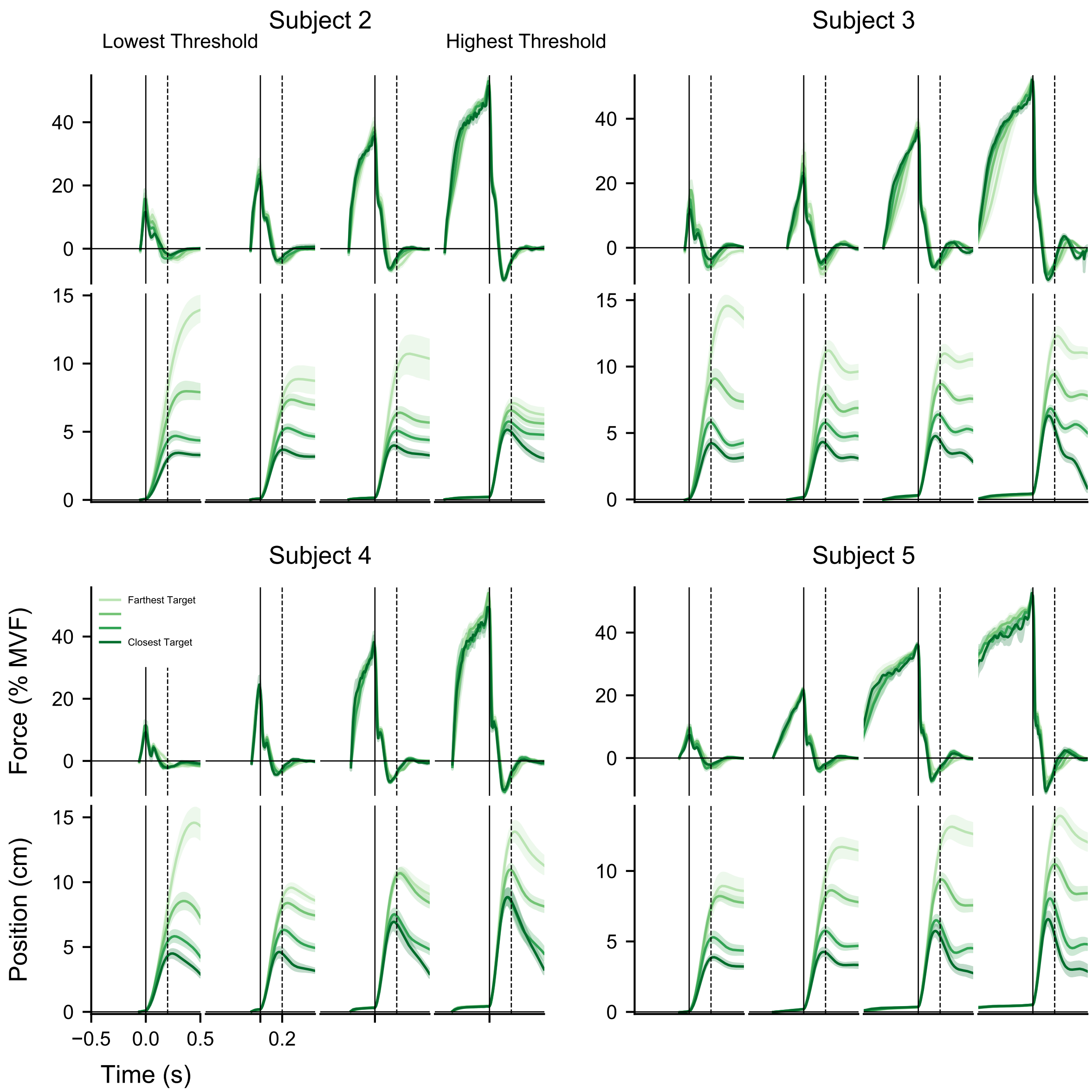
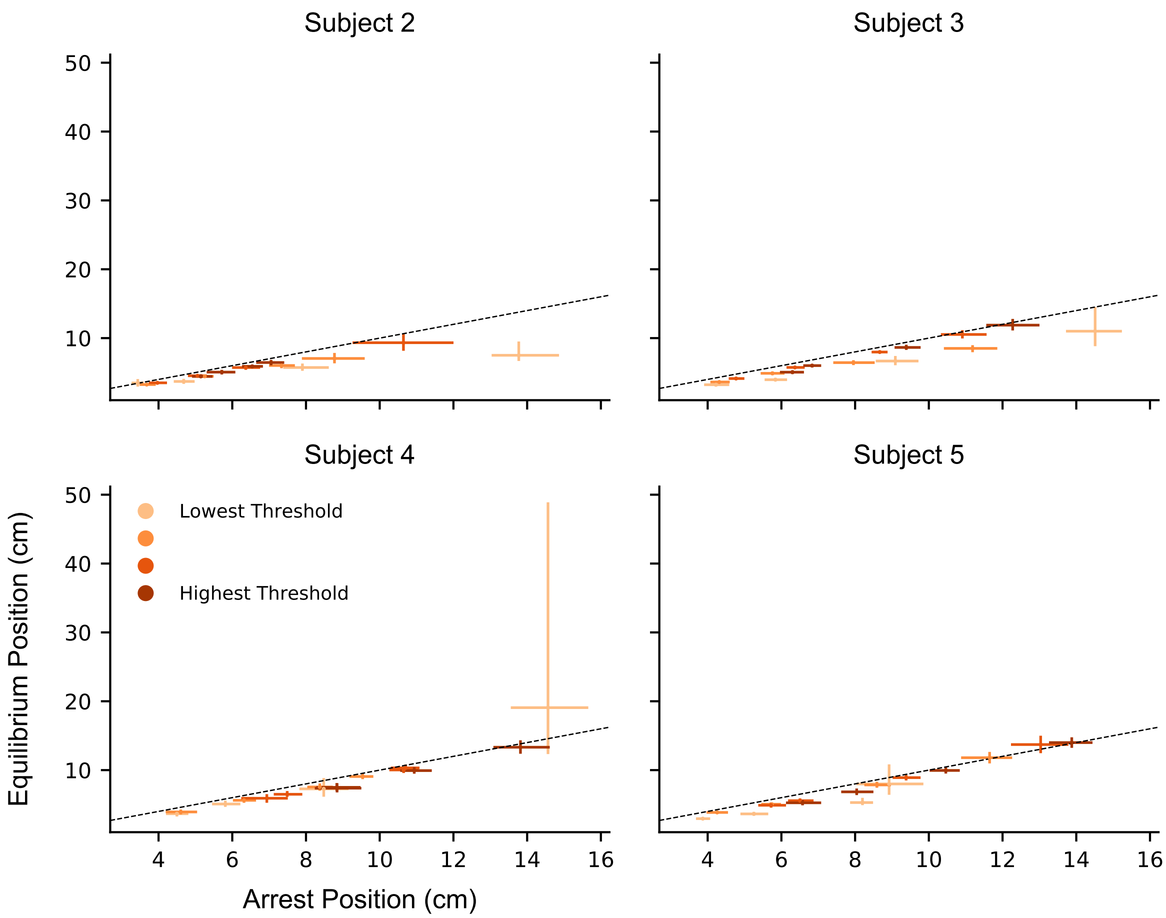
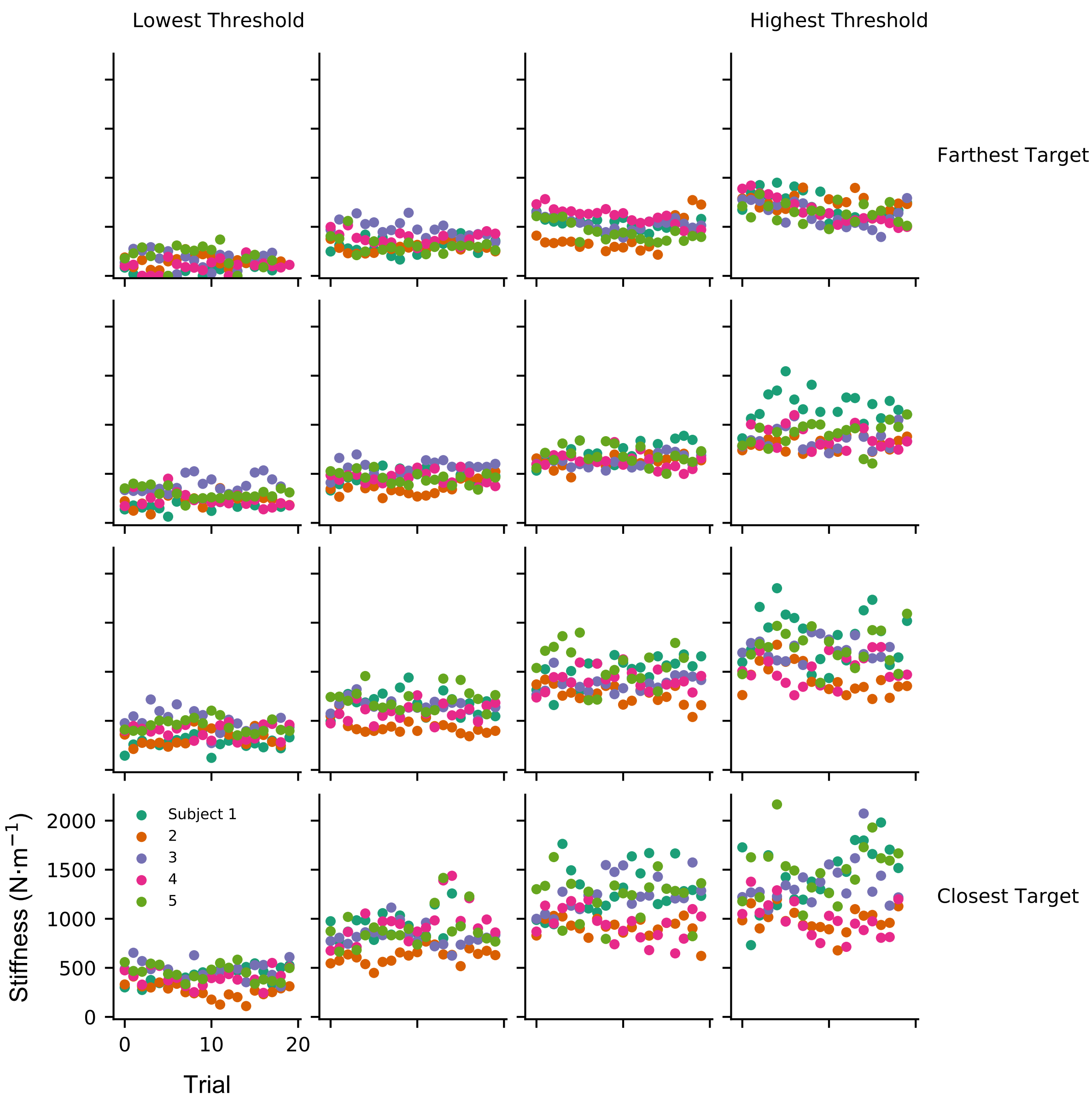


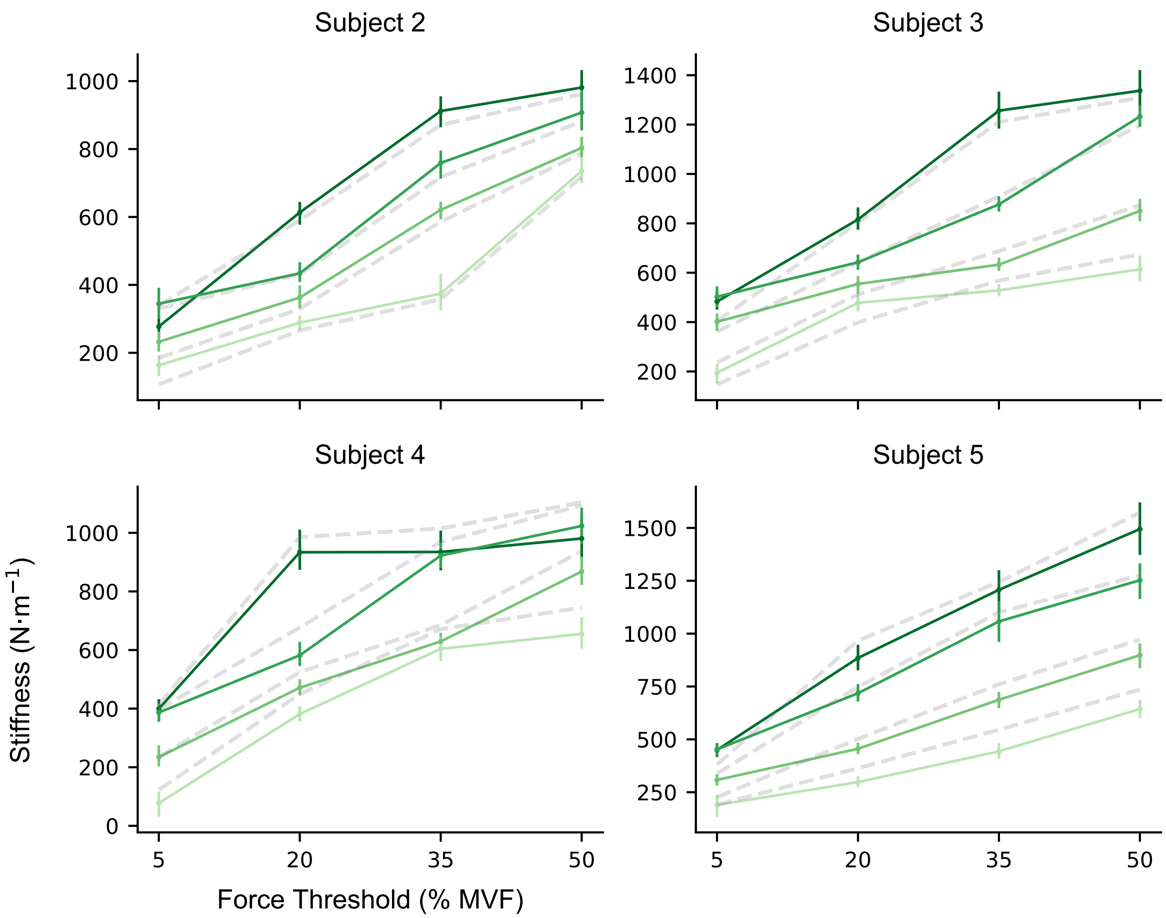
Supplementary Figure S1: **Behavioral data for all subjects.** Movement varied considerably across subjects. However, across-trial variability was much less. For some conditions, the subjects returned the handle to the start position without holding the handle in place (see Subject 4, highest threshold). Additionally, Subject 2 adopted the strategy for the highest threshold of arresting the handle in the same position, regardless of the target. The