

Exp 3,5,6,7 - Writeup

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Data quality and eye-gaze processing analysis

Here are the demographic statistics from the 4 experiments:

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## `summarise()` ungrouping output (override with `.groups` argument)
```

Experiment	num_Ps	num_Females	num_Males	mean_Age	min_Age	max_Age	ICU_mean
Exp3	46	30	16	19.0	18	27	21.9
Exp5	49	42	7	20.7	17	37	19.4
Exp6	162	94	68	19.8	17	42	22.3
Exp7	38	22	13	19.5	18	26	22.6

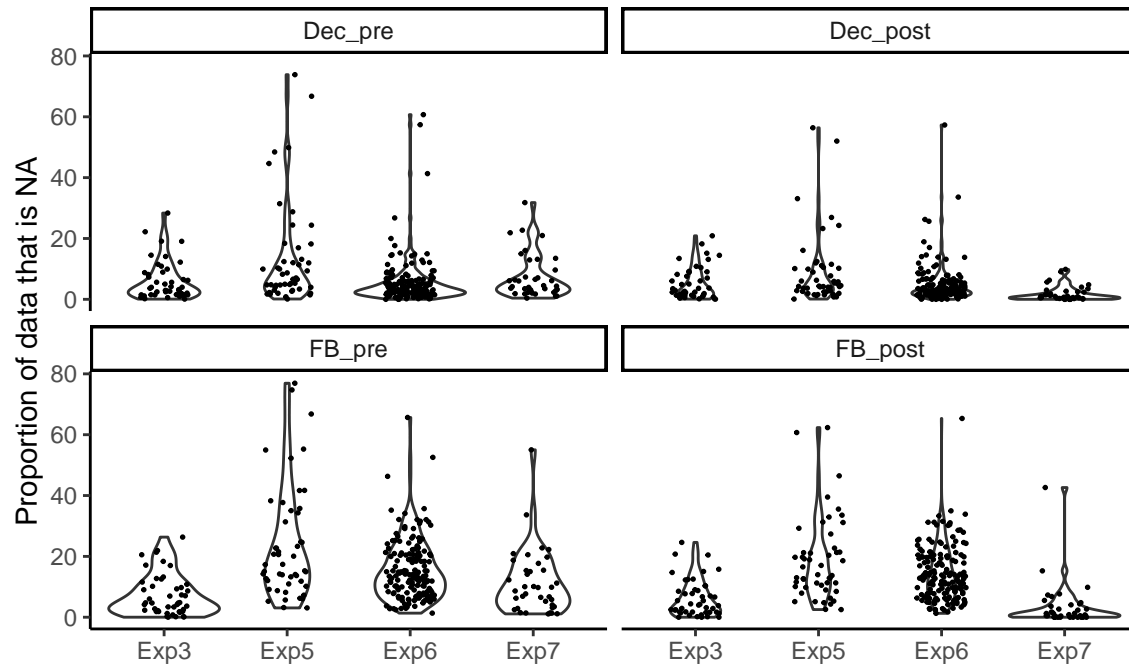
Here are some statistics on the number of samples and number of missing samples before and after the interpolation process (patching up of eye-gaze samples):

Experiment	samples_p1	raw_NA_p1	interp_NA_p1	samples_p2	raw_NA_p2	interp_NA_p2
Exp3	673.0	54.6	48.9	250.5	18.3	15.7
Exp5	649.9	105.8	74.6	791.1	187.4	147.9
Exp6	642.3	49.2	43.3	811.5	125.2	116.5
Exp7	269.6	26.6	9.0	99.1	11.3	3.4

From the “samples_p1” column it looks like the sample rate was set lower in Experiment 7 compared to the others (decision time should not be shorter in this experiment). Also we see here the restricted time for the feedback period in Exp3 and Exp7 (samples_p2).

Looking at the proportion of missing data (across periods) for the individual participants, we can see considerable variability both within and across the experiments. We can see how the interpolation of the raw eye-data reduces considerably the amount of missing data:

The proportion of missing data pre– and post–interpolation



Experiment 7 looks a bit unusual post-interpolation. If the sample rate was lower, then the interpolation process might have had a rather dramatic effect, reducing considerably the proportion of NAs. We can look at the **number of fixations** to see if there's anything unusual there too:

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## `summarise()` regrouping output by 'Experiment' (override with `.groups` argument)
```

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

Experiment	Dec	FB
Exp3	10.4	4.2
Exp5	11.7	14.2
Exp6	10.6	14.1
Exp7	7.3	3.0

It does seem that Experiment 7 had fewer fixations in the decision period compared to the others. The shorter feedback time means there were also fewer in the feedback period too, and notably less than Experiment 3. Again, it's likely the lower sample rate has led to fewer fixations being detected, or perhaps the more aggressive interpolation process has led to fewer fixations. It might be something to look at later, to make the number of fixations detected more comparable (if possible).

For each experiment we can see whether any participants had particularly poor eye-gaze data and then remove them from the sample for further analysis. Here are

```
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```
## `summarise()` ungrouping output (override with `.groups` argument)
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```
## `summarise()` regrouping output by 'Experiment' (override with `.groups` argument)
```

Experiment	subj	mean_NA	outlier_criterion
Exp3	P145_Exp3	30.5	23.2
Exp5	P117_Exp5	57.6	46.1
Exp5	P119_Exp5	57.9	46.1
Exp6	P107_Exp6	30.5	29.9
Exp6	P235_Exp6	63.2	29.9
Exp6	P351_Exp6	30.0	29.9
Exp7	P1277_Exp7	18.3	14.3

The proportion of trials in which there is no recorded eye data across the two periods is very low for all experiments:

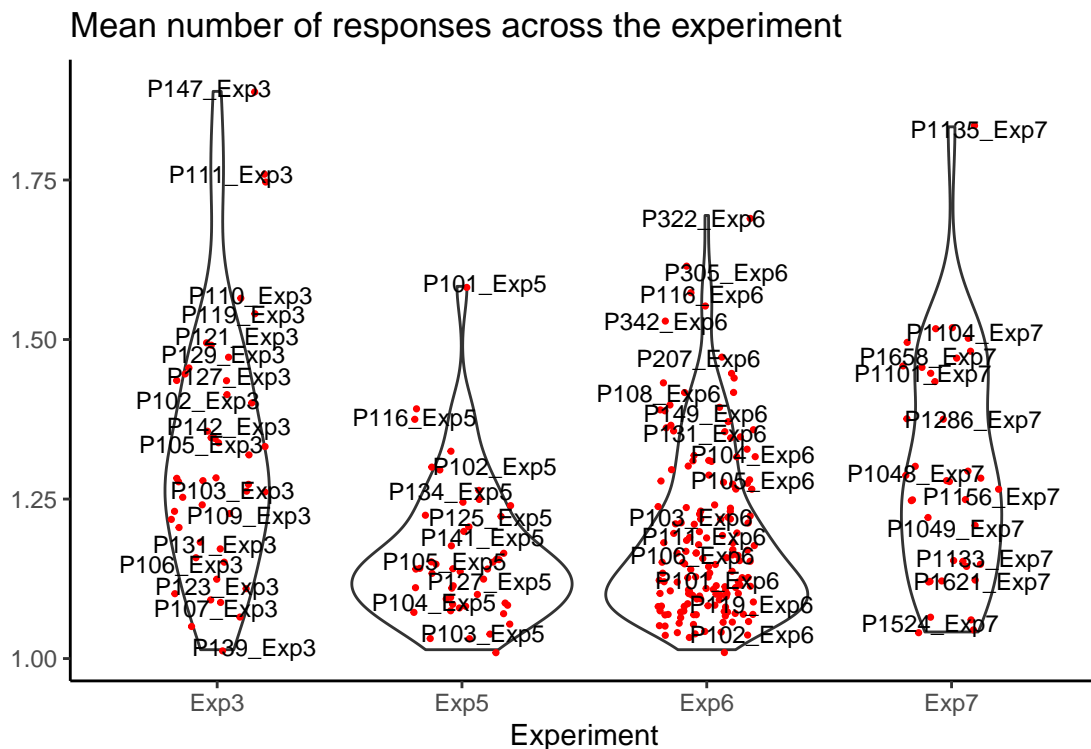
```
## `summarise()` ungrouping output (override with `.groups` argument)
```

Experiment	Dec	FB
Exp3	0.5	0.6
Exp5	0.9	0.8
Exp6	0.5	0.2
Exp7	0.0	0.1

Analysing participant responses

What was the distribution of mean responses across the experiments? Did any participants just not get it and respond fairly randomly?

