# Do the different actions required to gain a palatable food make a difference in the activation of the brain?

The motivated behaviour that underlies the food intake is a complex process mediated by various neural circuits. One of these is the mesolimbic system that employs the dopamine (DA) as neurotransmitter. In particular, in the responsiveness to food consumption, it has been observed a relevant implication of a terminal area of this system: the nucleus accumbens (NAc).

The NAc is an heterogeneous structure, being made of two subdivisions: the ventro-medial shell and the dorso-lateral core, with different functions. The NAc shell is an area with limbic functions and encodes the hedonic valence of food taste; the NAc core encodes the generic salience and can not discriminate between sweet and bitter taste. In fact, in naive rats, a salient sweet taste (chocolate) increases, while a bitter taste (quinine) decreases DA transmission in the NAc shell. DA in the NAc core is affected by both the taste stimuli.

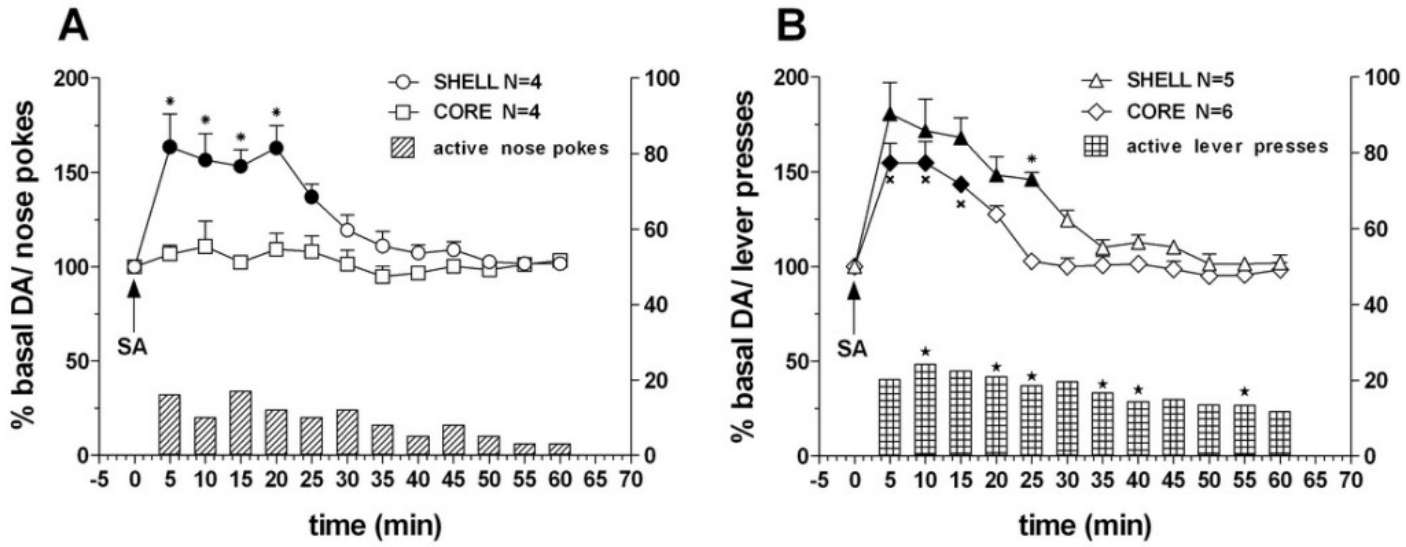


Fig. 1. Time-course of dialysate DA in the NAc shell and core and active nose-pokes (A) or lever presses (B) (bars, means of shell and core group) under FR1 nose poking or lever pressing for sucrose. Data are means ± SEM of the results, expressed as a percentage of basal, obtained in the number (N) of rats indicated in the figure.

In previous studies we found that in rats self-administering sucrose pellets just inserting the nose in a hole (nose poking), DA increased selectively in the NAc shell and not in the core. Our observations, however, contrast with those of the literature showing that in rats self-administering food, extracellular DA increases both in the NAc shell and core. As we have already noted, the

most consistent difference between our studies and those of the literature is that they utilized a different operant behaviour: rats have to press a lever to obtain the food instead to put the nose into a hole.

The instrumental behaviour of lever pressing is quite difficult for rats and require more time to be learned. In order to clarify these differences we compared the changes in extracellular DA in the NAc shell and core in two groups of rats differing only in the response modality utilized for responding, lever-pressing and, respectively, nose-poking for sucrose pellets.

In rats responding for sucrose by nose poking dialysate DA increased in the shell but not in the core. In contrast, in rats responding by lever pressing dialysate DA increased both in the shell and in the core. These findings provide an explanation for the discrepancies existing in the literature over the responsiveness of shell and core DA in rats responding for food and demonstrate that NAc shell and core DA are affected differently depending on the kind of behaviour required to obtain the reward.

In contrast to lever pressing, nose poking is a natural response modality of a macrosmatic species like the rat. Due to this, nose poking, in contrast to lever pressing, would not require learning of a new motor program in order to perform it. The extraneous nature of lever pressing from the natural motor repertoire of the rat would make it a kind of skill that, as such, in contrast to nose poking, would require the concourse of NAc core DA to be learned and performed.

The present observations and those of our previous studies confirm and extend the notion that DA transmission in the two NAc subdivisions, the shell and the core, encodes different aspects of instrumental goal-directed responding. While NAc shell DA might encode the incentive valence (positive or negative, appetitive or aversive, rewarding or punishing) of stimuli, NAc core DA would encode the motivational value and its activational properties necessary for learning and expressing complex instrumental motor patterns (skills).

***Bassareo V, Cucca F, Frau R, Di Chiara G***
*Department of Biomedical Sciences*
*University of Cagliari*
*Cagliari, Italy*

## Publication

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