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Selective hemispheric stimulation by unilateral forced nostril breathing

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Summary. We have previously demonstrated by the integration of EEG amplitudes, that an ultradian rhythm of alternating cerebral dominance exists in humans. This rhythm is tightly coupled with the nasal cycle, since its lateralization correlates with shifts in airflow through the left and right nostrils, where relatively greater integrated amplitudes in one hemisphere correspond to predominant airflow in the contralateral nostril. The nasal cycle is known to be regulated by the sympathetic and parasympathetic branches of the autonomic nervous system. This dynamic lateralization of alternating activity in the autonomic nervous system exists in other peripheral structures and is also likely to be the mode of regulation of the cortical rhythm. This paper shows that forced nostril breathing in one nostril produces a relative increase in the EEG amplitude in the contralateral hemisphere. This phenomena was demonstrated in 5 out of 5 untrained subjects. These results suggest the possibility of a non-invasive approach in the treatment of states of psychopathology where lateralized cerebral dysfunction have been shown to occur.

Key words: Cerebral dominance – Nasal cycle – Autonomic function – Unilateral forced nostril breathing – Non-invasive stimulation

A number of different laboratories have reported evidence that suggests the existence of a natural rhythm with ultradian periodicity of alternating dominance between the two cerebral hemispheres in awake humans. This has been demonstrated through the use of electroencephalography (EEG) (Werntz et al. 1983), via psychological testing (Klein et al. 1986; Lavie et al. 1984; Gordon et al. 1982; Klein and Armitage 1979; Wada 1922), and by studies of cerebral blood flow (Prohovnik and Risberg 1979). EEG experiments have also provided evidence for rhythms of alternating cerebral cortical activity during sleep in humans (Banquet 1983; Goldstein et al. 1972). This phenomena of alternating cerebral hemispheric activity is coupled to the phases of REM and nonREM sleep (Goldstein et al. 1972). Alternating cerebral dominance with sleep stages has been demonstrated in several nonhuman species, including rabbits (Nelson et al. 1977; Goldstein et al. 1972), cats (Webster 1977; Goldstein et al. 1972), dolphins (Mukhametov et al. 1977) and fur seals (Mukhametov et al. 1985).

The work of Werntz et al. (1983) was the first to link this innate rhythm of the central nervous system (CNS) with a correlate of rhythmic activity in the peripheral autonomic nervous system (ANS). Their work described a tightly coupled relationship of this brain rhythm with the nasal cycle, where relatively greater integrated EEG amplitudes correspond to enhanced airflow in the contralateral nostril. The nasal cycle describes an ultradian rhythm of the relative efficiency of breathing in the right and left nares with an average period during waking of about 2–3 h (Kayser 1895; Keuning 1968). The studies by Werntz et al. (1983) therefore suggest that the rhythm of alternating cerebral dominance might also be regulated by the ANS in a manner similar to the nasal cycle.

Numerous experiments in both human (Keuning 1968; Stoksted 1952) and nonhuman species (Eccles and Lee 1981) have shown that the nasal cycle is regulated by the sympathetic and parasympathetic branches of the ANS. Unilateral sympathetic dominance produces vasoconstriction and decongestion in one nare while a simultaneous parasympathetic dominance exists in the other producing a vasodilation and congestion of that nare thereby reducing airflow.

Recent studies of the nasal cycle comparing plasma catecholamine levels in the venous circulation in the two arms demonstrate alternating levels of norepinephrine on the two sides that covary with the rhythm of sympathetic activity in the nose (Kennedy et al. 1986). This further supports a generalized mechanism of alternating autonomic function in the periphery. Also the observations of Neligan and Strang (1952) in newborn humans demonstrate how a distinct and lateralized dominance of

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autonomic tone throughout the periphery is possible. They termed this the harlequin color change to illustrate the dramatic differences in color on the two sides of the body that were exhibited with a well defined midline.

