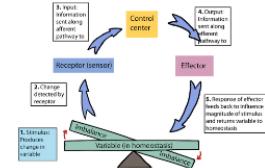
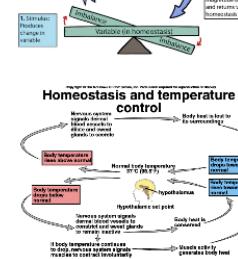


From Homeostasis to Allostasis

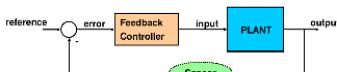


Definition (Merriam Webster):

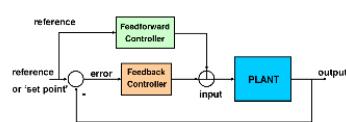
For an organism: the maintenance of relatively stable internal physiological conditions (as body temperature or the pH of blood) in higher animals under fluctuating environmental conditions



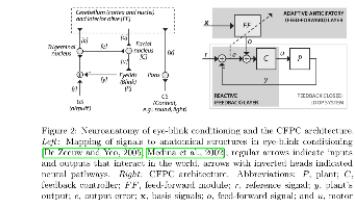
Feedback control



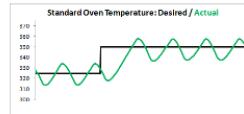
Coupling Reactive Feedback with Adaptive Feed-Forward Control



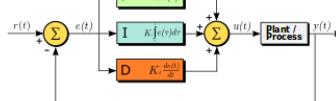
Adaptive control in the cerebellum (Herreros et al., 2013)



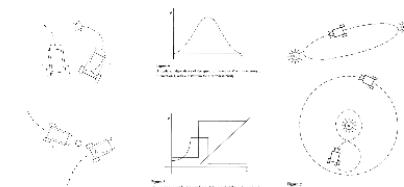
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Proportional-Integral-Derivative controller (PID)



Homeostasis in Braatenberg Vehicles



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(The sims)



Allostatic Control in a Synthetic Forager (Sanchez-Fibla et al., 2010)

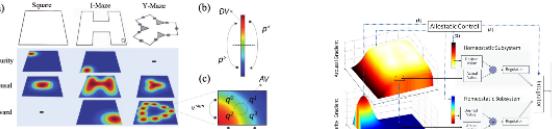


Fig. 2. Behavioral gradients used in the allostatic control system. (a) Table of the used gradients were converted to security, arousal and reward respectively and enhanced to the different settings. The car gradient as it is quadratic and is used in Fig. 7. Maze B is not shown. The present work uses the same gradients as in Sanchez-Fibla et al. (2010) and the same scaling of the gradients. The switching modulus of external source D^* is increased by the probability of being close to a food item, p^* , and p^* is a low value. (c) A zoom-in of the gradients indicate the local direction of the gradient is always directed towards the food source to insure the gradient search is computed.

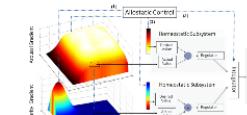


Fig. 3. General behavior of a synthetic forager. These experiments are designed to compare the performance of a synthetic forager with a real-world forager. The forager is able to learn the local direction of the gradients to insure the gradient search is computed.

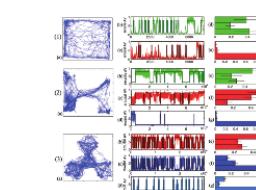


Fig. 4. Trajectories and activity maps. (a) Trajectories from 10 runs. (b) Activity maps for Space, E-Maze, V-Maze, Security, Arousal, and Reward. (c) A zoomed-in view of the activity maps. The activity maps show the spatial distribution of the different gradients. The activity maps are generated by averaging the activity maps of all the runs. The color scale indicates the strength of the gradient. The activity maps are generated by averaging the activity maps of all the runs. The color scale indicates the strength of the gradient.

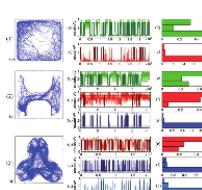


Fig. 5. Trajectories and activity maps. (a) Trajectories from 10 runs. (b) Activity maps for Space, E-Maze, V-Maze, Security, Arousal, and Reward. (c) A zoomed-in view of the activity maps. The activity maps show the spatial distribution of the different gradients. The activity maps are generated by averaging the activity maps of all the runs. The color scale indicates the strength of the gradient.



Allostatic Control and Personality

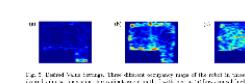
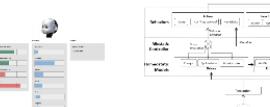
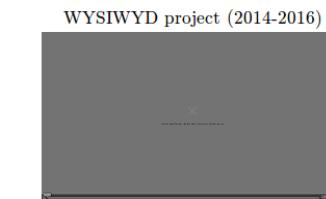


Fig. 6. Trajectories and activity maps. (a) Trajectories from 10 runs. (b) Activity maps for Space, E-Maze, V-Maze, Security, Arousal, and Reward. (c) A zoomed-in view of the activity maps. The activity maps show the spatial distribution of the different gradients. The activity maps are generated by averaging the activity maps of all the runs. The color scale indicates the strength of the gradient.

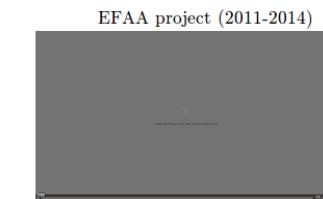


(Lallee et al., 2015)

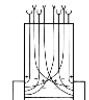


WYSIWYD project (2014-2016)

(Vouloussi et al., 2013)



Back to Braatenberg

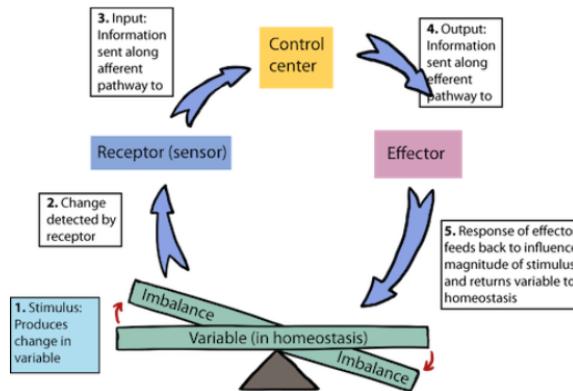


Homeostasis

Definition (Merriam Webster):

For an organism: the maintenance of relatively stable internal physiological conditions (as body temperature or the pH of blood) in higher animals under fluctuating environmental conditions

