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Computational psychotherapy: cognitive distancing alters reinforcement learning

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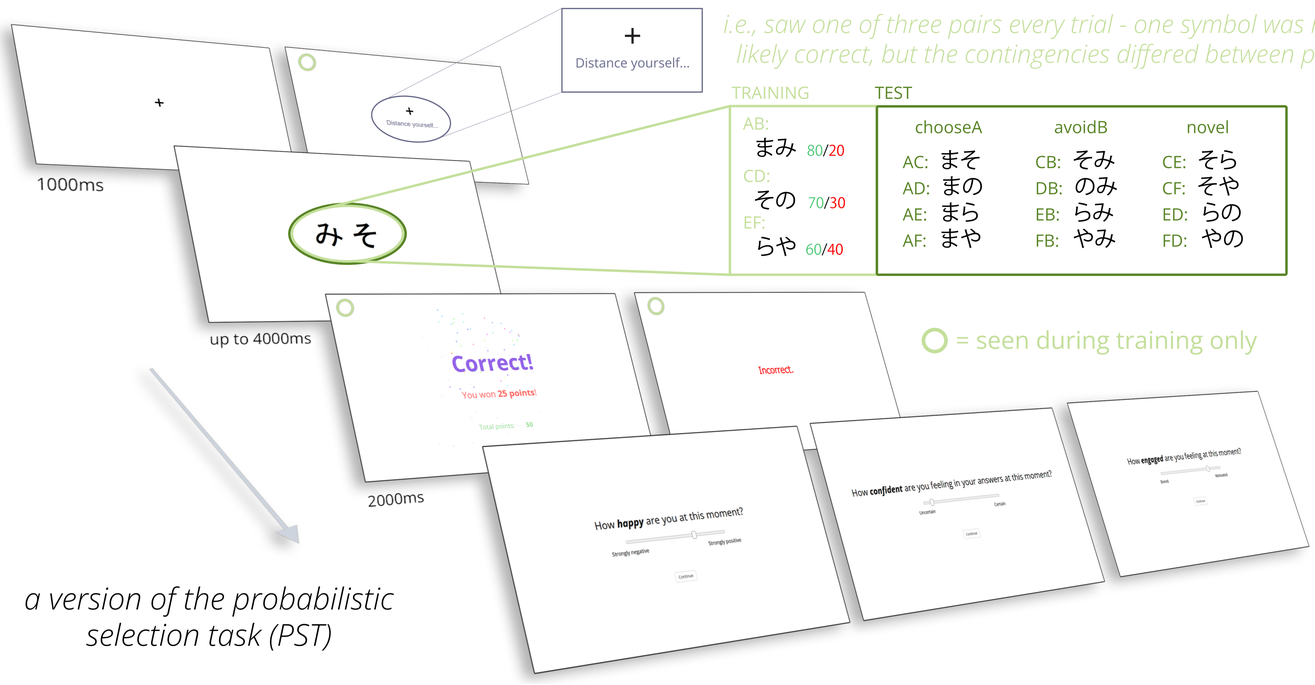
BACKGROUND, PARTICIPANTS AND TASK DESIGN

