The bridge - Part 2

By Professor Jan Willem de Graaf
Professor of Brain and Technology, Saxion University of Applied Sciences, Deventer, Netherlands

Last week we discussed dynamic systems, which often have two (or more) states: (1) the stable bridge, (2) the wobbly bridge, (1) moving cars on the highway, or (2) cars stuck in a traffic jam, horse in (1) walk, (2) trot or (3) canter. The transition from one state to another occurs at fairly predictable moments: a certain speed of the horse, or with increasing number of pedestrians on the bridge, or cars on the highway. The "control parameter" - speed, number of passers-by - activates the switching ("bifurcation") between the states. The states in which the "behaviour" of the system stabilizes - the phases - are called attractors.

Biological systems arise from the coupling of many cyclic (oscillating) processes. In such dynamic systems, the attractor states are recurrent hunger, thirst, sleep, etc. Equilibria and imbalances motivate to restore equilibrium. Hunger motivates eating, drinking thirst, restoring the state of contentment, etc.

Phase transitions are discontinuous. There is no continuous (linear) transition between water and ice or walk and trot. However, we think in terms of continuity, while not realizing the limited validity of 'linear' thinking, for example when we say that we behave the way we do because of perceived personal characteristics or disorders, such as autism. While linear thinking helps us "understand" each other (and ourselves), it is certainly not scientific. Yet we base political policy on this. Let's take an example.

Due to an unhealthy lifestyle and diet, many people are overweight. A lot of research money is being spent to tackle this. However, we understand this mainly linearly. From a dynamical systems perspective we see that with regard to weight, everyone has a number of attractor states, in which the equilibrium can stabilize. After pregnancy, the weight balance of adolescents and young adults - which was stable despite alcohol, drugs, sex and rock 'n' roll - is often no longer achievable. However, sometimes the whole coupled metabolic and hormone cyclic system can be neatly returned to pre-pregnancy balance. But certainly after a number of deliveries, it is at least as likely that the system will stabilize in a body that is a few sizes larger. This is development/normal aging.

Rural women

Old photos of Dutch rural women from the 19th and late 18th centuries show hard-working women. Almost all of them were then considered to have a healthy appearance, which would now be considered overweight. They also all worked hard, at home and often in the fields, many hours a day, while they were not yet addicted to sweets and Netflix (or other "passivities" that can be bought off in the gym for an hour of exercise). What is visible is another attractor state, in which the body automatically ends up after a number of births with the passing of the years. That is why we speak of self-organization in dynamic systems. As with the bridge, highway and horse gaits, the body has a limited number of possible attractor states in size/weight: S, M, L, XL. In healthy aging, S is often no longer feasible. Between the attractors, the size / weight is not stable. So all this can't just be traced back to lifestyle.

A healthy lifestyle is important, but should not only be a revenue model for economic powers (including gyms, healthcare and research groups). Keeping your body in a 21-year-old state for as long as possible is admirable - it takes a lot of discipline, training, etc. - but it produces at least as much frustration, fear and sadness. Sure, it is feasible for some of us for a long time, but it is certainly not the most "natural" attractor state for an adult body (hidden anorexia/bulimia). For those who really do not succeed, because the other attractors after, for example, childbirth are much too strong, it results in completely unjustified ridicule, fear and sometimes even exclusion. Again, for many of us it is healthier not to deny images of an aging body. Eternal youth is a bridge too far!