Degree of seriousness		1	2	3
	Normal	F	E	A
Step length (m)	0.81	0.78	0.74*	0.74*
Frequency (Hz)	1.95	1.88*	1.81*	1.83*
Vert. displ (cm)	4.90	5.00	5.80*	6.10*
Speed (m/s)	1.58	1.39*	1.35*	1.36*
Number of steps	21.26	23.56*	23.43*	23.64*
Step Time (s)	0.51	0.53*	0.55*	0.55*
Step time L (s)	0.52	0.53*	0.59*	0.59*
Step timeR (s)	0.51	0.53*	0.52*	0.52*
Asymmetry	3.80	5.20*	11.20*	12.90*
Irregularity L	0.013	0.018*	0.023*	0.023*
Irregularity R	0.013	0.015*	0.018*	0.018*

Table 1: Mean values for normal walking, flexion (F) and extension (E) limitation and arthrodesis (A). *significant change with regard to normal.

Results

The simulated conditions induced acute changes in the subjects. In all conditions, the asymmetry, irregularity and step time increased, while the step length, -frequency and speed reduced. During flexion limitation and arthrodesis, all movement parameters changed significantly. In contrast the changes in step length and vertical displacement did not change significantly for the extension limitation condition (table 1).

Discussion

The results indicate that a tri-axial accelerometer is sensitive enough to differentiate healthy gait from pathological gait observed in orthopaedic patients. The degree in which the movement parameters was affected increased with the severity of the knee limitation. By using accelerometers relative small but clinically relevant differences in gait pattern can be detected. For example the decrease in step length (6cm) is difficult to detect visually but is responsible for a slower walking speed, which can be a limiting factor for activities of daily life. Moreover the application of accelerometery gives insight in the compensation mechanism applied to adapt to the functional limitation. Flexion limitation and arthrodesis was compensated by an increase in step time of the non-affected leg (left), while extension limitation was compensated by longer step times of the affected limb. This study has shown that a tri-axial accelerometer produces clinically relevant output parameters which could be used to monitor the functional changes in individual patients leading to or following orthopaedic interventions such as joint arthroplasty.

Keywords

accelerometer, sensitivity.

Free Communications

Session 1

Chair: Peter Beek

Rhythmic instruction and motor learning

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The purpose of this study is to investigate the effectiveness of rhythmic teaching methods and the changes of internal representations as well as their interactions during motor learning. Previously, these aspects have only been studied separately. A sequence of dancing movements constituted the learning task. We investigated the effects of verbal cues (VC) (Landin, 1994) on motor performance and internal representations during initial learning. With reference to Magill and Schoenfelder-Zohdi (1996) we assumed that the effects of VC on performance and cognitive representations depend on the mode of instruction (model instruction (MI)/ verbal instruction (VI)).

Based on pretest results, 80 participants were randomly assigned to one of four experimental groups: MI-plus-VC, MI-only, VI-plus-VC, VI-only. Practice trials were video taped and analysed for structural/ adaptive movement form and movement timing. Internal representations were acquired by a computer-aided selection test (CAST) which was provided instruction-related as picture selection test (CA-P-ST) or text selection test (CA-T-ST).

The acquisition phase consisted of two sessions with an interval of one week. The retention test was performed one day later. The acquisition phase was structured as follows: instruction phase – CAST – 5 practice trials (PT) without KR Subjects performed this sequence three times per session. The retention test started with the instruction-related CAST followed by 3 PTs. Finally the participants had to complete the other CAST

The analysis yielded no significant group differences regarding structural/adaptive movement form. The performance of all groups improved significantly during the experiment ($F_{(3, 218)}$ [1] = 116.261, $p < 0.001$). Analysis of the movement timing revealed a significant improvement of all groups ($F_{(2, 104)}$ [1] = 19.898, $p < 0.001$), a significant effect of the mode of instruction in favor of MI ($F_{(1, 52)}$ = 25.345, $p < 0.001$), and a significant interaction effect of time of measurement x mode of instruction ($F_{(2, 104)}$ [1] = 19.898, $p < 0.001$). Internal representation data yielded significant improvements of all groups ($F_{(4, 318)}$ [1] = 47.629, $p < 0.001$), a significant effect of the mode of instruction in favor of VI

($F_{(1,76)}$ = 42.355, $p < 0.001$) and a significant interaction of time of measurement and mode of instruction ($F_{(4, 318)}$ [1] 47.629, $p < 0.001$).

