

## Supplemental Data

**Summary of significance levels** - Tables S1 and S2 summarize the results of the correlation analysis between visual and motor performances. Table S1 shows the correlations between the percentages of correct ‘same’ responses in the visual task and the performances for the execution of the novel motor pattern measured with the two motor performance indices, for the different gait patterns (180, 225 and 270deg).

To ensure that our results were not dependent on perceptual bias effects we conducted a signal detection analysis, which takes into account also the incorrect “same” responses. The  $d'$  values were computed by evaluating the difference  $z(\text{hit}) - z(\text{fa})$ , where  $z(\text{hit})$  is the z-score of the probability of a ‘hit’ (i.e. the probability of a correct “same” responses in trials in which the two stimuli exhibited the same phase difference) and where  $z(\text{fa})$  is the z-score of the probability of a “false alarm” (i.e. the probability of a “same” response in trials in which the two stimuli did not exhibit the same phase difference).

Table S2 shows correlations between visual discrimination performance ( $d'$ ) in the visual task and motor performance for the three gait pattern (180, 225 and 270deg). Both tables show the values of the Spearman rank correlations and the associated significance probabilities. Values reaching a significance level of at least  $p < 0.05$  are indicated in red.

Table S3 summarizes the results of 2-way repeated-measures ANOVAs on visual performance in the main experiment (left column) and in the control experiment (right column). A significant influence of the training (interaction effect,  $p < 0.005$ ) was found only for the motor training, but not for the visual training in the control experiment.

$I_{sin}$	<i>180</i>	<i>225</i>	<i>270 deg</i>
<b>Before Training</b>	$r_s=0.10, p=0.82$	$r_s=-0.61, p=0.11$	$r_s=0.17, p=0.69$
<b>After Training</b>	$r_s=-0.28, p=0.51$	$r_s=-0.36, p=0.38$	$r_s=0.91, p<0.005$

$I_{stab}$	<i>180</i>	<i>225</i>	<i>270 deg</i>
<b>Before Training</b>	$r_s=-0.24, p=0.57$	$r_s=0.37, p=0.37$	$r_s=-0.44, p=0.28$
<b>After Training</b>	$r_s=0.16, p=0.71$	$r_s=0.25, p=0.55$	$r_s=-0.9, p<0.005$

**Table S1** – Summary of the correlations between motor performance indices  $I_{sin}$  and  $I_{stab}$  and performance in the visual test (percent same responses) for the 3 prototypical gait patterns before and after motor learning (8 subjects).  $r_s$  is the Spearman rank correlation, and  $p$  indicates the statistical significance levels. Correlations that are significant with  $p < 0.05$  are marked in red.

$I_{\text{sin}}$	$d'_{180}$	$d'_{225}$	$d'_{270}$
<b>Before Training</b>	$r_s = -0.24, p = 0.57$	$r_s = -0.36, p = 0.39$	$r_s = 0.08, p = 0.84$
<b>After Training</b>	$r_s = -0.36, p = 0.39$	$r_s = -0.55, p = 0.16$	$r_s = 0.81, p < 0.05$

$I_{\text{stab}}$	$d'_{180}$	$d'_{225}$	$d'_{270}$
<b>Before Training</b>	$r_s = 0.10, p = 0.82$	$r_s = 0, p = 1$	$r_s = -0.4, p = 0.33$
<b>After Training</b>	$r_s = 0.10, p = 0.82$	$r_s = 0.50, p = 0.21$	$r_s = -0.88, p < 0.005$

**Table S2** – Summary of the correlations between motor performance indices  $I_{\text{sin}}$  and  $I_{\text{stab}}$  and performance in the visual test ( $d'$  values) for the 3 prototypical gait patterns before and after motor learning (8 subjects).  $r_s$  is the Spearman rank correlation, and  $p$  indicates the statistical significance level. Correlations that are significant with  $p < 0.05$  are marked in red.

