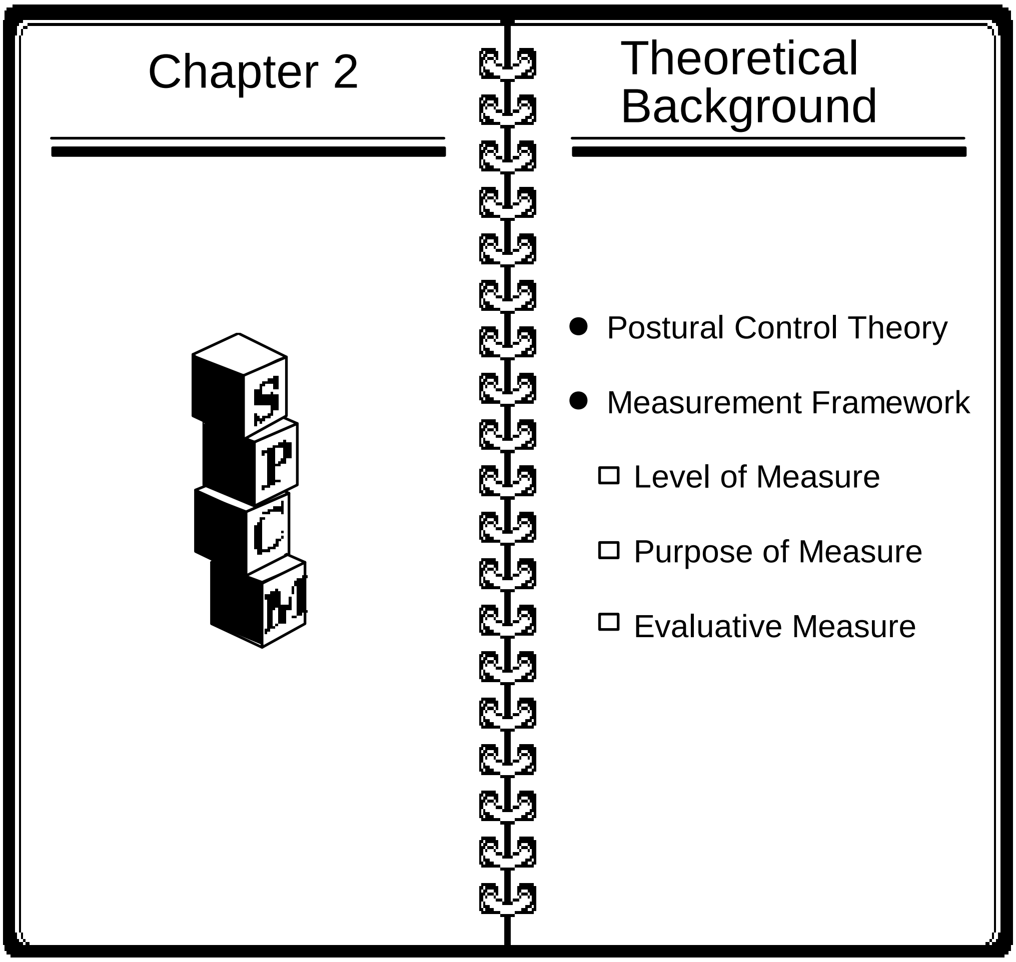
Chapter 2: Theoretical Background



Postural Control Theory

Current concepts of motor control provided the basis for instrument design. The prevailing view of the function of postural control is the integration of movements into coordinated action sequences to achieve a task goal (Reed, 1989). According to dynamical systems theory, postural control is an emergent property which is determined by the interaction of numerous subsystems (Kamm, Thelen & Jensen, 1990). Although some controversy exists regarding the range of subsystems which are involved, there is general agreement that the neurological system, the muculoskeletal system, the sensory system, the environmental context, and the task demands are important contributors to postural control.

Of particular significance to adaptive seating intervention are the biomechanical factors which influence the musculoskeletal system. Three such factors are the starting conditions of the movement, the degrees of freedom of movement, and the limits of movement available. The starting conditions are the alignment of body segments relative to each other, the alignment of body segments relative to the line of gravity and the combination of body segments which are constrained and those which are free to move. The constraints may be internal, such as muscle length, or external, such as a chair back. Postural control strategies used to perform an activity will be different if the starting position of the body changes. For example, when sitting with the feet unsupported and attempting to reach for an object, knee flexors may contract first to stabilize the calves against the legs of the chair before leaning forward to reach. However, if the legs are supported on a footrest, trunk flexors may contract first and an entirely different sequence of muscle activation occurs.

