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A class of difference equations modeling state-dependent delay

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We consider difference equations of the form

$$x_{k+1} = x_k - ag(x_k)x_k - a(1 - g(x_{k-1}))x_{k-1}, \quad a > 0, \quad g\colon \mathbb{R} \to [0, 1].$$

We view g as determining the share of a feedback response that occurs “quickly" versus “slowly"; thus the above equation can be viewed as a simple discrete-time model incorporating state-dependent delay. We present some preliminary results and pose several open questions.