

Speaking from Two Sides of the Mouth

Roger E. Graves and Susan M. Potter

Department of Psychology,
University of Victoria,
Victoria, B.C., Canada,
V8W 2Y2

Visible Language XXII, 1
Roger E. Graves and Susan
M. Potter, pp. 128-137
© Visible Language, Rhode
Island School of Design
Providence, RI 02903

Differences while speaking from the two sides of the mouth are both visible and audible. Careful observation has shown that the right side of the mouth typically opens wider and moves more during speech. This visible asymmetry reveals the underlying physiology in which expression of speech is controlled primarily by the left side of the brain. Since the left side of the brain has better control of the right side mouth muscles, an asymmetry favoring the activity of the muscles of the right side results during articulation of speech sounds. In contrast, more equal activity from the left side of the mouth can be seen during emotional expression, prosodic expression, and singing which reveals a greater role of the right side of the brain during these latter types of expression. There are also audible manifestations of the physiological asymmetries. In a new study, subjects were required to speak from only one side of the mouth. Better quality of articulation was audible from the right side for most subjects.

“My left hand never learnt what my right one’s been doing” (Treat, 1943).

Most of us are quite familiar with the fact that we have a “preferred” or “dominant” hand which is more skilled for many actions, such as writing. Less familiar but equally true is that the non-preferred hand is more skilled for certain other actions. Try, for example, to tie your shoelace backwards. You will probably find that neither the left nor the right hand seems to know what the other one has learnt. None of this will be surprising to anyone save the few ambidexters among us, after all we do have two hands and use them differently. We have only one mouth, however, and we tend to view speech as a unitary act employing a single central organ which has no essential left versus right side difference. Thus, we may be somewhat surprised to discover that the left side of the mouth may also not have learnt what the right side’s been doing, and vice versa. Now neither the hand nor the mouth actually has much learning ability, the site of the learning and memory is usually considered to be the cerebral cortex of the brain. Furthermore, the brain is so constructed that skilled control of the right hand depends mainly on motor control areas on the left side of the brain, while control of the left hand depends on the right side of the brain. The superior right hand performance of right handers is thus thought to reflect superior praxic skill representation in left brain motor control areas.

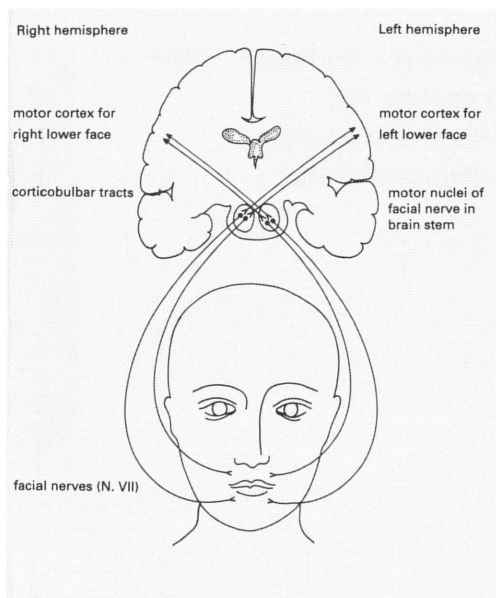
The situation is actually much the same for speech and the two sides of the mouth as for skilled actions and the two hands. The learning and memory for speech, at least as far as words, grammar, and the control of speech articulation is concerned, is for most of us strongly dependent on one side of the brain, namely the left cerebral hemisphere. As with the hands, the right side mouth muscles are mainly controlled by the left half of the brain and vice versa (see figure 1). From this anatomical perspective it is understandable that the right side of the mouth, which is controlled by the side of the brain with the superior speech control ability, might behave differently than the left side of the mouth during speech articulation. Furthermore, the *left* side of the mouth is

We have only one mouth, however, and we tend to view speech as a unitary act employing a single central organ which has no essential left versus right side difference. Thus, we may be somewhat surprised to discover that the left side of the mouth may also not have learnt what the right side's been doing, and vice versa.

controlled by that side of the brain which is superior for the perception and expression of emotional and prosodic aspects of speech (Ley & Bryden, 1981; Ross & Mesulam, 1979). (Prosody is the rising and falling pitch pattern which, for example, conveys information about whether a particular word or string of words is a statement, command, question, etc.) Thus, the left side of the mouth may behave differently than the right side of the mouth during expression of emotion and prosody.