data are trial-averaged and shading represents the median and 95% confidence interval. Each plot depicts four target zones with the same force threshold. Movement onset began at time 0 (solid vertical line). The maximum voluntary force (MVF) for Subject 2-5 was 100, 160, 200, and 200 N.



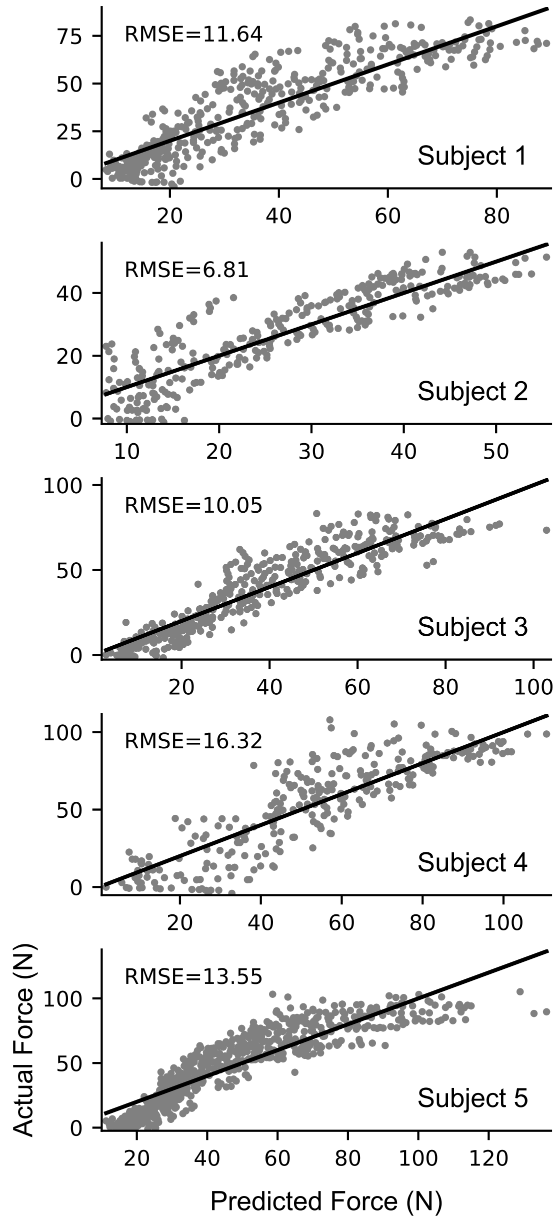
Supplementary Figure S2: **Equilibrium position for all subjects.** The distance to the equilibrium position (EP) was similar to the distance to the arrest position, suggesting that the physical dynamical model could describe important aspects of the behavior. The distance to the EP was