Intro to Discussion?

There are a number of features of piscivorous interactions which have yet to receive the attention of theoreticians and therefore have unclear strategic implications. For example, pursuit games often assume that both pursuer and evader possess perfect information, which is analogous to formulating strategy in a chess match Salen:2004wp. In contrast, predator-prey interactions may proceed more like a game of cards, where both players possess partial information about the state and capabilities of their opponent. Therefore, sensory systems may constrain the ability to conform to an optimal strategy or different optima may be possible for a player operating with imperfect information.

Mechanical constraints may also inform the strategy of predators and prey. The performance of motor systems is constrained by neuro–muscular physiology and, in the case of fish, hydrodynamics. The mechanics of suction feeding offers some strategic constraints on the predator. The impulsive burst of low pressure that a predator generates for suction feeding is limited in duration to tens of milliseconds by the finite expansion permitted by the buccal cavity Wainwright:2001ufa. In addition, the pressure gradient that captures prey is only effective in a small region (about one-half of the gape diameter) in front of the mouth Day:2005p5856. These spatial and temporal restrictions appear to necessitate high accuracy in strike targeting and may explain why a large diversity of predators slowly glide, or brake, on their approach toward prey Higham:2005iu, Higham:2007go.

Prey fish will generally initiate a high-speed escape response if they detect an approaching predator. This fast start escape consists of curling the body into a C shape (Stage 1) and then unfurling (Stage 2) to initiate high-speed swimming D:1973up. The neurophysiology of the fast start has offered an prolific model on vertebrate motor control (CITE) and some investigators have considered the strategic implications of fast-start kinematics [reviewed by][]Domenici:2011tv, Domenici:2011vl. However, it remains unclear how the direction of a fast start affects a prey's probability of surviving an encounter with a predatory fish.

[Text from earlier versions]

This effect may be understood by considering the timing of the minimum distance formulated by Weihs and Webb (1984).

For $K < 1$ the prey is faster than the predator. In this case, intuition leads us to accept that an escape directly away from the predator ($\alpha = 0$) is the best solution. What is not so obvious, is that there exists a range of possible escape angles for which the minimum distance function does not change.That is, there is no single optimal escape angle. Thus, a prey can escape along any direction within this range with no penalty.

We begin by noting that at $t = 0$, $D^2 = X_0^2$. For this case, we are interested in escape angles between the two optimal solutions given by Weihs and Webb equation $0 \leq \alpha \leq \arccos(K).anglerange$