The Cardiac–Somatic Relationship

I. Introduction

To my surprise, the work we began in the mid-1960s observed a direct relationship between HR and somatomotor activities in several behavioral paradigms. This covariation between HR and somatomotor activity is what I call the cardiac–somatic relationship. The surprise came because I had viewed HR as a rather simple, direct index of the behavioral states generated by these paradigms, a measure independent of somatomotor activity. In fact, I had such a primitive understanding of somatomotor activity and related metabolic processes that initially I did not view the HR and somatic changes as integrated aspects of some more global response process that characterizes the cardiac–somatic concept. Rather, I looked at such HR changes as caused by the actual execution of the somatomotor response similar to the manner HR was viewed in the curarization studies concerning visceral learning (Miller, 1969). As such, these HR changes could be considered artifacts, as Smith (1954) proposed was the case for all conditioned autonomic responses.

At the time, Smith’s position was quite bothersome to a behavioral scientist such as myself who viewed these autonomic events as objective indices of behavioral states. In fact, one of the first research projects I was involved in as a graduate student was an evaluation of Smith’s position. Here we classically conditioned the pupillary response attempting to control somatomotor activity by curarization (Gerall & Obrist, 1962). The results did not support Smith’s position: we observed conditioned pupillary dilation with and without striate muscle paralysis. This result gave me confidence that autonomic events
could be used to index motivation and affective states. Thus, one of my succeeding efforts was to evaluate the relationship between motivational states, as indexed by HR, and verbal learning (Obrist, 1962). The inconclusive results of this study are not relevant to this discussion. The point to be made is that in my earlier research efforts I viewed HR and somatomotor activity as independent events and had no particular ax to grind demonstrating that they were anything but this.

I changed my viewpoint only when the data began to consistently suggest that HR and somatomotor activity were related. Also, as I became better informed about basics of cardiovascular physiology, the possibility of a relationship between HR and somatomotor activity no longer appeared absurd. The interpretation that such HR changes were artifactual with regard to behavioral states (i.e., now had little relevance) did not bother me. I felt it was time we carefully delineated the cardiosomatic relationship. Why continue to disillusion ourselves? Also, I still believed that there were circumstances where this relationship did not hold. Finally, one could even make a case that HR, to the extent it was related to somatomotor activity, could provide some useful information: it was not completely artifactual. For example, it might provide a global index of the status of the striate muscles, which could prove useful when indexing attentional states. Also, it provided a mechanism for the Laceys’ (Lacey & Lacey, 1974) afferent feedback hypothesis as to what triggered the phasic HR deceleration.

This chapter will trace the development of the cardiosomatic formulation, as it grew in our thinking, from the first data that we thought of as a dubious coincidence to a variety of observations that consistently pointed to its conceptual necessity. I shall primarily focus on HR because it is a measure we have obtained in all studies, and because it appears most sensitive to somatomotor activities. This is in contrast to other measures of myocardial performance and BP. The sensitivity of HR to somatomotor events is not particularly surprising in the light of the role HR has in the control of the CO. Also, we most commonly measured these other aspects of cardiovascular functioning under conditions where even HR appeared independent of somatic activity (see Chapter 4).

After reviewing our own work, I shall briefly examine research by others who have used various behavioral paradigms and whose results are consistent with the cardiac–somatic formulation. I shall also discuss why I think HR and somatic changes can be integrated events.