

The Role of the Basal Ganglia in Mental Laziness and Procrastination

Luca Dellanna

Email: Luca@luca-dellanna.com

Website: www.luca-dellanna.com

Twitter: @dellannaluca

Why can't we get ourselves to do what we know is good for us, such as writing the paper we need to complete by the end of the week? The short answer is: the part of our brain which makes plans (the Cortex) is not the part of our brain which decides which of them we enact (the Basal Ganglia). If we want to be able to control our own actions, we need to understand how the two influence each other.

In this paper, I will describe a hypothesis for how the Basal Ganglia (BG) determines whether the plans proposed by the Cortex will be acted upon. I will describe the metric used by the BG to evaluate plans (Expected Emotional Outcome), how EEO is linked only to past emotional experiences (not to rational nor conscious considerations), and I will show how concepts such as willpower, procrastination and choices are confabulations for the outcome of the evaluations made by the BG. I will also describe how low EEO associated with mental manipulation tasks (such as mental rotations or mental permutations) could be responsible for many behaviors which are grouped under the label of "mental laziness".

Understanding the above is critical to become able to effectively influence our own behavior, so that we can change our own habits and, with them, our own future.

The role of the Basal Ganglia

We have all experienced making a plan and failing to act upon it. New Year's resolutions, for example.

The reason we fail to act on our plans is: the part of our brain which makes plans is different from the part which decides whether we will act upon them.

Plans are made by the Cortex, the part of our brain which is responsible for understanding the world around us (Tanjiab & Hoshia, 2001). When the Cortex plans for us to do something, that proposition is sent to the Basal Ganglia (BG), another part of our brain, which decides whether we will take action (Nelson & Kreitzer, 2014).

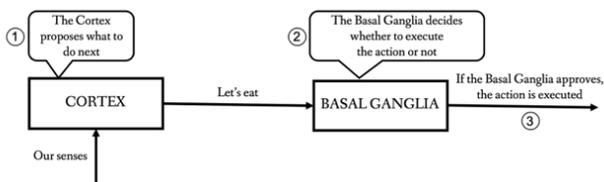


Figure 1

Example: deciding to run

What follows from now on, are illustrations of the behaviors emerging from the model proposed in this paper. The Basal Ganglia approves actions based on their Expected Emotional Outcome (EEO): how good or bad one will feel

doing something, based on his or her past emotional experiences having done the same action. The EEO is represented in our brain as the difference between the two currents which are the output of the direct and indirect pathways of the BG. The outputs of the two pathways have opposite effects on action inhibition (Nelson & Kreitzer, 2014).

Example: whether you will go running early next morning will depend on how you felt the previous times you ran and the previous times you woke up early.

The EEO of an action is the sum of the valence of our past emotional experiences associated with that action, plus that of some emotions innately associated with cues related to that action.

The Basal Ganglia only enacts actions if they have a positive Expected Emotional Outcome

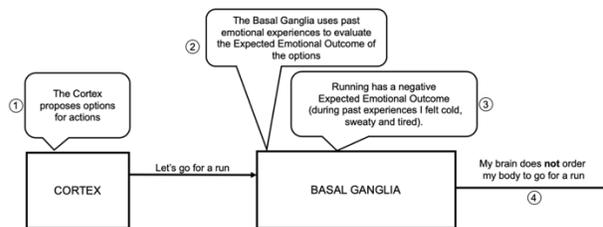


Figure 2

For example, if the first time we run we have a great experience, a positive emotional association is created in our Basal Ganglia and the EEO associated with running becomes positive. We now feel eager to run again. If, the second time we run, it is rainy and cold and we have

a terrible experience, then a negative emotional association is recorded in our Basal Ganglia. The EEO associated with running is now updated to a neutral score.

If, the third time we run, we have a negative experience again, then another negative emotional association is recorded in our Basal Ganglia. The EEO associated with running is now a negative score. The next time our Cortex plans to run, our Basal Ganglia will refuse to act.

Multiple associations

When computing the EEO, the Basal Ganglia factors in all emotional associations with each component of the action. For example, while computing the EEO of “running early in the morning”, the Basal Ganglia will check the emotional associations with “running”, “waking up early” and “doing things outdoor”.