The presented results do not confirm our assumption. Verbal cues did not result in differential effects for either performance or internal representations. The differential effect of the mode of instruction on the development of performance and internal representations is remarkable.

Notes

[1]ε-corrected

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The ambivalence of self-controlled (motor) learning: A model-guided psychological analysis

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Self-controlled learning (SCL) is a relative new topic in the field of motor learning and simply means that the learner has control over (at least) one aspect of the learning situation. Results of studies who typically compared a group of self-controlled learners to a yoked group of externally controlled lear-ners, show that self-control, in fact, enhances the effectiveness of motor learning. Thus, there is some 'self-control effect' (Bund & Wiemeyer, 2005). However, this effect consistently occurs delayed: While both groups show similar performance during acquisition, the self-control group outperforms the externally controlled group in the retention test. To explain this delay of the self-control effect, a model was developed which contrast the cognitive and motivational processes of self-controlled lear-ning and externally controlled learning. The basic assumptions of this model are:

1. Self-control learners have to organize their learning process by themselves. Therefore, their cogni-tive load is higher than the cognitive load of the externally controlled (yoked) learners.
2. Self-controlled learners are more intrinsically motivated than externally controlled (yoked) learners. This compensates the cognitive disadvantage and leads to similar acquisition scores of both groups.
3. In the retention test, self-controlled learners benefit from their individual learning during the acqui-sition phase and outperform their externally controlled counterparts.

The present study was conducted to evaluate the model.

Participants: 48 students, 32 men and 16 women (M = 23.5 years), participated in this study. None of them had previous experience with the task, and all were naive as to the purpose of the experiment.

Task and dependent variables: The learning task was to throw a standard tennis ball to a 1x1m-target with the nondominant hand. Throwing form and throwing accuracy were the dependent measures.

Experimental groups and procedure: Participants were randomly assigned to one of four experimental groups: 1. Self-control (SC), 2. Yoked (YO), 3. Self-control + Training (SC+T), 4. Yoked + Training (YO+T). Participants of the SC groups determined autonomously the frequency of augmented feed-back. Prior to the experiment, subjects in the SC+T group took part in a special training with the ob-jective to reduce the cognitive load during self-controlled learning. Both SC groups were paired with yoked groups. All participants completed two acquisition sessions (each with 100 throws), seperated by an 1-day-interval and were then given a no-treatment retention test (20 throws) 4 days later.

According to the model, the SC+T group should outperform the yoked groups not only in the retention test but also (already) in the acquisition phase. *Throwing accuracy*: A 2 (control of learning) x 2 (trai-ning) x 20 (blocks of 10 trials) indicate that all groups enhanced their throwing accuracy during acqui-sition, $F(19,836) = 4.36$, $p < 0.05$, $\eta^2 = 0.06$. However, the effects of control of learning, $F(1,44) < 1$, and training, $F(1,44) < 1$, were not significant. Analysis of retention data yielded a significant effect of con-trol, $F(1,44) = 5.37$, $p < 0.05$, $\eta^2 = 0.08$, with the SC groups showing more accurate throws than the YO groups. The effect of training was not significant, $F(1,44) < 1$. *Throwing form*: All groups improved clearly their throwing form during acquisition, $F(19,836) = 17.26$, $p < 0.001$, $\eta^2 = 0.21$. Again, the main effects were not signifikant, both $F(1,44) < 1$. Across retention, the form scores of all groups were simi-lar, i.e., the effects of control and training were not significant, both, $F(1,44) < 1$. Due to the fact that the SC groups were (partly) superior to the YO groups in the retention test, the results of this study verify prior research. However, the SC+T group did not show better acquisition performance than the other groups, which is contradictory to our model. Possible reasons are discussed in the presentation.

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