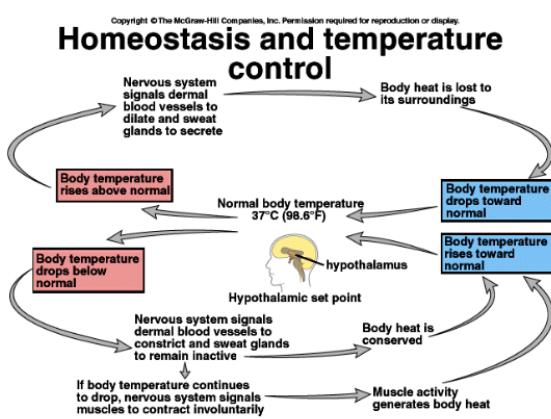
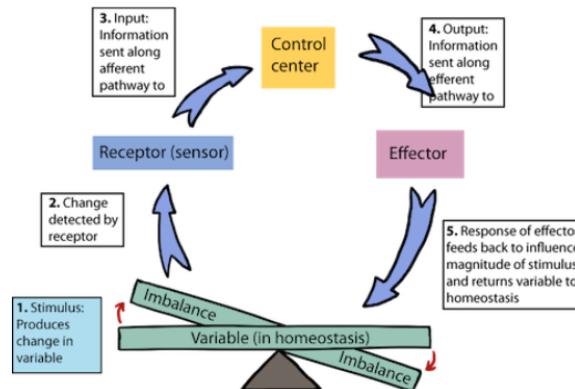
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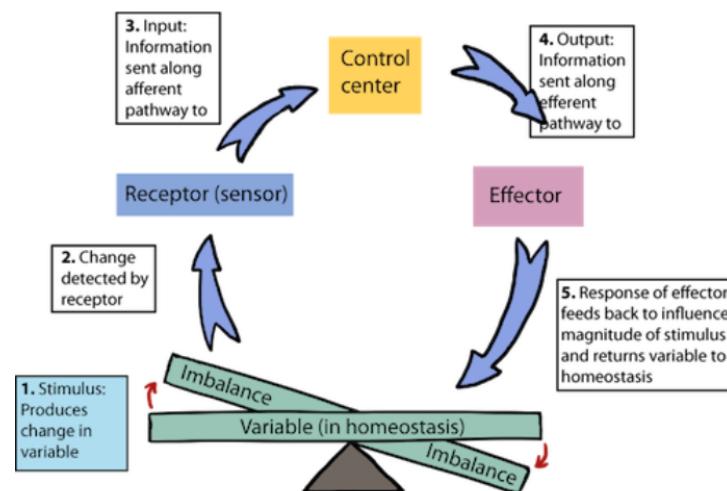
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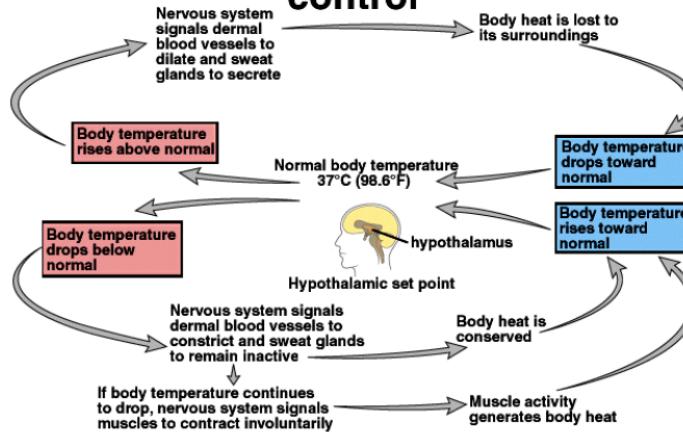
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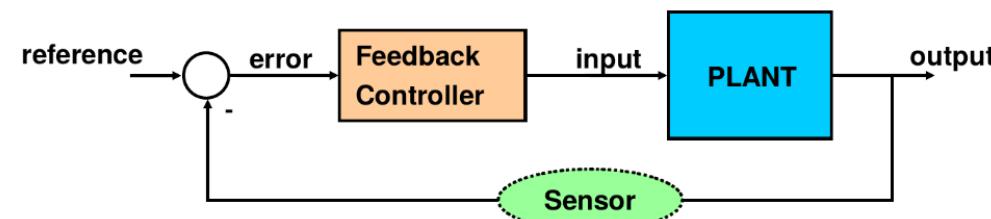
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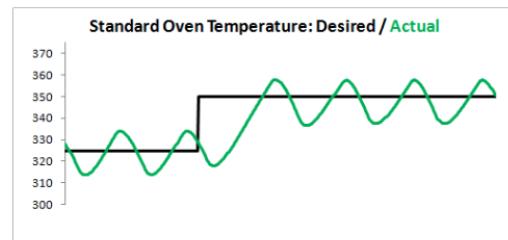
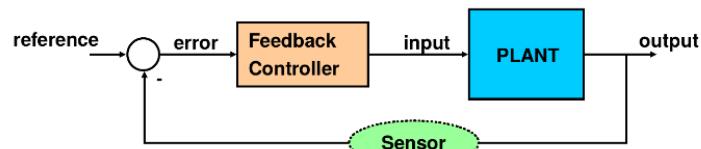
Homeostasis and temperature control



Feedback control



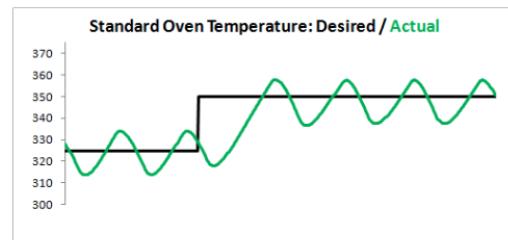
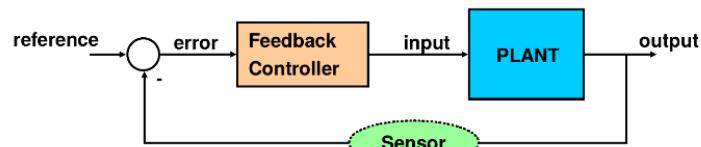
Feedback control



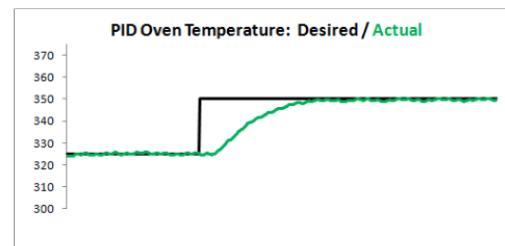
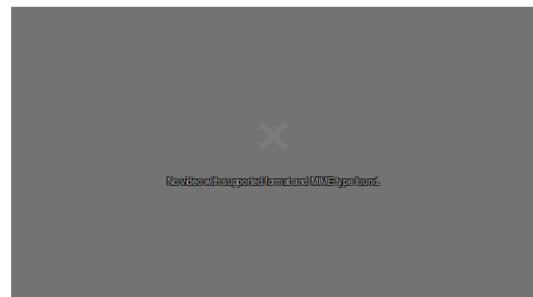
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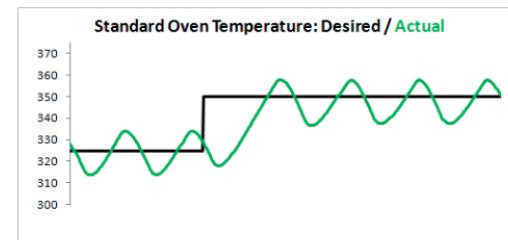
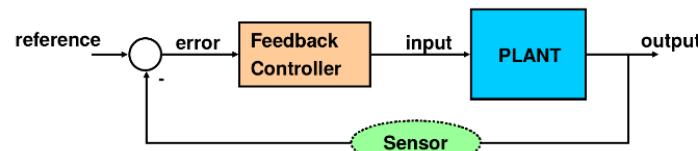
Feedback control