generally a little less than the distance to the arrest position, especially for Subject 5, which could be explained by an underdamped physical system and result in the position overshoot observed in Supplementary Figure S1. Markers are the median and 95% confidence interval.



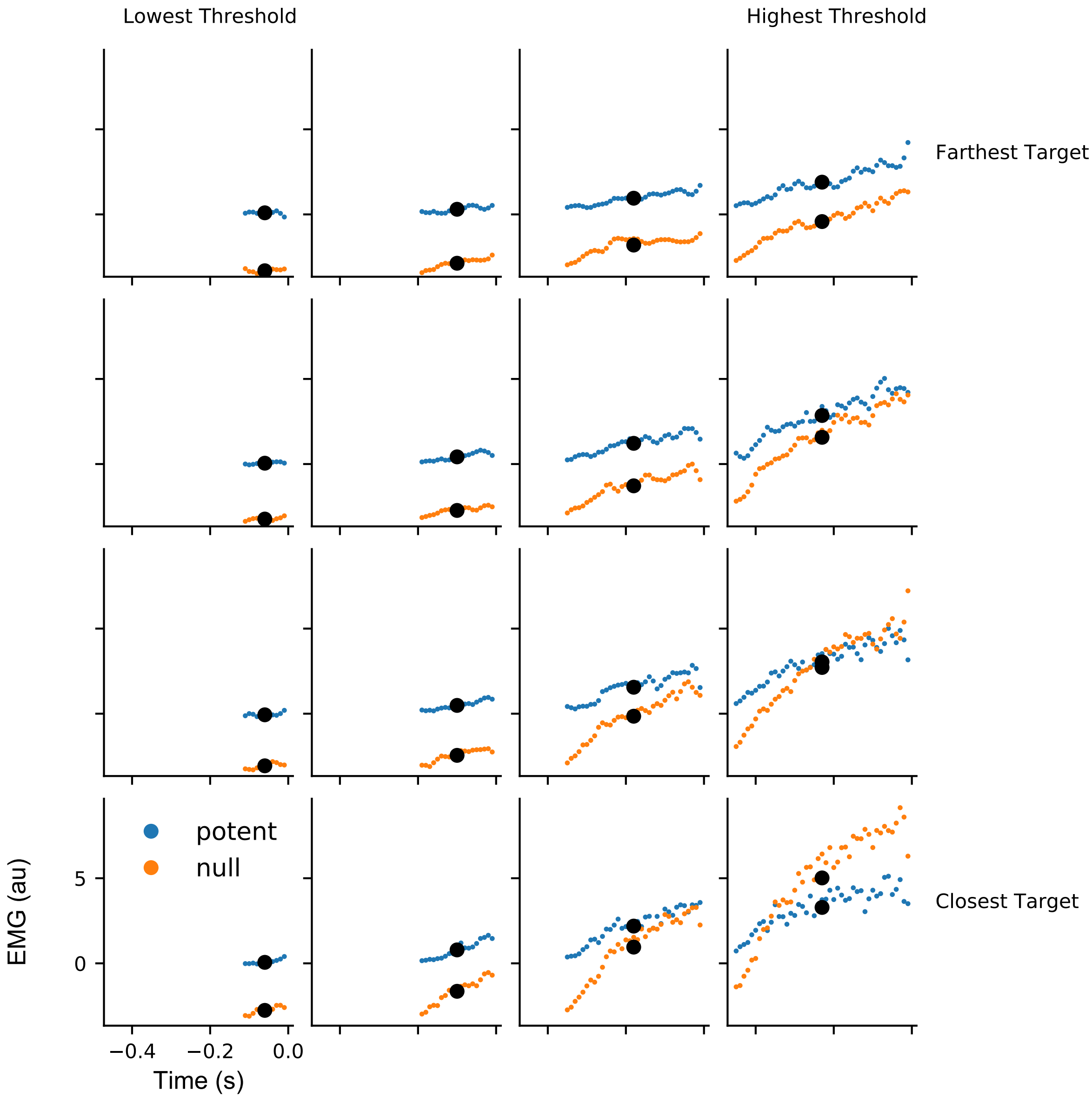
Supplementary Figure S3: **Stiffness across trials for all subjects and task conditions.** Subjects did not appear to modulate their stiffness consistently across trials for a given condition. However, variability within a given condition did increase with stiffness, suggesting signal-dependent noise that could be linked to similar signal-dependent noise in muscle force.