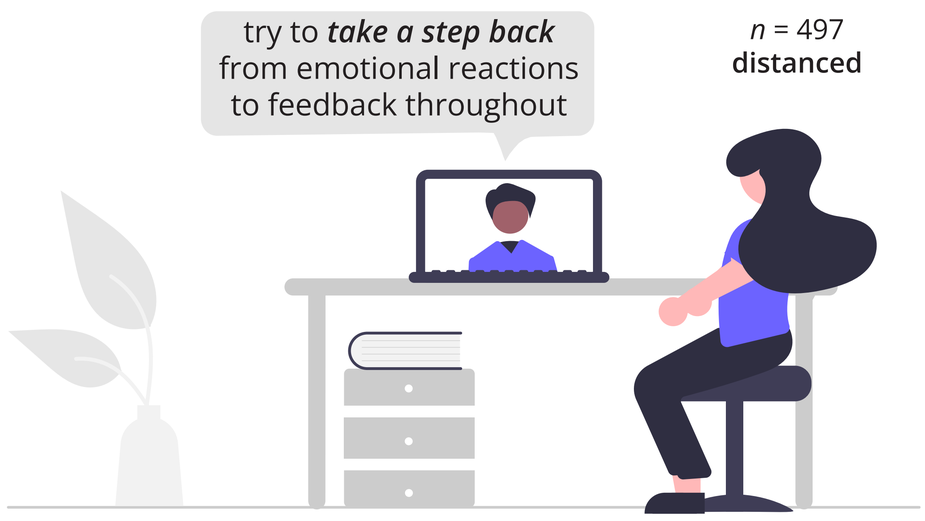
Cognitive distancing is an emotion regulation strategy core to many psychological therapies. Patients are encouraged to view negative thoughts from afar, reducing distress and depressive thoughts (*1*). Linguistic measures of distancing are also reliable markers of symptom severity and treatment progress (*2*).



a version of the probabilistic selection task (PST)

The sample was recruited to be **representative** of the UK adult population in terms of **age**, **sex**, and self-reported **psychiatric history.**

Half the sample was randomised to the self-distancing intervention. This consisted of a short explanatory video including some ideas as to how they could implement it:



COMPUTATIONAL MODEL

Computational models fit to RL tasks decompose behaviour into a small number of learning parameters. These may capture the computations underlying the known effects of distancing on neural representations of expected values and prediction errors (*3*). In the case of the PST, a dual learning rate Q-learning model has been shown to capture choice behaviour well (*4*).

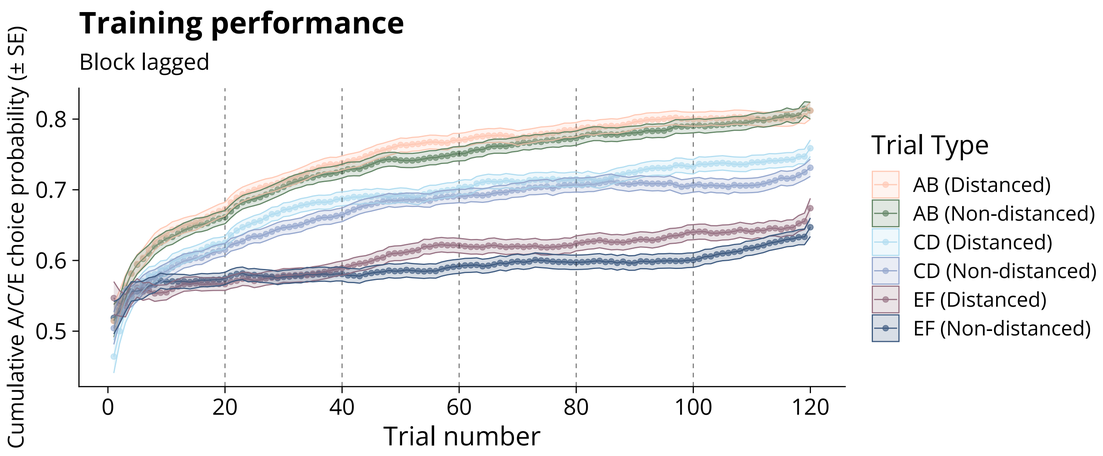
state at time t · action (choice) at time t · $\delta_t = reward_t - Q_t(s_t, a_t)$

$$Q_{t+1}(s_t, a_t) = \begin{cases} Q_t(s_t, a_t) + \alpha_{reward}\,\delta_t & \text{if } \delta_t \geq 0, \text{ or} \\ Q_t(s_t, a_t) + \alpha_{loss}\,\delta_t & \text{if } \delta_t < 0 \end{cases}$$