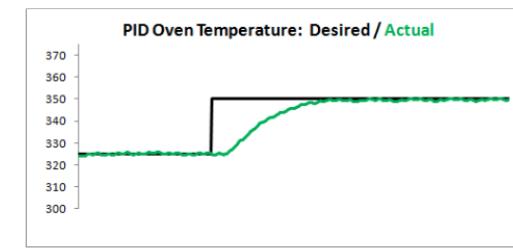
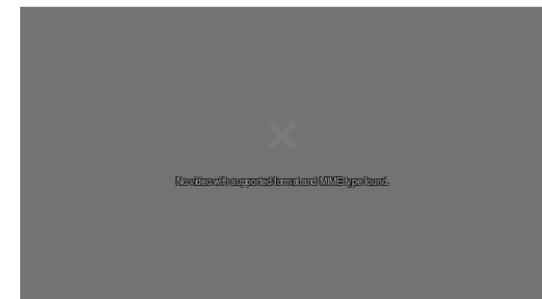
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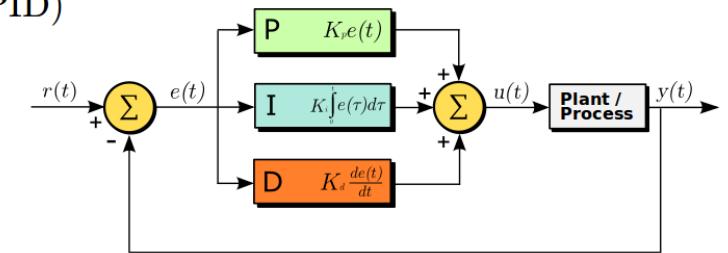
Feedback control



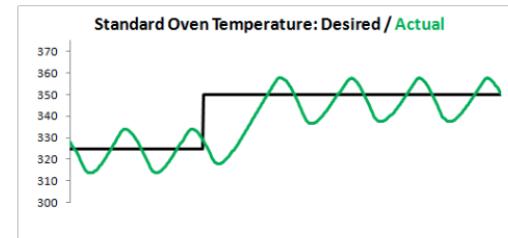
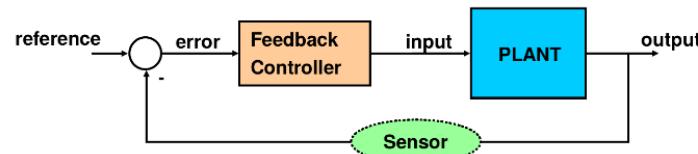
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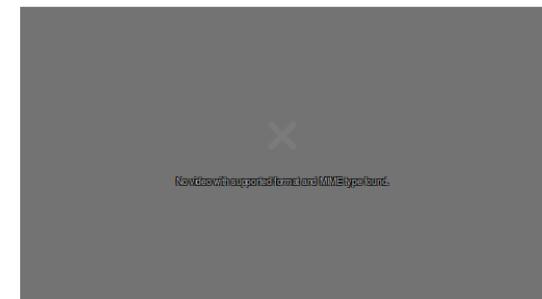
Proportional-Integral-Derivative controller (PID)



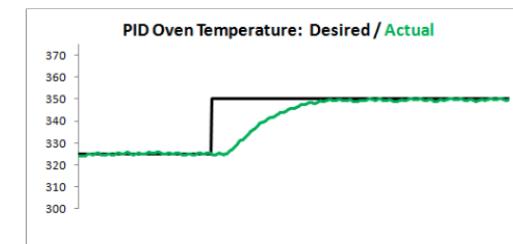
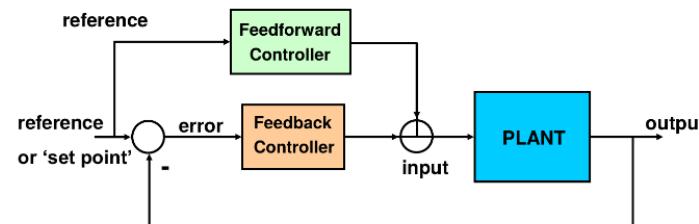
Feedback control



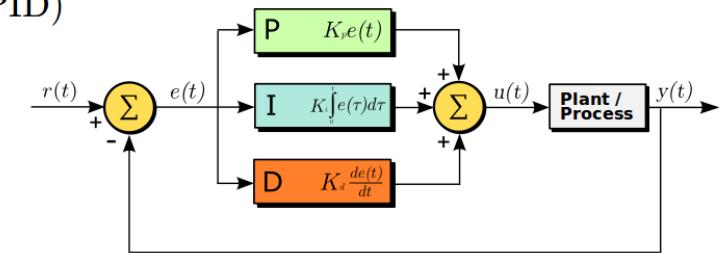
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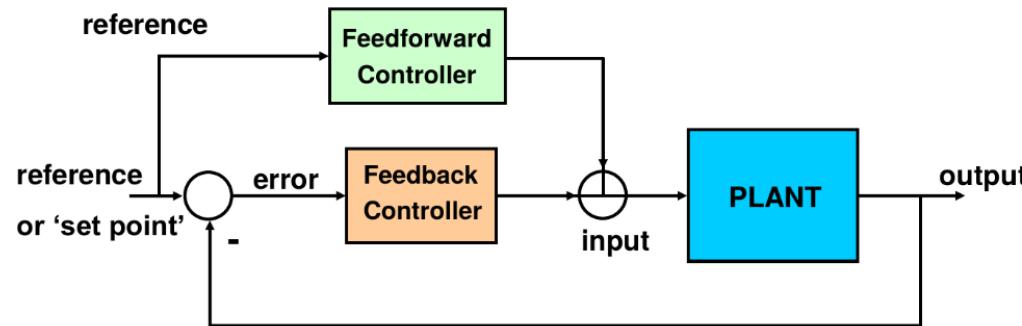
Coupling Reactive Feedback with Adaptive Feed-Forward Control



Proportional-Integral-Derivative controller (PID)



Coupling Reactive Feedback with Adaptive Feed-Forward Control



Adaptive control in the cerebellum(Herreros et al., 2013)

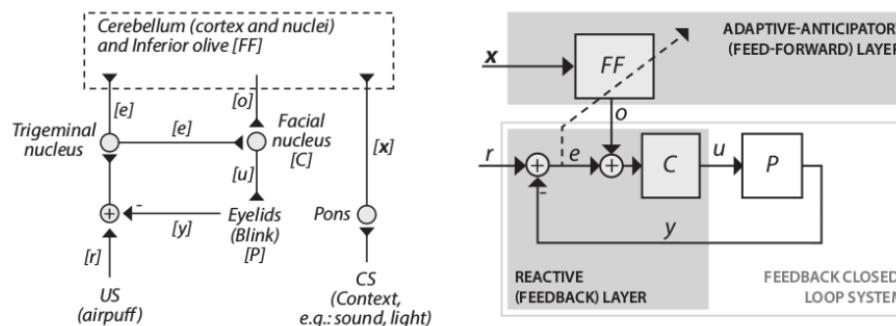


Figure 2: Neuroanatomy of eye-blink conditioning and the CFPC architecture. *Left:* Mapping of signals to anatomical structures in eye-blink conditioning [De Zeeuw and Yeo, 2005] [Medina et al., 2002]; regular arrows indicate inputs and outputs that interact in the world, arrows with inverted heads indicated neural pathways. *Right:* CFPC architecture. Abbreviations: P , plant; C , feedback controller; FF , feed-forward module; r , reference signal; y , plant's output; e , output error; x , basis signals; o , feed-forward signal; and u , motor command.

