Figure 1. The different escape rules different species may follow based on the slope of the relationship between FID and approach speed. Positive slopes are associated with the temporal margin of safety, a slope near zero is associated with a spatial margin of safety, and negative slopes are associated with the delayed margin of safety. If the slope is positive FID increases until it reaches AD, at which point FID is equal to AD. If the slope is negative FID decreases until it reaches 0, at which point FID is equal to 0. The minimum distance threshold is the last distance at which the animal will tolerate the approach of a threat whereafter if the threat continues to approach to where the animal will escape, regardless of the threats approach speed.

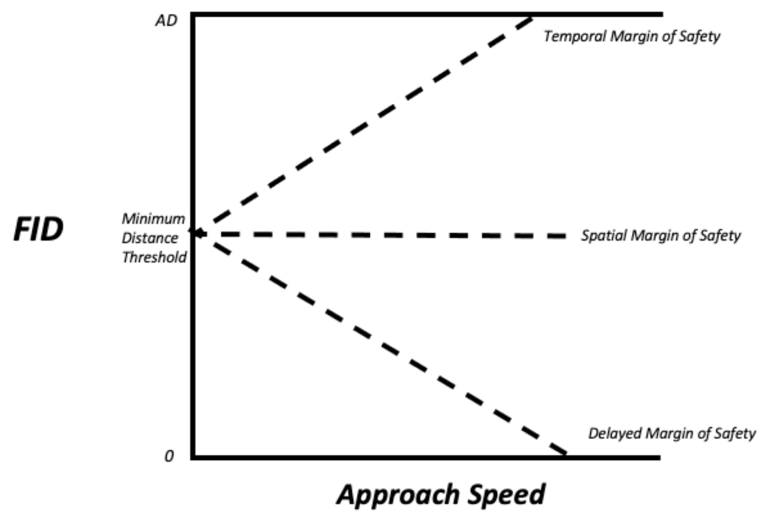

Figure 2. A flowchart with the different steps used to evaluate sensitivity to speed for the FEAR hypothesis, Looming stimulus hypothesis, and the Bayesian optimal escape model. Step 1: we reviewed the literature for studies which explored the effect of approach speed on FID in different avian taxa. The goal was to characterize the range of observed slopes of the FID vs. approach speed relationship when birds were exposed to human-related threats. Step 2: We established the distributions of AD, FID, then slope and intercept of the FID vs. approach speed relationship. Step 3: We simulated AD and FID based on the observed distributions from step 2 All three models required information on either FID, AD, or both to make quantitative predictions. Step 4: We generated model-specific FID predictions using additional parameters when needed. Step 5: We evaluated sensitivity to approach speed by estimating the average effect size of approach speed on model predicted FID at different slope values for each model.