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## `summarise()` regrouping output by 'Experiment' (override with `.groups` argument)
```



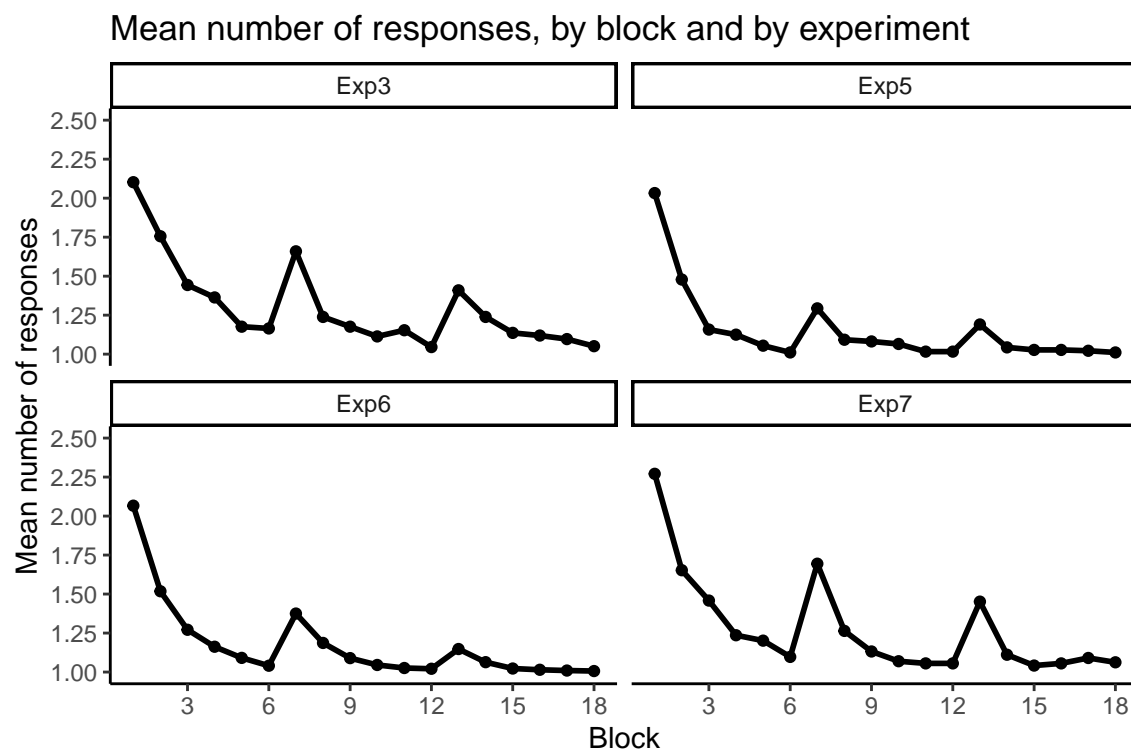
Seems like a few participants showed high levels of mean responses, and may not have learnt about the contingencies. To establish outliers we can set a criterion of more than 2.5 SDs above the mean response rate in each experiment.

The following participants should be considered outliers. These participants are removed from further analysis:

Responses across blocks

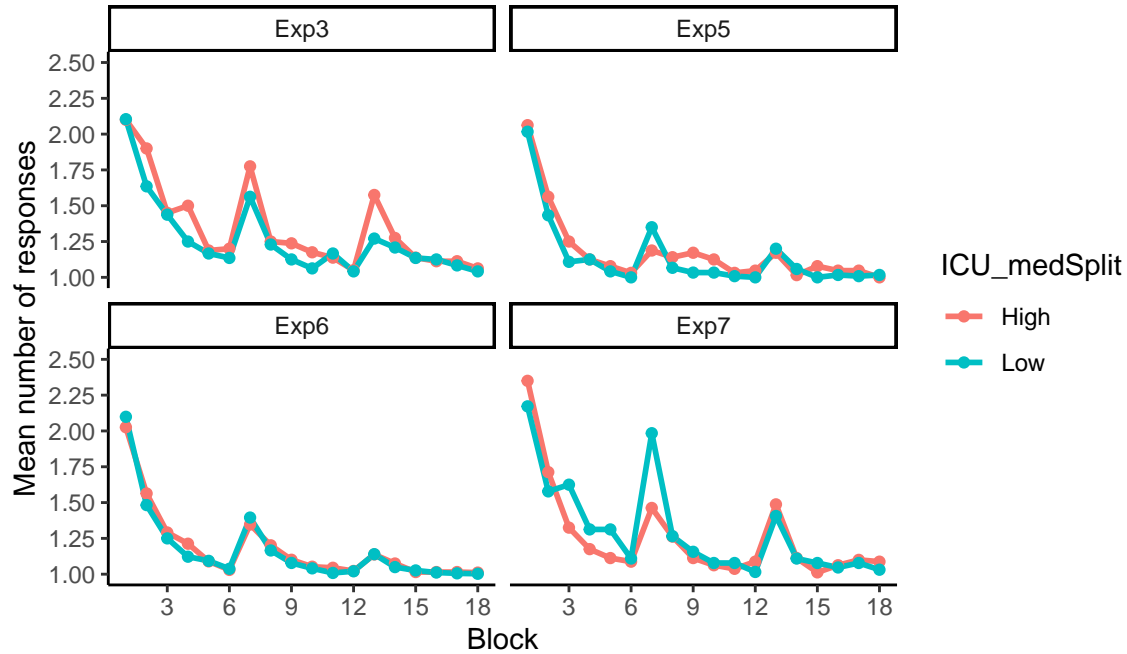
The next two figures show mean number of responses broken down by block and by experiment. In the second of these, the data is split into two groups on the basis of each experiment's median ICU score.

```
## `summarise()` regrouping output by 'Experiment' (override with `.groups` argument)
```



```
## `summarise()` regrouping output by 'Experiment', 'block' (override with `.groups` argument)
```

Mean number of responses, by block and by experiment
Plotted separately for High and Low ICU groups

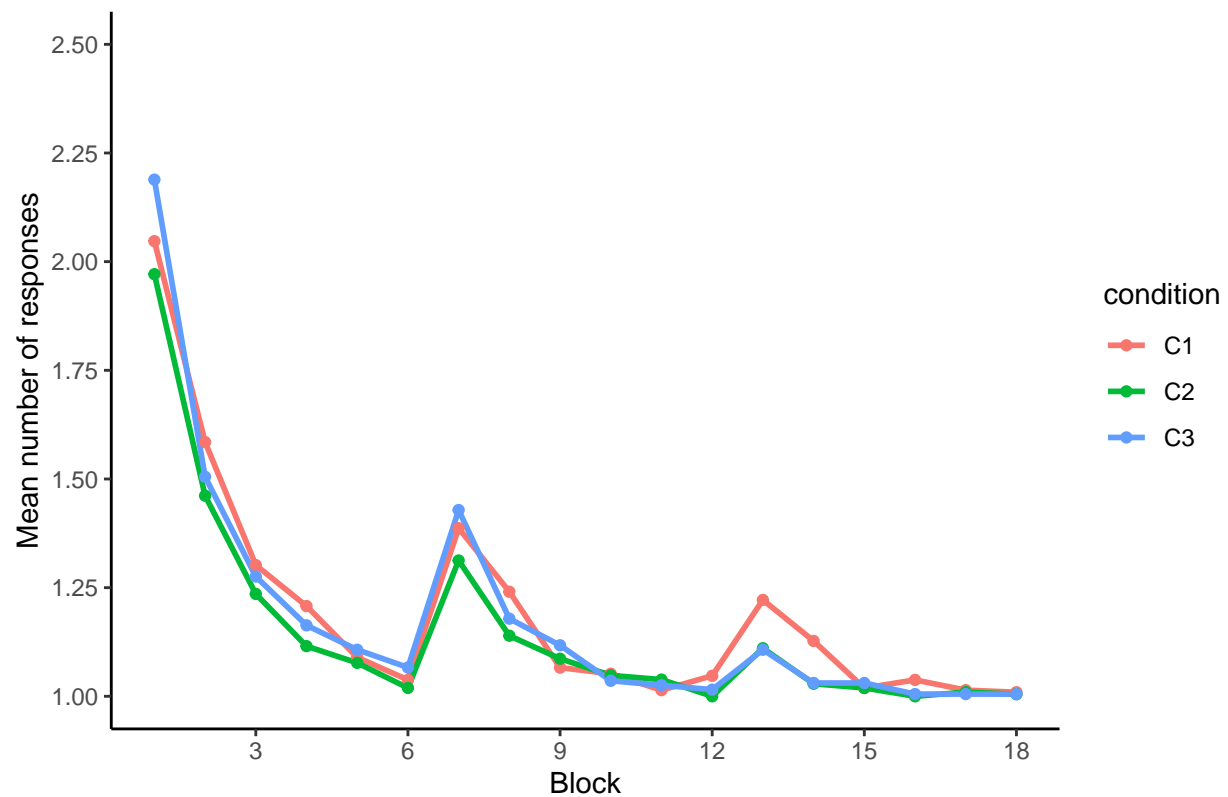


Experiment 6 - Differences between conditions

Experiment 6 had 3 conditions. Condition 1 was a replication of Experiments 3 and 5. Condition 2 had outcomes positioned adjacent to the responses. Condition 3 had the normal outcome positions (top of the screen), but used different stimuli and different cover story (“non-social” - marbles in bags).