No video with supported format and MIME type found.

Homeostasis in Braitenberg Vehicles

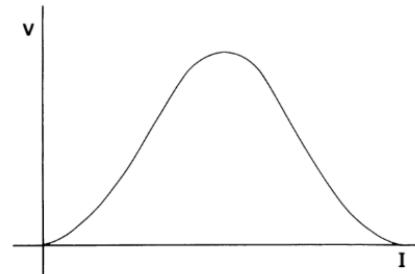
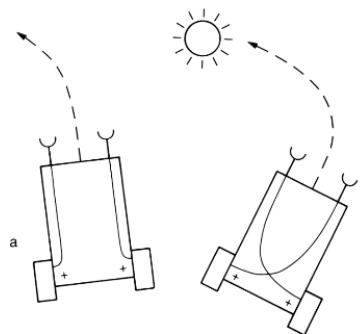


Figure 6

A nonlinear dependence of the speed of the motor V on the intensity of stimulation I , with a maximum for a certain intensity.

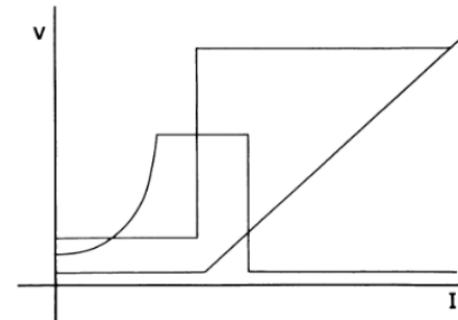
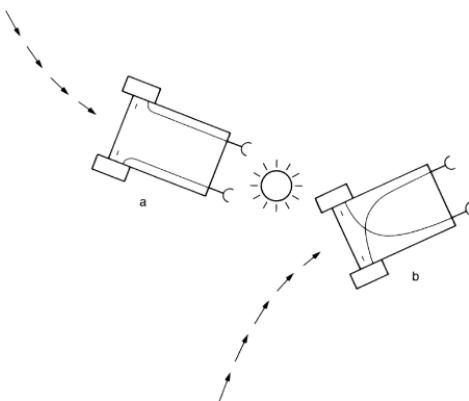


Figure 8

Various bizarre kinds of dependence of the speed of the motor (ordinate) on the intensity of stimulation (abscissa) in Vehicle 4b.

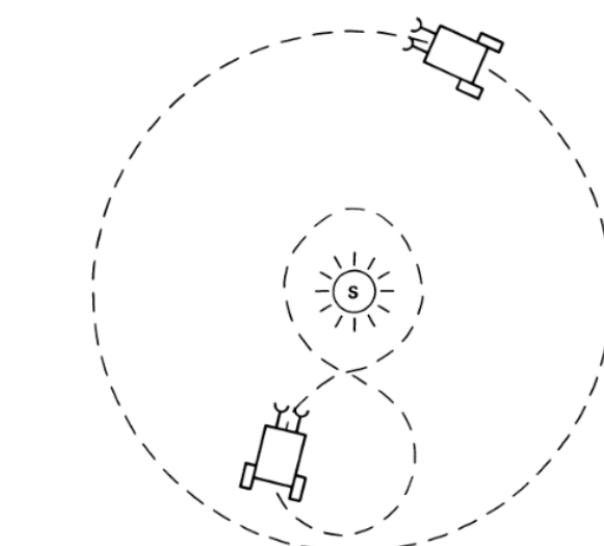
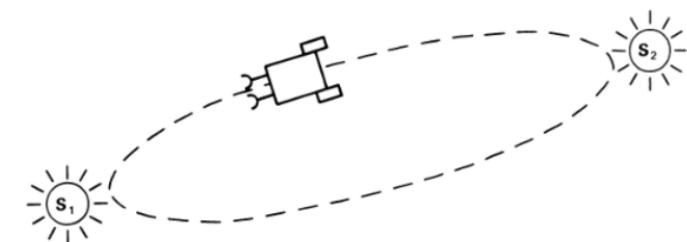
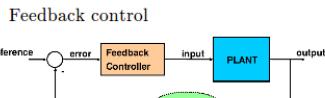
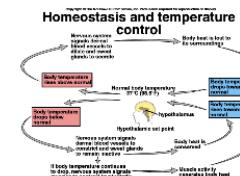


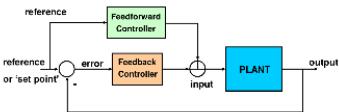
Figure 7

Trajectories of vehicles of brand 4a around or between sources.

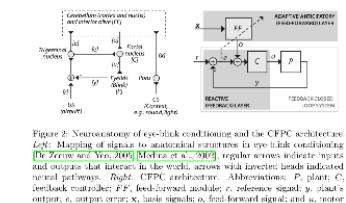
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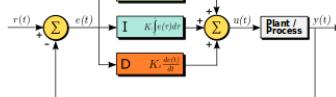
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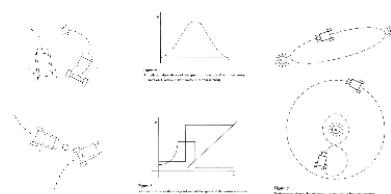
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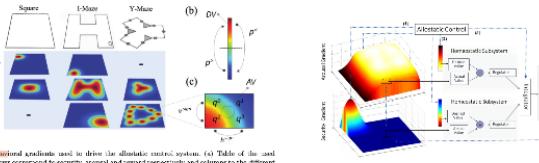


Fig. 2. Behavioral gradients used in the allostatic control system. (a)–(f) Heatmaps of the local gradients were converted to security, arousal and reward respectively and enhanced to the different settings. The color gradient in (a) is quadratic and is used in Fig. 3. (a) is not shown. The present figure shows the heatmaps of the local gradients used in the different settings. The color gradient in (b) is quadratic and is used in Fig. 3. (b) is not shown. The present figure shows the heatmaps of the local gradients used in the different settings. The color gradient in (c) is quadratic and is used in Fig. 3. (c) is not shown. The present figure shows the heatmaps of the local gradients used in the different settings. The color gradient in (d) is quadratic and is used in Fig. 3. (d) is not shown. The present figure shows the heatmaps of the local gradients used in the different settings. The color gradient in (e) is quadratic and is used in Fig. 3. (e) is not shown. The present figure shows the heatmaps of the local gradients used in the different settings. The color gradient in (f) is quadratic and is used in Fig. 3. (f) is not shown. The present figure shows the heatmaps of the local gradients used in the different settings.

Fig. 2. Behavioral gradients used in the allostatic control system. These represent the local gradients of the different settings with a quadratic gradient. The local gradients are converted to security, arousal and reward in other local settings, several which are not shown for clarity of presentation.

