BACKGROUND

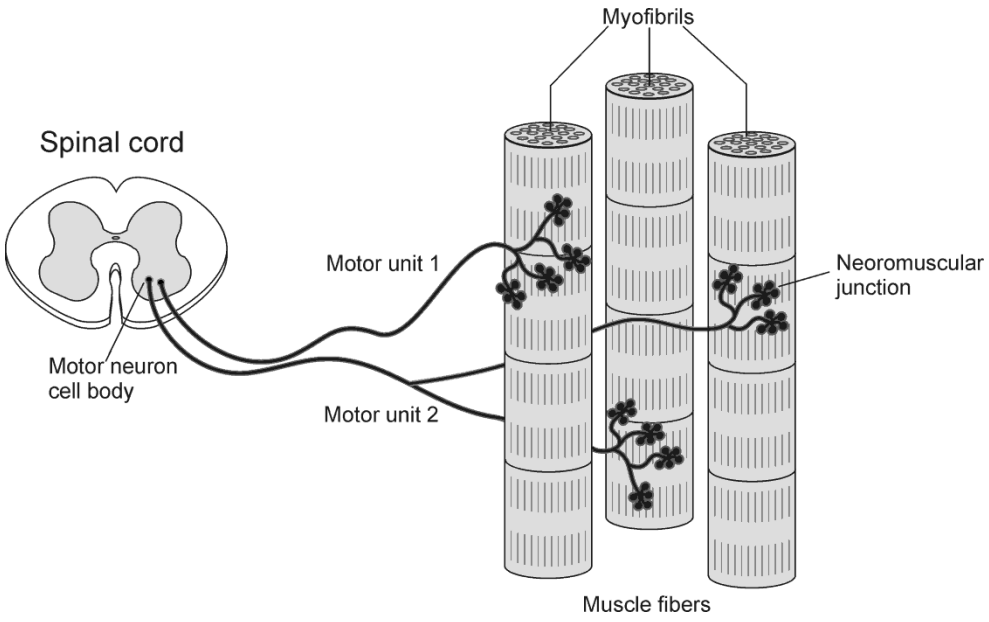
Voluntary muscle contraction is the result of communication between the brain and individual muscle fibers of the musculoskeletal system. A thought is transformed into action potentials which travel down motor neurons via the spinal cord and peripheral nerves to the neuromuscular junctions to form a motor unit (see Figure below). A motor unit is a motor neuron and all of the muscle fibers that it innervates. If a motor neuron is firing action potentials then all of the muscle fibers that that motor neuron is connected to are contracting. Conversely, if muscle fibers are contracting, then the motor neuron that they are connected to is firing action potentials.

Skeletal muscle is composed of bundles of individual muscle fibers and has unique properties which allow it to respond to stimuli by contracting. The individual muscle fibers within each motor unit contract with an "all or none" response when stimulated by an action potential, meaning the muscle fiber contracts to its maximum potential or not at all. The strength of contraction of a whole muscle depends on how many individual fibers are activated, and can be correlated with electrical activity measured over the muscle with an EMG sensor.

Muscle fatigue occurs with prolonged or repetitive use of a muscle group. With fatigue, there is a sense of weakness and even discomfort, which eventually leads one to discontinue the activity that is causing it. The mechanism of fatigue is multifactorial and not fully understood, but is felt to involve the central nervous system, peripheral nervous system, muscle units and individual muscle fibers. At the level of the muscle fiber, depletion of ATP plays a role in fatigue.

Although muscle fatigues, action potentials and electrical activity do not. Only the number of motor neurons firing action potentials or nerve damage can change the electrical activity going into the muscle.

Regular exercise is important for maintaining muscle strength and conditioning. The most common form of non-aerobic exercise is *isotonic* (weight training). In isotonic exercise, the muscle changes length against a constant force. In *isometric* exercise the length of the muscle remains the same as greater demand is placed on it. An example of this is holding a barbell (or suitcase) in one position for an extended period of time. Muscle fatigue occurs with both forms of exercise.



ANALAYSIS QUESTIONS

1. Examine your answers for Questions 1 and 2, your graph from Part 1 and your data from Table 1 (Continuous Grip Without Visual Feedback). **What is the relationship between grip strength and the electrical activity of the muscle? (Is grip strength directly related, indirectly related, or not related at all to electrical activity of the muscle?)** Create a claim. Next, provide evidence by circling **ALL** parts of each graph that supports your claim. Finally, provide the reason that links your evidence to your claim from the given background text.