	<i>Main Experiment</i> (motor training)	<i>Control Experiment</i> (visual learning)
<b>Factor Phase Difference</b> (180, 225, 270 deg)	$F(2,14) = 19.5; p < 0.0001$	$F(2,14) = 13.7, p < 0.001$
<b>Factor Training</b> (Before/After)	$F(1,7) = 0.2; p = 0.67$	$F(1,7) = 0.29, p = 0.61$
<b>Interaction</b>	$F(2, 14) = 9.8; p < 0.005$	$F(2,14) = 1.32, p = 0.30$

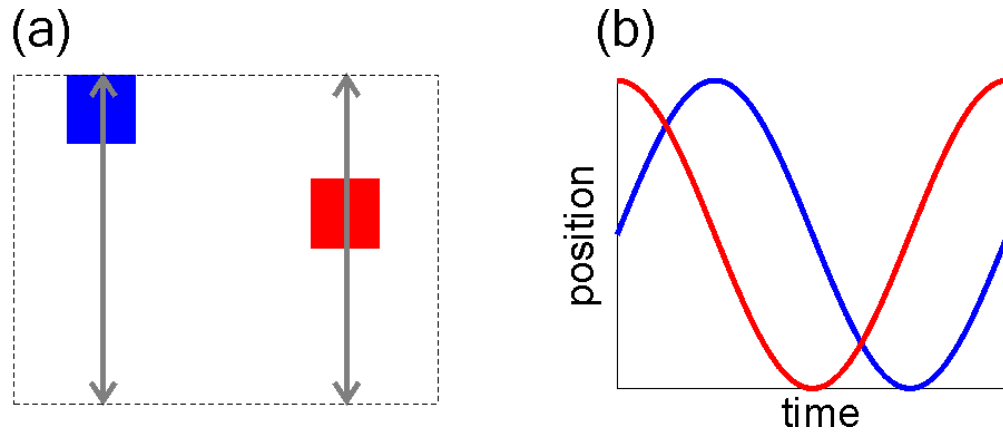
**Table S3** – Results of a 2-way repeated measures ANOVA of the visual performance (percent correct “same” responses) in the main experiment, and in the control experiment. Statistically significant effects ( $p < 0.05$ ) are indicated in red.

**Control Experiment** – The control experiment tested whether the observed motor-visual transfer can be accounted for predominantly by the learning of a rhythm. The control experiment had the same basic design as the main experiment, but the motor training was substituted by a purely visual learning task. This training required participants to discriminate the phase relationships of pairs of squares that oscillated periodically along the vertical axis (Figure S1). Only subjects who performed above chance level for the 180 deg condition of the visual pre-test, and whose recognition rates differed at least by 10% between the 180 and 270 deg conditions underwent this visual training. A total of eight subjects took part in this experiment.

Stimuli were presented on an LCD monitor. The oscillating squares had a length of about 0.3 degree of visual angle and the vertical amplitude of the oscillation was about 6 degree. Their oscillation frequency was about .8 Hz, matching the basic frequency of the gait patterns in the test blocks. In each trial, subjects were presented with two successive stimuli at two different fixed positions on the screen. The first stimulus was the prototype (270 deg), and the second stimulus was either the prototype (50 % of the trials) or a stimulus with a different phase difference. Subjects had to report whether the two stimuli were perceived as identical. Subjects were explicitly instructed to base their judgment on the 'rhythm' of the pairs of dots. Four complete cycles of both stimuli were presented. The initial phases of the sinusoidal oscillations were randomized across trials and subjects.

