Wheel-running in day-active and night-active grass rats is related to increased Fos expression in non-dopaminergic cells of the reward system

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BACKGROUND

• In the diurnal grass rat (*Arvicanthis niloticus*), access to a running wheel switches some individuals to a predominantly nocturnal activity pattern (night-active individuals, NA, Fig.1A), while others keep their diurnal activity pattern (day-active individuals, DA, Fig.1B) [1].

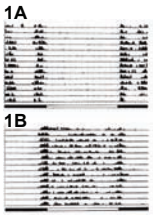
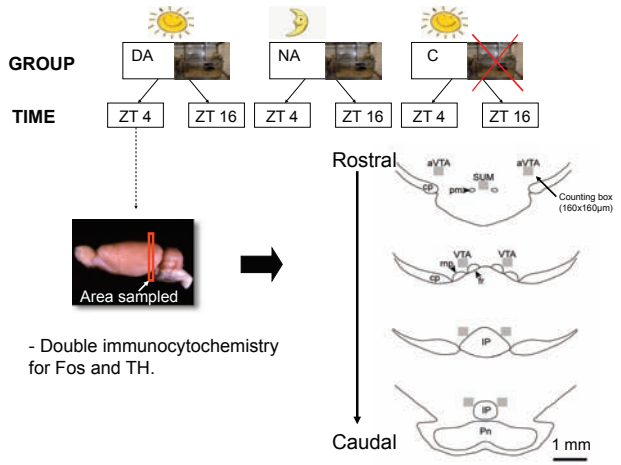


Figure 1. Representative actograms of DA (1A) and NA (1B) grass rats.

• In the present study we investigated the relationship between the voluntary shifts in locomotor activity seen in these animals and neural activation in dopaminergic cells* and non-dopaminergic cells of the ventral tegmental area (VTA) and the supramammillary nucleus of the hypothalamus (SUM), since these two areas have been involved in reward and wheel running has been postulated to be rewarding and possibly addictive [2].

(*) The only statistically significant effects were seen in non-dopaminergic cells with very few neurons showing double labeling for Fos and tyrosine hydrozylase.

METHODS



Abbreviations: aVTA: anterior VTA, C: control, cp: cerebral peduncle fr: fasciculus retroflexus, IP: interpeduncular nucleus, mp: mammillary peduncle, pm: principal mammillary tract, Pn: pontine nuclei, TH: tyrosine hydroxylase, ZT: Zeitgeber time.

SUMMARY

• Access to a running wheel induces increased neural activation of non-dopaminergic cells of two components of the reward system: the aVTA and SUM (Fig. 2 and 3). This effect is seen regardless of ZT.

IMPLICATIONS

• Because the SUM and VTA project widely throughout the brain, the effects of altered neural activation in those regions are likely to be seen in a broad range of neural functions and behaviors.

• These effects may also occur in humans, since voluntary exercise and voluntary display of activity during the night are widespread practices around the world [3].

RESULTS

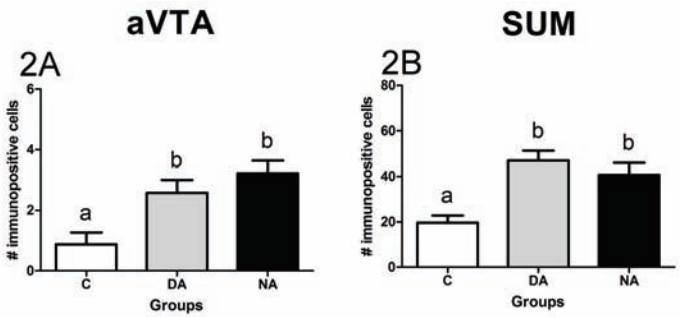


Figure 2. Patterns of Fos expression in non-TH cells of the aVTA (A) and SUM (B). The effect of group was statistically significant. Different letters note significant differences among groups ($p < 0.05$).

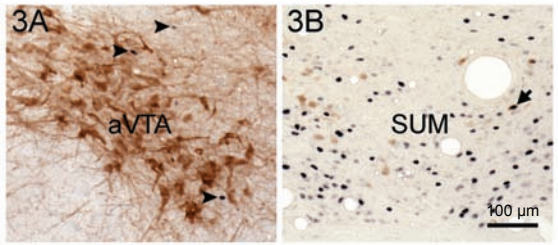


Figure 3. Photomicrographs of Fos and TH cells in the aVTA (A) and SUM (B). Double-labeled cells were scarce (arrow in B) or absent in both areas. In addition, note that TH cells were abundant in the aVTA. However, these cells were not positive for Fos, even though this protein was observed in the vicinity of those neurons (arrowheads).

REFERENCES AND ACKNOWLEDGEMENTS

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