

## **Description of Additional Supplementary Files**

### **Supplementary Movie 1**

This video shows representative forelimb tremor observed in A53T Parkinson's disease model mice.

### **Supplementary Movie 2**

This video shows representative ataxic rearing behaviour observed in A53T Parkinson's disease model mice.

### **Supplementary Movie 3**

This video shows representative hindlimb trailing behaviour observed in A53T Parkinson's disease model mice.

### **Supplementary Movie 4**

This video shows representative performance in the elevated beam walking test observed in control and A53T Parkinson's disease model mice.

### **Supplementary Movie 5**

This video shows representative hindlimb clasping behaviour during the tail suspension test observed in A53T Parkinson's disease model mice.

### **Supplementary Movie 6**

This video shows representative walking behaviour observed in control mice, A53T Parkinson's disease model mice, and A53T mice with optogenetic stimulation.