Stoksted (1953) and Eccles (1978) have proposed that the hypothalamus may be responsible for regulating the cyclical changes in nasal resistance. Experimental evidence in the cat shows that the hypothalamus does directly influence the sympathetic innervation of the nasal mucosa both unilaterally and bilaterally (Eccles and Lee 1981; Malcomson 1959). Therefore, a lateralized vasoconstriction on one side of the brain and the relative dilation of blood vessels on the other may be the means by which a central mechanism regulates the alternating dominance of the cerebral hemispheres.

Since the endogenous rhythm of alternating cerebral dominance is tightly coupled to the nasal cycle, the question of the effect of active interference with the nasal airflow on cortical activity was of interest[1]. The following study was undertaken to further investigate the effects of unilateral forced nostril breathing on cortical activity in humans. The results suggest that unilateral forced nostril breathing does selectively alter the pattern of cortical dominance as exhibited by integrated amplitudes of EEG activity. Forced breathing through the right nostril increases the EEG amplitudes in the left hemisphere and vice versa. Results of psychological task performance efficiency comparing the relative ratios of both verbal (left hemisphere skill) and spatial testing (right hemisphere skill) and the effects of unilateral forced nostril breathing support the interpretation of these EEG findings (Beubel and Shannahoff-Khalsa 1987). Enhanced cognitive performance was correlated with forced breathing through the contralateral nostril.

Methods

Subjects were recruited by advertisement in the University newspaper and paid on hourly wage. They were told that they would perform breathing exercises while having their brain waves measured. The subjects sat in a comfortable chair, in a quiet private room, and were instructed to remain motionless during the exercises. The course of the experiment varied with the subjects ability to cooperate without exhibiting excess muscle artifact or complaining about fatigue. Subjects were preselected for the absence of any nasopharyngeal abnormalities or respiratory ailments.

The relative airflow through the nostrils was measured with thermistors. Two identically matched thermistors, with a response range including the span 21 – 38 degrees C, were attached to a small clip that fits over the nose. A circuit using a wheatstone bridge converted the resistance change into a voltage change which is written out on the EEG machine simultaneously with the EEG. The respiration from each nostril was exhibited on the polygraph and recorded onto FM magnetic tape for later analysis by integration. An electrode cap with 10 – 20 placement was used. The EEG was recorded on a Grass Model 6 and stored on magnetic tape for analysis by integration as described in our earlier report (Werntz et al. 1983).

After a 15-min recording period where the baseline values in the EEG and in the nostrils were recorded, the subjects were requested to close off the designated nostril (the side previously more open and allowing for greater airflow as determined by the on-line primary recording of the nasal thermistors) with the index finger of the ipsilateral hand and force breathe through the more congested nostril. 11 – 20 min of forced nostril breathing were then followed by at least one, two, or more periods of this breathing exercise, alternating sides at each phase of the experiment. Final baseline values for the EEG activity and nostril dominance were then determined. This entire procedure was again repeated in one subject giving six complete periods of forced nostril breathing during one experiment.

The recorded data was later subjected to continuous integration and subtraction in time and the output was exhibited on the polygraph for the two homologous EEG leads and the two airflow thermistors. This was done with an analogue device which rectifies, subtracts and integrates each pair of signals, as reported earlier (Werntz et al. 1983). Subjects 1 and 5 (Fig. 5) were also run using the Bic Mini-CEARS computer system (Bickford 1981) to determine the mean difference between the left and right hemisphere EEG amplitudes using 7 and 6 pairs of bipolar montage respectively. Each sample plotted is from 2 minutes of EEG. Subject 5 was only run using the Bic Mini-CEARS system. Subjects EEG were recorded from the occipital, parietal, frontal and temporal lobes using either bipolar montage or the central midline reference. EEG recordings that had more than 20% of the record contaminated by muscle artifact as detected visually were not analyzed. The runs of those subjects that complained of difficulty in force breathing through only one nostril during any phase of the recording were discontinued.

The correlation of the relative EEG baseline and the phase of the nasal airflow were calculated using statistics as in the previous study (Werntz et al. 1983). A percent concordance based on a measurement of each consecutive 2.5-min interval of the right or left nostril airflow and the EEG symmetry was calculated and then a p value was obtained using the nonparametric sign test (Goldstein 1964). With no concordance (null hypothesis) $r = 50\%$.