   Claim:

   Evidence 1: (Insert copy of graph with circled evidence below)

   Evidence 2: (Insert copy of data table and circle the data that supports your claim)

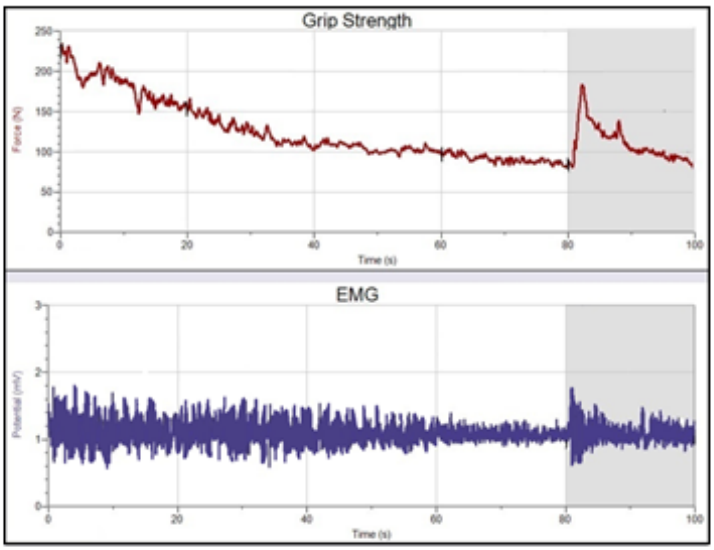
   Reason: (Copy the reason from the background and insert below)

2. Look at your graphs and data tables from Parts 1 and 2. What affect did visual feedback (looking at the screen) have on the grip strength and the change in electrical activity (ΔmV) versus having no visual feedback? Justify your explanation with the correct data from your data tables.

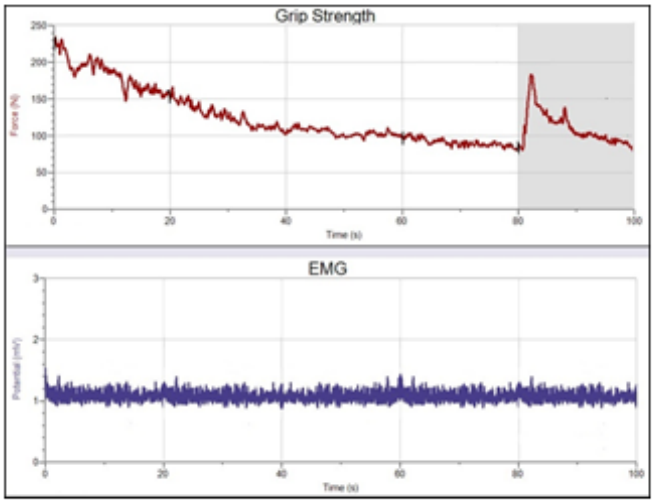
Use the following graphs to answer Questions 3 and 4.

3. Compare graphs in B with the normal graphs. What is happening in both graphs in B? Give a possible explanation for the cause for the graphs in B.

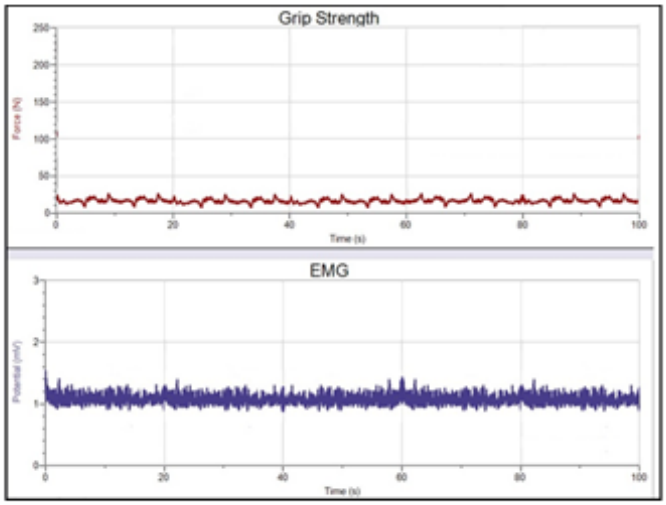
4. Compare graphs in C with the normal graphs. What is happening in both Graphs in C? Give a possible explanation for the cause for Graphs in C.


Grip Strength
Force (N)
Time (s)
EMG
Potential (mV)
Time (s)

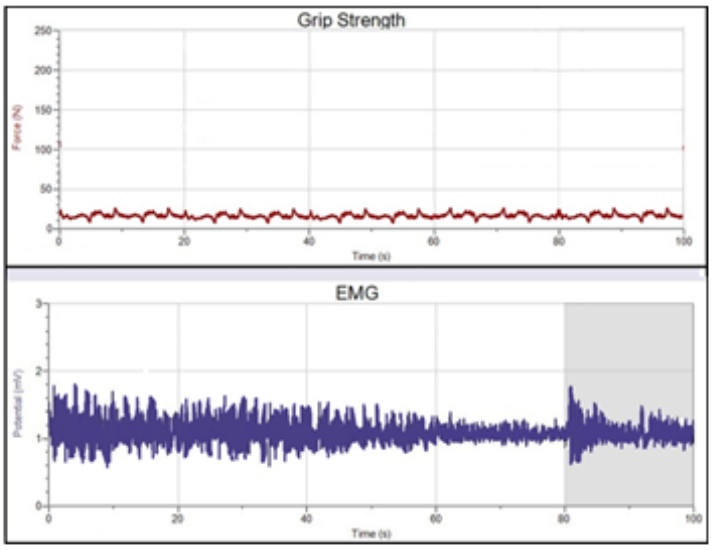
Normal


Grip Strength
Force (N)
Time (s)
EMG
Potential (mV)
Time (s)

A


Grip Strength
Force (N)
Time (s)
EMG
Potential (mV)
Time (s)

B


Grip Strength
Force (N)
Time (s)
EMG
Potential (mV)
Time (s)

C