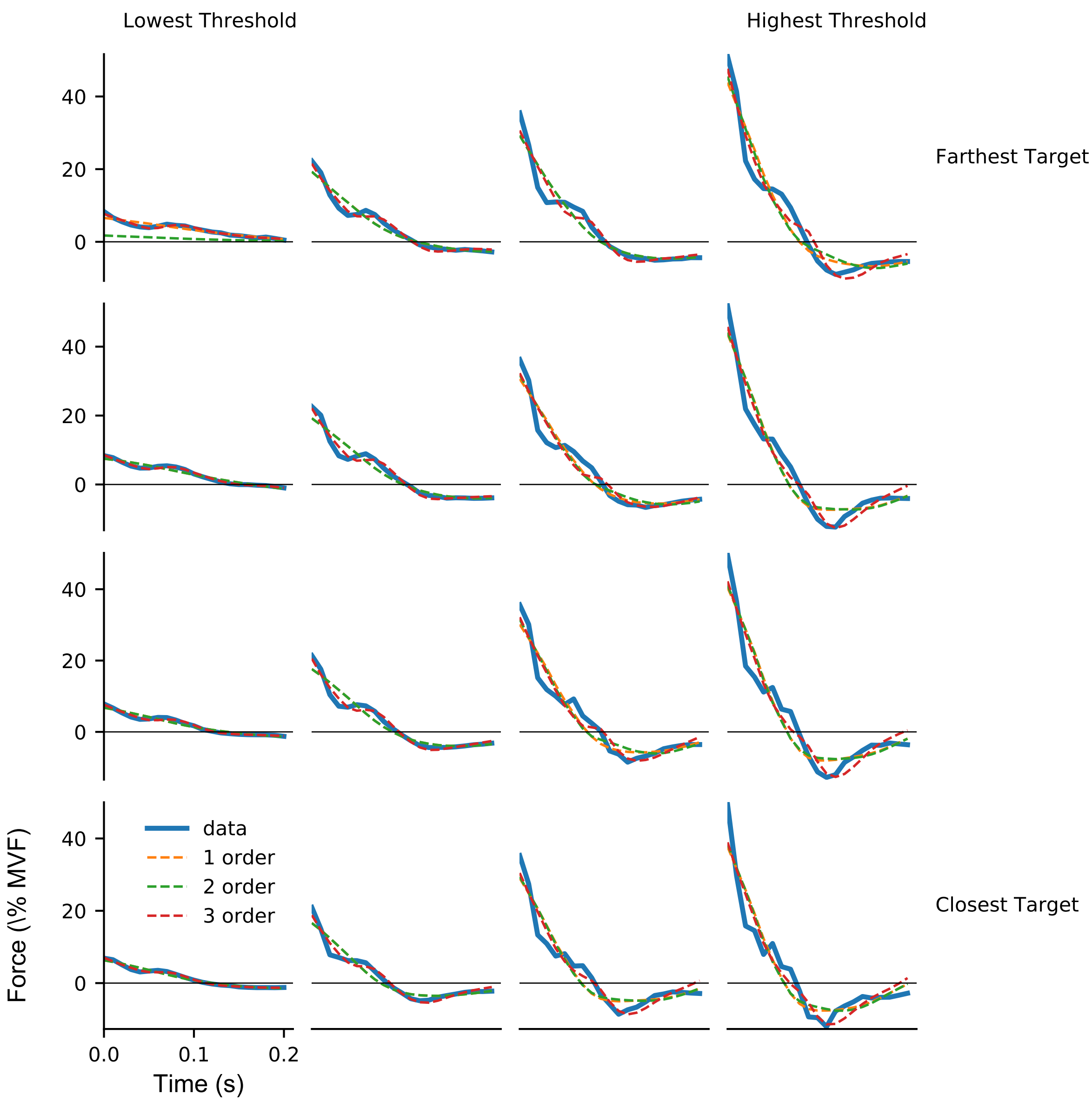
Supplementary Figure S4: **Stiffness depended on both force and movement.** Stiffness exhibited a strong linear relation with force threshold, particularly for Subjects 3 and 5. Solid lines are the stiffness values from the physical dynamical model. The dashed grey lines represent stiffness values calculated as force at release / arrest position. Error bars indicate median and 95% confidence interval. The physical dynamical model was fit using 200 ms of data beginning at movement onset.