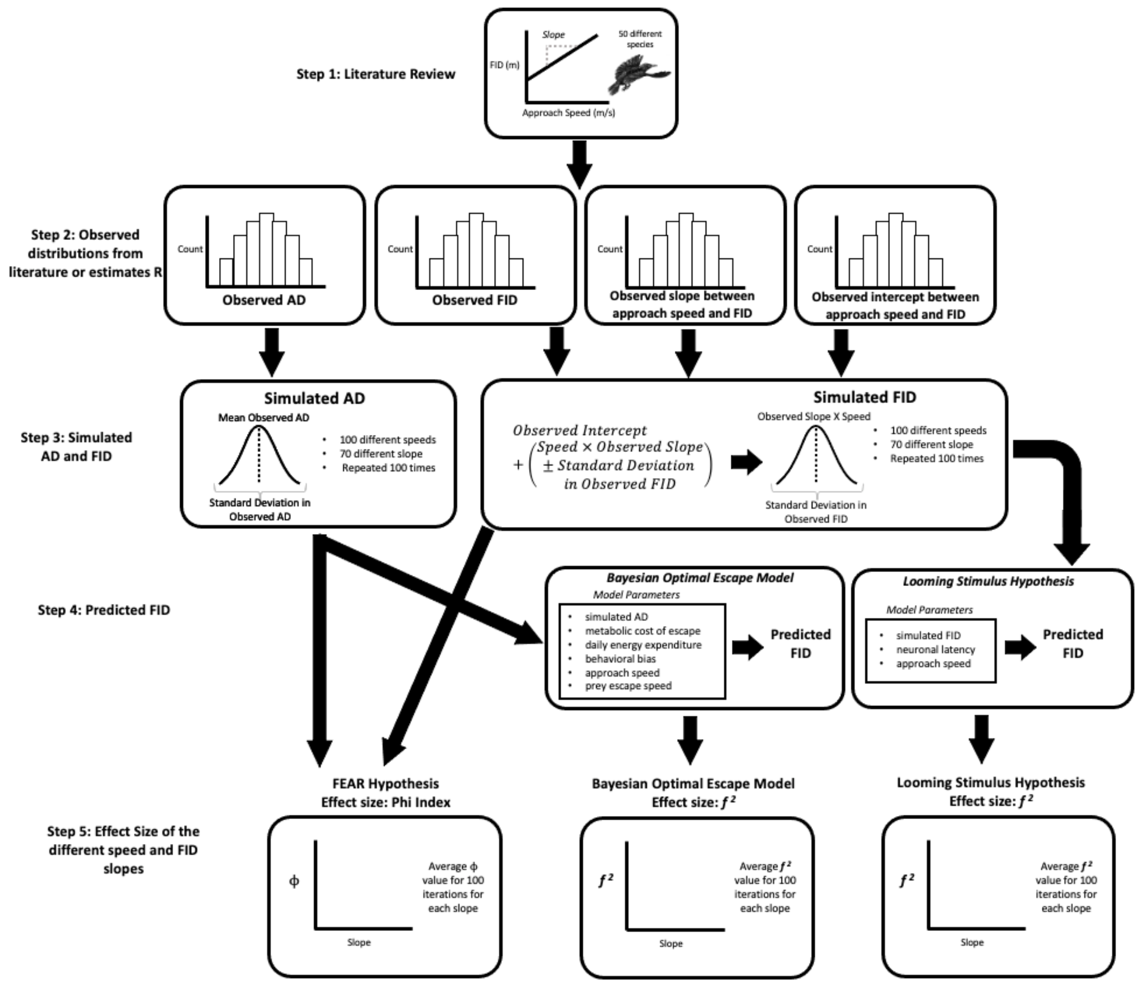

Figure 3. a) Economic escape model is a graphical model. The x-axis is the distance between an animal and an approaching threat (i.e., predator-prey distance). The red curve represents cost of not fleeing, R(d), and the blue curve represents the cost of fleeing, S(d). The x-coordinate where the two curves intersect is the predicted FID for the animal. b) As speed increases, the cost of not fleeing curve becomes more shallow and an animal's predicted FID increases (R2(d)). As risk increases the absolute value of the slope for the cost of not fleeing curve approaches 0. c) If the two curves do intersect than FID becomes limited by the cost of fleeing. d) If the cost of fleeing is also shallow and the two cost curves do not intersect then FID = SD.

