Swimming Behaviour of the upside-down swimming Catfish (Synodontis nigriventris) at high-quality Microgravity - a Drop-Tower Experiment

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The catfish Synodontis nigriventris often shows a unique swimming behaviour in being oriented upside down. In the course of a parabolic aircraft flight (PF) experiment conducted by Ohnishi et al. (Abstract COSPAR04-A-00961, 2004, www.cosis.net), specimens of this species were subjected to diminished gravity, and the dorsal light response (DLR) was tested. Usually, the DLR is more clearly exhibited by fish in a low-gravity environment, since they then need to use visual input as the major (or even the sole) cue for postural control. It was shown by Ohnishi et al. (2004), however, that S. nigriventris did not reveal a DLR during the PF-phases of diminished gravity, and it was concluded that the species has a novel balance sensation which does not induce a DLR. In the course of an earlier drop-tower (ZARM, Bremen) experiment, we had analysed the swimming behaviour of cichlid fish (Oreochromis mossambicus) at various levels of diminished gravity ranging from 0.009g until 0.3g (the animals were housed within a centrifuge during the drop-tower flights) with the finding that the (residual) level of gravity, which is usually gained aboard PFs (i.e., 0.03-0.05g), is sufficient for most fish of a given batch to maintain a normal postural control (Anken, Medicine and Mobility 7: 18, 2005). The vestibular organ of S. nigriventris, moreover, is assumed to be more sensitive than that of O. mossambicus due to “hanging” utricular otoliths in the upside-down posture. Thus, we hypothesized that the residual gravity aboard PFs might well be sufficient for the catfish to be perceived and used as a cue for orientation. In order to test this assumption, we repeated the experiment of Ohnishi et al. (2004), but we subjected S. nigriventris to drop-tower flights at high-quality microgravity (i.e., 10-6g). Interestingly, the behaviour of the catfish did, at microgravity, not differ from the behaviour of 1g controls. Our results are therefore fully in line with those of Ohnishi and colleagues. However, there is no need to speculate about a novel balance sensation in S. nigriventris as did Ohnishi et al. (2004), since this species is able to maintain any posture without interference from tilt-counterreacting vestibular reflexes due to a postural control mechanism termed ventral substrate response (e.g., Meyer et al., J. Comp. Physiol. 110: 323-331, 1976). Further experiments at diminished gravity should be conducted using S. nigriventris in large containers in order to prevent the action of the ventral substrate response. Acknowledgement: This work was financially supported by the German Aerospace Center (DLR) (FKZ: 50 WB 9997/50

WB 0527).