Indicative solution Housebreaking and Policing case (EN)

dr. Erik Pruyt

September 2012

The housebreaking (HB) case is a case of intermediate difficulty about recurrent and reinforced cycles of housebreaking. First, students need to build a SD model (see Figure 1) and specify all functions, including information delays, a sinus function, max/min functions, and 'with lookup' functions. After verifying and validating the model, students are asked to draw the model behavior over time (see Figures 2a and 2), perform sensitivity analyses (see Figures 2c and 2d). Here, a decrease of the *acceptable number of HB* by 11% (sens1) and an increase of the *chance of being caught for HB in neighboring countries* by 10% (sens2) are visualized: *sens1* leads to an overall decrease of HB both by occasional thieves and by OC (Organized Crime) (more vigilance leads to fewer opportunities, and hence, a higher chance of being caught), and *sens2* leads to more HB by the OC, more vigilance, and therefore less HB by occasional thieves.

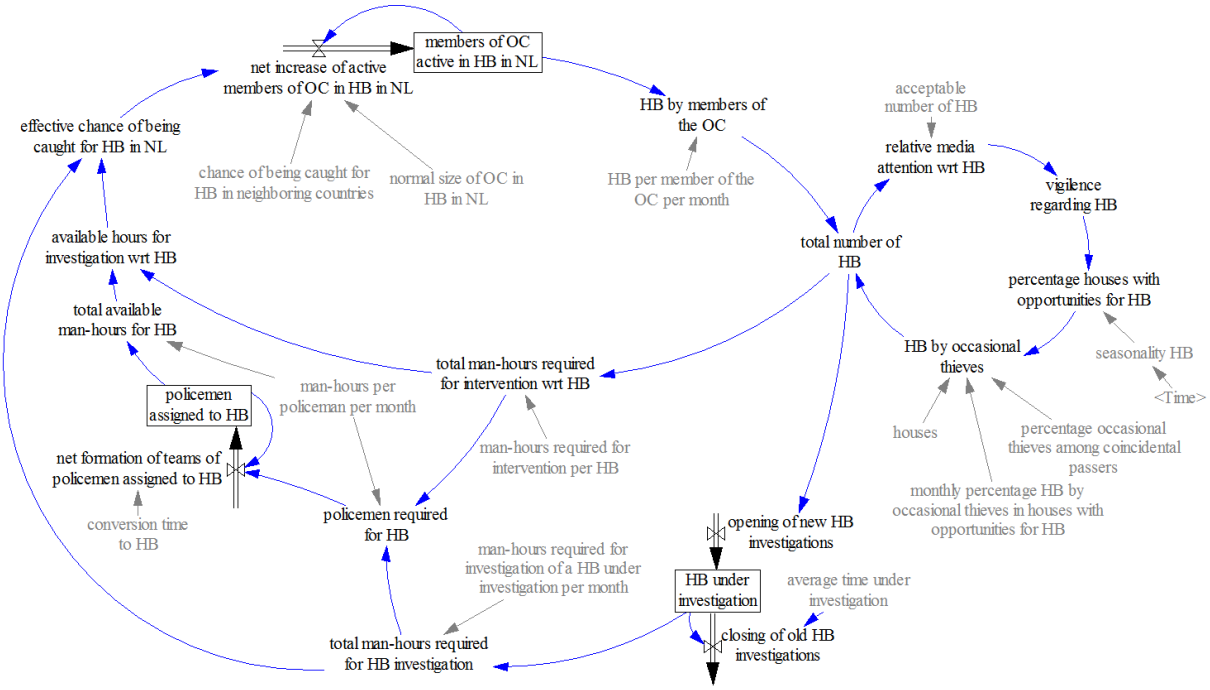
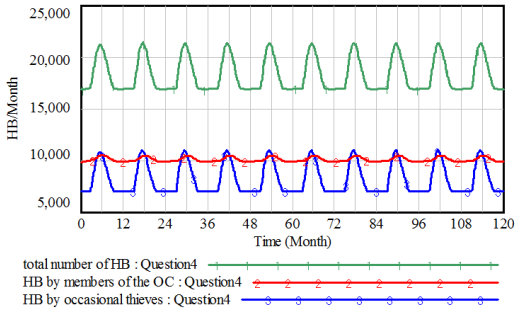


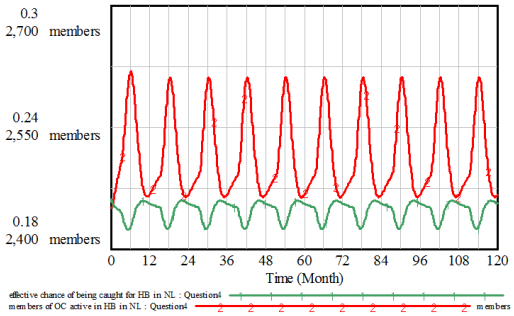
Figure 1: Stock-flow diagram of the HB model

Then students are asked to make an extremely aggregate causal loop diagram (see for example Figure 2e) in order to communicate the relation between structure and behavior of the model to the chiefs of police. Using the diagram in Figure 2e, the explanation could be as follows:

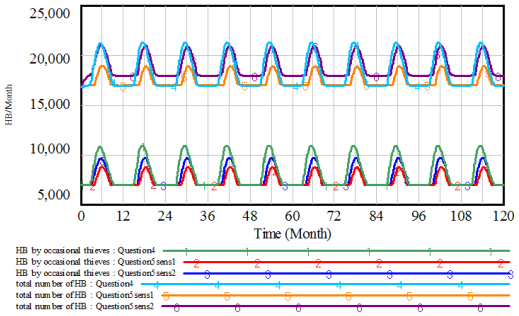
> 'The *occasional HB* loop balances the exogenous seasonal pattern but with a delay: summer offers more opportunities for occasional thieves, resulting in a seasonal increase in the number of housebreakings, after a while to more media attention, more vigilance,



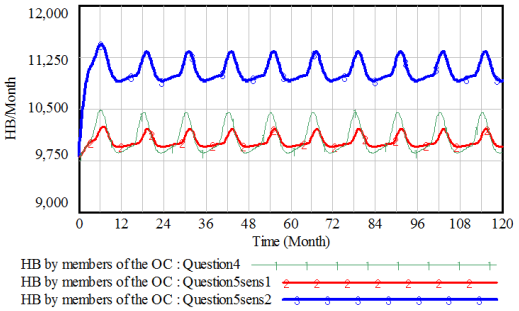
(a) Base case behavior of housebreakings and...



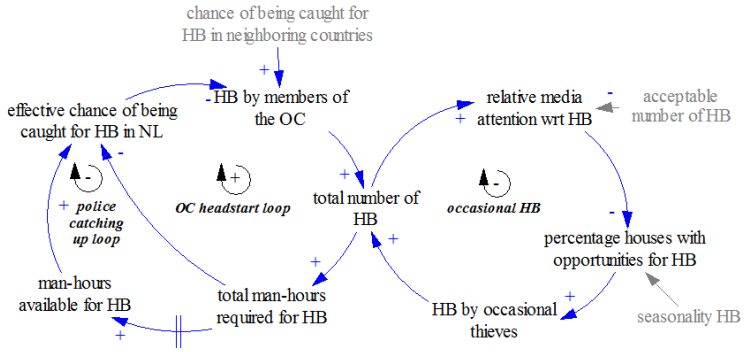
(b) ...the chance of being caught vs OC activity



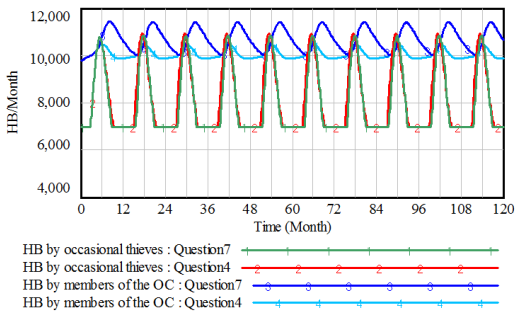
(c) sens1: *acceptable number of HB* = 4000 instead of 4500 – sens2: chance of being caught for HB...



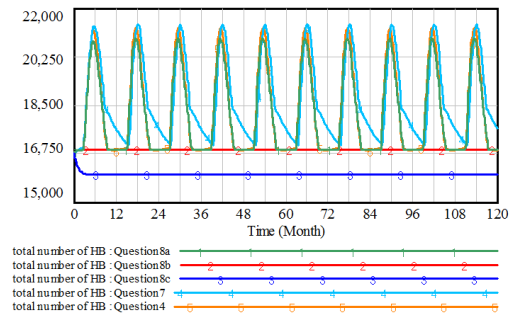
(d) in neighboring countries = 0.22 instead of 0.2



(e) CLD to explain the link between structure and behavior



(f) Hacked behavior



(g) Policies to reduce both types of HB

Figure 2: Base case behavior, sensitivity analysis, causal loop diagram, hack, and policy analysis related to the HB case

> and therefore after some time to fewer houses with opportunities for occasional thieves. However, an increase in the number of housebreakings also leads –given a given total amount of man-hours dedicated to housebreakings– to a lower relative chance of being caught, and consequently, more housebreakings by the OC, until the total amount of man-hours dedicated to housebreakings has increased, raising the chance of being caught, and reducing the number of housebreakings by the OC.'

Finally, students are asked to hack the model in order to adapt it to a client's remark (see Figure 2f), and use the model for policy analysis; acceptable policy advice would for example be to reduce the acceptable number of HB in order to raise media attention and vigilance and proactively assign policemen to housebreaking by the OC (see Figure 2g).

Almost all students were able to build the model. Many students made specification errors, especially errors related to min/max functions. Another common –but surprising– error was the modeling of the *total number of HB* as a stock variable with two inflows and no outflows instead of a simple auxiliary variable summing the values of the *HB by members of the OC* and the *HB by occasional thieves*. During the validation phase, some students realized something was wrong and corrected their error – a few students by extending the stock-flow structure correctly beyond the model description. Many students lost many points because they did not spend sufficient time/effort at answering the open questions.