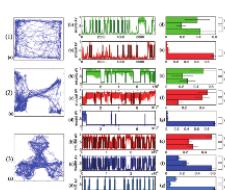


Fig. 3. Time series of the local gradients. (a)–(l) Spatial maps and corresponding neural activity plots. The figure shows 12 panels of spatial maps and corresponding neural activity plots. The spatial maps show the local gradients for different settings. The neural activity plots show the activity levels for various neurons over time.

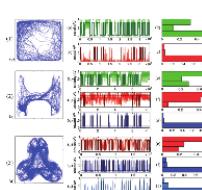


Fig. 4. Neural activity during reactive navigation. (a)–(l) Spatial maps and corresponding neural activity plots. The figure shows 12 panels of spatial maps and corresponding neural activity plots. The spatial maps show the local gradients for different settings. The neural activity plots show the activity levels for various neurons over time.

Allostatic Control and Personality



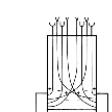
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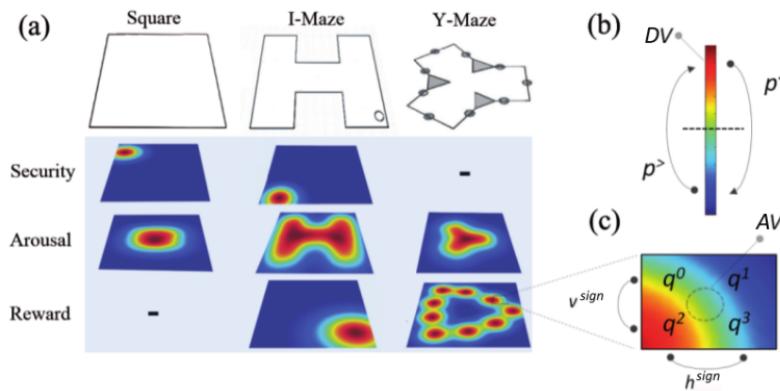


Fig. 2. Behavioral gradients used to drive the allostatic control system. (a) Table of the used gradients: rows correspond to security, arousal and reward respectively and columns to the different setups. The cue gradient as it is dynamic and is only used in the Y-Maze it is not shown. The presence of a reward port is indicated with a circle in the arena schema (top row). (b) Color scale of the gradients. The switching mechanism of desired values DV is illustrated. $p^>$ is the probability of switching to a higher DV , and $p^<$ to a lower one. (c) A zoom in one of the gradients indicates the four quadrants into which the local detection of the agent is divided to make the gradient ascent/descent computation.

Allostatic Control in a Synthetic Forager (Sanchez-Fibla et al., 2010)

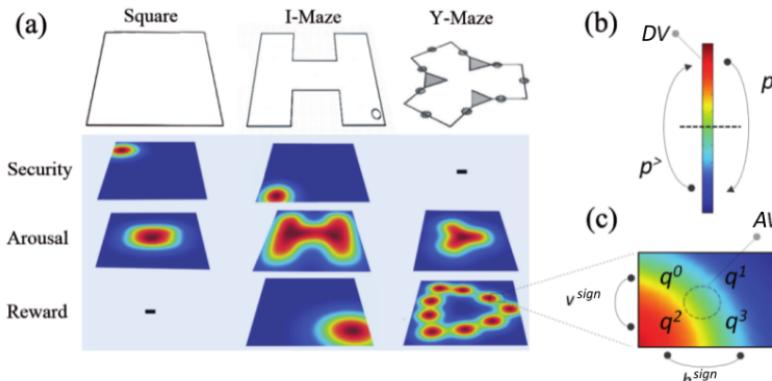


Fig. 2. Behavioral gradients used to drive the allostatic control system. (a) Table of the used gradients: rows correspond to security, arousal and reward respectively and columns to the different setups. The cue gradient as it is dynamic and is only used in the Y-Maze it is not shown. The presence of a reward port is indicated with a circle in the arena schema (top row). (b) Color scale of the gradients. The switching mechanism of desired values DV is illustrated. $p^>$ is the probability of switching to a higher DV , and $p^<$ to a lower one. (c) A zoom in one of the gradients indicates the four quadrants into which the local detection of the agent is divided to make the gradient ascent/descent computation.

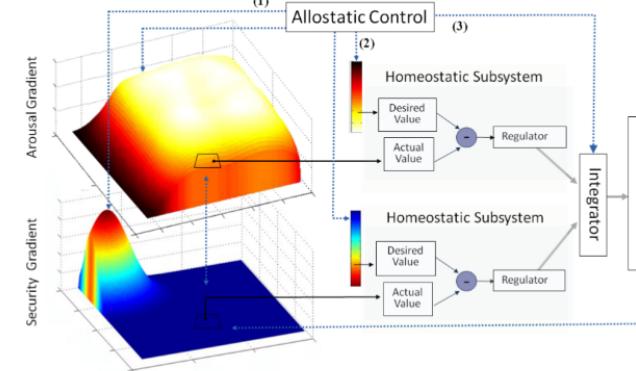


Fig. 1. Minimal allostatic control integrating two homeostatic subsystems. These subsystems can be related to a security subsystem (on bottom) with a preferred location on the top right corner and an arousal subsystem with its maximum in the center and dropping to zero close to the walls. See text for further explanation.



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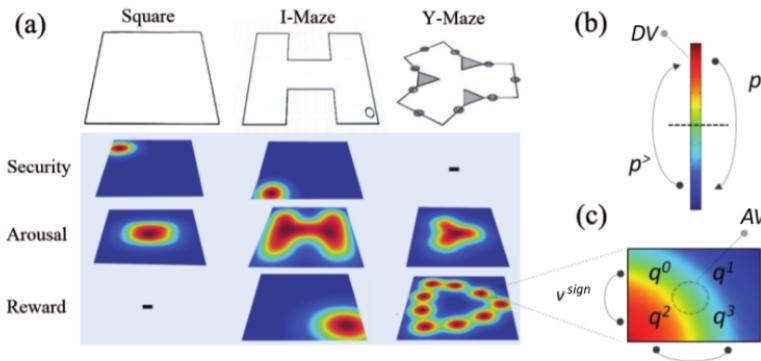


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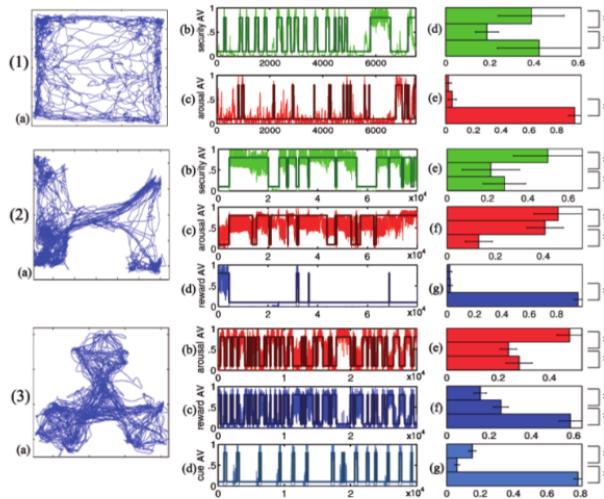


Fig. 4. Rat behavior in various mazes. (1) Square arena Rat Sessions. (1,a) Trajectory plot of one rat. (1,b) Security AV time series of the chosen session. (1,c) Arousal AV time series of the same session. (1,d) Histogram of the AV security values. For the histogram the AV are divided in 3 groups corresponding to the range $0 \leq 0.33 \leq 0.66 \leq 1$. Error bars correspond to standard deviation of the 13 available sessions. (2) I-maze Rat Sessions. The plot of the reward AV temporal series and histogram is added (2,d) and (2,g). For the I-maze histograms 8 sessions were available. (3) Y-maze rat sessions. Security AV plot is not applicable in the Y-maze. The cue AV plot is added (3,d). The Y-maze histograms correspond to 11 rat sessions. When two groups are significantly different, we indicate it with a star next to the corresponding bars.

