Improvements in Temporal Expectancy by Motor Activity

Lilian Fautrelle | Caspar Addyman | Denis Mareschal | Robert French | Elizabeth Thomas

ToNIC, UMR 1214, INSERM, Toulouse. INU JFC Albi Rodez | Goldsmith, Londres | CBCD, The Babylab, Londres | LEAD, CNRS, U-Bourgogne |U1093, INSERM, U-Bourgogne

Interval timing involves durations in the range of 500ms to a few minutes. This is in contrast to precision timing of shorter durations. An example of precision timing would be timing during speech generation while an example of interval timing would be estimating how long it would take a traffic light to change. As opposed to precision timing which is implicit and more automatic, interval timing requires cognitive resources and is more explicit. Several previous studies have shown that the accuracy of interval timing can be influenced by stimulus characteristics and stimulus movement velocity. In contrast to the above studies however, very few investigations have explicitly attempted to explore how motor activity can affect interval timing. This is surprising as many of the areas in the brain found to be important in interval timing such as the basal ganglia and the supplementary motor cortex. This raises the possibility that motor activity might influence interval timing. As it is an important skill which is deficient in some patient populations such as Parkinson's and schizophrenia, it might provide a means for improving this capacity.

To test this hypothesis we assessed interval timing in healthy adults who underwent interval timing training with or without incorporated motor activity. Testing consisted of a button press in response to the regular appearance of a visual stimulus. A faster reaction time was taken as an indicator of improved temporal expectation. Training for the groups with incorporated motor activity consisted of responding to a series of regular stimuli with a motor response: either pressing a button with an outstretched arm or bending over to press a button. The use of groups with different types of motor responses allowed us to test if the type of motor activity used is important. A third group did not use real motor activity but motor imagery. Previous studies have shown that motor imagery activates motor areas of the brain. The control groups consisted of subjects who did not use any motor activity during the training phase but only watched the regularly appearing stimuli, and a group of subjects that read a newspaper.

Our results showed that significant improvements in temporal expectancy were only observed in subjects who had incorporated motor activity with the timing training. No significant differences in reaction times were observed between the groups which had undergone whole body training and the group with only arm movement. On the other hand, both were found to have faster reaction times in the test phase than the subjects who had only used motor imagery. Several tests were conducted to eliminate some possible explanations for the differences between the groups with and without motor training. No improvements were observed following training that combined irregular stimuli presentations and motor activity. This eliminated the explanation that the improvements in timing judgments described earlier were purely due to improvements in motor capacity. Equivalent performances of a secondary task by the members of all the training groups also allowed us to eliminate the explanation that the observed reductions in reaction times could be explained by differences in attention.