A mixture of fast and slow

In the task switch paradigm people perform two tasks alternately. The time to prepare for the upcoming task is often manipulated. In this paradigm, a mixture of fast and slow responses is found on trials that demand a task switch and have ample time for advance preparation. Typically, the fast responses are as fast as on trials on which the task is repeated. The slow responses are as slow as on trials that demand a task switch, but have no time for advance preparation (see Figure 1). Two possible explanations have been proposed to account for this mixture.

**Figure 1:** Cumulative Distribution Functions (CDFs) for each task transition (task repetition and task switch) and Response-Stimulus interval (RSI). The distribution of switch trials following a long RSI can be modelled as a mixture of the fast nonswitch distribution and the slow switch, short RSI distribution. The model fit shows the results of an equal mixture of the fast distribution and the slow distribution.

The preparation of stimulus-response pairs

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**Method**

Participants (n=18) performed either a color-discrimination or a shape-discrimination task on every trial (see figure 2). Participants reacted with their index finger when the relevant stimulus was red or a triangle (S-R pair 1), with their middle finger when the relevant stimulus was green or a diamond (S-R pair 2), and with their ring finger when the relevant stimulus was blue or a square (S-R pair 3). The RSI was 2000 ms during the first half of the experiment and 200 ms during the second half of the experiment.

**Figure 2:** The 2x2 grid was continuously present on the screen. The location of the stimulus rotated clockwise through the four quadrants over the trials. The vertical position in the grid indicated which of the two tasks had to be performed.

**Results**

The mean response times (RTs) show a clear switch cost for all S-R pairs that diminishes with increasing RSI (F(1,17) = 24.2, p<0.01), see figure 3. There is also a difference in RT between the S-R pairs, and this difference is bigger for switch trials than for repetition trials (F(2,16) = 5.2, p<0.05). However, there is no interaction between this difference and RSI (F(2,16) = 1.3, p=0.3).

**Figure 3:** Mean RTs for all conditions and S-R pairs.

The cumulative distribution functions (CDFs) of the three S-R pairs for all the conditions provide information about the mixture of fast and slow responses (see figure 4). The CDFs of the switch trials following a long RSI show that the slow part of the distribution is not as slow as the CDF of switch trials with a short RSI. Although there are some differences between the S-R pairs, this pattern seems consistent over S-R pairs.

**Figure 4:** CDFs of repetition trials, switch trials following a short RSI and switch trials following a long RSI.

**Conclusions**

The mean RTs show no differences in advance preparation between the S-R pairs. This is in contrast with the prediction of the PMP hypothesis. Although the FTE hypothesis can explain the differences between the S-R pairs, their interaction with switch/repetition trials, these effects are not incompatible with the FTE hypothesis.

The CDFs show that preparation is approximately equal for all three S-R pairs on switch trials following a long RSI. This again is in contrast with the predictions from the PMP hypothesis. These results can be interpreted with the FTE hypothesis as a mixture containing a higher proportion of fast responses than slow responses.