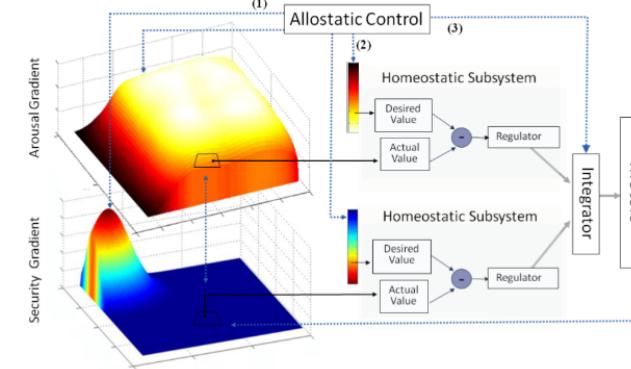


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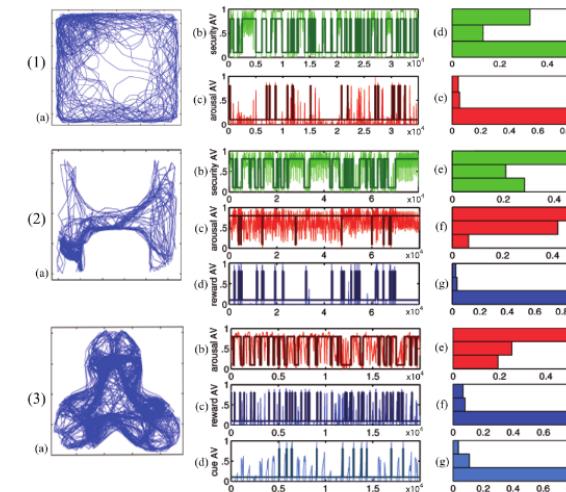
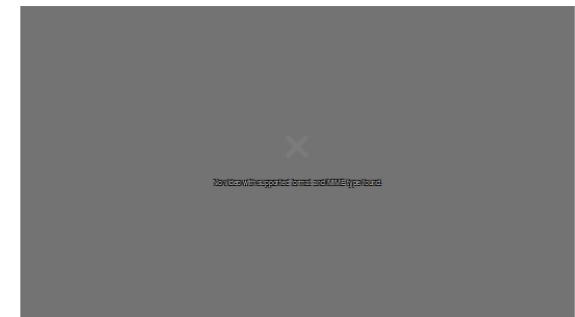


Fig. 6. Robot Simulations. Data plots follow the ones of figure 4. In the AV time series different intervals are shown to plot a representative part of the whole data set. See text for further explanation.



(a) (b) (c)

Allostasis Control and Personality

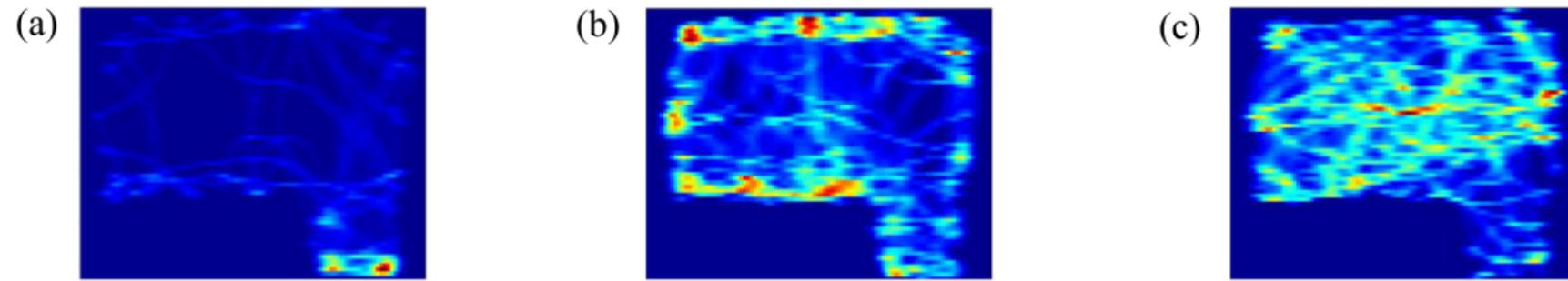
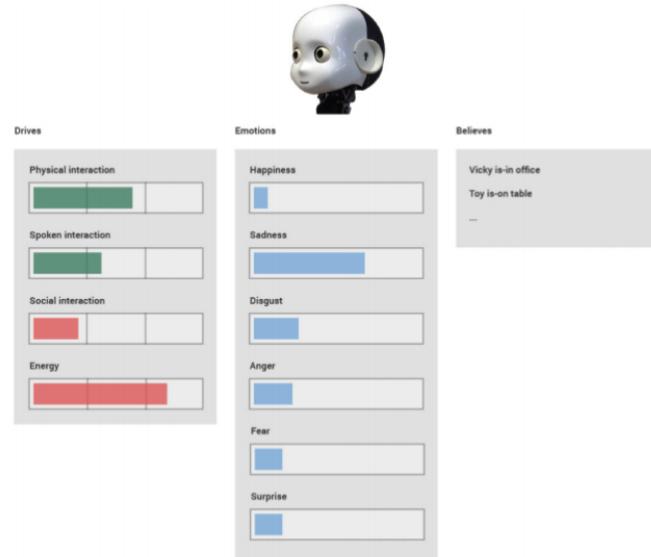


