

CHAPTER 6

GENERAL CONCLUSIONS

The purpose of the present study has been to investigate and contrast the potential value for addressing the problems of piano technique of the motor and action systems approaches to motor control and learning, of which piano playing is one of the most sophisticated manifestations.

A fairly large variety of different aspects of the motor perspective to motor control and learning, and the action perspective to motor control, was discussed - it was found that the action approach to motor learning at present appears to be undefined to such an extent that some theorists even regard the action approach as unsuitable to account for motor learning. Examining many and varied topics from motor behaviour science - even although in some cases, for practical purposes, only essentials were pointed out - ensured that motor control and learning were to a reasonable degree represented as the highly multi-faceted fields of study they are, regardless of one's theoretical orientation. Considering a broad variety of topics also made it possible to form a conception of the "research culture" behind especially the relatively long-established motor systems approach, which was essential for an understanding of the fundamental nature of action theorists' reservations with respect to this approach. The treatment of many concepts from motor behaviour science applied to motor skills other than playing the piano, was a matter of necessity rather than choice, because scientifically-based empirical findings on piano playing in the motor control and learning context are extremely scant. In some cases, especially where conditions for practice were concerned, findings involving other motor skills were presumed to be of possible significance for piano playing as well.

If motor systems theory - and especially the notion of the motor program - is correct, then scientifically-based experimental and/or theoretical grounds exist to presume that the following premises, among others, with respect to piano playing and practising may be correct (some of the notions on practice were formulated on the grounds of experiments involving other motor skills, but no apparent reasons exist for them not being applicable to piano playing as well): it is better to practice rapid passages at a fast speed as near as possible to the required speed, and not engage in slow practice. Practising rapid passages in varied rhythmical patterns can be counterproductive. In the acquisition stage of learning a piece containing polyrhythms distributed between the hands, massive interference occurs, because the motor program can handle only one underlying temporal construct; therefore some (mental) strategy, at least initially, must be contrived to link the rhythms in both hands to some common temporal basis. Students should not refrain from attempting difficult rhythmical constructs like playing *rubato* proper, as each hand can be thought of as regulated by a

rather flexible internal clock; thus the motor system is equipped for dealing with such problems. Because of a "coupling" of the muscles in the dominant hand to the corresponding muscles of the non-dominant hand via the muscle-selection parameter in the generalized motor program, the simultaneous execution of figurations which are mirror images of each other with respect to the keyboard lay-out is a relatively easy matter. Simultaneous leaps in opposite directions can be controlled by the same generalized motor program; even if different distances are traversed, the hands should reach their destinations simultaneously, because different overall-force parameters can be selected for each limb. It is better to practice hands together rather than apart, because motor programming of the movement patterns in a particular hand may be quite different for the hand playing in the two-handed context, than for the hand playing on its own. When the non-dominant hand only has a simple accompaniment to deal with, practising hands apart would not make too much of a difference. Variable practice should produce improved learning - although it is not certain *what* should be varied - due to the fact that more effective schema are formed this way. Because massed practice induces greater variability in the task and/or causes the relevant information-processing to be more exhaustive, it is almost as effective as distributed practice, even though performance during the task deteriorates because of fatigue. Thus the fact that quality of performance will probably decrease during long practising sessions should not discourage students from practising hours at a time, because a decrease in performance quality does not necessarily imply a decrease in learning. Similar reasons hold for random practice being generally more effective than blocked practice; a deterioration in performance being associated with random practice as well. Practising a part of a piece in isolation, may so change the programming of the part, that it is no longer the same as it is in the context of the total piece; therefore at least some practice of the piece as a whole should be included in a practice session. Practising parts in isolation of piano pieces with predominantly serial characteristics, can be beneficial; it is not certain whether this will always be the case for pieces with predominantly continuous skill characteristics. Mental practice can in a sense be considered as fulfilled practice, because the generalized motor program controlling the task is executed as usual, the only difference being that the gain is turned down, so that physical movements are not observable.