```
## `summarise()` regrouping output by 'condition' (override with `.groups` argument)
```

Experiment 6 – Mean number of responses, by block and by condition

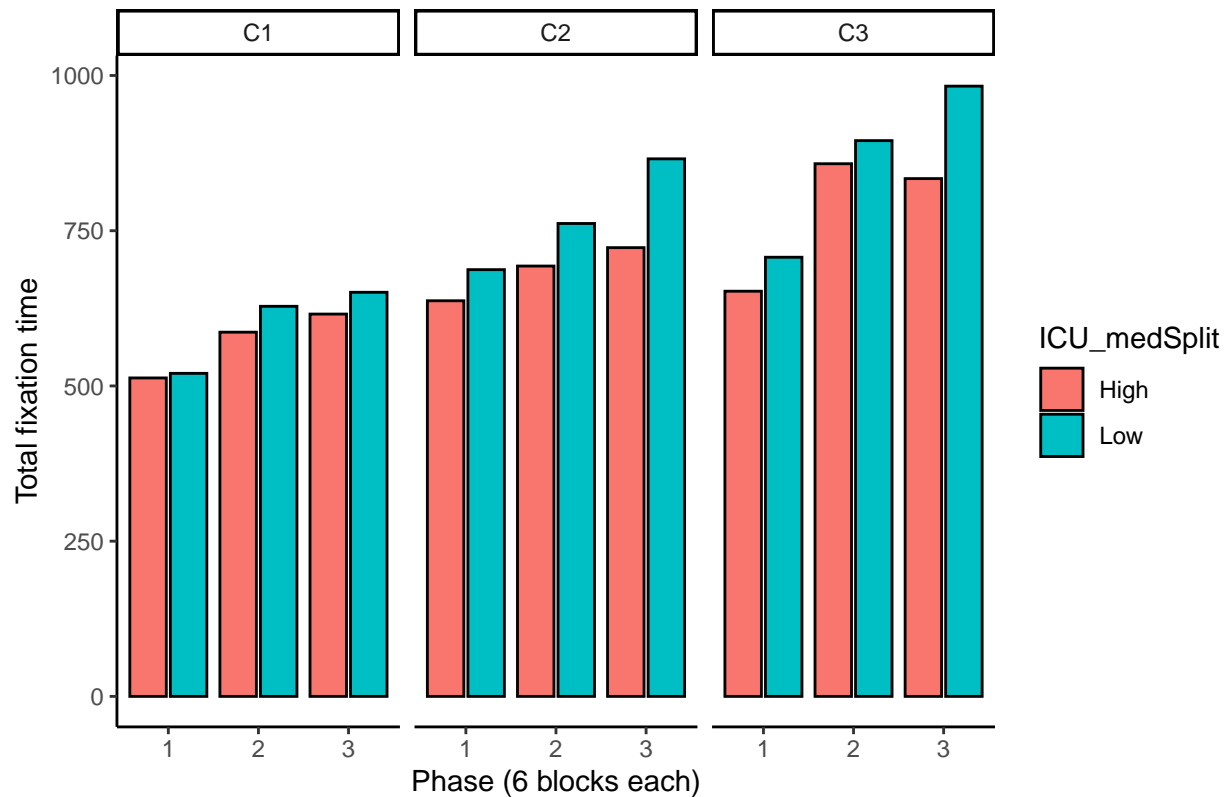


Interestingly, the most noticeable increase in responding at the start of Phase 3 is seen in the replication condition (C1).

Here are the critical eye-gaze data just for Experiment 6:

```
## `summarise()` regrouping output by 'condition', 'phase' (override with `.groups` argument)
```

Experiment 6 – Eye-gaze on outcomes during feedback, by condition



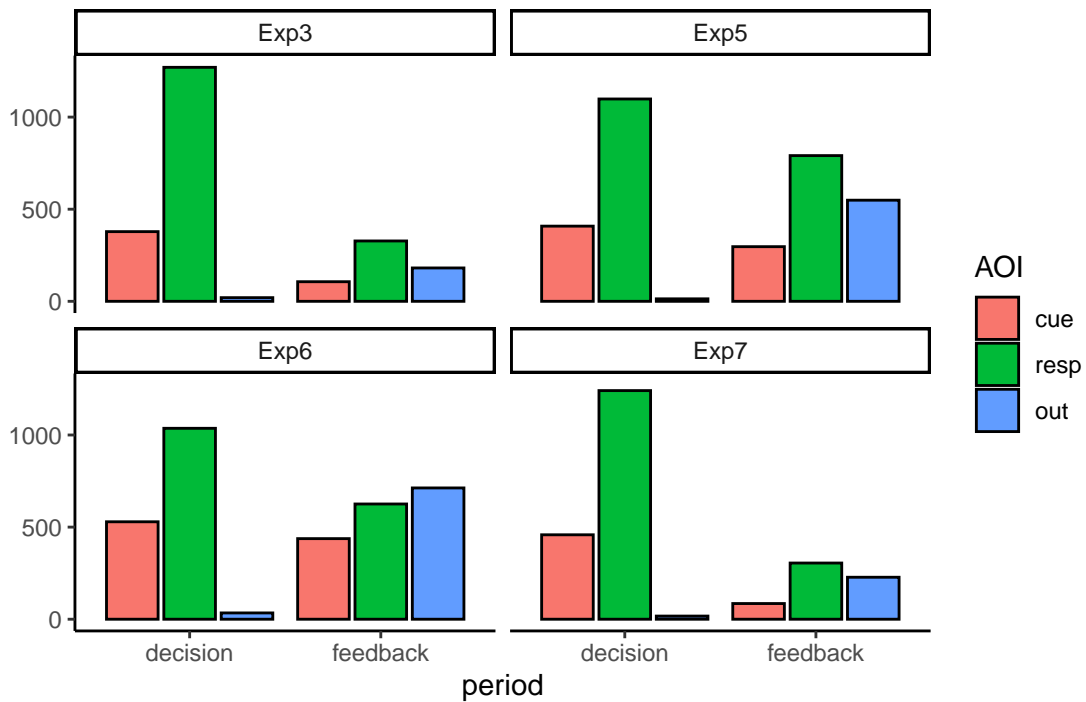
There doesn't appear to be any major differences between the conditions here. It seems that, if anything, condition 1 is showing the weakest ICU split effect of the lot...

Analysing eye gaze on areas of interest

How much time did participants spend looking at the 3 areas of interest (cue, response, outcome), during the two periods of the trial (decision and feedback)?

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

Fixation time on AOIs, by period of the trial and experiment

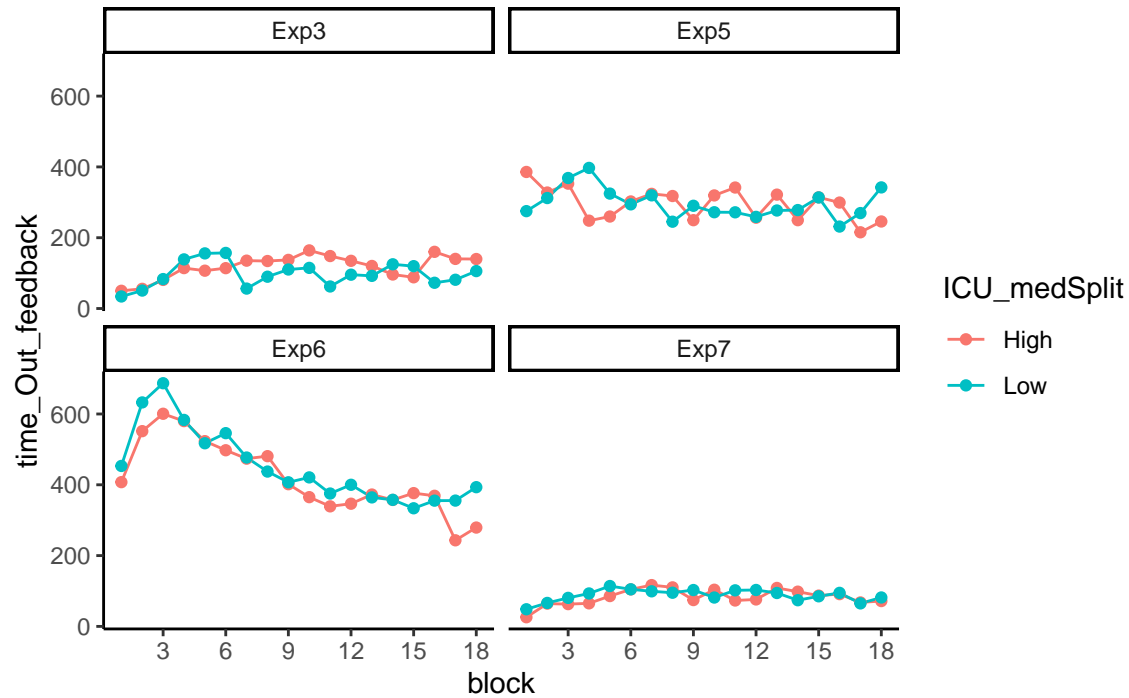


Participants mostly focus on the cue and the responses during the decision period. In the feedback period, attention is more evenly distributed, with greater processing of the response and the outcome.

We are particularly interested in the feedback period. Does the processing of the AOIs change as a factor of block (training) and ICU score?

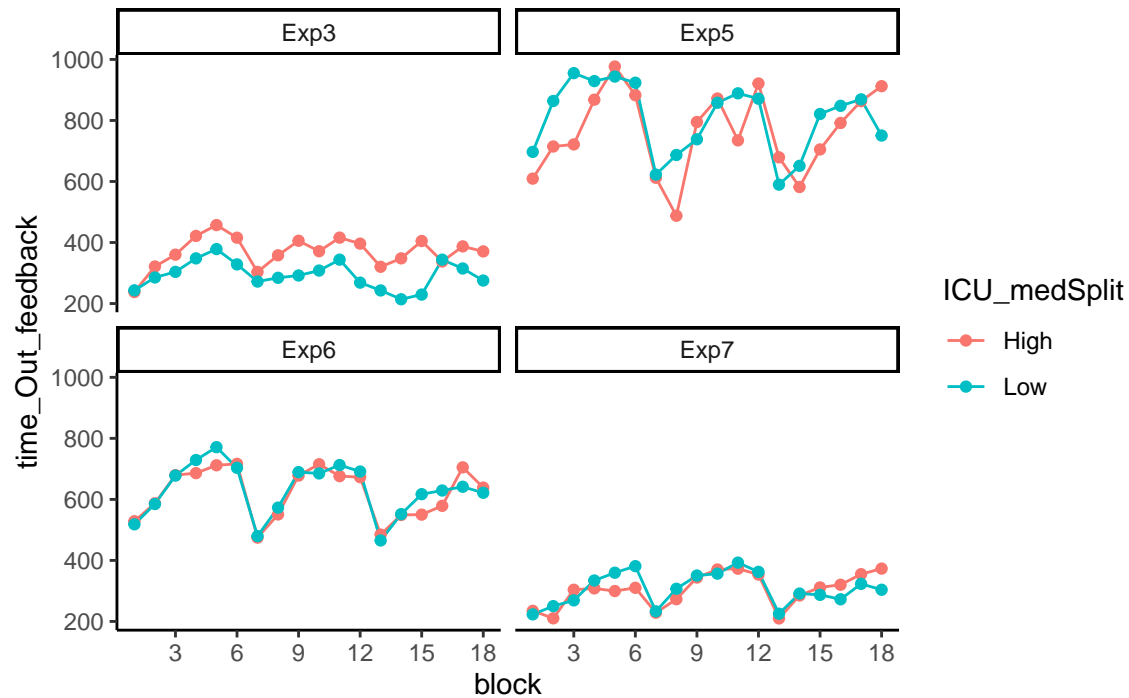
```
## `summarise()` regrouping output by 'Experiment', 'block' (override with `.groups` argument)
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Eye-gaze on CUES during feedback