Results

Our experiments were designed to examine the effects of altering the natural phase of the nasal cycle on the patterns of EEG activity in the two hemispheres. This was done by using unilateral forced nostril breathing as the method for altering the nasal cycle. The results are summarized for each subject, along with the trial number, sex, EEG montage, handedness, EEG band, statistical results, and are listed in Table 1.

The measurement of the integrated EEG demonstrates that the forced nostril breathing exercise produces a shift in the dominance of the EEG amplitudes in the two hemispheres. Relatively larger amplitudes are generated in the hemisphere contralateral to the nostril used. In Figure 1, Subject 1 performed 6 periods of uninostril breathing, each time the EEG amplitude shift occurred in the direction predicted by the earlier studies with the natural rhythms, i.e., relatively greater EEG amplitudes manifested with dominance of airflow in the contralateral nostril. This concordance was statistically significant at the $p < 0.002$ level. Also in Figure 1, the shifts in EEG amplitude were strikingly visible in the primary recording. However, this was the only subject in which the shifts in EEG asymmetry were so strikingly visible in the primary recording. Representative segments are shown in

[1] An earlier presentation of this work was made: Werntz DA, Bickford RG, Bloom FE, Shannahoff-Khalsa DS (1981) Western EEG Society Meeting, Reno, Nevada, February 21, 1981

the bottom of Figure 1. The most striking shift was in going from right nostril 1 (RN1) to left nostril 2 (LN2). In RN1 the EEG amplitude in the left hemisphere is larger. The fact that this result occurred 6 consecutive times is strong evidence that the untrained individual can use unilateral forced nostril breathing to alter their cerebral cortical activity. Subject 1 was repeated on a different day for only 3 periods of the breathing exercise. In this experiment 3 different electrode recording sites (occipital, parietal and temporal regions) were used. The results are shown in Figure 2. As seen in the tracings, the shift occurs as predicted at all 3 sites and are statistically significant at the $p<0.002$, 0.002, 0.05 level respectively. It should be noted that the relative values of the EEG amplitudes are shifted and that on occasion the baseline of the EEG can have a greater absolute value of amplitude in the hemisphere ipsilateral to the nostril being used. This is the case with Subject 1 in Figure 2. Therefore, it is the relative level of activation of each hemisphere that is of primary concern. This result does not contradict the basic relationship where changes in the relative values of the EEG are observed in the predicted direction during the rhythmic shift of this phenomena (Werntz et al. 1983). The real midline between hemispheres is indicated in each figure (by a dash at the right of the EEG recording) if it is not identical to the line that is drawn as the midline. In Figure 2, the EEG amplitude is much greater in the right hemisphere during the entire recording period. Subject 1 was repeated for a third time with three episodes of forced uninostril breathing (see Fig. 3). All shifts were in the predicted direction and statistical analysis showed this to be significant at $p<0.03$. Figures 3 and 4 show 3 more individuals (Subjects 2, 3 and 4), where 8 out of 9 attempts to produce a shift in EEG asymmetry occurred in the predicted direction with forced uninostril breathing. Again the statistical analysis was significant for each subject (Subject 2, $p<0.001$; Subject 3, $p<0.01$; Subject 4, $p<0.002$). Figure 4 shows

