Fast-starting after a breath: air-breathing motions are kinematically similar to escape responses in the catfish Hoplosternum littorale

Fast-starts are brief accelerations commonly observed in fish within the context of predator-prey interactions. In typical C-start escape responses, fish react to a threatening stimulus by bending their body into a C-shape during the first muscle contraction (i.e. stage 1) which provides a sudden acceleration away from the stimulus. Recently, similar C-starts have been recorded in fish aiming at a prey. Little is known about C-starts outside the context of predator-prey interactions, though recent work has shown that escape response can also be induced by high temperature. Here, we test the hypothesis that air-breathing fish may use C-starts in the context of gulping air at the surface. Hoplosternum littorale is an air-breathing freshwater catfish found in South America. Field video observations reveal that their air-breathing behaviour consists of air-gulping at the surface, followed by a fast turn which re-directs the fish towards the bottom. Using high-speed video in the laboratory, we compared the kinematics of the turn immediately following air-gulping performed by H. littorale in normoxia with those of mechanically-triggered C-start escape responses and with routine (i.e. spontaneous) turns. Our results show that air-breathing events overlap considerably with escape responses with a large stage 1 angle in terms of turning rates, distance covered and the relationship between these rates. Therefore, these two behaviours can be considered kinematically comparable, suggesting that air-breathing in this species is followed by escape-like C-start motions, presumably to minimise time at the surface and exposure to avian predators. These findings show that C-starts can occur in a variety of contexts in which fish may need to get away from areas of potential danger.

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