**Diagrammatic representation
of the neural control of the
lower facial musculature.**

Figure 1

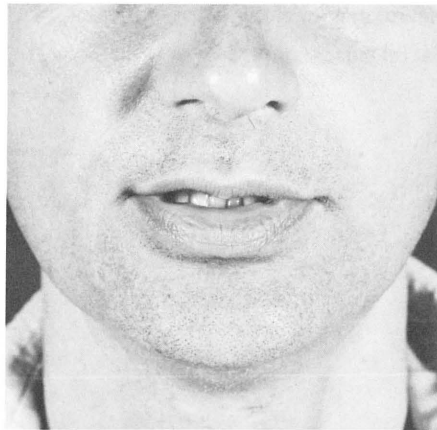


By 1980 a number of studies had discovered that emotional expressions, at least of certain types, were indeed expressed more strongly on the left side of the face (Borod and Caron, 1980; Campbell, 1978; Thompson, 1985). The first investigators looking for mouth asymmetry during speech then confirmed their prediction that the right side of the mouth would open more than the left side during speech articulation (Graves, Landis, & Goodglass, 1982). These studies observed that 150 of the 196 subjects had greater right side mouth opening during speech. Figure 2 shows the photographed asymmetry of one subject. Informal real time observation of speakers on TV or in person can sometimes also reveal an asymmetry, and more often than not it is the right

side which shows the greater opening (Hager & van Gelder, 1985). Anyone tempted to make such observations at the next cocktail party should be forewarned that people usually become quite uncomfortable when they notice someone staring at their mouth, and their discomfort does not decrease if you explain that you are looking at their asymmetries. There appears to be a social taboo against staring at your conversant's mouth, and this may have inhibited earlier discovery of mouth asymmetry during speech.

Photograph of a right handed male speaking "Pea" showing greater opening of the right side of the lips.

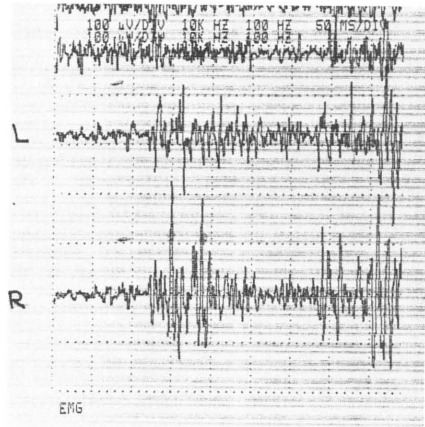
Figure 2



Studies of mouth asymmetry have shown that, when normal subjects are speaking, the right side of the mouth *opens more widely* (Graves et al., 1982; Graves, 1983; Wyler et al., 1987). This asymmetry was observed using still frame photographic techniques at a time about 50 milliseconds from the initial lip opening of a bilabial consonant (e.g., "B" or "M"). Landis, employing a computerized tracking system (Graves et al., 1982), also showed that the right side of the mouth moves more overall during continuous speech. Preliminary observations with a few subjects (Graves, Landis, & Simpson, 1985) have shown that asymmetry in muscle activity can also be seen in electromyographic recordings from surface electrodes placed around the mouth (see figure 3). The asymmetry in the electrical correlates of muscle activity appeared to be most prominent during fast changes in lip configuration such as with bilabial consonants, especially those in the middle of words.

EMG recordings from the left and right side lip musculature of a right handed male speaking "Bobbing".

Figure 3



Greater right side mouth opening or mouth movement during speech has been seen in all groups of normal subjects reported to date, these included both left and right handers and both men and women. The incidence of greater right side opening varied depending on the recording technique and the subjects' speech task. The highest incidence (80-90%) was observed with photographic recording and a word list task which discouraged visual, emotional, and prosodic involvement. Left handers in general also typically show greater right sided mouth activity during speech (Graves et al., 1982). This is consistent with the evidence that the percentage of left handers having left hemisphere control of speech is much higher than the percentage having right hemisphere control (Rasmussen & Milner, 1977).