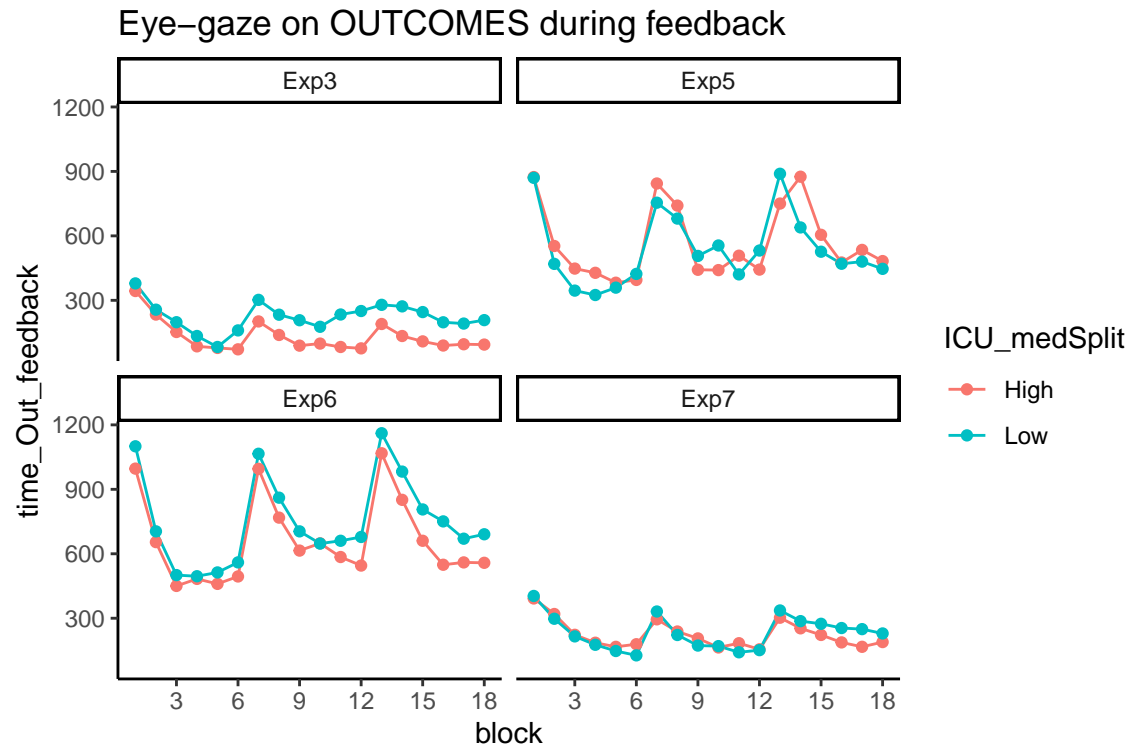


```
## `summarise()` regrouping output by 'Experiment', 'block' (override with `.groups` argument)
```

Eye-gaze on RESPONSES during feedback

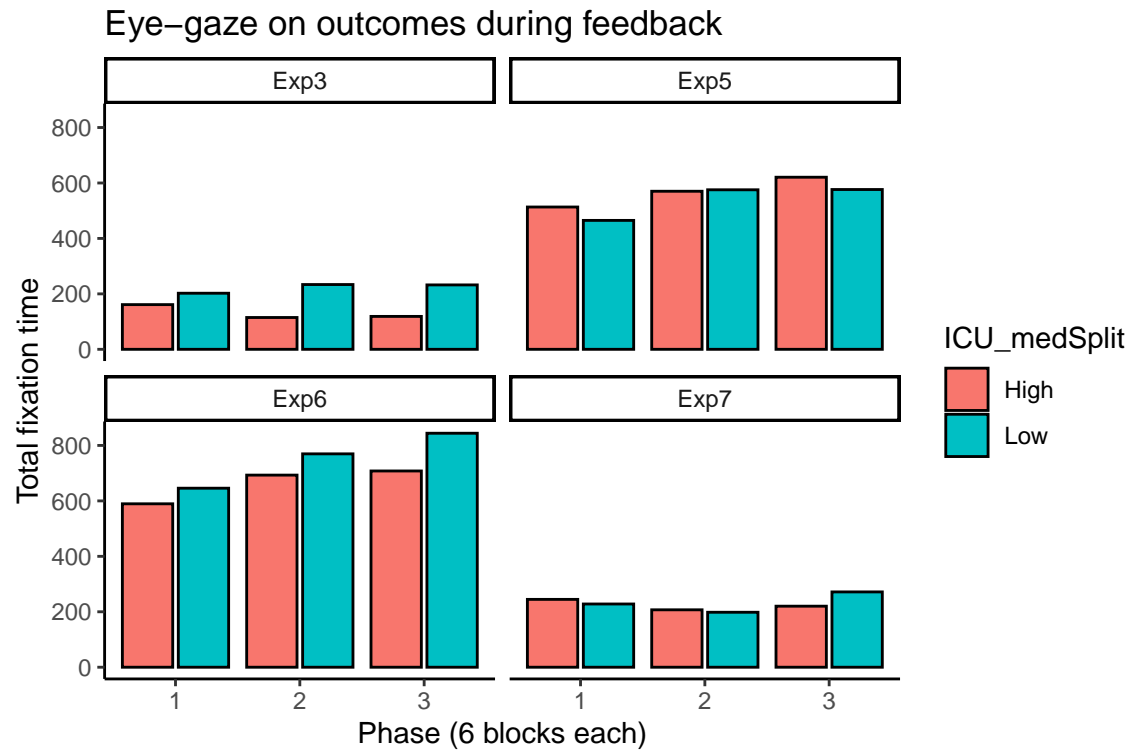


```
## `summarise()` regrouping output by 'Experiment', 'block' (override with `.groups` argument)
```