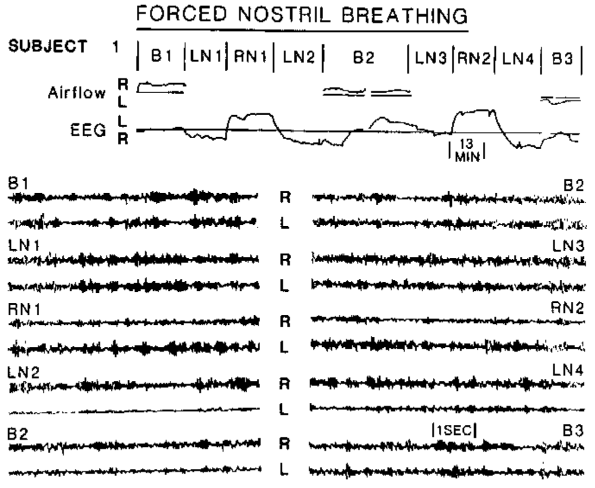

Fig. 1. Effect of forced uninostril breathing on EEG asymmetry. Subject 1 – Trial 2. *Top section.* 'Airflow' tracing – points above the baseline indicate greater right nostril airflow µ points below – greater left nostril airflow. Periods of forced nostril breathing are indicated. 'EEG' tracing – points above the baseline indicate relatively greater left hemisphere EEG amplitude; points below relatively greater right hemisphere amplitude. B = baseline; LN = left nostril breathing µ RN = right nostril breathing. Montage = $(O_2 - P_4 : O_1 - P_3)$. *Bottom section.* Segments of the primary EEG that were integrated and subtracted to produce the tracing in the top section. For each pair the top tracing is from the right hemisphere and the bottom is from the left hemisphere

Subject 4 with a bipolar electrode montage, $P_4T_6:P_3T_5$, performing 3 periods of uninostril breathing and the EEG shift occurs only on the last two attempts. Subject 4 was also recorded from $O_2T_6:O_1T_5$ and $O_2P_4:O_1P_3$ during the same experiment. The EEG shift occurred only on 1 of 6 attempts with these two montages (not shown), and was not statistically significant. This may be due to the fact that these montage cover relatively small brain regions and do not reflect the activity of the entire

Table 1. This table gives a summary of the 5 subjects and their recording periods

Subject	(Trial)	Sex	Montage	HDNS	EEG band	%Conc = r	*p* value
1	1	F	$O_2O_1:C_z$	L	Total	80%	<0.002
			$P_4P_3:C_z$		Total	80%	<0.002
			$T_4T_5:C_z$		Total	68%	<0.05
	2		$O_2P_4:O_1P_3$		Total	84%	<0.002
	3		$O_1O_2:C_z$		Total	76%	<0.03
	4[a]		7 pairs		Total	92%	<0.01
	5[b]		$P_4F_4:P_3F_3$		Total	67%	<0.05
2	1	F	$O_1O_2:C_z$	R	Total	90%	<0.001
3	1	M	$O_1O_2:C_z$	R	Total	73%	<0.01
4	1	F	$P_4T_6:P_3T_5$	R	Total	89%	<0.002
			$O_2T_6:O_1T_5$		Total		ns
			$O_2P_4:O_1P_3$		Total		ns
5	1[a]	F	6 pairs	R	Total	88%	<0.01

O is occipital, P is parietal, T is temporal, C_z is central montage. HDNS is handedness. %Conc = r is the percent concordance between the EEG tracing and the respective nostril. The *p* value was calculated by the sign test (non parametric). [a] Indicates that this trial is run using the Bic-MiniCEARS apparatus; [b] indicates that this is the control trial for Subject 1