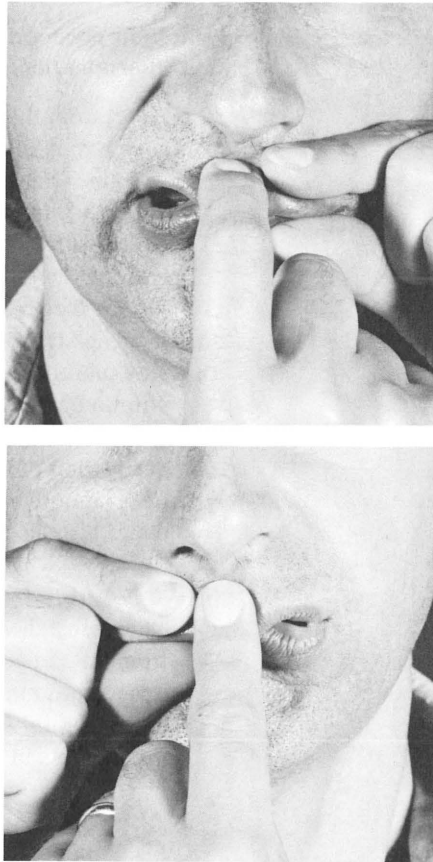
The initial studies also indicated that asymmetry in mouth opening during speech reflected more than just the left hemisphere control of articulation of speech sounds. This and subsequent work has shown a reduction in the strength of the greater right side mouth opening when subjects are describing visual situations of emotional significance (Graves et al., 1982; Wyler, Graves, & Landis, 1987). This effect does not typically involve a reversal to greater left side activity, but rather involves more equal levels of activity on the two sides of the mouth. More equal levels of mouth muscle activity on the two sides has been assumed to reflect participation of both sides of the brain in the expressive control.

Equal level of activity need not mean identical activity, of course, and the two sides of the mouth (and brain) may be expressing qualitatively different things. Smiles may produce a reversal to greater left sided activity (Wyler et al., 1987), although this has been an inconsistent observation (Campbell, in press).

All of the studies of mouth asymmetry which have so far been mentioned have looked for differences in the movements of the two sides of the mouth when people were speaking naturally. The latest study took a different approach. Subjects were asked to speak using one and then the other side of the mouth and differences in the quality of articulation were looked for. Sixteen right handed male university students took part in this study. The task was to say quickly two tongue twisters, "Peter Piper picked a peck of pickled peppers", and "Bobbling babies blowing bubbles burble and babble". These were chosen because they contain bilabial phonemes which require precise coordination of lip movements. Each subject said each tongue twister first from one side, then from the other side of the mouth. Half the subjects began with the left, half with the right side. The method used for speaking out of the right side of the mouth was for the subject to pinch the lips together in the midline using the tips of the thumb and index finger of his right hand and to pinch the lips on the left side of the mouth together using the thumb and index finger of the left hand placed parallel to the lips. For speaking out of the left side, the positions of the hands were changed accordingly (see figure 4). The tape recorded speech samples were judged by a listener who did not know which side of the mouth was which. The result was that, for the 16 subjects, quality of articulation was judged as better from the right side for 10 subjects, as better from the left side for 2 subjects, and as not discernably different for 4 subjects. This simple procedure thus showed that most of these right handed male subjects spoke better out of the right side of the mouth ($t(15) = 2.65, p < .01$, one-tail). Some subjects exhibited a virtual hemiparalysis of the left side lips when attempting this task.

Photographs of a right handed male speaking from the two sides of the mouth illustrating the technique used to restrain one side of the lips.

Figure 4



An important implication of the studies with normal subjects is that mouth asymmetry can be used as a tool to reveal underlying distinct components of the organization and control of expression, as well as to reveal the relative involvement of the two hemispheres of the brain with these functional components. One study with patients (Graves & Landis, 1985) employed this tool in order to understand better why some types of speech are more impaired while other types of speech are more preserved following brain damage. The results indicated that spontaneous speech, which is typically the most impaired following left hemisphere damage, showed greater right side mouth activity and thus is strongly dependent on left hemisphere control. Singing and serial speech (counting, for example), which are typically less impaired following left hemisphere damage did not

show greater right side mouth activity and thus are less dependent on left hemisphere control.