The pattern for **outcomes** is somewhat inconsistent, though there is a trend to seeing more eye-gaze to outcomes in the **low** ICU condition compared to the **high** ICU condition. Here are the same data averaged over each phase, rather than each block:

```
## `summarise()` regrouping output by 'Experiment', 'phase' (override with `.groups` argument)
```

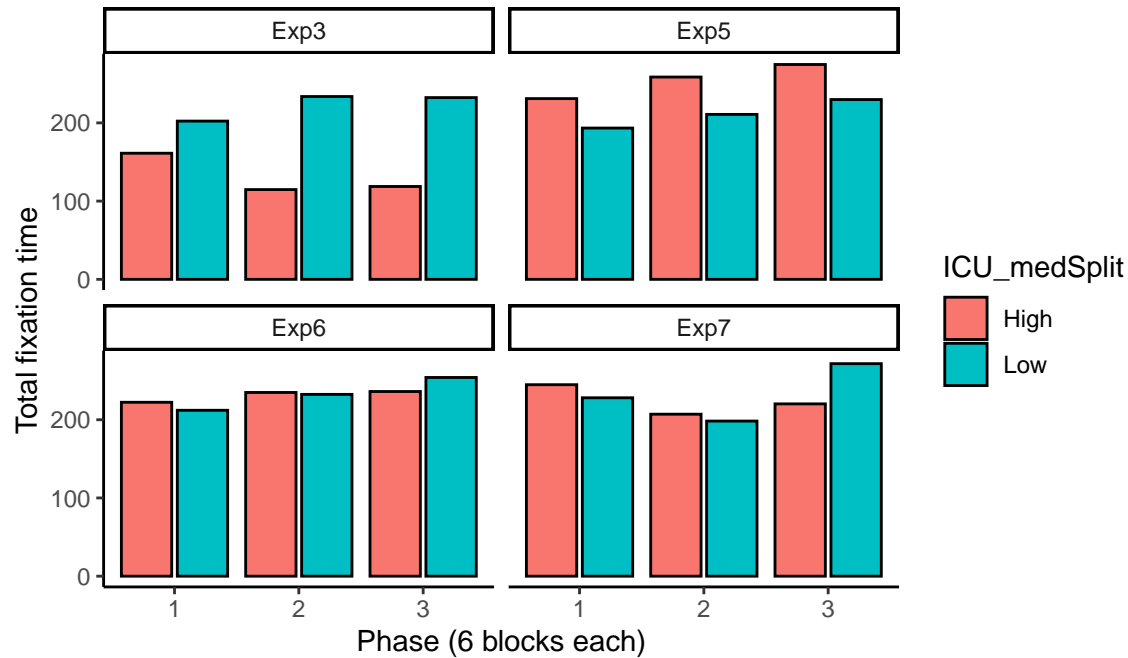


What about looking at the data from just the first second in Experiments 5 and 6 - this makes them more comparable with Experiments 3 and 7. Here I've taken fixations that must have started within the first 1 second of the feedback period (they were allowed to end after this cut off).

```
## `summarise()` regrouping output by 'Experiment', 'phase' (override with `.groups` argument)
```

Eye-gaze on outcomes during feedback

Experiment 5 and 6 reduced to first 1 second of processing



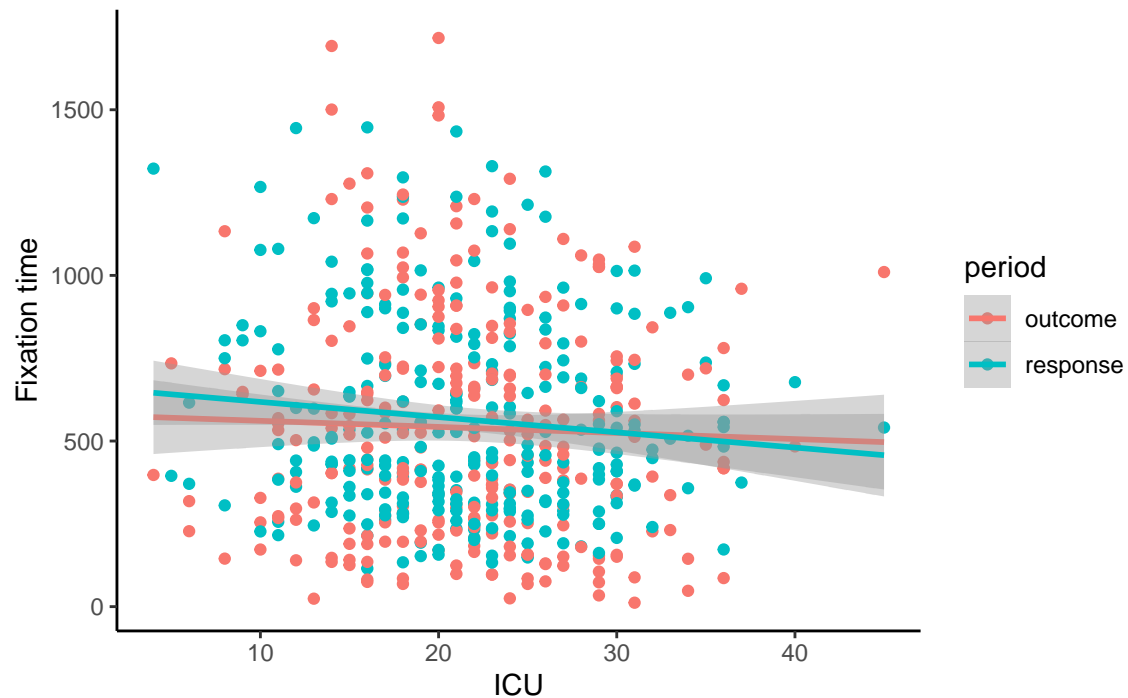
It doesn't seem to change the pattern that dramatically.

Looking at correlations between eye-gaze patterns and ICU

There doesn't appear to be any overall correlation between the processing of responses and outcomes in the feedback phase and the ICU score:

```
## `summarise()` ungrouping output (override with `.groups` argument)
```

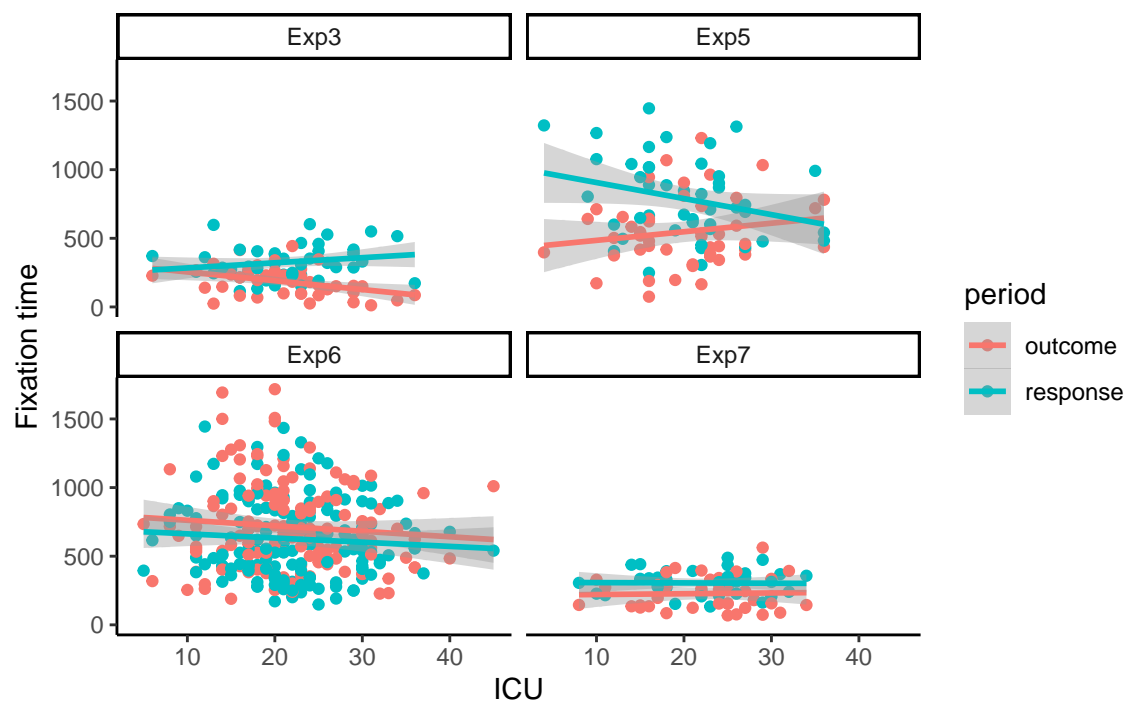
Correlation between fixation time on responses or outcomes and ICU