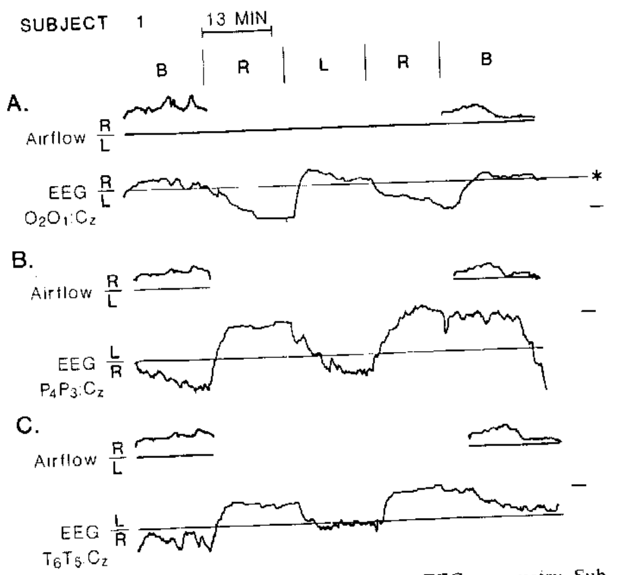

Fig. 2. Effect of forced uninostril breathing on EEG asymmetry. Subject 1 – Trial 1. *Airflow tracing.* Points above the baseline indicate greater right nostril airflow, points below the baseline indicate greater left nostril airflow. *EEG tracing.* Points above the baseline indicate relatively greater EEG amplitude in the left hemisphere (except Section A which is reversed), points below the baseline indicate relatively greater EEG amplitude in the right hemisphere. Periods of uninostril breathing are indicated. The dash to the right of the EEG tracing indicates the real midline. *Section A.* $O_2O_1:C_z$ = occipital leads linked to central midline reference. * indicates that the leads were reversed in the orientation of the printout. *Section B.* $P_4P_3:C_z$ = parietal leads linked to central midline reference. *Section C.* $T_6T_5:C_z$ = temporal leads linked to central midline reference

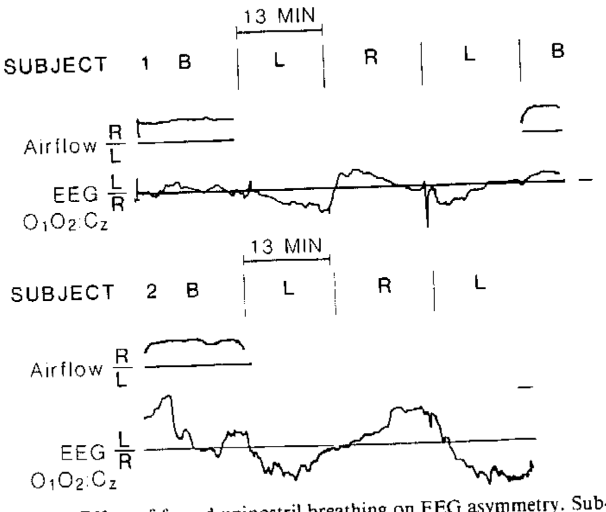

Fig. 3. Effect of forced uninostril breathing on EEG asymmetry. Subjects 1 and 2. (Third recording session for Subject 1.) *Airflow tracing.* Points above the baseline indicate greater right nostril airflow, points below the baseline indicate greater left nostril airflow. *EEG tracing.* Points above the baseline indicate relatively greater EEG amplitude in the left hemisphere, points below the baseline indicate relatively greater EEG amplitude in the right hemisphere. Periods of uninostril breathing are indicated. $O_1O_2:C_z$ montage for both subjects; occipital leads linked to central midline reference. The dash to the right of the EEG tracing indicates the real midline

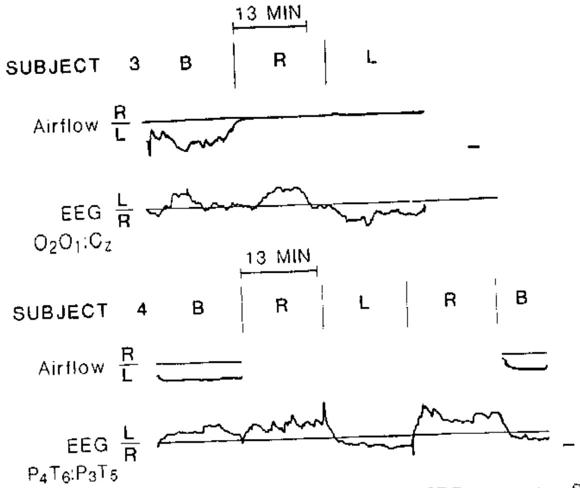

Fig. 4. Effect of forced uninostril breathing on EEG asymmetry. Subjects 3 and 4. *Airflow tracing.* Points above the baseline indicate greater right nostril airflow, points below the baseline indicate greater left nostril airflow. *EEG tracing.* Points above the baseline indicate relatively greater EEG amplitude in the left hemisphere, points below the baseline indicate relatively greater EEG amplitude in the right hemisphere. Periods of uninostril breathing are indicated. Subject 3 used $O_1O_2:C_z$ montage; occipital leads linked to central midline reference. Subject 4 used $P_4T_6:P_3T_5$ bipolar parietal-temporal montage. The dash to the right of the EEG tracing indicates the real midline

