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A Möbian Doppelgänger Theory: On Testing It

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I. Introduction

In a recent study [1], we presented a "cracked" version of the SDT. The SDT [2] in its canonical form argues that:

- Due to their subcortical visual system connected to the amygdala and, also, to other (cortical) features, primates and, in particular, humans have keen perceptual abilities regarding the detection of snakes;
- The snake detection system relies mainly on spotting the angular and multilinear "camouflage" patterns, even when this design is masked by vegetation;
- We owe our stereoscopic vision to a common evolution of our ancestors and (some venomous) snakes.

The first question(s) should be: is the "cracked" version really better, more in line with the overall data, and solving more puzzles/ introducing more important ones? We wanted to address the soundest critical arguments looking at the SDT. Thus, we gave a new form to two of the original three points [1]:

- The effectiveness of human snake detection in real situations is not as great as according to the SDT [3];
- We have no objections to this (2nd) point;
- Stereopsis had emerged in many different taxa [4]: even if it's likely that the coevolution of our ancestors with poisonous snakes triggered various changes in the cortex and subcortex, stereopsis in humans being its output [5], there is still information that seems to point differently, even in an opposite direction [6]. Also, even if our ancestors entered in an arms race with some venomous snakes, this race should not be understood as ending with our victory. E.g., the role of the skin patterns in adders is not only camouflage, which we may "break" through, but also to confuse the mammalian eye through a flicker-fusion effect [7], and to inspire fear [7, 8]. As the arguments for the arms race go beyond the (reciprocal) modification of the visual systems [9], an arms race of reasonable proportions to be called as such is, in our opinion, plausible at best.

So, what is certain for us is solely the 2nd claim, according to which the angular and polylinear patterns are important for the subcortical processing of potentially deadly dangers. The "cracked" SDT takes from its "ancestor" the least speculative premises. Thus, it is not focused at all on the (co)evolution of our biological ancestors.

The SDT has recently passed some important tests for its macroevolutionary claims, everyone should acknowledge that. E.g., our pragmatic stance towards (what we call) the first point of the SDT proved to be wrong. A natural simulation showed the subjects' heartbeat always going up when aiming at the snake, and it made no difference whether the snake was or wasn't consciously perceived [10].

The essential differences between SDT and our "cracked" version will be listed further. Where our version differs in substance is in what it adds to the SDT, having included here the parts derived from the SDT, more exactly, from the details constituting the 2nd claim of the original SDT. So, let us proceed to describe synthetically our "cracked" SDT. We should see clearer what we can evaluate and how. Then, we can suggest proper experimental subjects.

According to those essential parts of the "cracked" version which are not shared with the original one, the subcortical visual passage involved in snake detection confuses artificial patterns, e.g., the characters in this article, with natural stimuli relevant for survival, e.g., the patterns of some venomous snakes, e.g., those of the Viperidae family. Experimental data shows that the subcortical visual system is alerted even if, or particularly if the snake patterns are partly occluded by vegetations. Many of the graphic characters, constituting angular and/ or polylinear formations would resemble dorsal patterns found in snakes, much more if presented in an occluded, interrupted manner. The fragmented patterns – and, as such, our theory goes, their formal siblings – initiate an alert state at the level of the right basolateral amygdala, i.e., the destination of the subcortical visual pathway. The passage is withdrawn from direct cortical control, an exceptional

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case of anatomical segregation, as tractographic data indicates. For such reasons, we have inferred, errors of the subcortical visual route would be virtually perpetuated indefinitely. Still, we should also expect two shifts regarding the perception of graphic characters. We start from the banal observation that the subcortical visual system can activate at various intensities, and from another type of observations, a topic explored in the paper, indicating that it is reasonable to expect the (right basolateral) amygdala endpoint of the pathway to "read" stimuli both as appetitive and/ or aversive – we may even conceptualize it as instilling maladaptive behaviour through enabling the instrumental pursuit of the appetitive stimuli, according to these data. Because we are dealing with resemblance rather than with correspondence, the intensity of the reaction should be lower. Yet also, as the resemblance is intriguing, appetition will largely replace aversion [1].

Now, we have arrived to the "juicy" part of our hypothesis. Light is a greater reducer of aversion/ enhancer of appetition, much better than sound. We have inferred from such data that, by promising greater chances of a happy-end encounter, light would increase the attractiveness of the graphic marks. It can be thus deemed a Pavlovian conditioned stimulus for attraction towards graphic characters. However, when using the route in a (more) luminous environment, we would reduce (at a faster pace) the intensity of the reaction, and this is how light becomes the main object of attraction: it compensates for the lower intensity of the stimulation induced by characters. The graphic characters will stay relevant even when becoming secondary, due to the anatomical and functional segregation of the subcortical system. The output deriving from a progressive attraction to light associated with fractured lines/ angular patterns/ multilinear patterns is likely the equivalent of a mass extinction scenario - at least, not unless (unforeseen and/ or powerful) "recoils" occur [1].

