Summary

Human movement behavior emerges from the interaction between organismic, task and environmental constraints. People suffering from a motor disorder or disease run the risk of relying too much or too long on compensatory movement behavior to try and cope with the changed organismic constraints. Physical therapists are confronted with their patients' compensatory movement behavior every day. Overcoming unnecessary, bad habits in motor performance requires carefully monitoring movement behavior during rehabilitation. Considering human movement as a complex dynamical system and digitally analyzing the dynamics with nonlinear analyses tools could provide physical therapists with better insights into human movement behavior. In this thesis the Solution Space Model is central in the examination of the movement behavior in knee osteoarthritis (KO) and after a Total Knee Arthroplasty (TKA).

Compensatory movement behavior of both the affected and non-affected leg are seen in KO. Although a TKA is an accepted treatment in KO, around 17% of the patients report to be dissatisfied after their TKA. Accurately predicting recovery outcome following the surgical procedure is crucial to create realistic expectations of the consequences of the surgical intervention. Because the non-affected leg cannot serve as stable frame of reference to accurately predict recovery outcome, the upper extremities and/or trunk may serve as stable frame of reference instead.

The aims of this thesis were (1) to scrutinize the movement behavior in people with KO and during recovery after TKA using nonlinear analyses tools; (2) to examine whether the upper extremities and/or trunk may serve as stable frame of reference for the recovery outcome after TKA; (3) to advocate that human movement can best be regarded as a complex dynamical system which in physical therapy deserves to be studied in detail with nonlinear, sophisticated analyses tools.

In **Chapter 2** we aimed to gain more insight into the degree of automaticity and (un)predictability in isolated cyclical arm and leg movements. The results showed that the movements during treadmill walking were more automatized and less predictable compared to repetitive punching. Furthermore, increased speed elicited more automatized and less predictable movements in treadmill walking and repetitive punching.

In **Chapter 3** the degree of automatization and (un)predictability of the movement behavior in people with KO was studied. We found less automatized and more predictable movements during treadmill walking in people with KO compared to healthy controls. Furthermore, we found that the upper extremities and trunk may serve as stable frame of reference in order to predict walking ability in KO.

In **Chapter 4** we investigated the degree of (un)predictability in the trunk's fronto-parallel plane movements during treadmill walking throughout the recovery after a TKA. More predictable lateral trunk movements were found in KO, which were restored 12 months after TKA. Furthermore, the results showed that the degree of (un)predictability the trunk's lateral sway may serve as stable frame of reference to predict walking ability after TKA.

In **Chapter 5** we scrutinized the degree of automatization and (un)predictability of the legs during treadmill walking. We found compensatory movement behavior of the legs during treadmill walking 12 months after TKA.

Finally, in **Chapter 6** the empirical results of the empirical studies reported in this are being discussed and their clinical implications are highlighted alongside resulting recommendations for physical therapy and some suggestions for future clinical research.