Apart from the potential of mouth asymmetry as a research tool, there are possibilities for therapeutic applications. Training of impaired speakers, including deaf children, stutterers, and brain damaged patients, could conceivably be facilitated by providing feedback concerning the relative activity of the two sides of the mouth. The results with aphasic patients suggest that feedback training to increase the relative amount of right side mouth muscle activity might assist the patient in employing the optimal (left hemisphere) system and inhibiting interfering (right hemisphere?) systems. Investigation of whether attention to one or the other side of the mouth would (or does) assist lipreading could also be considered.

Acknowledgement

This research was supported in part by Grant A-1021 from the Canadian Natural Sciences and Engineering Research Council. We thank Dr. Ruth Campbell for her many helpful suggestions which led to substantial improvements in this paper.

About the Authors

Ms. Potter was born in Middlesborough, England and moved to Canada. She attended Queen's University in Kingston, Ontario and then the University of Victoria, Victoria, B.C. where she received the B. Sc. degree in 1986. Her Honor's thesis concerned interhemispheric transfer of different types of information in normal adults. She is currently a doctoral student in Clinical Psychology at McGill University in Montreal, Quebec.

Dr. Graves received the B.S. (Electrical Engineering) and Ph.D. (Psychology) degrees from the Massachusetts Institute of Technology. He received training in Clinical Neuropsychology during a Postdoctoral Fellowship at Sunnaas Hospital in Norway and also during five years of association with Dr. Harold Goodglass in the Aphasia Research Center at the Boston Veterans Administration Medical Center. Since 1980 he has been on the faculty of the Department of Psychology of the University of Victoria.

References

- Borod, J.C. & Caron, H.S.** 1980. Facedness and emotion related to lateral dominance, sex, and expression type. *Neuropsychologia*, 18, 237–241.
- Campbell, R.** 1980. Asymmetries in the interpretation and expression of a posed expression. *Cortex*, 14, 327–342.
- Campbell, R.** in press. Asymmetries of facial action; some facts and fancies of normal face movement. In R. Bruyer (Ed.) *The neuropsychology of face perception and facial expression*. Hillsdale, N.J.: Lawrence Erlbaum.
- Graves, R.** 1983. Mouth asymmetry, dichotic ear advantage and tachistoscopic visual field advantage as measures of language lateralization. *Neuropsychologia*, 21, 641–649.
- Graves, R. & Landis, T.** 1985. Hemispheric control of speech expression in aphasia. A mouth asymmetry study. *Archives of Neurology*, 42, 249–251.
- Graves, R., Landis, T., & Goodglass, H.** 1982. Mouth asymmetry during spontaneous speech. *Neuropsychologia*, 20, 371–381.
- Graves, R., Landis, T., & Simpson, C.** 1985. On the interpretation of mouth asymmetry. *Neuropsychologia*, 23, 121–122.
- Hager, J.C. & Van Gelder, R.S.** 1985. Asymmetry of speech actions. *Neuropsychologia*, 23, 119–120.
- Ley, R.G., & Bryden, M.P.** 1981. Consciousness, emotion, and the right hemisphere. In *Aspects of Consciousness*, (pp. 215–240), Vol. 2. G. Underwood & R. Stevens (Eds.). New York: Academic Press.
- Rasmussen, T., & Milner, B.** 1977. The role of early left brain injury in determining lateralization of cerebral speech functions. *Annals of the New York Academy of Sciences*, 299, 355–367.
- Ross, E.D., & Mesulam, M.** 1979. Dominant language functions of the right hemisphere? *Archives of Neurology*, 36, 144–148.
- Thompson, J.K.** 1985. Right brain, left brain; left face, right face: hemisphericity and the expression of facial emotion. *Cortex*, 21, 281–300.
- Treat, L.** 1943. *O as in omen* (p. 23). New York: Sloan and Pearce.
- Wyler, F., Graves, R., & Landis, T.** 1987. Cognitive task influence of relative hemispheric motor control: mouth asymmetry and lateral eye movements. *Journal of Clinical and Experimental Neuropsychology*, 9, 105–116.