Adaptive seating is thought to influence postural control by affecting the starting conditions of the movement and by controlling the degrees of freedom and limits of movement. Selective support of body segments is provided through the use of specific seating system components. Re-orientation of the body, relative to the line of gravity, is achieved through adjusting the orientation of the entire seating system. It is hypothesized that optimizing these starting conditions for movement and limiting the range of movement to that which is controllable by the individual will enhance functional movement capacity.

Based on postural control theory, the seated postural control outcomes to be measured with the SPCM were thus conceptualized in two domains. These domains were postural alignment and functional movement.

An additional aspect of systems theory which was considered when generating items within the functional movement domain was the important effect of the task goal on movement performance. All motor actions involve a cognitive-perceptual component. For example, the feedforward command will call for greater or smaller effort depending on the demands of a specific task. As well, the context of the task and motivational factors affect performance. Hence the grading and selection of items for the functional movement domain needed to be based on goal-directed actions that are significant in everyday function rather than requests for movements without a purpose meaningful to the child. Items were therefore developed which measured the effects of alignment changes on functional movements with varying task demands.

Measurement Framework

In addition to the selection of a conceptual framework of the postural control system, selection of a measurement framework was a prerequisite to test development. Important measurement issues considered in developing and using a measure were the level of measurement and the purpose of the measure.

Level of Measurement

Several authors have stressed the importance of conceptualizing the levels of the human system at which our interventions are being directed (Guccione, 1991; Kielhofner, 1985) and ensuring that our measurement tools are valid for assessing the level of the system of interest (Campbell, 1991; Haley 1992). Campbell (1991) and Haley (1992) have both proposed measurement frameworks for assessing motor performance based on the World Health Organization's (WHO) classification of impairment, disability and handicap (World Health Organization, 1980). In applying the WHO classification to motor performance, impairment refers to the abnormality or loss of a motor component or process, disability refers to the restriction of functional activity and handicap refers to the inability to perform a social role due to the motor impairments or disabilities (Haley, 1992). Campbell (1991) recommended the use of Nagi's (1969) model to develop a measurement framework for children; this model adds a functional limitations category between the impairment and disabilities categories. Haley (1992) recently proposed further elaboration of this model to include developmental and contextual dimensions as well as measurement constructs. His measurement construct associated with the functional limitations classification is the capacity to demonstrate discrete functional *skills* (usually tested within a clinical context). The measurement construct associated with the disability classification is the performance of functional *activities* (within a natural context) and that associated with the handicap classification is the performance of social, family, and personal *roles*.

Utilizing Haley's expanded model, the Seated Postural Control Measure can be considered to measure seating outcomes at both the impairment and functional limitation levels. The alignment section, which measures changes in alignment of body segments, evaluates abnormalites in a postural control component which could be considered the impairment level. The functional movement section of the SPCM assesses the capacity to achieve a specific task in the clinical setting and is thus measuring functional limitations as described in the Haley model.

Purpose of Measurement

A classification system for assessing health measures has been developed by Kirshner and Guyatt (1985) based on the three purposes of discrimination, prediction, and evaluation. A discriminative measure was identified as one which is used to distinguish between individuals on an underlying characteristic. Developmental screening tests are frequently of this type, assessing developmental characteristics which distinguish delayed or disordered development from normal development. An example of a seating measure which has been developed for this discriminative purpose is the Level of Sitting Ability Scale (Mulcahy et al 1988). This scale, which distinguishes between children based on their sitting abilities, consists of seven developmental sitting levels defined by the ease of placement and stability in sitting

A predictive measure forecasts future health status or performance based on current test scores. Seating scales which attempt to assign risk scores for pressure sore development fit into this category. Pressure sore risk scales assign risk scores to factors which are known to be associated with an increased incidence of pressure sore development. Factors such as age, incontinence, duration of paralysis, smoking, use of anticoagulants, previous fractures, and previous skin breakdown are items frequently included on these risk scales (Crenshaw & Vistnes, 1989).

An evaluative index measures the degree of change of an underlying characteristic over time or as a result of treatment. It is for this purpose that the Seated Postural Control Measure has been developed and thus the properties of an evaluative measure will be discussed in greater detail.

Features of an Evaluative Measure

A number of key considerations for developing an evaluative measure have been described by Kirshner and Guyatt (1985) and expanded upon by the developers of the Gross Motor Function Measure (Russell et al., 1990):

- Items must be selected for their responsiveness (i.e., their capacity to detect clinically important change)

- Item scaling must incorporate sufficient gradations to register change

❑ A sufficient range of items is required to detect all clinically important treatment effects

❑ The stability of the measure must be demonstrated to show that scores of children who are not changing do not vary significantly on repeated testing (small within-subject variation)

❑ Validation of the responsiveness of the measure requires demonstrating that it is capable of detecting clinically important change when it does occur and is stable in the absence of change

The subsequent chapter describes how these features have infuenced the development of the SPCM.