

# *Pulleys—A demonstration of control*

E-mail by Bill Powers to CSGnet. Tuesday, May 10, 2011.

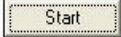
Edited [and embellished] by Dag Forssell

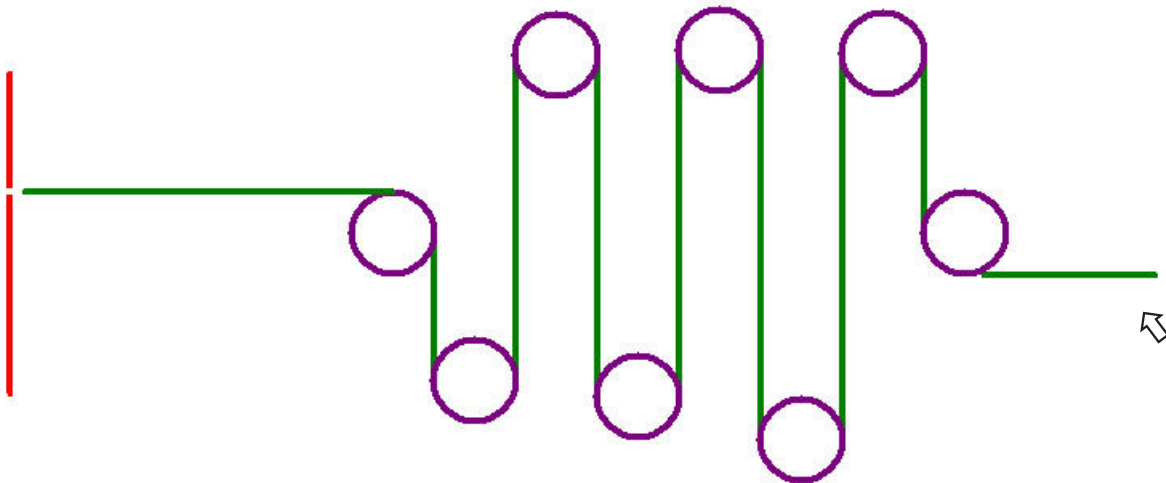
...After all, one of our main points is that theories need to be challenged and pass tests before they are accepted. Stimulus-response theory has never, to my knowledge, been tested, much less passed a test. The same goes for the theory of cognitively planned actions. Theories are used as explanations and seem to be judged mainly by how easily they can be made to fit (verbally) what has already been observed. Theory-specific predictions don't ever seem to be made (i.e., if this prediction is wrong, so is the theory that made it).

...[We can demonstrate] control phenomena and especially the principles that they illustrate.

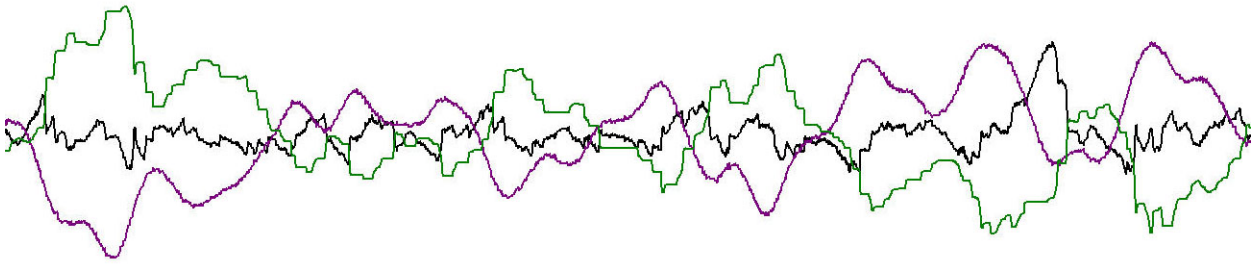
We could show a task, for example, in which it seems that there are plans of action based on perceptions of disturbances, and show that the actual behavior does not follow those plans although the consequences of the behavior do.

One demonstration I've had in mind for a long time is illustrated by the "pulleys", which I haven't got around to showing anywhere yet [or documenting], though it's running.

[When you activate the program, note the  button on the right. The demo starts with an image of pulleys, rope, target and pulley movement.\*] The cursor is located at the right end of the green string. Moving the cursor left and right pulls that end left and right. The task is to keep the left end of the left-hand green string exactly in the gap between the red target lines. The middle six pulleys wander slowly and independently up and down, so when the right end of the green string is stationary, the end over on the left side moves left and right (imagine there is an invisible string pulling on the left end of the green string all the time to keep it taut).



\* As you activate the program, PulleyPr.exe, it immediately generates a file with random numbers, Distable. This file determines the movement of the pulleys. Unless you delete Distable, the same movements will repeat the next time you click on the Start button. It is a good idea to delete Distable before you make the next run so that the program will generate a new file with random movements—which you will have no way of predicting.



[When the program has run for a minute, it stops and displays a trace of the net disturbance working on the pulleys (purple), your working on the mouse (green) (I, Dag, used a track ball and my movements were a bit jerky), and the result (black). Notice that my movements (green) oppose the disturbance (purple)]

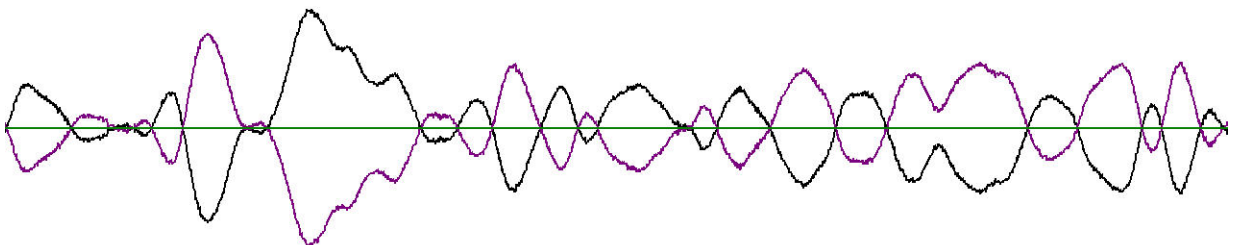
Explaining this demo using the cognitive plan-of-action theory can be done, at the risk of making a lot of dubious assumptions about what the brain can do. No matter what they are, they can be disproven immediately by hanging a piece of cardboard over the part of the screen where the pulleys are. When the pulleys can't be seen, control continues just as before.