Joking a little, even if, now, it may seem inappropriate, you might say it is a möbian snake theory. We may not perceive when we, as individuals, or as a species, pass from that which is rather a longing for light-accompanied terrifying patterns to a "full-blown" addiction towards patterns-accompanied light. But why throw it fully on the snake? The addiction is not towards authentic snake patterns, but towards unacknowledged imitative representations. This act of imitation has some nasty repercussions (not to say the least), so we named the "cracked" version a/ the Möbian Doppelgänger Theory (MDT).

II. In Order to Test it

We were making a case for the plausibility of the MDT in our previous article. Its basis are the following observations:

1. When aiming at venomous snakes: coactivation of the subcortical visual route with the V2 plus V4 cortices, the latter two areas being known to possess neurons sensible to angular structures and fractured colinear segments (V2), respectively complex multilinear patterns (V4);
2. When aiming at achromatic diamond/ checkerboard patterns, isolated from the snake: idem, coactivation of the subcortical visual route and of the V2 and V4 areas;
3. When aiming at characters pertaining to writing systems with more complex aesthetics: coactivation of the V2 and V4;
4. When aiming at letters of (classical) alphabets: activation of the V2.

To these, we may add – yet, it should not be deemed an observation of the subcortical pathway activity:

5. When learning to read the Devanāgarī, an alphasyllabary which borders ideograms aesthetically: coactivation of two subcortical formations (the right superior colliculus, and the bilateral pulvinar nuclei) partially superposable with the subcortical route, together with V2 and V4 [1].

One may say: the participation of the subcortical visual pathway in reading is to be highly doubted. No activity of the third key-element of the subcortical route, the amygdala, was detected. But if we follow closely the MDT, it is precisely this activity which is the one that is harder to detect. The emotional reaction towards characters is supposedly reduced, first of all because of overall dissimilarities between the typical look of (fragmented) snake patterns and the graphic patterns. Now, if the activity in the bilateral pulvinar and right superior colliculus has something to do with the subcortical pathway, we should perhaps give a big "thanks!" to the very rare design of the study in question, because it involved illiterate subjects, because illiterates – maybe those from more oral communities particularly because selection towards less prominent snake reactions may have massively occurred in our literate societies since centuries/ millennia – may have comparatively (much) stronger reactions [1].

Thus, to better evaluate the MDT, we need to fulfil at least one of these three conditions in a similar experiment:

1. have more sensitive/ better (neuroimaging) tools;
2. the ambient is rather dimly lit;
3. the subjects have a strong subcortical vision in the presence of patterns of the mentioned types.

Regarding the first condition: we should expect difficulties when studying the human subcortex! This land asks for measuring very deep and very fast

Global Journal of Researches in Engineering (J) Volume XXI Issue III Version I Year 2021

neural activity. Measuring such activity is difficult for the fMRI and the M/EEG approaches alike. As a general point, because of the methodological and interpretative boundaries pertaining specifically to the various approaches that may prove useful here, we can only recommend the comparative use of multiple approaches in order to better understand this domain [11]. On another hand, we can breathe easily: it is far easier to satisfy the second condition. Considering these, we find ourselves primarily concerned, for the moment, with the third condition. We will try to identify subjects that would be suitable for testing the MDT.

Subjects with autism spectrum disorder (ASD) or, if you prefer the plural, autism spectrum disorders (ASDs) – the debate looks far from being settled [12] – seem proper for testing our theory. ASD(s) clearly has/have a very strong genetical basis, one which is proved by studies on monozygotic twins [13]. Yet, ASD(s) is/are among the most genetically heterogeneous neuropsychiatric disorder(s) [14]. The structural differences in ASD(s) vary highly with age [15]. Despite all this heterogeneity, there is some order to be found even here. One object of interest for us is that amygdala neurons in children with ASD(s) consist of unusually greater numbers. The number of these neurons will decrease drastically with age. Adults with ASD(s) have much fewer amygdala neurons than neurotypical individuals [16]. Because of their great number of neurons in amygdala, children with ASD(s) may seem close to the ideal subjects for testing the MDT. We take notice that there are impairments in ASD(s) possibly impeding us to test the MDT in this manner, e.g., due to dorsal stream processing being disrupted, ASD(s) children need somatosensory feedback where watching would be enough (for learning) for neurotypical subjects [17]. So, before trying to (in)validate MDT, examining snake detection in ASD(s) children seems critical. It might be that illiterate [1] children with ASD(s) are ideal. Or, and that is our recommendation, that we should stick to studies on illiterate subjects. Taking into consideration the possible relevance of genetical selection, illiterate people from largely illiterate communities are ideal.

III. Conclusion

Both illiterates, especially those with a more traditional way of life, and children with ASD(s) are marginal in many (contemporary) societies. We usually expect scientific approaches to improve their condition, not vice versa. So, things seem to be reversed. We, as researchers, need to appeal to these people. It might sound even "worse": that, because, after weighing the plausibility of the MDT in correlation with the size of the problem the MDT is pointing out, scientific thinking may become a "suicidal" and "patricidal" tool, i.e., targeting the fundaments of science. We are thus in need of asking what will we do: go with the science, perhaps against it (and against much, much more)? Or, go with something that we call science to defend… exactly what?

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