Human motor control incorporates movement preparation and execution. Research has shown that preparation of movements improves subsequent motor performance. Studies typically use a paradigm whereby participants are pre-cued to prepare and subsequently cued to perform particular movements.

The application of this paradigm to our area of interest (motor recovery in stroke patients) led us to include a new condition - a pre-cue for no preparation followed by a movement. Movements in the real-world may not always be accompanied by preparation and it was felt inclusion of this no-response pre-cue would improve ecological validity.

A well-replicated finding is that movement execution is faster for correctly prepared movements and slower and more error-prone for incorrectly prepared movements - the validity effect. Study 1 (the pre-cue was 80% predictive of the response) and Study 2 (the pre-cue was 100% predictive) examined the following questions:

(1) Does the no-response pre-cue affect the validity effect? The prediction is that the validity effect will not be affected.

(2) No-response pre-cue: Is there any motor-related preparation? The prediction is there will be no motor-related preparatory EEG activity following a no-response pre-cue.

Method

**Study 1 (80% predictability)**
- Participants: 14 right-handed students (mean age 25.5, sd 3.6).
- Procedure: pre-cue valid cue (80%) invalid cue (20%)
  - LH RH
  - LH NO
  - NO RH

**Study 2 (100% predictability)**
- Participants: 14 right-handed students (mean age 20.1, sd 1.9).
- Procedure: pre-cue valid cue (100%)
  - LH RH
  - LH NO
  - NO RH

Participants were pre-cued to prepare and then cued to perform particular movements (see Figure 1).

Results & Discussion

(1) Does the no-response pre-cue affect the validity effect?

- **Behavioural data:** ANOVA showed a significant effect of preparation condition on reaction times (F(3, 39) = 54.05, p < 0.001) and accuracy (F(3, 39) = 6.6, p < 0.01).

![Figure 2. Mean reaction times](image)

**Study 1 (80% predictability)**

• The validity effect was not affected by the no-response pre-cue. Reaction times increase and errors decrease across the three conditions as predicted.

• The validity of the no-response pre-cue is questionable - reaction times in the NOGO condition were faster than GO-INVALID trials. It was predicted that NOGO responses would be slower as no preparation had occurred.

• The NOGO condition produced similar results to the NEUTRAL condition in both reaction times and response accuracy.

• Study 2 behavioural data also showed the validity effect.

(2) No-response pre-cue: Is there any motor-related preparation?

- **EEG data:** Figures 4 and 5 (studies 1 and 2) show the EEG activation stimulus-locked to the response cue during the foreperiod (between the pre-cue and the response cue).

  - In Study 1 the activation is similar in the NOGO condition to the NEUTRAL and GO conditions (F(2, 26) = 0.45, p = 0.7) whereas in Study 2 it is significantly lower (F(2, 26) = 8.85, p = 0.001).

  - The topographies in Study 1 demonstrate a similar pattern of activity in the NEUTRAL and NOGO conditions supporting the conclusion drawn from the behavioural data that these two pre-cues are eliciting similar behaviour.

  - The topography in the NOGO condition in Study 2 is very different from both the GO and NEUTRAL conditions suggesting a lack of motor preparation in this condition.

Conclusions

(1) Does the no-response pre-cue affect the validity effect?

No! Behavioural data shows the validity effect is replicated in both studies.

(2) No-response pre-cue: Is there any motor-related preparation?

No in Study 2 (100% cue predictability) but importantly, yes in Study 1 (80% cue predictability). EEG data suggests that due to the uncertainty in Study 1 participants are preparing to move following a no-response pre-cue just in case. This is not the desired behaviour. Follow up work is required to determine the effect of predictability on this behaviour.