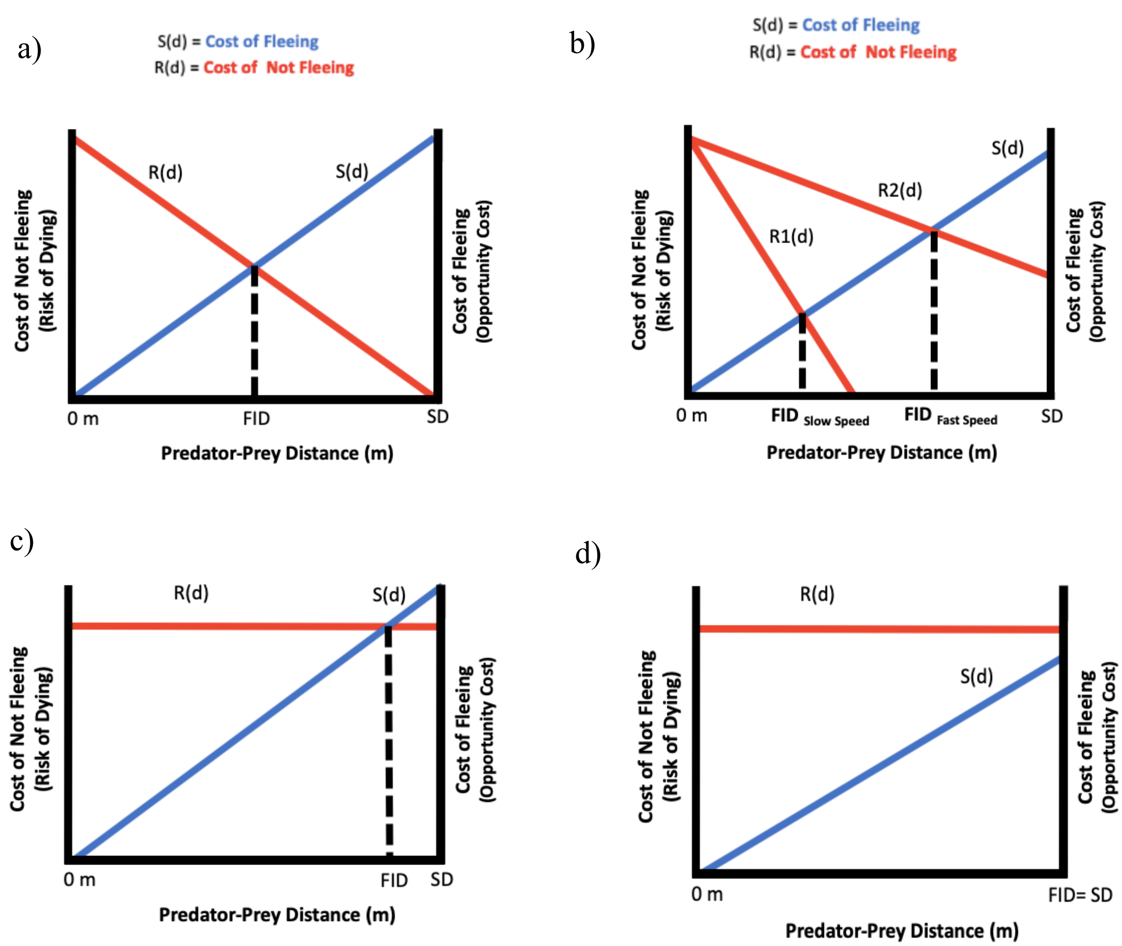

Figure 4.a) Graphical representation of Blumstein's economic escape model. The x-axis is the distance between an immobile animal and an approaching threat (i.e., predator-prey distance). The red curve represents the cost of not fleeing, R(d), and the blue curve represents the cost of fleeing, S(d). a) In the original formulation Zone I, is from 0 to d_{min} and an animal always flee if a threat is detected. Zone II is from d_{min} to d_{max} and the predicted FID is determined by the animals assessment of the cost of not fleeing and the cost of fleeing. Zone II is similar to Economic escape model. Zone III is any distance greater than d_{max} and the animal does not respond to threats in this zone. b) Optimal escape model offers explicit mathematical formulations for an animal's escape behavior. The x-axis is the distance between an immobile animal and an approaching threat. The interaction begins with the animal's detection distance (DD). In optimal escape model an animal's fitness, $F(d)$, is determined by how initial Fitness ,(F_0), the benefits gained during a threat's approach, $B(d)$, and the escape cost ,$E(d)$, multiplied by the probability of survival, $P_s(d)$, affect an animal's initial fitness (F_0). Fitness increases as the benefits functions increases at shorter distances away from the threat. Fitness then decreases as the probability of survival decreases at very close distances to the threat. Escape cost is a one-time cost the prey pays when it flees. Initial fitness does not change with distance. c) Animal escape (FID) at the peak of the fitness function ($F(d)$) in the optimal escape model. d) Illustration of the phi index was developed to determine if the AD vs. FID relationship supports the FEAR hypothesis. The range of ϕ is between 0 and 1. A ϕ value of 0 occurs when animals do not escape at all even after detection and a ϕ value of 1 occurs when prey escape the moment it detects the predator. ϕ must be greater than 0.5 to support the FEAR hypothesis (Samia & Blumstein 2014).