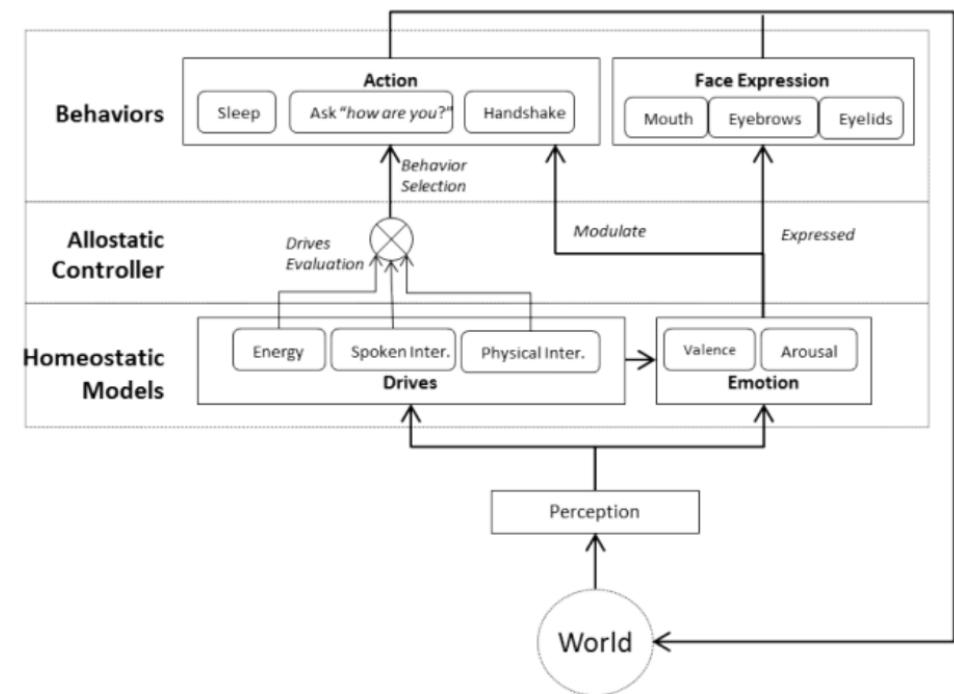
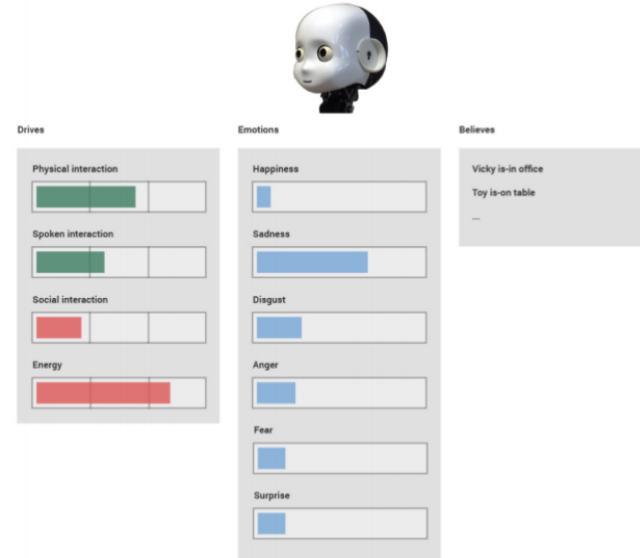
Fig. 5. Desired Value Settings. Three different occupancy maps of the robot in three different desired value settings using the gradient ascent method with inertia. (a) Low arousal, high security. (b) Low arousal, low security. (c) High arousal, low security.

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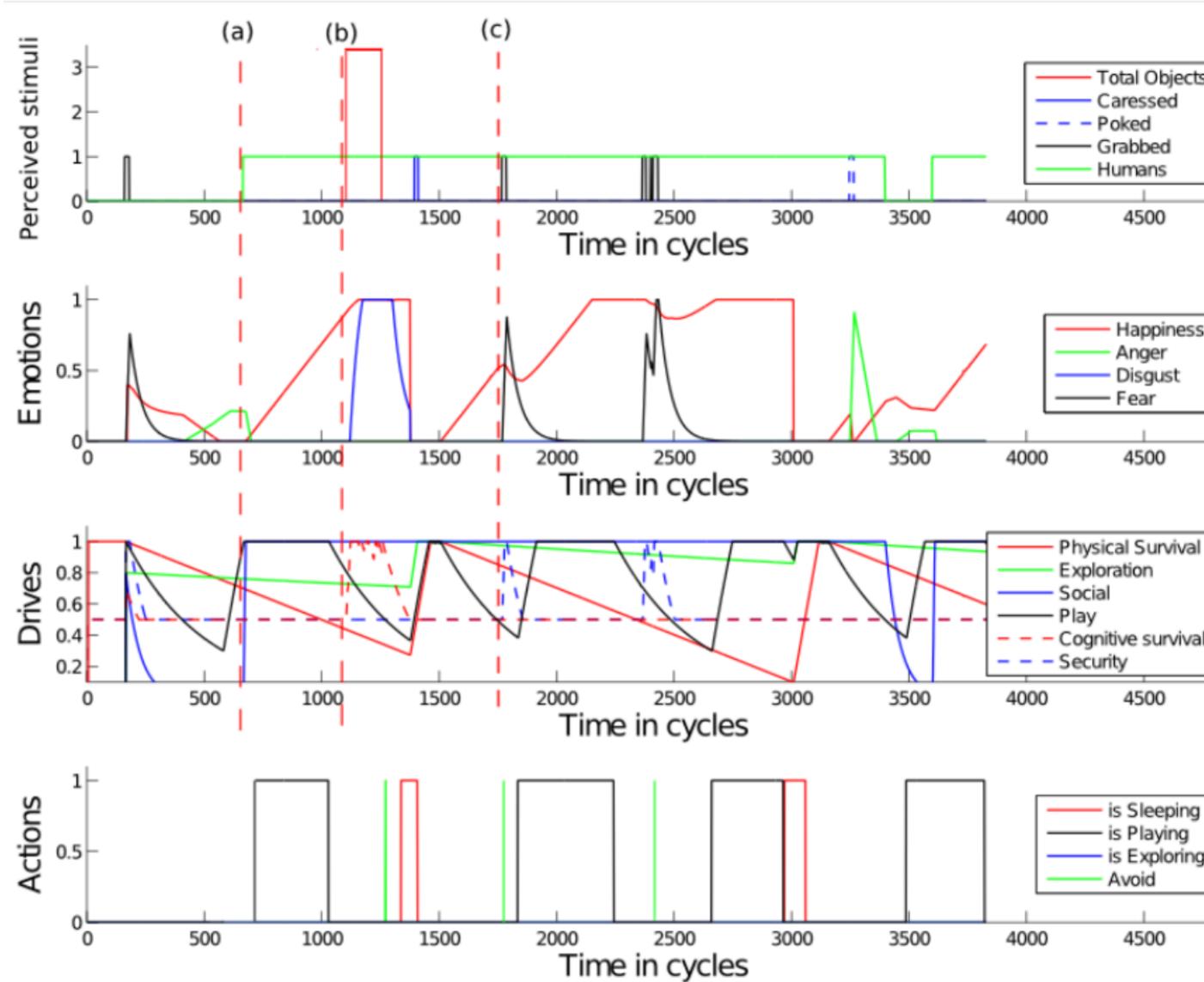


(Lallee et al., 2015)

Allostastic Control and Personality



(Lallee et al., 2015)



(Vouloumou et al., 2013)

