Hunting experience and prey predictability jointly shape individual foraging specialisation in a predator-prey videogame

# Abstract

Keywords: foraging behaviour, individual specialization, experience, learning, prey predictability, online videogames

# Introduction

Individual variation in predator foraging behaviour is increasingly recognized as a major driver of trophic interactions and community dynamics (Lima 2002; Schreiber et al. 2011; Pettorelli et al. 2015; Michalko and Pekár 2016). Indeed, predator populations are often composed of assemblages of individuals specializing in different foraging strategies or resources (Estes et al. 2003; Tinker et al. 2008; Kernaléguen et al. 2015; Phillips et al. 2017). It is now well established that individual foraging specialization cannot be attributed exclusively to intrinsic factors such as sexual, morphological, or age-related differences (Bolnick et al. 2003; Bolnick et al. 2011). A growing body of evidence suggests that ecological interactions, such as predator-prey interactions, may instead act as the major drivers of individual foraging specialization (Araújo et al. 2011; Toscano et al. 2016). For instance, predators species often use hunting techniques that are fine-tuned to the type of prey that they encounter (Davoren et al. 2003; Estes et al. 2003; Woo et al. 2008; Courbin et al. 2018), and their capacity to learn through experience how to effectively use them is essential to maintain foraging success. Yet, we have very limited knowledge on how predator foraging specialization develops through experience and interactions with prey, and the resulting ecological consequences of such among individual behavioural differences for predator-prey interactions.

Learning how to hunt prey is crucial for young predators to reach adulthood and survive (Phillips et al. 2017; Heithaus et al. 2018). Theory predicts that specialization through learning may result from past experiences in handling prey as well as a limited ability to retain complex learned skills for multiple prey types (Tinker et al. 2009). Empirical studies shows that learning can optimize the efficiency of foraging strategies (e.g. search and handling times, return rates) potentially via associative images or increased reliance on prey and environmental cues (Edwards and Jackson 1994; Morse 2000; Reid et al. 2010; Wilson-Rankin 2015). While this does not directly indicate foraging specialization, such optimization may reinforce the use of the same strategy (i.e. specialization) if its success is constant through repeated attempts. *parler des couts d’apprendre de quoi d’autre*

*expliquer comment ça optimise* *expliquer comment ça peut mener aussi à de la plasticité* *parler des coûts*

(apprentissage, search images, prior information) (par contre, décomposer l’âge de l’expérience est difficile, et particulièrement chez des espèces sur le terrain puisque ça peut impliquer des techniques invasives) (parler des études qui ont montré que certains spécialistes étaient meilleurs, mais que c’était confondu par l’âge) [*références learning : phillips, Haage(minks = learn mène à plasticité), Tinker (théorique), Weimerskirch (only suggest memory)*] *[courbin = switch souvent possiblement avec learn, Zango = suggère, Woo = suggère, Estes = suggère.]*

*Wilson-Rankin: Because resources and their distribution vary both in time and space, foraging strategies must allow for the detection and response to fluctuations in resource levels* (Ishii et Shimada : learning = plasticity)

A number of long-term studies observed that generalist and specialist individuals can achieve similar fitness [sources: à partir de Woo]. An emerging explanation is that temporal fluctuations in the predictability of resources (abundance, availability, behaviour) may favor one or the other strategy depending on time scales [sources : Woo, Phillips, Ceia, etc, Courbin, Chang]. The resource-predictability hypothesis advances that when resources are predictable, particularly on short time-scales, individual specialists should benefit from higher fitness returns. The rationale is that individuals should have higher prey delivery rates when they repeatedly employ the same foraging technique, as it is easier to assess prey predictability over shorter time-scales. In contrast, individual generalists should be advantaged over longer time scales, as resource parameters are expected to fluctuate. [revoir ceia et ramos pour les sources] *ce qu’il manque, c’est qu’on a aucune idée comment des différences individuelles de variabilité environnementale se traduisent par des différences de stratégies*

sources générales sur heterogeneité(Weimerskirch 2007; Ceia and Ramos 2015; Phillips et al. 2017; Patrick et al. 2021).

(travailler ceci) An important question that remains unanswered is how can generalist and specialist individuals coexist within predator populations. If foraging and resource specialisation can help maintain community stability by promoting species coexistence [sources: bolnick, araujo, wolf, etc], it is crucial that we develop studies that integrate the causes and consequences of these two individual components.

Several studies have shown that individual specialists can outperform

Here, we collected individual behavioural data from players in *Dead by Daylight* to investigate how hunting experience and the behavioural variation in prey encountered shaped predator foraging specialization. This enabled us to have a high degree of precision on the interaction as both the behaviour of the predator and the four prey were measured simultaneously in each trial. First, we hypothesize that individual predator behaviour will change with hunting experience. If experience reduces the costs of switching between hunting tactics, then predators should become more flexible through time. Alternatively, if experience enables the refinement of the hunting tactics, then individuals may instead specialize through time. Second, we hypothesize that prey behaviour will shape the developmental trajectories of the predator hunting tactics. Whether predators specialize or not with experience may depend on the behaviour of their prey, for instance, as it may be harder to specialize on prey that are more variable. Third, if individuals differ in their degree of foraging specialization, then we expect that the success of foraging specialists and generalists will be equal. Specialist hunters should fare better when prey variability is lower, while flexible hunters should fare better when prey variability is higher.

# Squelette de l’intro

* Paragraphe 1 : Importance of among-individual variation in foraging behaviour
* Paragraphe 2 : Factors shaping individual variation in foraging behaviour - the role of experience (sources Weimerskirch, 2005, 2007) (explain mechanisms). Explain how it may unravel why foraging specialists are often thought to be more succesful.
* Paragraphe 3: (Linking prey variability to experience (woo et al.)) how trophic interactions are probably the main driver of learning and experience
* Paragraphe 4 (système qu’on utilise) (jeux vidéo : paragraphe le + court possible)
* Paragraphe 5 (objectifs et hypotèses)

*Idéé* : - Est-ce que ça se pourrait que les proies déterminent si les prédateurs se spécialize avec l’expérience ou plutôt deviennent flexible? Dans ce cas, j’utiliserais pas la covariance mais le comportement des proies en effet fixe sur la variance? ou il faudrait que je change les covariances?

*Ideas* : - \* we now have metrics that enable the quantification of individual specialization (cleasby)\*

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