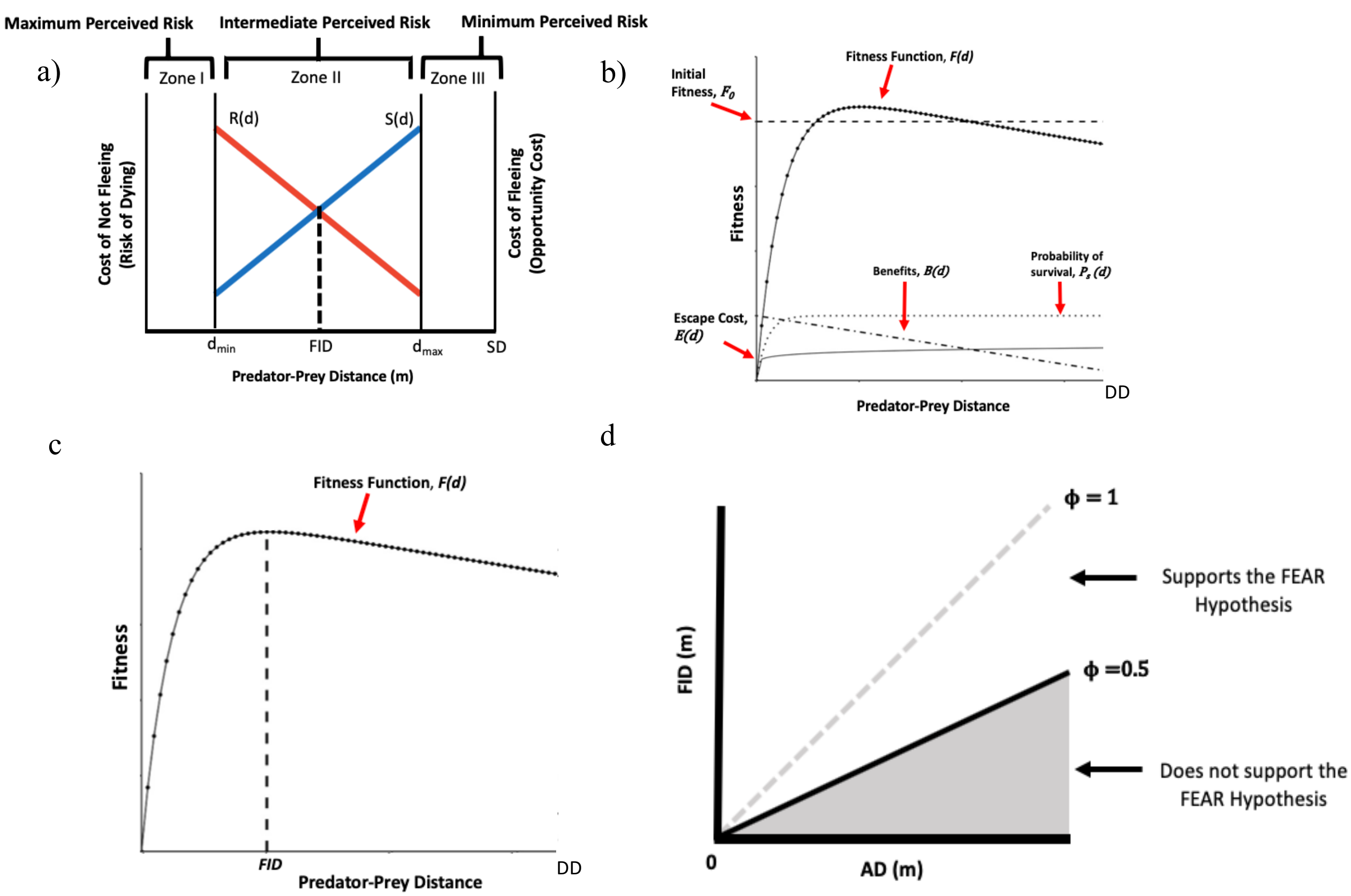

Figure 5. a) The mean phi-index, the effect size metric for the FEAR hypothesis, across iterations for each slope. The figure suggest that model is most sensitive to vehicle approach speed when the slope is equal to or greater than zero. b) The mean f^2 across iterations for each slope according to the looming hypothesis when latency is 0.075 seconds, which suggest the model is sensitive to the delayed margin of safety. c) The mean f^2 across iterations for each slope according to the Bayesian optimal escape model when the body mass is 267.4 grams, which suggest the model is not sensitive to approach sped. d & e) The mean f^2 across iterations for each combination of slope and neuronal latency value for the looming stimulus hypothesis. d and e show the same graph but from two different viewpoints. Across neuronal latency values it seems the model is sensitive to the speed effect at slightly negative slopes. f) The mean f^2 across iterations for each combination of slope and body mass value for the Bayesian optimal escape model. The figure suggests that only at a size of larger then 1kg is the model FID predictions sensitive to vehicle approach speed.