...Also, don't forget that S-R and cognitive theories don't have any demonstrated relevance, either, because they misrepresent what is observed. And we mustn't overlook the fact that both SR and cognitive approaches seem aimed at correcting behavior, which in itself is a mistake since it's not behavior that needs fixing.

...We are not going to convince die-hard old-timers who are determined not to be convinced. Let's just forget about them. There are plenty of reasonable people out there who can be convinced by a well-constructed argument that engages their interest. Let's aim at them. Sooner or later, the balance is going to shift and we will stop being in the minority.

Best, Bill

If you run the demo for a minute without touching your mouse, the program will display the net disturbance and its effect on the controlled variable.



Disturbance function: *The effect (by itself) of pulley action on the target end of the rope.*

Observation by Dag Forssell... May 25, 2011

This demo has much in common with the tracking task in the DOS tutorial program DEMO1, as well as with the tracking demo TrackAnalyze in Bill's 2008 work *Living Control Systems III*. The difference here is that the environmental disturbance is clearly visible rather than hidden during the run.

Looking at this demo, it is easy to see how it represents daily life, such as driving a car. In that case, the target to the left represents the position of your car in the lane you choose. The pulleys represent friction in your steering, slope and bumps in the pavement and invisible crosswinds that push your car sideways. The end of the rope on the right represents the steering wheel, which you operate with your hands, the mouse.

Bill's comments highlight the obvious: Neither the behavioristic Stimulus-Response (S-R) idea that the environment makes us do things (which permeates our culture) nor the current cognitive psychology idea that the brain evaluates what is going on and issues commands to our muscles is viable. Contemporary psychology has no valid concept of how individual behavior works.

Relating and explaining this demo in terms of the generic control diagram  
*Interpretation of this particular demo shown in italics*

Where do you want the target end of the rope? At the red wall as suggested?  
 You can run the demo wanting the end of the rope an inch to the left or right.  
 The results will be the same.

Where is the target end of the rope?  
 This is displayed in your brain.  
 (Everything you see, hear, smell, and feel is a display in your brain.)

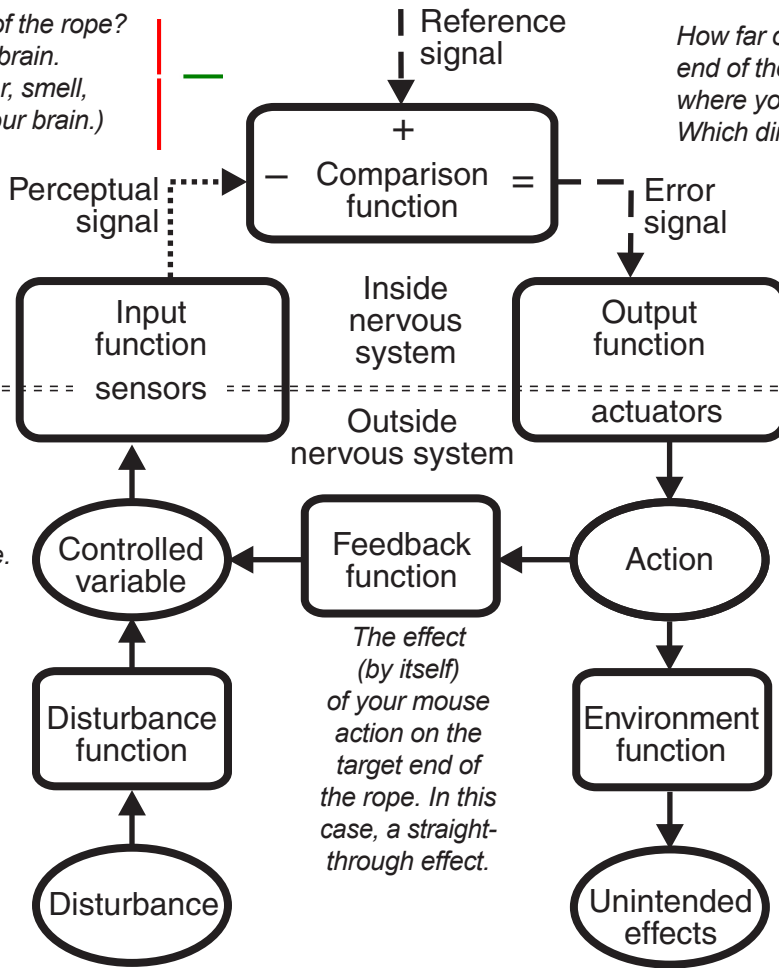
How far off is the target end of the rope from where you want it?  
 Which direction?

Light from your screen is focused on your retina, interpreted by your nervous system, and displayed in your brain.

The physical position of the target end of the rope.  
 (Simulated in computer).

The effect (by itself) of pulley action on the target end of the rope.

The physical disturbance in the environment.  
 In this case the action of the pulleys.



The changing error becomes changing reference signals for hand / mouse position, which in turn become reference signals for velocity and acceleration = muscle tension.

Pulling your end of the rope with the mouse

Effects of mouse movement on the environment...

...such as sound, heat from friction, tiring muscles

