Learning Spinal Manipulation: The Effect of Expertise on Transfer Capability

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Abstract

Objective: Transfer capability represents the changes in performance in one task that result from practice or experience in other related tasks. Increased transfer capability has been associated with expertise in several motor tasks. The purpose of this study was to investigate if expertise in spinal manipulation therapy, assessed in groups of trainees and experienced chiropractors, is associated with increased transfer capabilities.

Methods: Forty-nine chiropractic students (fifth- and sixth-year students) and experienced chiropractors were asked to perform blocks of 10 thoracic spine manipulations in 3 different conditions: preferred position and table setting, increased table height, and unstable support surface. Spinal manipulations were performed on a computer-connected device developed to emulate a prone thoracic spine manipulation. Thrust duration, thrust force rate of force application, and preload force were obtained for each trial and compared across groups and conditions.

Results: Results indicated that both expertise and performance conditions modulated the biomechanical parameters of spinal manipulation. Decreased thrust duration and increased rate of force application were observed in experienced clinicians, whereas thrust force and thrust rate of force application were significantly decreased when task difficulty was increased. Increasing task difficulty also led to significant increases in performance variability.

Conclusion: Overall, this study suggests that when instructed to perform spinal manipulation in a challenging context, trainees and experts choose to modulate force to optimize thrust duration, a characteristic feature of high-velocity, low-amplitude spinal manipulation. Given its known association with motor proficiency, transfer capability assessments should be considered in spinal manipulative therapy training. (J Manipulative Physiol Ther 2015;38:269-274)

Key Indexing Terms: *Manipulation; Spinal; Chiropractic; Learning*

Expertise in health professions is most often associated to the initial training and the accumulated years of practice. However, one can easily conceive that other factors and sometime intangible criteria can be used to define expertise. For years and despite the lack of clear scientific evidence, expertise in manual therapy has been associated with motor proficiency. Over the last 20 years, several researchers have attempted to identify and characterize markers of expertise in spinal manipulative therapy (SMT).[1] Although definite markers of expertise remain elusive, a few biomechanical parameters have systematically been associated to SMT expertise in cross-sectional and longitudinal studies.[2,3] Such parameters include preload force (gradual force applied to the spine before the thrust), time-to-peak force (impulse duration), peak force, and rate of force application.[4] Most studies also indicate that these basic components are sequentially mastered by trainees in such a way that, by the end of their clinical training, students achieve, for these basic components, performances similar to the experts' performances.[2,4]

Conversely, advanced components such as coordination, weight transfer, retention, and transfer capabilities may develop later during the first years of clinical practice, which are characterized by increased and regular training of SMT skills.[4] Yet, scientific evidence supporting this assumption is scarce. The investigation of transfer capabilities, which reflect one's ability to compensate for environmental

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Table 1. *Participants' Characteristics for Each Group*

	Fifth-Year Students n = 16	Sixth-Year Students n = 17	Expert Clinicians n = 16	*P* Value
Age (y)	23.8 (2.2)	25.8 (3.8)	34.0 (9.0)	$P < .001$
Weight (kg)	65.93 (12.23)	68.47 (12.83)	68.25 (11.52)	$P > .05$
Height (m)	1.71 (0.10)	1.72 (0.10)	1.70 (0.07)	$P > .05$
BMI (kg/m^2)	22.51 (2.90)	23.04 (2.78)	23.58 (2.86)	$P > .05$
Sex (n)	Men: 6 Women: 10	Men: 7 Women: 10	Men: 8 Women: 8	

BMI, body mass index.

changes during motor task execution (motor adaptation), constitutes the framework of the present study.[5]

Transfer capability, also called *motor generalization*, is defined as the persistence of acquired capability for performance in a given motor task when switching to other related motor tasks; it is often considered a hallmark of motor learning.[6] In other words, it represents the gain (or decrement) in performance in one task as a result of practice or experience in some other tasks.

Fundamental motor control research has shown that the amount of transfer between 2 tasks strongly depends on the similarity of the tasks.[6] It has also shown that transfer is small but positive in most cases. One must, however, keep in mind that these results are mostly based on short-term learning and transfer with simple motor tasks. In such experimental designs, participants can be considered learners but perhaps not experts.

The investigation of transfer capability or motor adaptation in newly acquired skills is highly relevant in educational and clinical research and has potential implications in sports performance as well as in clinical training, where expertise is characterized by years of intensive and deliberate practice.

For instance, in an early study by Leavitt (1979)[7], experienced ice hockey players were shown to better maintain skating speed during various dual-task conditions (skating combined with stick handling, skating while identifying geometric objects) compared with novice players. Such an example highlights the ability of learners to adapt their performance in increasingly difficult tasks. Likewise, in health-related research, a systematic review of skills transfer after surgical simulation training reported that skills learned in a simulated environment were positively transferred to the operative setting.[8] This review clearly suggests that simulated environments and devices offer complex various constraints that closely match the demands of the natural task. Overall, these results suggest that transfer capabilities need to be assessed in more ecological learning environments to truly evaluate the extent of the persistence of acquired capability for performance throughout various yet related motor tasks. This particularly holds true for most SMT skills, which are too often practiced in simplified version of the task.

Consequently, the main objective of this study was to investigate if expertise in SMT, assessed in groups of trainees and experienced chiropractors, is associated with increased transfer capabilities. It was hypothesized that experienced clinicians would better maintain their SMT performances when switching from one task to another compared with trainees with limited experience and task exposure.

Methods

Participants

Forty-nine participants (chiropractic students and experienced chiropractors) voluntarily participated in the current study. All participants gave their informed written consent according to the protocol. This study was approved by the University du Québec à Trois-Rivières ethics committee (CER-14-201-07.17). Participants' SMT performances were assessed during a brief (15 minutes) experimental session conducted in the institution's research laboratory. Three different groups of participants were tested based on their clinical experience and level of training. Participants in group 1 (n = 16, mean age = 23.8) were all fifth-year students who had previously completed 3 years of supervised SMT practice. Participants in group 2 (n = 17, mean age = 25.8) were sixth-year students cumulating 4 years of high-velocity, low-amplitude SM training and 1 year of supervised clinical practice. Participants in group 3 (n = 16, mean age = 34.0) were all experienced chiropractors with clinical postgraduation experience ranging from 2 to 26 years of clinical practice. Participants' characteristics are presented in Table 1.

Procedure

Participants were instructed to complete 10 consecutive thoracic spine manipulations on an instrumented device using a right-handed pisiform contact. The maneuver, identified as a prone unilateral hypothenar transverse push adjustment, was performed with a posterior to anterior force vector using either a left or a right contact and the body positioning of their choice. First, all participants were instructed to complete 10 trials of their "best" thoracic spine manipulation using their preferred table height and positioning. Instructions were given without emphasizing on any specific SMT parameters, and no feedback regarding their performance was provided. Following these trials,

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