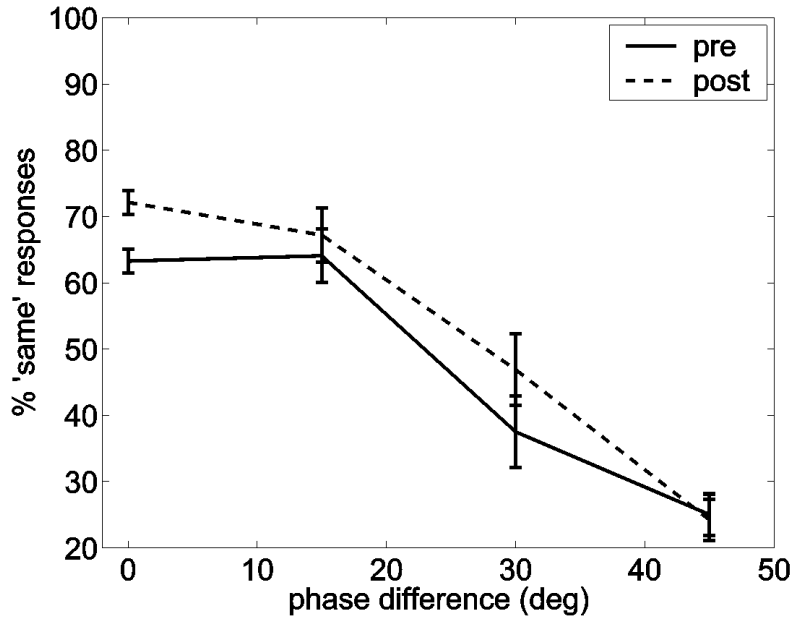
Stimuli were presented in consecutive blocks, each consisting of 24 trials. Each training session consisted of 10 successive blocks. During the first two blocks subjects received no feedback; during blocks 3 and 4 subjects received feedback, and so on. Training lasted several days with 4 training and 6 test blocks administered every day. Training was terminated when either (a) the number of correct same response in the last two training blocks was higher than 85% (matching the average percentage of correct same responses for the normal gait pattern in the main experiment), or (b) if no improvement was observed within two consecutive training blocks. Most subjects required two days of training to reach this criterion.

In order to prove the occurrence of visual learning for the phase relationship of 270 deg in the visual learning task we compared the performance in the first two and the last two



**Figure S1** - Stimulus used for the visual training in the control experiment. (a) Arrows indicate direction of sinusoidal motion of the two squares. (b) Vertical positions of the squares as a function of time for the phase difference of 270 deg. Squares in the real stimulus had identical colors.

blocks of visual training. The average percentage of correct “same” responses increased from the initial value of  $68\% \pm 5.1\%$  to the final value of  $90\% \pm 2.8\%$ . This increase was statistically significant ( $t(7)=6.1$ ;  $p<0.001$ ). Also the comparison of the  $d'$  values before and after visual training revealed a significant increase from  $.65 \pm .16$  to  $1.8 \pm .15$  ( $t(7)=6.09$ ;  $p<0.0005$ ). These results confirm that subjects really learned the phase relationship of 270 deg during the visual training. If the motor-visual transfer in the main experiment was achieved solely by learning the rhythm that characterizes the phase relationship of 270 deg, subject should be expected to show a transfer between the two visual tasks in the control experiment, in which they were explicitly instructed to use the rhythm. Our experimental result rules out this possibility.



**Figure S2** – Average percentages of “same” responses as a function of the phase difference between the two successively presented gait patterns for the trained prototype (270 deg). Vertical bars represent standard errors over 8 subjects.

**Tuning curves of the visual performance** – Figure S2 shows the average, over 8 subjects, of the percentages of “same” responses for the trained gait pattern (270 deg) as a function of the phase difference between the two successively presented stimuli. As expected, the percentage of “same” responses decreased with the phase difference between the discriminated stimuli. The steepness of these curves provides a measure for the visual sensitivity of the subjects for the trained pattern. We evaluated this steepness by computing the slope of a linear trend fitted to the two curves. The slope increased from 0.94, before the training, to 1.15 after training. This increase suggests that motor training might improve the visual selectivity of the subjects for the trained motor pattern. This interpretation seems consistent with the observed increase of the  $d'$  values with motor performance after training (Table S2).