This concept is important, because it shows how one easy way to manipulate an action’s EEO is to bundle in pleasant situations or to unbundle unpleasant ones.

Emotional vs rational

The Basal Ganglia approves actions based on past emotional associations only (and on some innate emotional associations). It does not consider rational facts. For example, reading an article on the health benefits of running will not influence the Basal Ganglia’s decision on whether to run. Facts do not affect the EEO. Conversely, having experienced feeling good during running would positively affect the EEO. The reason why people make plans but often fail to act on them is because the Cortex plans based on rational considerations but the Basal Ganglia approves based on emotional considerations only (the EEO).

Rational plans (i.e., Cortex-initiated) will become action only if they make sense from the emotional point of view (as subjectively determined by the Basal Ganglia).

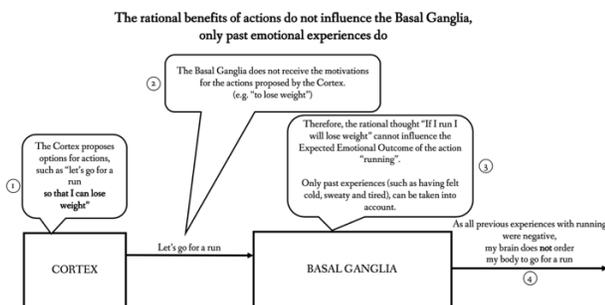


Figure 3

Prioritization

Sometimes, having a positive EEO is not enough for the Basal Ganglia to approve it. This is the case of when our

Basal Ganglia has multiple options to choose from.

For example, even if drinking cold water on a sunny day has a positive EEO, one will not perform that action if the alternative is an action to whom he associates an even higher EEO, such as drinking a Coca-Cola.

When two or more plans are possible, the Basal Ganglia only enacts the one with the highest Expected Emotional Outcome and inhibits all other ones.

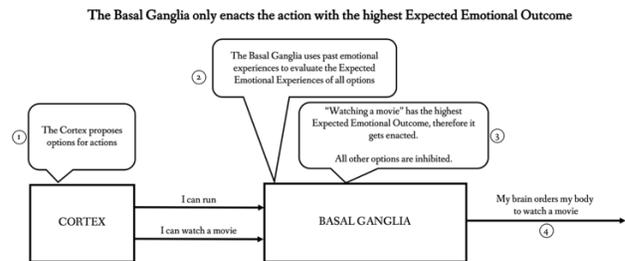


Figure 4

Procrastination: a confabulation

In the previous section of this paper, I hypothesized that most times we make a plan for action, the BG might inhibit the action, solely based on the action’s Expected Emotional Outcome (EEO).

If EEO is indeed the only criteria used to decide whether actions are inhibited, then it follows that procrastination is not a decision. Instead, it is the consequence of the too-low EEO of the action being postponed.

Whenever an action has an EEO which is too low, absolutely or relative to alternative actions, it gets inhibited by the BG. However, the Cortex does not have direct access to the BG’s “decisions”: it only notices that our body is not acting to bring the action to completion. Therefore, the cortex comes up with confabulations to explain the inactivity. Procrastination, the illusion of a conscious choice to delay the action, is one of such confabulations.

Studies such as those of split brain patients (Gazzaniga, 1967) exposed the extraordinary ability with which our Cortex is able to convince ourselves that we genuinely know the reasons for which we took a given action. Therefore, it should come with no surprise that, even if we think we know why we are procrastinating an action we believe we should take, we actually do not.

The real reason is only one, I propose: whenever we do not act on a plan of ours, it is because the EEO of that plan is not high enough (either on an absolute scale, or compared to the EEO of alternative actions). Every other reason we give ourselves is a post-fact confabulation, made *after* the BG decided to inhibit the action.

The confabulated timeline for deciding, for example, not to run this morning is as follows:

1. Alice thinks it might be good for her to run this morning, to lose weight.
2. However, this morning is particularly cold.
3. Therefore, Alice decides not to run today.