If we split it by experiment? It's pretty inconsistent. Somewhat of a negative trend in Experiment 3 for outcomes, but not much else.

```
## `summarise()` regrouping output by 'Experiment' (override with `.groups` argument)
```

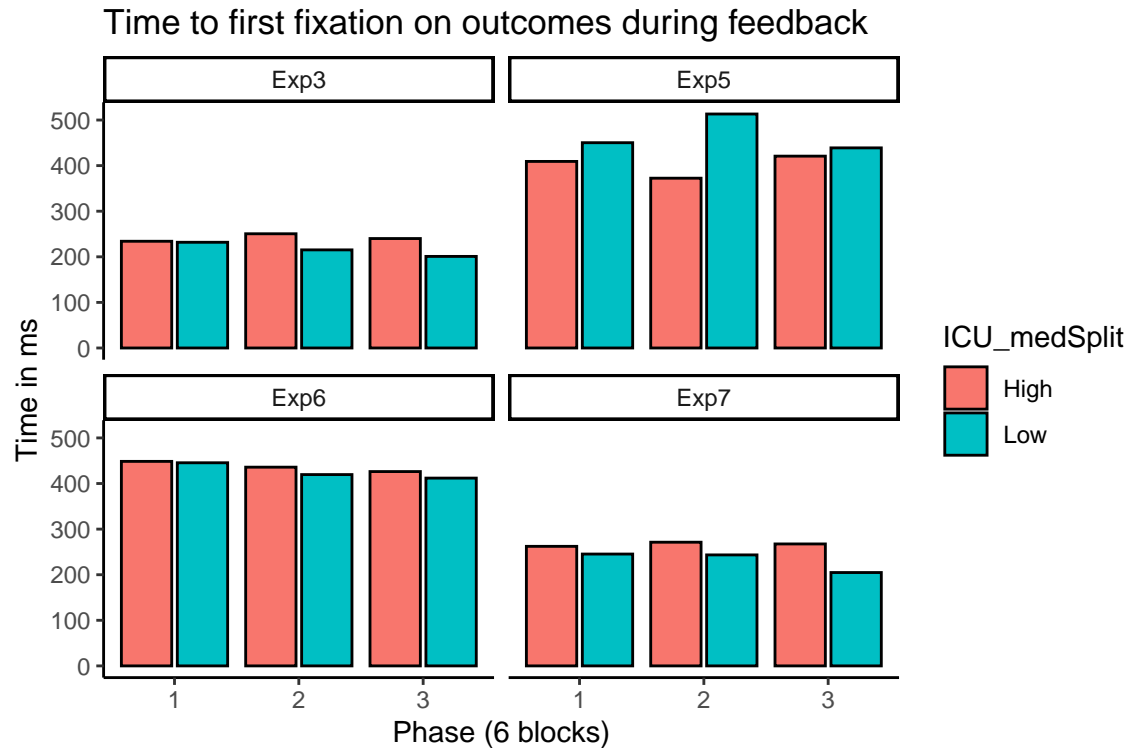
Correlation between fixation time on responses or outcomes and ICU



Time to first fixation on outcomes

Of particular interest is the speed at which participants begin processing the outcome stimuli during the feedback phase. The data presented below show these latencies across the four experiments, and between the median splits on ICU. No strong patterns jump out here, but it's clear that the timing is affected by the feedback duration - participants make quicker movements to the outcomes when the time is limited (Exp 3 and Exp 7).

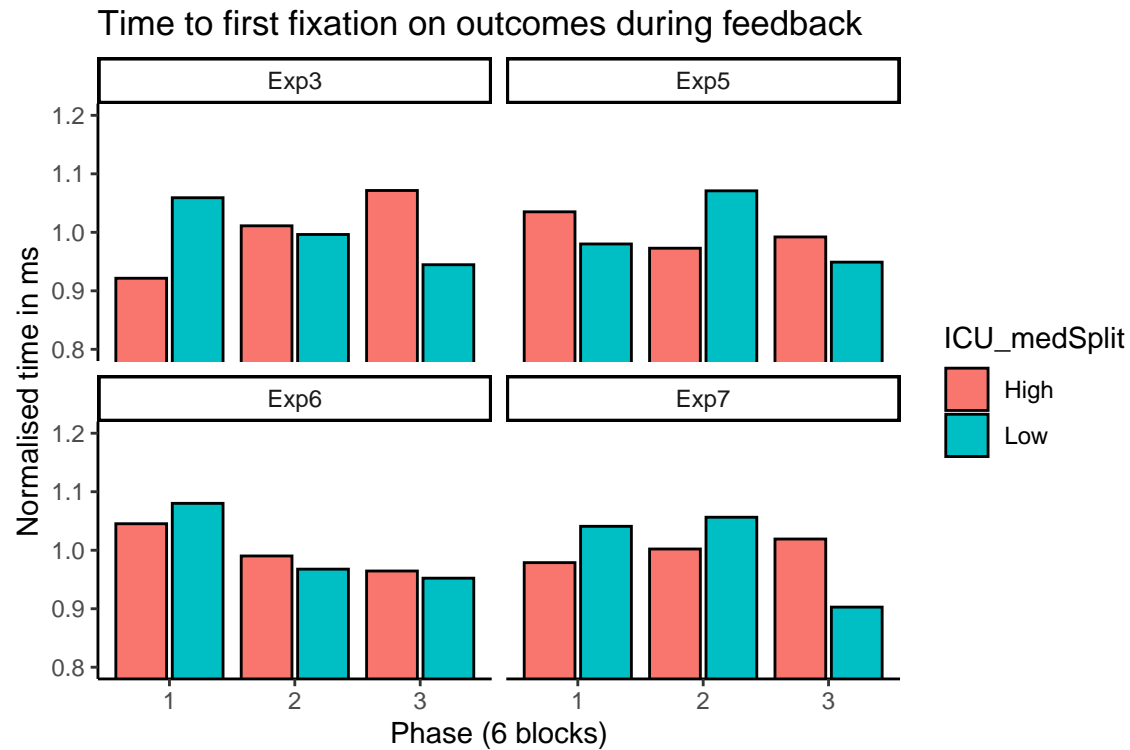
```
## `summarise()` regrouping output by 'Experiment', 'phase' (override with `.groups` argument)
```



In order to make comparisons across the different experiments, we can normalise the data, by expressing the data as a ratio against the mean time for each participant. Values above 1 indicate slower times to fixate compared to the mean, and values lower than 1 faster times.

```
## `summarise()` regrouping output by 'subj', 'Experiment', 'phase' (override with `.groups` argument)
```

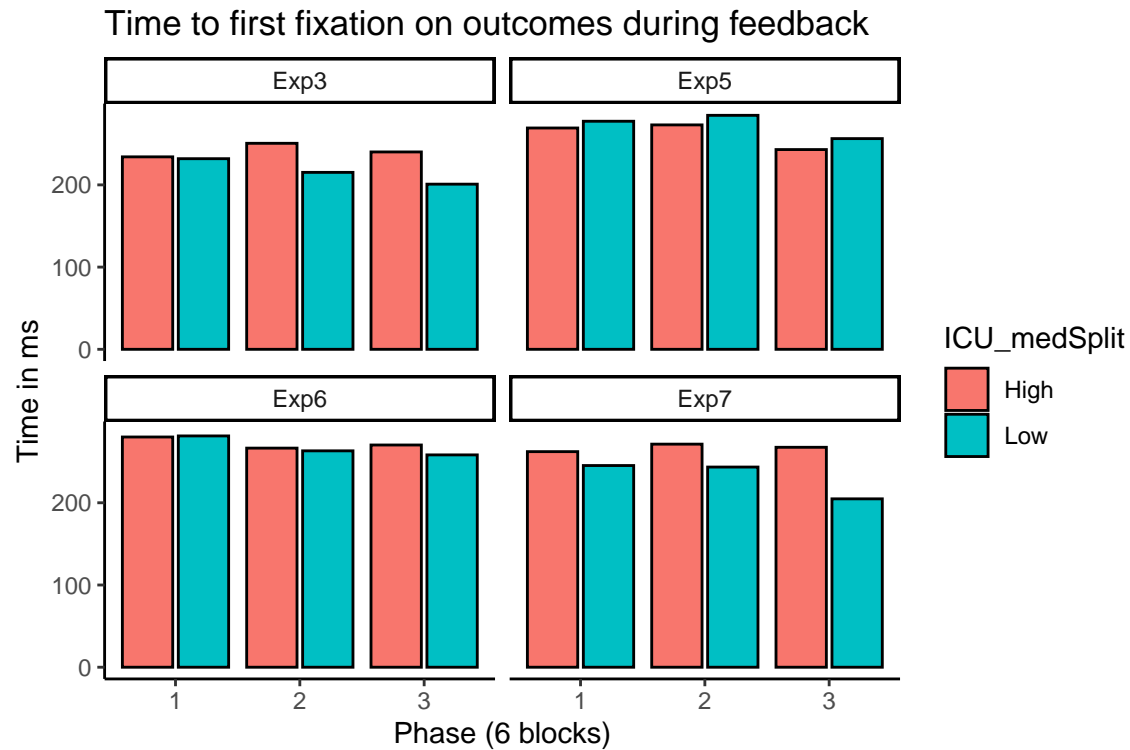
```
## `summarise()` regrouping output by 'Experiment', 'phase' (override with `.groups` argument)
```



