**Response to Editors**

* **Lack of novelty**

Wallpaper groups are complete set of symmetries in images, no one has looked at that before with brain imaging and psychophysiscs

* **Technical nature of the manuscript**

We can address this on two fronts:

1. descriptions of the wallpaper groups and group theory
2. descriptions of EEG and the SSVEP method

* **Broader biological context beyond human visual perception**

We should bring up how these groups occur spontaneously in nature and were discovered initially by crystallographers. We can bring up more examples of symmetry perception in animals (bees, pidgeons etc.), possibly bring up the macaque fMRI paper that is currently under review with Nature Comms also using wallpaper groups.

**Response to R1**

We thank the referee for their kind and helpful comments and have implemented their suggested changes as described below:

* **The 17 wallpapers are historically interesting and well codified. However, there are some downsides. While the authors are familiar with the elegant crystallographic notations such as P2 and CM, less specialist readers are faced with a daunting marathon of code breaking and puzzle solving. For instance, why should P31M should be considered a subgroup of CM? In my opinion the paper could be improved by removing the challenge.** **The paragraph from lines 49 to 62 is very good, because it illustrates the concept of subgroup. Another similar 'concept illustration' paragraph, using different examples is still needed. Even two such paragraphs would be justifiable, if space permits.**

Okay, we can add another paragraph on another subgroup relationship.

* **The figures are extremely creative, but I would like another figure illustrating sub-groups hierarchies.**

I actually made a figure like that once, but we may have to remake it.

* **You even could include a link to the Wikipedia page (if you believe this is accurate?)** [**https://en.wikipedia.org/wiki/Wallpaper\_group#Group\_pg**](https://en.wikipedia.org/wiki/Wallpaper_group#Group_pg)

We can add links to the Wikipedia page for sure.

* **The discussion needs to say more about previous EEG work. Could we say that visual symmetry generates an ERP called the ‘Sustained Posterior Negativity’ (SPN), and that SSVEP is another way of isolating this symmetry response?  As well as mentioning the holographic model (Makin, 2016), we could say SPN also scales with proportion of symmetry in symmetry + noise displays (PSYMM, Makin, Rampone, Morris, & Bertamini, 2020; Palumbo, Bertamini, & Makin, 2015).  Sasaki et al. (2005) and Keefe et al. (2018) also observed parametric responses to PSYMM with fMRI.  These papers seem relevant, given that we are talking about parametric responses to regularity again.**

We are already citing some of these. We could definitely add a section in the discussion about the relationship between the SPN and our SSVEP measures. We can cite my NeuroImage paper which used event-related approach and found the same parametric response.

* **Would the SSVEP response to wallpapers increase if regularity were task-relevant? Makin et al. (2020) found that the SPN was enhanced when regularity was task-relevant. You could also mention top-down factors in the discussion as a topic for future work.**

We don’t know if the SSVEP response would increase, but we can definitively add a paragraph discussion top-down effects as an important direction for future work.

* **As you say, the retinal image of a 2D textures are often distorted by viewpoint. The perfect flat textures used here might be seen as a super-texture. Another alternative is that representations of regularity in the extrastriate cortex are view-invariant.  Indeed, the system can extract view invariant, post-constancy representations of regularity under some conditions (Keefe et al., 2018; Makin, Rampone, & Bertamini, 2015). This could also be a topic for future work.**

Yes, definitively. I think it is possible that super-textures is how viewpoint invariance is implemented by the visual system.

* **(Minor comment) Could we say more about how sample size was chosen?** Hm, we have to justify smaller sample size in psychophysics, perhaps referto prior work on symmetry detection.
* **(Minor comment) Tyler et al. (2005) was actually conducted before Sasaki et al. (2005) and reported similar results. We should probably cite that paper as well.** Done.

**Response to R2:**

* **In terms of limitations this is a single study (N=25) with a type of stimuli that the authors have used before (Clarke et al., 2011; Kohler et al., 2016). Although the previous study in 2016 focused only on rotation the approach is similar.**

We can mention that we are using 16 groups instead of 4 which gives us a complete picture of the subgroup relationships, that we are looking at behavioral data as well as EEG and that we are using a completely distinct analysis approach.

* **In the intro it says "Most of this work has focused on mirror symmetry or refection, with much less attention being paid to the other fundamental symmetries". This is true but also overstated. Although the work on reflection is more extensive, there are plenty of papers on translation and rotation, from some very old ones with behavioural data (Royer, 1981, JEP:HPP) and some more recent using also EEG (Makin et al., 2013, Psychophysiology).** We can rephrase this to be less strong and cite the relevant papers.
* **With respect to the comparison with the psychophysical data, it was not clear to me in which order the data was collected. Was the EEG study always second?**

We should say that the distinct participants were used for the two experiments.

* **The supplementary file is very well organised and explain the analysis. However, the osf project does not have either the stimuli or the data. If there is no strong reason for this, I would recommend that the authors do upload these datasets, in the spirit of open science.**

Yep, we should do that.

* **(Minor comment): "Two times per trial, an image pair was shown at reduced contrast, and the participants were instructed to press a button on a response pad." It was not clear to me what the participants judged, or whether they had to press the button as quickly as possible.** We should make that clearer.