Allostasis Control and Personality

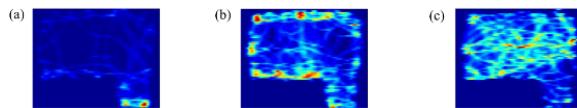
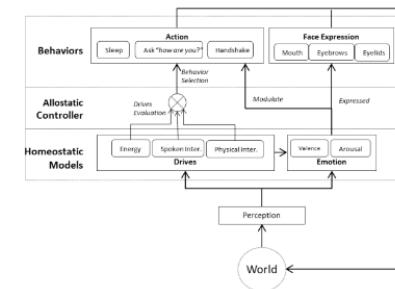
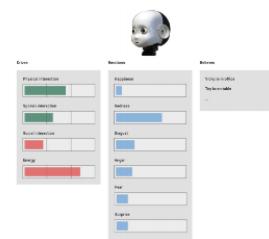
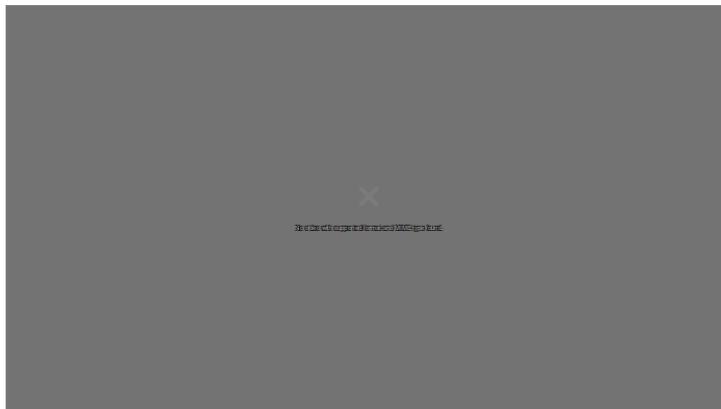


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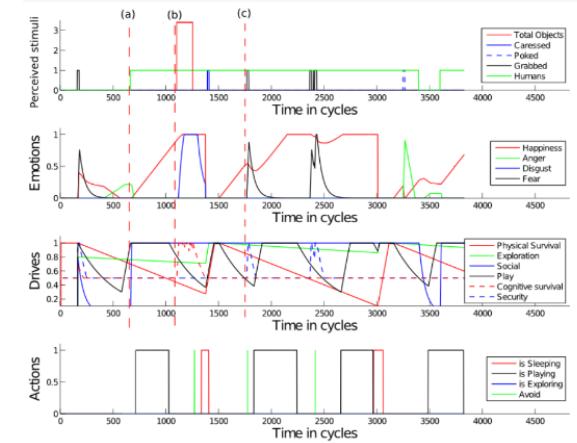
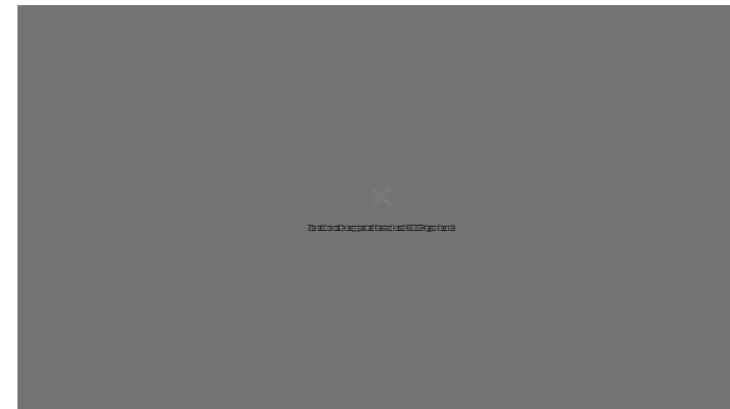


(Lallee et al., 2015)

EFAA project (2011-2014)



WYSIWYD project (2014-2016)



(Vouloutsi et al., 2013)

Allostasis Control and Personality

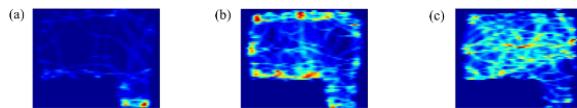
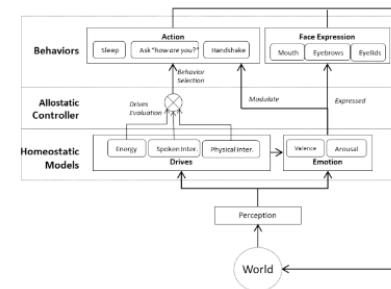
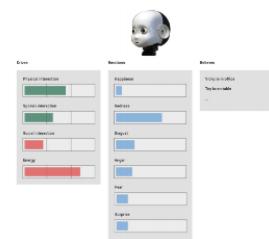
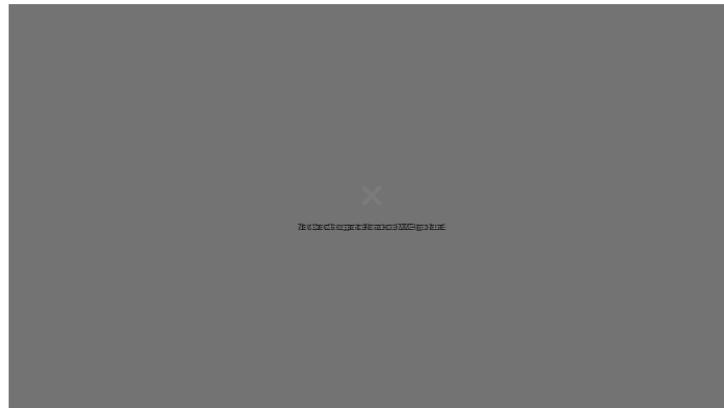


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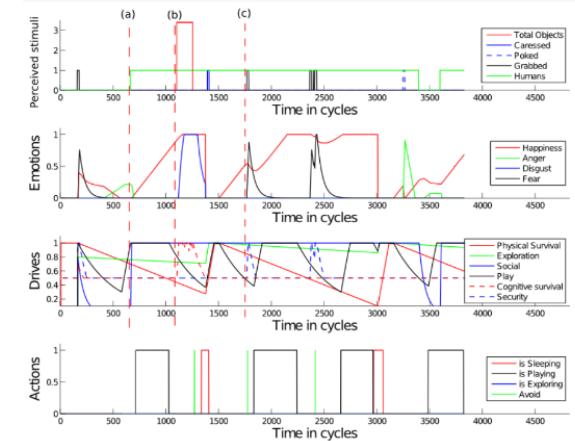
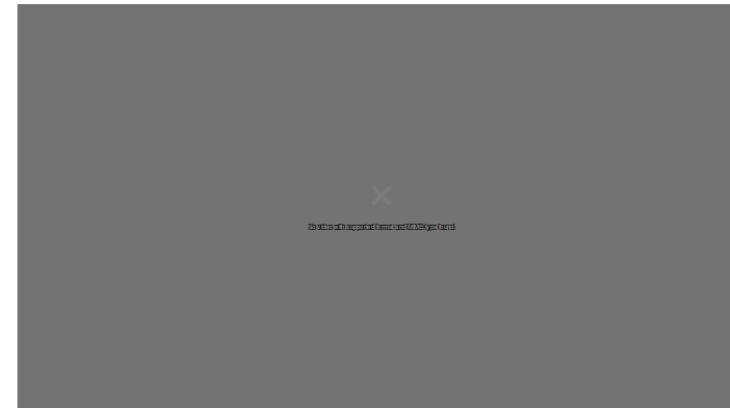


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