Differentiating serial cue prediction from motor sequence learning during long term skill training
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Background
Planning and execution of sequential actions requires the recruitment of many cognitive processes that are distributed across the brain (see Doyon et al., 2008). Over days and weeks of practice, serially cued actions become "bound" or "chunked" together, yet the representational level (i.e., cues or motoric responses) that this learning occurs in remains poorly understood.

Hypothesis
At long time scales of training, learning a serial order of cues will happen at a different rate than learning a serial order of motoric actions.

Methods
Participants
Healthy adults (N=47) were recruited via Carnegie Mellon University's paid participant website and all subjects were college aged adults. Two subjects dropped out leaving a total of 45 subjects, 15 in each testing group. All testing was approved by the local IRB.

Serial Reaction Time Task
On each trial, a centrally presented symbol (within a cued subject's preferred hand) mapped to a key on the keyboard with the right hand. On each day, the mapping from cue to key was pseudorandomly assigned and subjects were trained to learn a new mapping. After two blocks (144 trials per block) of randomly ordered cues, subjects were trained on a hidden 12 item sequence for two blocks, followed by another random block and then a final sequence block.

Sequence: 1-2-3-1-3-2-4-1-2-3-4

The Cue Group (N=15, 6 male): repeated sequence of visual cues over all 5 training days.
The Motoric group (N=15, 6 male): repeated sequence of motoric actions over all 5 training days.
The Control Group (N=15, 5 male): repeated sequence of actions & cues over all 5 training days.

Response Binding Across Groups
Before learning each response plan (Xn) is independent of temporally adjacent responses (Xn-1 & Xn+1): however with training the responses become bound together to a certain degree. This causes the autocorrelation function to become non-zero for adjacent lags (see Verstynen et al., 2012).

All subjects showed an increase in non-zero auto-correlations (for the first three lags) across training (F(4,8) = 8.59, p<0.001).

There was no effect of group in the degree of response chunking (F(4,8)=1.399, p=0.227).

Conclusion
Learning a sequence of symbolic cues happens at a faster rate than learning a sequence of motoric actions.
The presence of the motoric sequence appears to interfere with cue sequence learning.
All groups appeared to bind their responses into local “chunks” at the same rate across the testing sessions.

References