hemisphere as well as the montage that use the midline recording sites. It could also be that certain brain regions at times in individuals show discrepancies from the overall pattern. Recording from many sites at the same time would help to clarify this issue.

We used another recording device, the Bic Mini-CEARS computer system, with two subjects, to measure the EEG in a number of different regions simultaneously. This system calculates the power (which is proportional to the amplitude) of the EEG. The power in the total EEG using 2-min samples from 16 channels of bipolar EEG from 4 – 5 different cortical regions was measured simultaneously. The mean (L-R) difference was then calculated from the artifact free data. Figure 5 (Subjects 1 and 5) shows the results. In both subjects the mean (L-R) difference shifts more positive for right nostril breathing and more negative for left nostril breathing as would be expected. These differences were significant at $p<0.01$ for both subjects.

In order to demonstrate that the arm and hand position were not causing this effect and the blockage of airflow on one side was necessary, control experiments were done. First, the hand was put into position, but the nostril was not closed to eliminate the arm as a possible cause of the effect. In 3 separate episodes, similar to the earlier experiments, no shift in EEG occurred (results not shown). Subject 1 was used for this experiment, since she proved to be such a good candidate during 4 earlier recordings. She was again used in a control experiment where one nostril was alternately taped closed (without

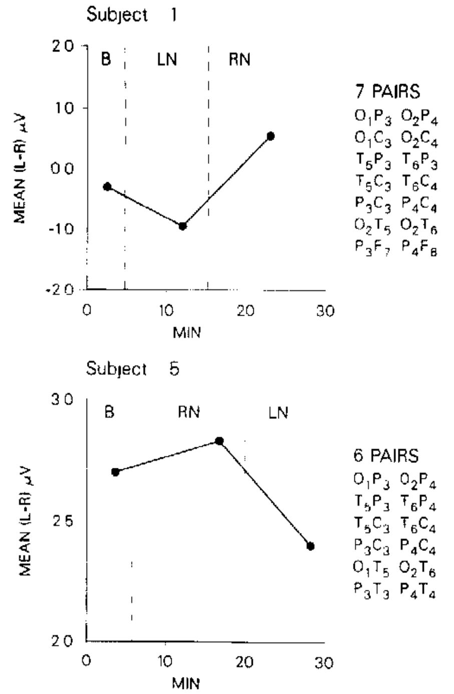

Fig. 5. Effect of forced uninostril breathing on EEG asymmetry. Subjects 1 and 5. Use of the Bic Mini-CEARS computer system. With Subject 1 the mean difference between the left and right hemisphere EEG amplitudes were measured from 7 pairs of EEG recordings and is plotted during uninostril breathing. Each sample is from 2 min of EEG. The subject was originally breathing predominantly through the right nostril. With Subject 5 the mean difference between the left and right hemisphere EEG amplitudes were measured from 6 pairs of EEG recordings and is plotted during uninostril breathing. B = baseline; RN = right nostril breathing; LN = left nostril breathing. Each sample is from 2 min of EEG. The subject was originally breathing predominantly through the left nostril