updated Q-value for a_t · learning rate

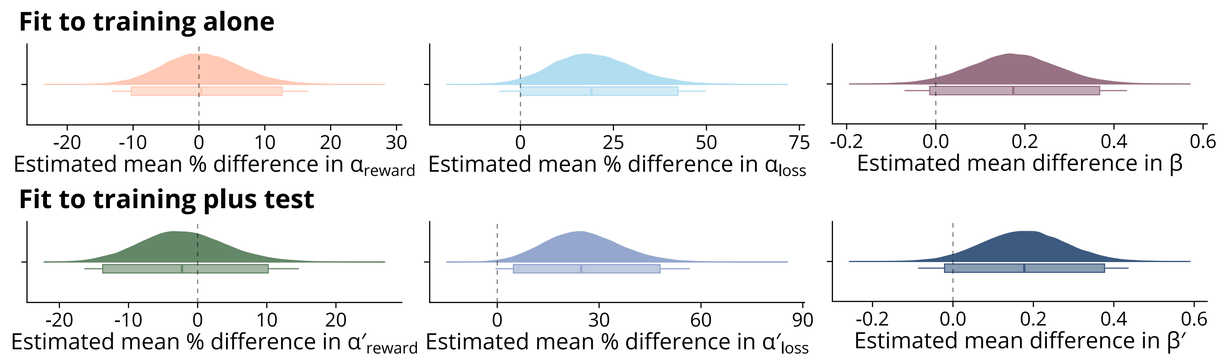
BEHAVIOURAL RESULTS

Distanced participants overall performed slightly better on the task during training, and subsequently when tested on novel combinations of stimuli, particularly on 'harder' pairs including symbol C or E.

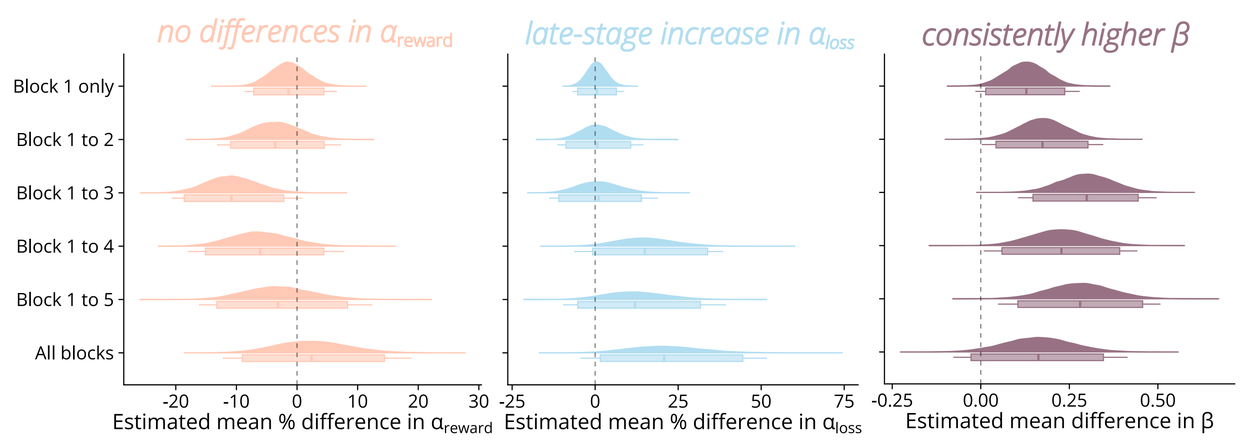


MODELLING RESULTS

There was consistent evidence for small increases in inverse temperature (β) and loss learning rate (α_{loss}) by the end of training in the distanced group.



Though meta-analysis has found evidence of higher punishment sensitivity in mood & anxiety disorders (*5*), late-stage increases in α_{loss} may be adaptive, e.g., enabling by choices with similar expected values to be disambiguated.



CONCLUSIONS

- Cognitive distancing enhanced RL performance in the probabilistic selection task
- Results from Q-learning models indicated distancing led to:
  1. Choosing more driven by (expected) Q-value differences
  2. Adaptive increases in the effects of losses on Q-value updating
- Distancing may improve symptoms of mental health disorders by promoting more effective engagement with negative information

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