Summary
It has consistently been reported that with ageing, from middle adulthood onward, motor performance and learning decline. Intriguingly, however, there is growing literature that suggests that the decline is particularly evident for explicit, conscious types of motor learning. By contrast, implicit motor learning, which relies on unconscious processes, would be relatively spared with ageing. Hence, a major aim of the current thesis was to test these conjectures and assess the relative benefits (or disadvantages) from implicit and explicit interventions in middle-aged and older adults’ sequential motor learning. To this end, investigations were conducted that evaluated the effects of interventions that restrict a learner’s awareness of the sequential motor tasks to various degrees in comparison to the more traditional instruction-based interventions used for motor learning. The investigations compared young and middle-aged adults’ motor learning on both the classical laboratory serial reaction time tasks (i.e., SRT-task) on a keyboard as well as gross assembly tasks, which was taken from the manual assembly industry and requires more complex movements. The investigations not only evaluated the amount of learning, but also a learner's resilience after learning against distractions and transfer.

The first study confirmed that in the SRT-task, implicit sequential motor learning remained unaffected with ageing, whereas explicit sequential motor learning was degraded among middle-aged adults compared to young adults. However, there were clear learning differences within the group of middle-aged adults, and in a second study, it was found that releasing the stringent time constraint, which is normally imposed in SRT-tasks allowed some middle-aged adults to actually benefit from the explicit instructions they were unable to use in the first study. These observations raised the possibility that middle-aged adults’ enhanced problems for explicit learning relative to implicit learning is due to a slowing down of voluntary movement control processes, while automatic movement control processes are less adversely affected with ageing. In a subsequent study, therefore, the effect of ageing on
voluntary and automatic movement control processes was investigated in an anti-pointing task. It was found that the voluntary movement control processes slowed down with ageing. Yet, it remained somewhat unclear whether this also occurred for the automatic control processes. Despite this ambiguity, the findings clearly indicated that age-related slowing down was more pronounced for voluntary movement control processes than for the automatic processes.

The two final studies examined sequential motor learning for applied and much more representative tasks, namely gross manual assembly. In contrast to the SRT-task, the manual assembly task does not impose time constraint (i.e., participants can choose their own pace). One study examined the effects of different amounts of explicit instruction for learning the task. It was found that the amount of instruction did not make a difference for young adults’ learning. Yet, among middle-aged adults, the more detailed instruction, which supposedly goes together with an increased cognitive load, was more beneficial for motor performance during retention (i.e., learning) and when transferred to dual task situation. In a final study, using the same manual assembly task, the capacity of middle-aged adults to handle slight deviations of the original sequence was examined. That is, participants learned two different but overlapping sequences and were tested with respect to proactive transfer (i.e., the effect of an earlier learned sequence on the learning of a new sequence) and retroactive transfer (i.e., the effect of learning a new sequence on the performance of the earlier learned sequence). For the assembly task at hand, only the middle-aged adults were found to benefit from sequence-specific proactive transfer (possibly, because their learning curve was less steep, and hence, further improvement was still possible). Regarding retroactive transfer, it was observed that both age groups suffered from retroactive interference, yet in terms of accuracy the impact was greater among the middle-aged adults. Interestingly, young adults who were fully accurate did profit from sequence-specific retroactive facilitation.
In sum, the thesis highlights that in evaluating (and thus in applying!) the relative benefits of implicit and explicit interventions for sequential motor learning in middle-aged and older adults, it is critically important to take the specifics of the task and performance context into account.