If action systems theory is correct in its presumption that the motor systems theory application of the information-processing computer metaphor to human motor behaviour is invalid, and that the motor programming notion is wrong, then many of the arguments stated above could lose their status as premises based on scientific theory, which is the very reason for endorsing their inclusion in a strategy for practice. Various arguments presented by action theorists to support their view that motor systems theory has incorrectly approached the study of human motor behaviour, indeed give rise to some rather disquieting questions regarding the validity of motor systems theory which remain unanswered. These arguments include the fact that many laboratory researchers have studied motor skills which are irrelevant for everyday skilled human motor behaviour in an impoverished controlled

environment; the inability of traditional motor systems theory to account for human use of tools, in spite of the fact that many laboratory experiments require some sort of tool use; and the complexity and cumbersomeness, if not the practical impossibility, of accounting for relatively simple movement activities through theoretical constructs like control systems and the motor programming notion. Underlying this complexity is of course the description by motor theorists of human movement in kinematical, kinesiological and/or dynamical terms.

If action systems theory is also correct in its notion that human motor activity should rather be described in terms of functionally-defined postures and movements that constitute interacting action cycles and action systems, then learning without repetition - a *most* exciting prospect! - should be at the order of the day; thus, after completing the functional organization of whatever postures and movements serve to get the job done, the actor should be able to give a proficient performance of the skill he was required to master. Approaches advocated by certain piano pedagogues seem to have much in common with action theory concepts; especially the theorizing of Abby Whiteside stands out in this regard. Unfortunately, it appears to be extremely difficult to extract from the former some suggestions of how motor skill learning under such a quasi-action approach would actually take place and what the conditions would have to be to cultivate such learning; there appears to be some uncertainty about what happens between the learner coming to the piano for the first time, and the final, coordinated result. Of course, it may also be possible, as pointed out by some theorists, that action systems theory is inherently incapable to account for motor learning due to its shunning of cognitive structures.

Although it is undisputable that action systems theory makes a substantial contribution in pointing out the fallacies of the motor systems approach to motor control and learning, its own premises on how human movement occurs still need to be tested in most areas. Uncertainty exists, especially in the area of highly-skilled motor behaviour, about how movement takes place according to the action view. It is also not known how the functional nesting of postures and movements into action cycles, for the basic acts, occurs. Research needs to be done, furthermore, on how treatment of the senses as perceptual systems, will influence the conception of piano playing that is currently in vogue; the sight-reading field should also gain from such investigations.

It can be taken for granted that years of research efforts by the motor behaviour science community lies ahead for the motor systems and action systems approaches to motor control and learning as separate orientations of study, as well as for the controversy in which these perspectives radically oppose each other in explaining motor control and learning. (Some theorists feel that comparison between the two theories is not possible because they operate at different levels of analysis). Much more research, which directly involves piano playing, is necessary from both the

motor and action viewpoints, before any definitive recommendations can be made on which of the two approaches, or what sort of synthesis (if any), can be used as a scientifically-verified basis for piano-technical instruction and learning. Although the motor perspective is an established one, research findings pertaining to piano playing appear to be very scant, and experimental results based on the action approach seem to be virtually non-existent. How experimentation in the action sense should be carried out with respect to piano playing is an open question; it should nevertheless be well worth the effort to attempt establishing a scientific basis with some sort of generality for the ideas of Whiteside and others that exude so much promise on paper.

Finally, it should be emphasized that the present study has clearly shown that matters of motor control and learning in general, and piano playing in particular, are neither simple and straightforward, nor very predictable. This has some obvious, though rather significant, implications for the practice of piano-technical skills: if a pianist manages to master a particular problem, this does not necessarily mean that he mastered it because he employed a strategy based on the correct theoretical principles; it could just as well imply that he unwittingly applied in his practising, some aspects of what is really the correct theoretically-based strategy. And if a pianist practises the piano, without success, according to a strategy planned along the lines of all the theoretical premises known to the pianist and teacher, all is not necessarily lost; it is indeed possible that some or all of these premises may be wrong, requiring some further experimentation or search for new or improved theoretical principles. It is well known that narrow-mindedness in any field of study should be avoided at all costs; narrow-mindedness or adherence to traditional beliefs and habits, simply because they have been in use for decades or even centuries, appear to be profoundly misplaced in the field of piano playing.