1. Project name: Robust valence-induced biases on motor response and confidence in human reinforcement learning

2. Lead researcher: Chih-Chung Ting

3. Data steward: Chih-Chung Ting

4. Research question(s): The strong correlation between accuracy, confidence and reaction times (RTs) has been identified in many perceptual decision and simple value-based decision tasks. This idea was challenged by recent findings in reinforcement learning. Recent studies showed that human can learn equally well to seek gains and to avoid losses (Palminteri et al., 2015), but reaction times (RTs) and confidence are significantly affected by outcome valence (Fontanesi et al., 2018; Palminteri et al., 2015). These findings raise two questions:
(1) Are valence-induced motor and confidence biases-robust and replicable?
(2) Can the confidence bias be observed in the absence of the motor bias?

5. Data to be gathered (including location): The behavioral data was gathered using computer and laptop in two places:
(1) the room E7.20 in the E2 and,
(2) Roeterseiland Campus and CREED Communication lab, E2, 7th floor

6. Method of data collection (in case of personal data indicate the basis (*grondslag*)):
General:
Six experiments were designed to address the research questions mentioned above. All experiments were adapted from the same basic experimental paradigm: participants repeatedly faced pairs of abstract symbols probabilistically associated with monetary outcomes (gains or losses), and they had to learn to choose the most advantageous symbol of each pair (also referred to as context), by trial and error. Two main factors were orthogonally manipulated (Palminteri et al., 2015): valence (i.e. some contexts only provide gains, and others losses) and information (some contexts provide information about the outcome associated with both chosen and unchosen options –complete information- while others only provided information about the chosen option –partial information). In addition, at each trial, participants reported their confidence in their choice on a graded scale as the subjective probability of having made a correct choice. In all experiments but one (Exp. 2-6) those confidence judgments were elicited in an incentive-compatible way (Ducharme and Donnell, 1973; Lebreton et al., 2018, 2019; Schlag et al., 2015).

Details:
All tasks were implemented using MatlabR2015a® (MathWorks) and the COGENT toolbox (http://www.vislab.ucl.ac.uk/cogent.php). In all experiments, the main learning task was adapted from a probabilistic instrumental learning task used in a previous study (Palminteri et al., 2015). Invited participants were first provided with written instructions, which were reformulated orally if necessary. Participants were explained that the aim of the task was to maximize their payoff and that gain seeking and loss avoidance were equally important. In each of the three learning sessions, participants repeatedly faced four pairs of cues - taken from Agathodaimon alphabet. The four cue pairs corresponded to four conditions, and were

presented 24 times in a pseudo-randomized and unpredictable manner to the subject (intermixed design). Of the four conditions, two corresponded to reward conditions, and two to loss conditions. Within each pair, and depending on the condition, the two cues of a pair were associated with two possible outcomes (1€/0€ for the gain and -1€/0€ for the loss conditions in Exp. 1; 1€/0.1€ for the gain and -1€/-0.1€ for the loss conditions in Exp. 2-6) with reciprocal (but independent) probabilities (75%/25% and 25%/75%) - see (Lebreton et al., 2019) for a detailed rationale. In order to address the research questions mentioned above, we manipulated in several ways the option-action mapping (experiment 3-5) and applied time pressure (experiment 6).

7. Individuals involved in data gathering, data manipulation/editing and with access to the data: Chih-Chung Ting; Jan Engelmann; Mael Lebreton

8. Data Protection Impact Assessment: N/A

9. Data editing/manipulation steps (e.g. SPSS Syntax files, R scripts). Data is analyzed using Matlab

10. Where and how will the data be stored (including temporary storage for research use) and security measures applied: Data is anonymized and is stored on figshare.

11. Approval EBEC (Economics & Business Ethics Committee) obtained: approval **yes**/no

12. Intellectual property, copyright and ownership of the data: Chih-Chung Ting; Jan Engelmann; Mael Lebreton