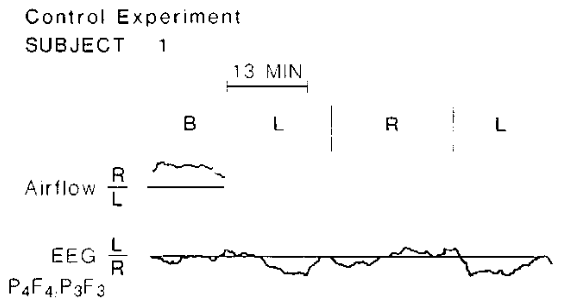

Fig. 6. Requirement of uninostril breathing to affect EEG amplitude asymmetry. Subject 1 – control experiment. The nostril was taped closed instead of using the hand as done previously. *Airflow tracing.* Points above the baseline indicate greater right nostril airflow, points below the baseline indicate greater left nostril airflow. *EEG tracing.* Points above the baseline indicate relatively greater EEG amplitude in the left hemisphere, points below the baseline indicate relatively greater EEG amplitude in the right hemisphere. Periods of uninostril breathing are indicated. Montage = $P_4F_4:P_3F_3$, a bipolar parietal-frontal recording

lifting the arm) to demonstrate that the uninostril airflow is required to produce these shifts. The results are shown in Figure 6. The shifts occur and are statistically significant at the 0.05 level by the sign test.

In summary, forced uninostril breathing produced a shift in the relative EEG amplitude asymmetry in the expected direction in 25 of 31 attempts. Statistical analysis of the concordance of the relative EEG dominance (the directional shift) and the respective nostril were assessed as in the previous experiment (Werntz et al. 1983). These results are listed in Table 1.

The effect on the shift in EEG dominance is usually least pronounced during the first period of forced nostril breathing. The latency for the effect varied anywhere between 1 second and 11 min with these subjects, but frequently occurred within the first 2 min.

Discussion

We have previously demonstrated a concordance between brain activity in the right and left cortex and a natural rhythm in the ANS. The dynamic lateralization of activity in the peripheral vasomotor tone on the two sides of the body, as exhibited by the nasal cycle (Werntz et al. 1983) is tightly coupled with a relative shift in the dominance of EEG activity in the right and left cerebral hemispheres. Earlier (Werntz et al. 1983) we suggested that the increased EEG amplitudes reflected enhanced mental activity, and not a decrease in the cognitive ability of the hemisphere contralateral to the dominant nostril as may have been expected by some evidence in the literature. Beubel and Shannahoff-Khalsa (1987) and Klein et al. (1986) have found that the testing of performance efficiencies of verbal and spatial tasks during both phases of the nasal cycle resulted in demonstrating that verbal efficiency is greater while the subjects were breathing primarily in the right nostril and that spatial skills were enhanced during left nostril dominance. This helps support our theory of contralateral dominance in the nostril-hemisphere relationships, as we suggested earlier on the basis of the neuroanatomical findings with the ANS. Ray and Cole (1985) have recently reported findings that also help support our interpretation of the EEG amplitudes. They have shown that the traditional model of EEG alpha interpreted in terms of arousal cannot account for the complexity of human behavior to which it is applied. It has long been assumed that since alpha is blocked when the eyes are open that this indicates that increased alpha amplitudes reflect mental inactivity. Ray and Cole have demonstrated that alpha is determined more by the attentional demands, i.e., whether the tasks measured are based on attention to environmental stimuli or internal processing. In tasks lateralized to either hemisphere, they found that the alpha amplitudes are substantially increased when the attentional demand is directed internally as with mental arithmetic, even with the eyes open, as opposed to arithmetical calculations based on external stimuli. Since in our earlier studies, as in this study, no additional external stimuli were provided for the subjects, the increased amplitudes observed must primarily reflect attention to internal processing, and therefore, increased mental activity in the hemisphere contralateral to the dominant nostril.

The experiments with unilateral forced nostril breathing help to further define the relationship between the nasal cycle and the alternating lateralization of EEG activity on the two sides of the brain. The nasal mucosa is one of the most abundant tissues that is innervated by both the sympathetic and parasympathetic branches of the autonomic nervous system. Greater airflow or decongestion in one nostril is regulated by greater sympathetic activity in the nasal mucosa of that side. Congestion or diminished airflow is maintained by enhanced parasympathetic dominance (Keuning 1968). Enhanced sympathetic dominance in the nasal mucosa would correspond to greater sympathetic tone in the ipsilateral hemisphere, and therefore, lesser blood flow and mental activity.