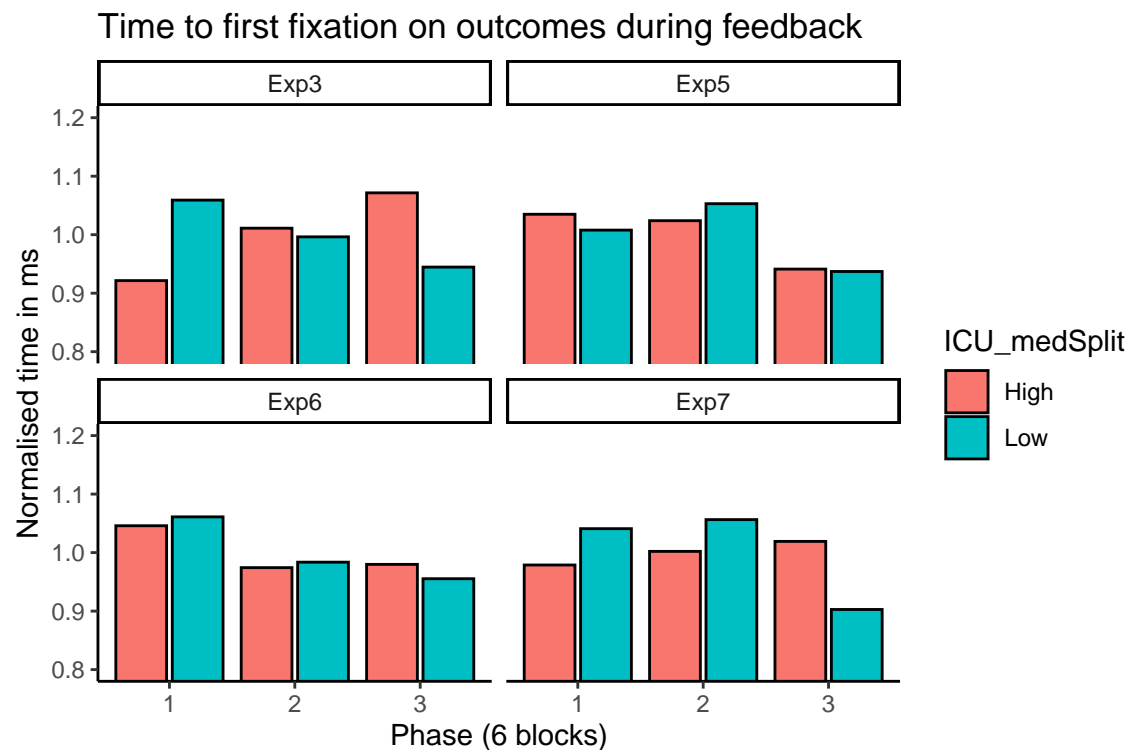
Some patterns begin to emerge, particularly in Exp 3 and Exp 7 (those with short feedback periods), where the low ICU participants seem to decrease time to fixate on outcomes, while the high ICU participants seems to increase time to process outcomes.

Do these patterns change if we just use the first 1 second of the feedback time in Experiment 5 and 6?

```
## `summarise()` regrouping output by 'Experiment', 'phase' (override with `.groups` argument)
```



```
## `summarise()` regrouping output by 'subj', 'Experiment', 'phase' (override with `.groups` argument)
## `summarise()` regrouping output by 'Experiment', 'phase' (override with `.groups` argument)
```



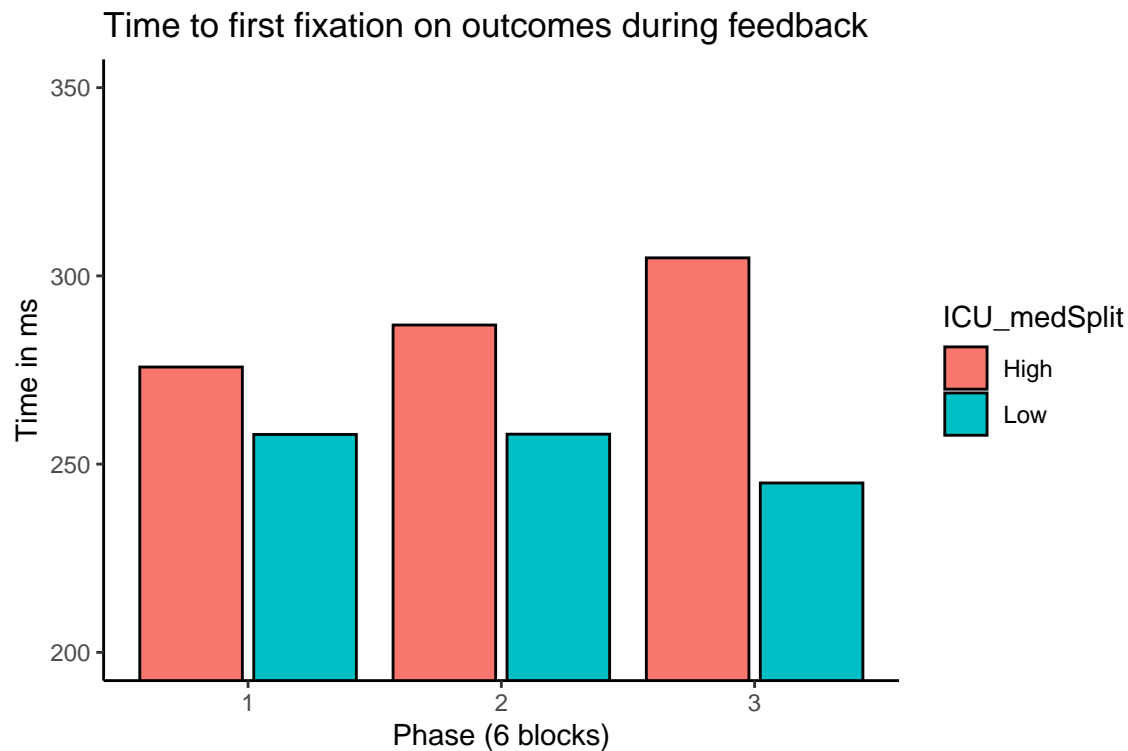
Again, I can't really see any noticeable change in the pattern of data when I restrict the analysis to the first 1 second of feedback time in Experiments 5 and 6.

