Supporting Information

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SI Methods

Model Details. We used the mathematical approach introduced by Amari (1) consisting of two separate layers for excitatory [$u(x)$] and inhibitory neurons [$\upsilon(x)$]:

$$\tau\dot{u}(x) = -u(x,t) + h_u + S_u(x,t) + \int w_{uu}(x,x')f_u[u(x',t)]dx' - \int w_{uv}(x,x')f_v[v(x',t)]dx'$$

$$\tau v(x,t) = -v(x,t) + h_v + S_v(x,t)\int w_{vu}f_u[u(x',t)]dx',$$

with τ fixing the timescale of evolution of activity, h_u and h_v being the resting levels of the respective fields (< 0), and w_{uu}, w_{uv}, and w_{vu} being the connectivity functions. Only sites that are sufficiently activated take part in the interaction with respect to neural mechanisms, which is mathematically achieved by a sigmoidal nonlinearity:

$$f(u) = \frac{1}{1+\exp[-\beta(u-u_0)]}.$$

Interaction has a homogeneous component and an inhomogeneous component. The inhomogeneous component is fundamental for mediating the experimental effects. It is excitatory for very small distances, strongly inhibitory for medium-size distances, and decays, but never reaches zero for larger distances. As a homogeneous component, global inhibition is independent of distance and ensures competition across all fingers, so that only one finger can respond at any given time. Both inhibitory components are additive. Stimuli and increased baseline activations for different subgroups are modeled through Gaussian-shaped functions:

$$S(x,t) = S_0\exp\left[-(x-x_0)^2/2\sigma^2\right].$$

Control Experiment. A control group ($n = 15$ subjects) performed the same experimental procedures of measuring reaction times on 2 subsequent days without application of coactivation (Fig. S1). Differences between reaction times (RTs) for different fingers reached significance on the left ($P < 0.001$) and right hands ($P < 0.001$), replicating the results observed for the baseline reaction time performance in the target group (Fig. S1*A*). Differences between pre- and postcondition reached significance on the left ($P = 0.003$) but not on the right hand ($P = 0.460$). Interactions for pre/post differences among fingers did not reach significance ($0.108 < P < 0.208$), indicating no differences in the gain of individual fingers. Computing pre/post differences (Fig. S1*B*) revealed no significant differences ($0.095 < P < 1$). These results indicate that whereas repeated task performance may yield small reductions in RTs through practice, the specific gain of performance for middle fingers (d3) observed in the target group was restricted to the condition under which coactivation was applied.

Reaction Time Measurements. Subjects were seated 3 m in front of a computer screen on which images of both hands were displayed (Fig. 1); the images covered a visual angle of 6°. For each trial, the finger to be selected was randomly indicated by a visual marker on the monitor. Responses were given via a hand-shaped 10-button keyboard (Fig. 1). Subjects were instructed to keep their fingers on the corresponding buttons and to press the button as soon as possible after the visual marker indicated the finger for one given trial. Under the 10-choice condition, each of all 10 fingers could be selected by the visual marker in any given trial. Under the two dual-choice conditions, only 2 out of the 10 fingers could be selected: under one condition left d3 and right little finger (d5), and in the other condition left d5 and right d3. Different conditions were tested in separate blocks, and subjects were instructed about the specific condition before each upcoming block. For each condition, each finger was tested 40 times. Statistical comparison of RT measures was conducted using repeated-measures ANOVA and post hoc Scheffé tests.

Coactivation. To apply coactivation, a small device consisting of a solenoid with a diameter of 8 mm was taped to the tip of right d3. The device allows stimulation of the skin portions underneath, thereby coactivating the receptive fields within this area. Coactivation stimuli were drawn from a Poisson process at interstimulus intervals between 100 and 3,000 ms; average stimulation frequency was 1 Hz and the duration of each pulse was 10 ms. The pulse trains required to drive the solenoid were recorded digitally and played back via MP3 players, allowing unrestrained mobility of the subjects during coactivation. Subjects were instructed not to attend the tactile stimulation on the fingers resulting from the coactivation procedure. In fact, all subjects resumed their normal daily activities. Laser vibrometer measurements revealed that the actual transmitted amplitude of the solenoids was 10–20 μm. The duration of coactivation was 3 h (for details, see ref. 2).

1. Amari S (1977) Dynamics of pattern formation in lateral-inhibition type neural fields. *Biol Cybern* 27(2):77–87.

2. Dinse HR, et al. (2005) Improving human haptic performance in normal and impaired human populations through unattended activation-based learning. *Transaction Appl Perc* 2(2):71–88.

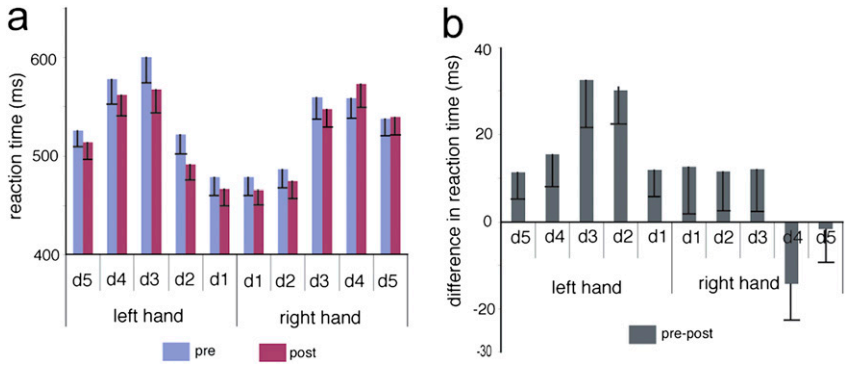

Fig. S1. Results of the control group (retested without coactivation). In the precondition (*A*, blue bars), subjects showed the same pattern as the experimental group, with slowest reaction times for d3 and fastest reaction times for d1 and d5. Subjects' performance improved significantly from pre- to posttesting for the left hand ($P = 0.003$) but not the right hand (*B*; magenta bars in *A*). There were not significant differences among individual fingers on either hand ($0.095 < P < 1$).