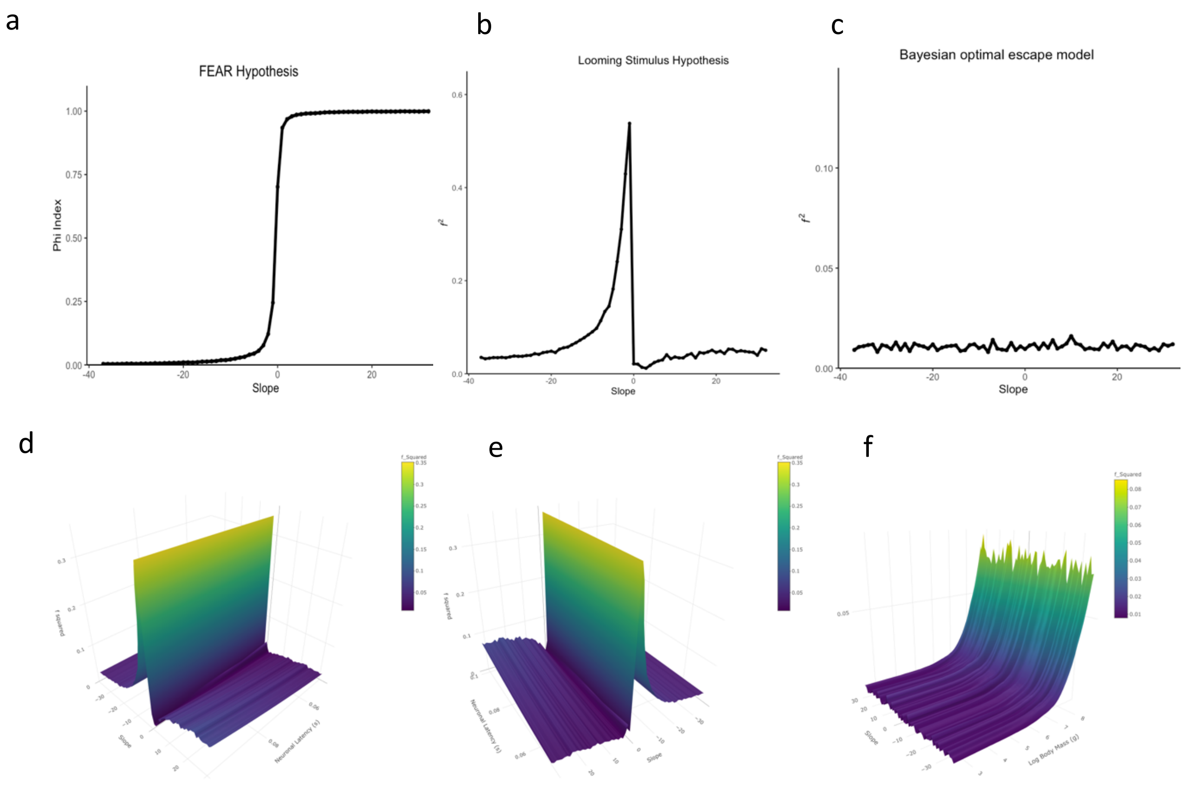

Figure 6. The illustrated differences in the detection assumptions for the five models capable of producing quantitative predictions. FID refers to flight initiation distance, AD refers to alert distances, and DD refers to detection distance.