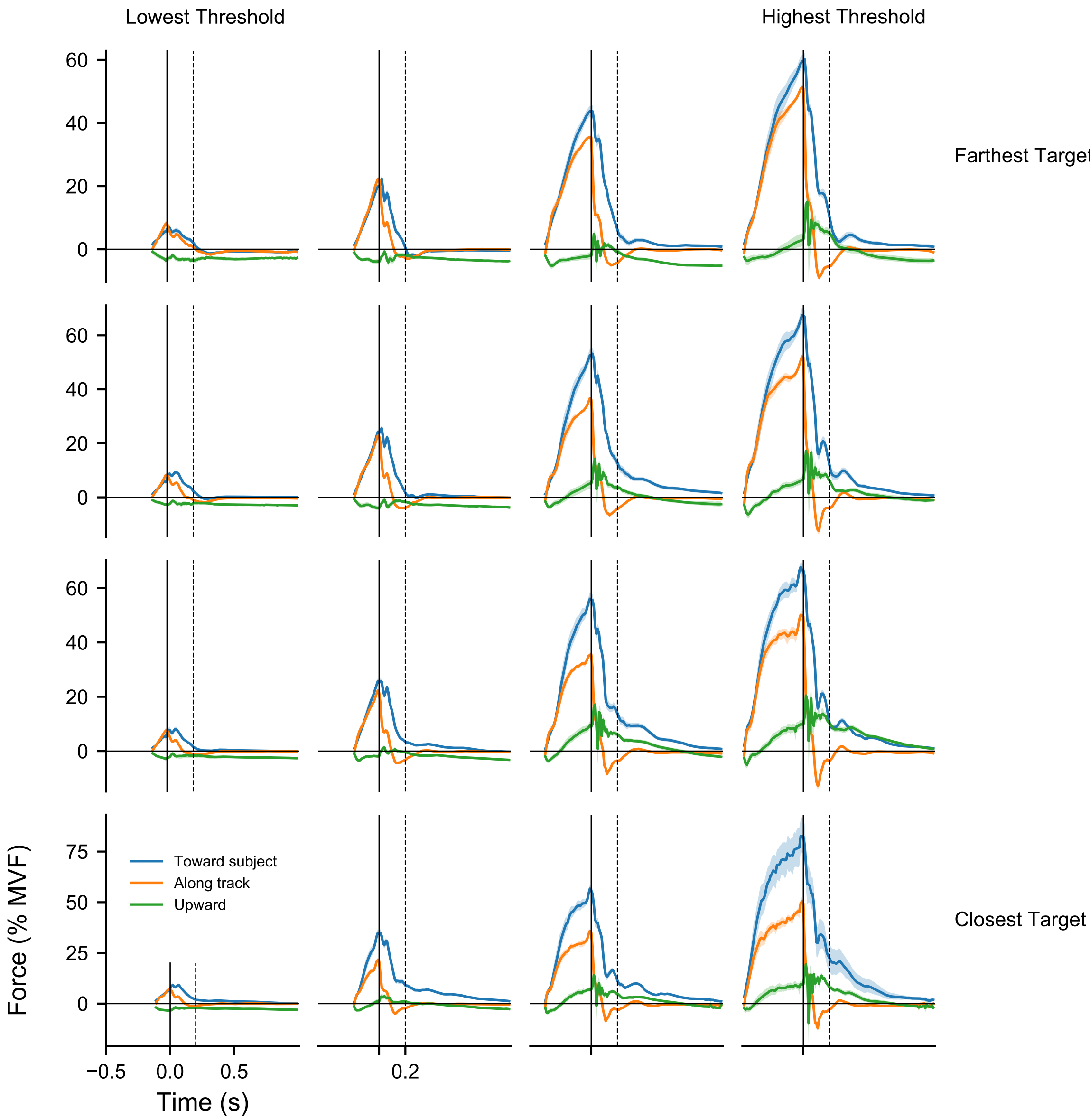
Supplementary Figure S5: **EMG approximates force.** Time-varying force during the force ramp was regressed on the EMG from all 8 muscles. The linear model was able to consistently capture variability across all subjects. The data displayed are the median predicted and actual values from the bootstrap. The dark black line is the unity line representing a perfect fit. Although the small deviations from the unity line could be due to the non-linear relation between EMG and force, a linear model is a good approximation.



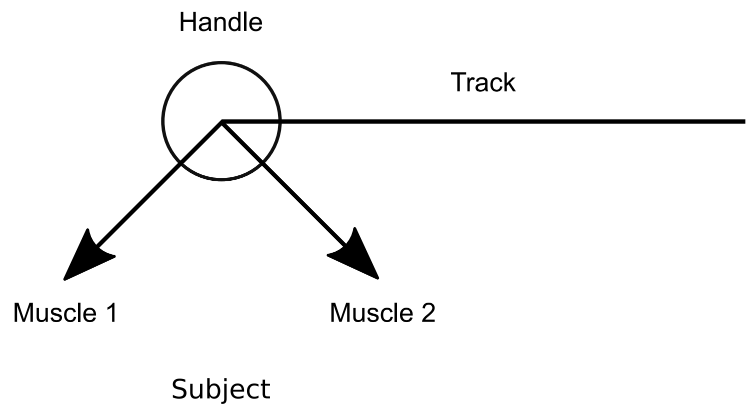