The present experiments were performed to investigate the possible effects of altering the natural phase of the nasal cycle on the pattern of EEG activity in the two hemispheres. The results indicate that forced nostril breathing through one side can generate a relative increase in the EEG activity of the contralateral hemisphere. This effect was demonstrated in 25 of 31 attempts using 5 different subjects. The effect appeared to be generalized across the entire hemisphere, as indicated by the use of a variety of scalp electrode montages in different subjects and by the use of multi-montage recording within some subjects. The effects of the breathing exercises produced almost immediate changes in the EEG in the vast majority of the attempts with these subjects. Although it has been questioned whether the lateralized differences in EEG amplitudes are due to changes in skin resistance as a result of impedence changes, this is not likely. Since the output of the EEG machine amplifiers are AC coupled and thus any DC shifts, which are what these impedance changes would be, are thus eliminated. Also this effect is unlikely since the point of impedance changes is the electrode gel/skin interface. This is the point of highest resistance and the only place impedance changes due to gel drying effects. This would not be affected by blood flow changes in underlying tissues.

Experiments by Kristof et al. (1981) and Servit et al. (1981) have shown the activating effect of hyperventilation through the nose (as opposed to oral breathing) on electrographic activity in the cortex in human and nonhuman species. The work by Kristof et al. (1981) suggests that the electrographic activity is produced by a neural reflex mechanism in the superior nasal meatus. This activating effect could be elicited by air insufflation into the upper nasal cavity without pulmonary exercise. Local anesthesia of the mucosal membrane suppressed these cortical effects of airflow.

In the experiments by Servit et al. (1981) deep breathing through one side of the nose was found to activate abnormalities in patients with unilateral focal or lateralized paroxysmal abnormalities in the temporal region (fronto-temporal or occipito-temporal). In a group of 12 patients with strictly unilateral temporal abnormalities, ipsilateral nasal airflow activated the EEG records in all 12 patients, whereas only 60% of them were activated by contralateral nasal ventilation.

With these patients, the results were determined by the frequency of occurrence of an abnormal EEG activation, or paroxysmal activity, produced by deep nasal breathing, above and beyond the level of the resting baseline recording period. We were monitoring the normal EEG wave activity and calculating the relative amplitude differences on the two sides. The type of measurements taken in our experiment and theirs are different. In our experiment the measurement is continuous, theirs is a matter of the frequency of occurrence with abnormality. Nonetheless they did find activation of cortical activity by deep nasal and/or uninostril breathing as opposed to oral breathing. The results of the effect of unilateral hyperventilation through the nose with the epileptic patients is somewhat different when compared to our study. On the whole we find a contralateral effect on EEG activity. It may be that the pattern of activation found with these patients is peculiar to this population group.

The consistent and selective effect of forced uninostril breathing in normal subjects on the general pattern of EEG activity in the hemispheres suggests the possibility of therapeutic approaches to states of psychopathology where lateralized dysfunction has been shown to occur. Flor-Henry (1983) and others have concluded from numerous studies that schizophrenia is associated with greater left cerebral hemisphere dysfunction and that depression and the other affective disorders are associated with greater right hemisphere dysfunction. It has also been hypothesized that the acute stages of these disorders exhibit as over- or underactivation of one hemisphere. It is possible that these mental disorders may manifest with degrees of symptomatology that correlate with the phases of the alternation of activity in cerebral dominance. A case study by Lynn, reported by Ischlondsky (1955), describes a significant neurological phenomena where a simultaneous hypersensitive-hyposensitive lateralization of activity in the sympathetic nervous system on the two sides of the body are associated with distinct and very different patterns of behavior in two patients with multiple personality disorder. The two most striking patterns of behavior exhibited by these patients were diametrically opposed personality types that have a consistent correlation with the congestion-decongestion response in nasal airflow. The switch from one personality type to the other would occur instantaneously. This was also accompanied by an immediate shift in nasal dominance. A study of the possible application of breathing exercises in the noninvasive treatment of personality disorders or states of psychopathology are warranted.

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