This is not what went on in Alice's brain, according to this paper's hypothesis. A quick test to ascertain the correctness of this timeline would be: "If Bob walked in the room right now, telling that outside feels warmer than it looks, would Alice run?". If not, then the "reason" was a confabulation. Instead, the real timeline is:

1. Alice's Cortex decides that running this morning would help her lose weight.
2. The order to wear the running shoes and run is sent to Alice's BG.
3. Alice's BG uses the past emotional associations with the actions of running and of doing stuff outside in the morning and computes an EEO.
4. The EEO isn't high enough, so Alice's BG decides to inhibit the action to run.
5. Alice's Cortex notices that Alice's body isn't moving towards her running shoes, nor it is feeling the urge to, and unconsciously selects the most admissible reason as the cause for deciding not to run (for example, it's cold outside).

If the BG is the real decision maker on whether to enact a plan, it follows that every reason which does not consider the BG's workings is a confabulation.

It might be that the confabulation and the real reason coincide, by chance. In the example above, it might be that Alice likes to run but has terrible past emotional associations with doing stuff in the cold

Willpower: a confabulation

Ego-depletion theories failed to replicate (Hagger, Chatzisarantis, Alberts, & others., 2016), hinting that willpower might not exist. I propose that willpower is a confabulation for having a high EEO associated to the actions that are undertaken (and, similarly, lack of willpower is a confabulation for having a low EEO associated to the actions that one wants to undertake but fails to).

If the above is true, it follows that "working on one's willpower" is useless. Instead, it is more effective to work on increasing the EEO of what we want to do (or decreasing the EEO of what we don't want to do).

Mental laziness

Mental rotation deficits follow damage to the Basal Ganglia (Harris & Caine, 2002). Huntington's disease, which causes neurodegeneration in the BG, also includes deficits in cognitive functions such as task-set switching, concentration and sequencing (Paulsen, 2011). The two results just described makes us think that the BG is involved in many cognitive tasks which are traditionally associated with the Frontal Cortex (FC), just as if our brain used the FC as the "muscles" to perform "internal manipulations", like it uses our real muscles to perform "external manipulations".

If this is the case, then the model described in this paper predicts that an inability or unwillingness to perform many cognitive tasks might be caused not only by neurological damage or disorders, but also by simply not having positive enough emotional experiences associated with such cognitive tasks. For example, a kid who seldom emotionally experienced the benefits of performing mental rotations might have a low EEO associated to them, and might therefore unconsciously refuse to perform them (i.e., his BG inhibits them), unless paired to some emotionally rewarding context (e.g., a videogame).

EEO is also influenced by whether an action's process and outcome are legible to the person performing them. Noisy processes and noisy outcomes make an action unpleasant. Whether an action's process and its outcome are noisy depend on whether the person is able to see the fundamental patterns of that action (Dellanna, 2018) and with the emotional associations with understanding those patterns. It follows that, whenever someone exhibits signs of mental laziness without clues pointing to an illness or a disorder, it would be useful to consider focusing the efforts towards teaching the fundamental patterns of that action (to make it less noisy) and to change the emotional associations with working with those patterns (to make it more likely that the necessary mental manipulations to learn those patterns are not inhibited by the BG).

Discussion

From the hypotheses brought forward by this paper, it follows that, to get ourselves to do what we rationally want to do, we need to make it the most desirable option from the emotional point of view (i.e., the option with the highest EEO). EEO is based upon past emotional experiences (our conditionings). To change our BG's willingness to act upon our plans we need to change the emotional associations with the actions and situations that are part of our plan. This should be the focus of everyone who wants to change his or her own habits.

Conclusions

In this paper, I hypothesized the interaction between the BG and the Cortex, and in particular how this interaction affects whether we act on our plans or inhibit action (the latter is later confabulated as laziness or procrastination).

I proposed how, most times we make a plan for action, the BG might inhibit the action, based on the action's Expected Emotional Outcome (EEO). In particular, the BG inhibits all actions that pass through it unless they have the highest EEO of all alternatives being considered.

This paper lays a framework for the functioning of the BG, for its control on whether we act on our own plans, and for how to proactively influence it (by changing our emotional associations with the actions and situations that are part of our plan).

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