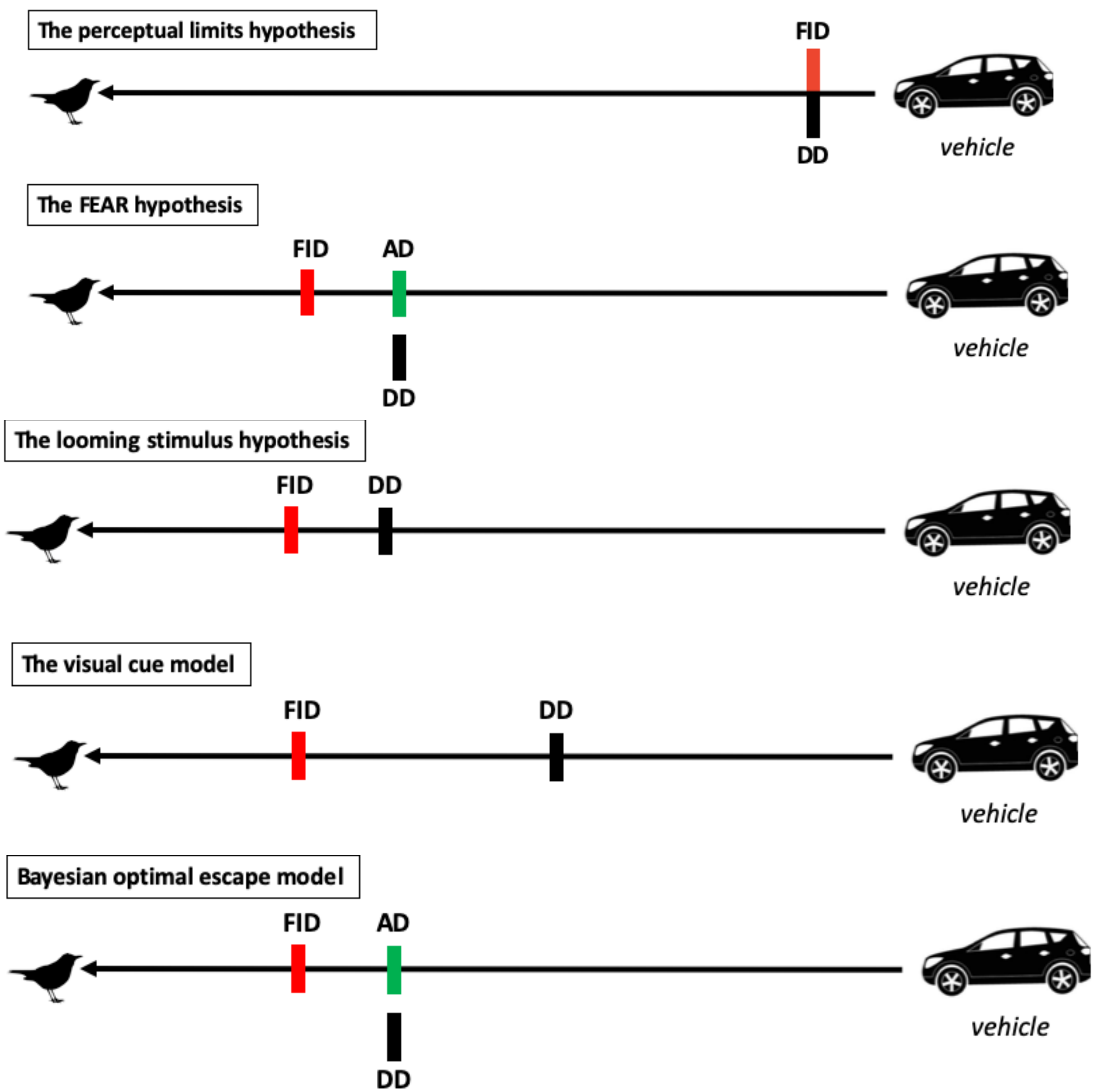

Table 1. We characterized each model based on its ability to generate either qualitative or quantitative predictions with different approach speeds. When possible we generated quantitative FID predictions with the model. We identified whether the model explicitly includes a parameter relative to the threats approach speed. Lastly we determined whether the model was sensitive to vehicle approach speed based on figure 5.

Model name	Can the model generate qualitative predictions relative to speed?	Can the model generate quantitative predictions relative to speed?	Quantitative FID predictions	Does the model have a parameter for speed?	Sensitive to vehicle approach speed
Economic escape model	Yes	No	N/A	No	N/A
Blumstein's economic escape model	Yes	No	N/A	No	N/A
Optimal escape model	Yes	No	N/A	No	N/A
The perceptual limits hypothesis	No	No	FID = 474.67 m	No	No
Flush early and avoid the rush (FEAR) hypothesis	Yes	Yes, implicitly	mean FID = 14.53 m	No	Yes, spatial & temporal margin of safety only
The looming stimulus hypothesis	Yes	Yes	mean FID = 30.03 m	Yes	Yes, speed effect only
Visual cue model	No	No	mean FID = 19.25	No	No
Bayesian optimal escape model	Yes	Yes	mean FID = 44.99 m	Yes	Yes, for spatial, temporal margin of safety, speed effect for species > 1kg.