relationship to hemispheric specialization, affect, and creativity. *Psychiatr Clin North Am* 1988;3:287–292.
- 46 Fricchione G, Howanitz E: Aprosodia and alexithymia – A case report. *Psychother Psychosom* 1985;43:156–160.
- 47 Spalletta G, Pasini A, Costa A, De Angelis D, Ramundo N, Paolucci S, Caltagirone C: Alexithymic features in stroke: Effects of laterality and gender. *Psychosom Med* 2001;63:944–950.
- 48 Berenbaum H, Prince JD: Alexithymia and the interpretation of emotion-relevant information. *Cogn Emotion* 1994;8:231–244.
- 49 Levy J, Heller W, Banich MT, Burton LA: Asymmetry of perception in free viewing of chimeric faces. *Brain Cogn* 1983;4:404–419.
- 50 Eviatar Z, Hellige JB, Zaidel E: Individual differences in lateralization: Effects of gender and handedness. *Neuropsychology* 1997;11:562–576.
- 51 Cole G, Bakan P: Alexithymia, hemisphericity, and conjugate lateral eye movements. *Psychother Psychosom* 1985;44:139–143.
- 52 Parker JD, Taylor GJ, Bagby RM: Relationship between conjugate lateral eye movements and alexithymia. *Psychother Psychosom* 1992; 57:94–101.
- 53 Bakan P: Hypnotizability, laterality of eye-movements and functional brain asymmetry. *Percept Mot Skills* 1969;28:927–932.
- 54 Hiscock M: Lateral eye movements and dual-task performance; in Hannay HJ (ed): *Experimental Techniques in Human Neuropsychology*. New York, Oxford University Press, 1986, pp 264–308.
- 55 Davidson RJ, Irwin W: The functional neuroanatomy of emotion and affective style. *Trends Cogn Sci* 1999;3:11–21.
- 56 Taylor GJ, Bagby RM: New trends in alexithymia research. *Psychother Psychosom* 2004;73: 68–77.
- 57 Haviland MG, Warren WL, Riggs ML, Nitch SR: Concurrent validity of two observer-rated alexithymia measures. *Psychosomatics* 2002; 43:472–477.
- 58 Lang PJ, Bradley MM, Cuthbert BN: *The International Affective Picture System (IAPS): Photographic Slides*. Gainesville, The Center for Research in Psychophysiology, University of Florida, 1995.
- 59 Kojima M, Senda Y, Nagaya T, Tokudome S, Furukawa TA: Alexithymia, depression and social support among Japanese workers. *Psychother Psychosom* 2003;72:307–314.
- 60 Picardi A, Pasquini P, Cattaruzza MS, Gaetano P, Melchi CF, Baliva G, Camaioni D, Tiago A, Abeni D, Biondi M: Stressful life events, social support, attachment security and alexithymia in vitiligo: A case-control study. *Psychother Psychosom* 2003;72:150–158.
- 61 Elzinga BM, Bermond B, van Dyck R: The relationship between dissociative proneness and alexithymia. *Psychother Psychosom* 2002; 71:104–111.

**© Free Author Copy - for personal use only**

ANY DISTRIBUTION OF THIS ARTICLE WITHOUT WRITTEN CONSENT FROM S. KARGER AG, BASEL IS A VIOLATION OF THE COPYRIGHT.

Written permission to distribute the PDF will be granted against payment of a permission fee, which is based on the number of accesses required. Please contact [permission@karger.ch](mailto:permission@karger.ch)