Supplementary Figure S6: **Example of time-averaged EMG for Subject 1.** There was a single value of stiffness for each task condition. To determine the effect of stiffness on potent and null EMG, we averaged EMG across time before movement onset. The result was a single potent and null EMG value for each task condition that was first averaged across trials and then averaged across time. The colored data are the time series EMG for a single sample and the large black dots are the averages across time.



Supplementary Figure S7: **Comparison of the force fit during movement from physical dynamical systems of different orders.** The simple first-order physical dynamical system was used to calculate impedance because higher-order models exhibited qualitatively similar fits to force during movement. Data are from subject 1 and the models were fit using the first 200 ms after movement onset.



Supplementary Figure S8: **Force in all 3 dimensions.** Although force exerted along the track did not vary across conditions with the same force threshold, force exerted toward the subject increased as the target moved closer to the start position. The correlation between the force exerted toward the subject and stiffness was likely due to the biomechanics of the arm, where modulation of off-axis muscle force enabled modulation of on-axis co-activation.



Supplementary Figure S9: **Off-axis forces could correlate with on-axis stiffness.** Two imaginary muscles exert force on the handle according to the labeled vectors. If the magnitude of the muscle forces are equal, then the sum of the two muscle forces would result in zero force along the track and a non-zero force toward the subject. In addition, increasing the muscle force would increase both the force toward the subject and the stiffness along the track, without changing the force along the track.