“Cherry picking?": Experiment Exp 3, Exp 6 condition 1, and Exp 7

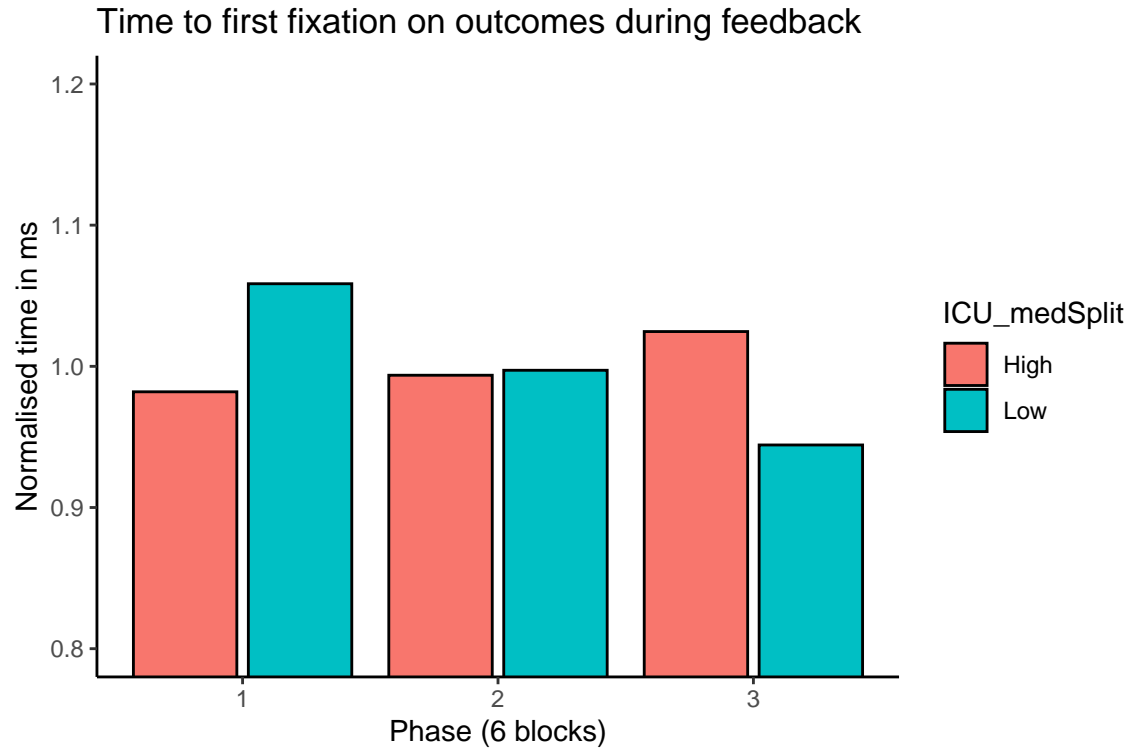
Here's an analysis which ignores Experiment 5, and focuses only on Condition 1 from Experiment 6, which is the true replication of the previous successful experiment (3). Here I've lumped all the data together (i.e., not broken down by experiment) and focused on the eye-gaze effect in the first 1 second of feedback time in the case of Exp 6, condition 1.

```
## `summarise()` regrouping output by 'Experiment', 'subj', 'phase', 'ICU_medSplit' (override with `.groups` argument)

## `summarise()` regrouping output by 'phase' (override with `.groups` argument)
```



```
## `summarise()` regrouping output by 'phase' (override with `.groups` argument)
```

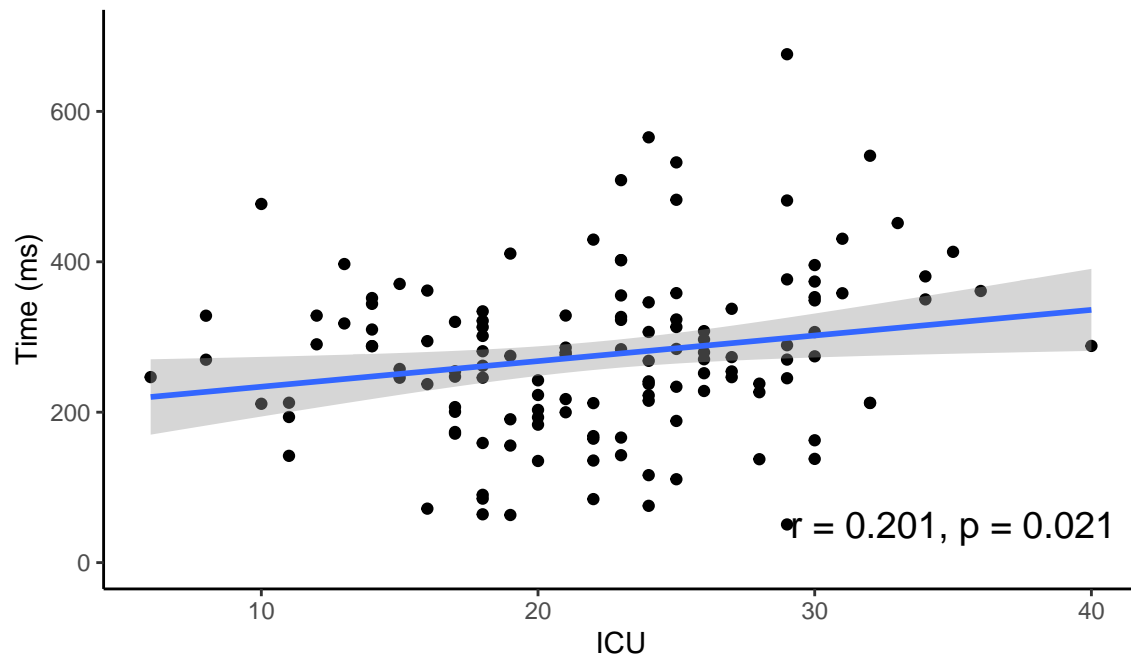


Here are the results from the ANOVA with the non-normalised data (first figure). I'm not too confident doing inferential stats in R yet, but I've checked these results in JASP and the main effect and interaction were confirmed as significant (though values differed a bit, not sure why yet).

stratum	term	df	sumsq	meansq	statistic	p.value
subj	ICU_medSplit	1	125022.309	125022.309	8.309	0.005
subj	phase	1	753.811	753.811	0.050	0.823
subj	Residuals	130	1956044.396	15046.495	NA	NA
subj:phase	phase	1	4970.151	4970.151	1.070	0.303
subj:phase	ICU_medSplit:phase	1	29776.669	29776.669	6.408	0.013
subj:phase	Residuals	130	604083.879	4646.799	NA	NA
Within	Residuals	132	327341.113	2479.857	NA	NA

Most of the effect seems to be happening in the change in eye-gaze between the second and third phases. What does the correlation look like between ICU and Phase 3 time to fixate on outcomes?

Correlation between ICU score and time to process outcomes in phase 3, 6.1, and 7



So this specific test does produce a significant correlation between ICU and time to process outcomes. Phase 2 is not significant.

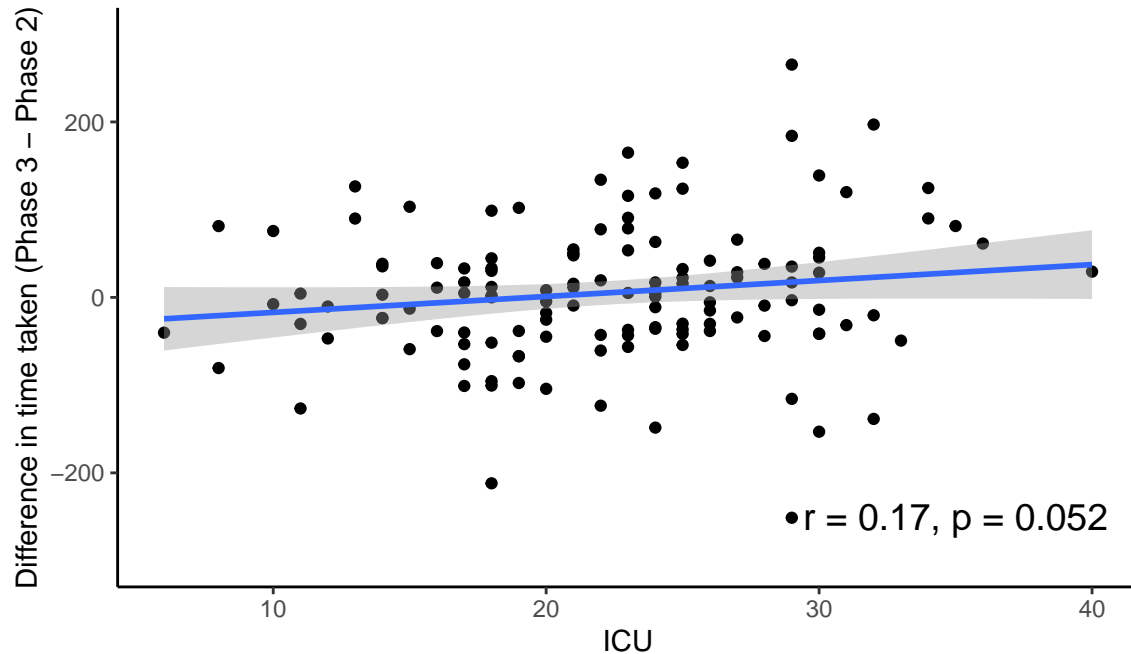
What about the change in time between phase 2 and phase 3?

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```

```
## Warning: Removed 1 rows containing missing values (geom_point).
```

Correlation between ICU score and change in time to process outcome

Exp 3, 6.1, and 7 | positive scores indicate an increase in time taken



You can see here that those participants who have higher ICU scores, tend to show an increase in time taken to process outcomes between phases 2 and 3. In contrast, those participants that have lower ICU scores tend to show a decrease in time taken to process outcomes (negative scores)

Further things to look at:

- Calculate the **difference** between the eye-gaze for outcomes and responses during feedback (i.e., the selective bias) and look at whether that correlates with ICU