Regularity ≠ symmetry: A comment on Makin, Rahman, and Bertamini (2020)

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Abstract

Previous studies have shown that the perceived duration of symmetrical visual patterns is longer than that of asymmetrical ones. In a different context, regular visual stimuli have been found to be judged as lasting longer than irregular ones. A recent replication study reported that the effect of symmetry on time perception might not be robust; however, the study jumbled the effects of regularity and symmetry. The stimuli used in our previous study on the effect of regularity were qualitatively and quantitatively different from those used in the study addressing symmetry. Moreover, the hypothesized underlying mechanisms involved in the effects of regularity and symmetry were completely different. Taken together, the present commentary claims that combining these findings based on the superficial similarity of these phenomena would lead to flawed scientific discussions.

Keywords: time perception, pattern regularity, pattern symmetry

How do we perceive time? To answer this question, several researchers have examined they types of visual information that distort perceived time. Previous studies have shown that the perceived duration of symmetrical visual patterns is longer than that of asymmetrical ones (Ogden, Makin, Palumbo, & Bertamini, 2016; Palumbo, Ogden, Makin, & Bertamini, 2015). Furthermore, we have demonstrated that visual stimuli comprising regular dot-patterns are judged as lasting for a longer duration than irregular ones (Sasaki & Yamada, 2017). Recently, a self-replication study reported that the effect of symmetry on time perception might be small (Makin, Rahman, & Bertamini, 2020). Although failures to replicate previous findings on time perception have been reported occasionally (e.g., Cai & Wang, 2014; Nomura & Yotsumoto, 2018), there have been few attempts to replicate studies on time perception. Therefore, Makin et al.'s (2020) study is highly beneficial and desirable for the field. We cordially hope that, with this opportunity, more replication studies on time perception will be published in the future. However, Makin and colleagues have jumbled the effects of regularity (Sasaki & Yamada, 2017) and symmetry (Ogden et al., 2016; Palumbo et al., 2015), leading to a flawed discussion. The present commentary aims to explain this point in detail.

Previous studies have revealed that the perceived duration of stimuli with symmetrical patterns was longer than that of asymmetrical ones (Figure 1; Ogden et al., 2016; Palumbo et al., 2015). These studies consistently explained this phenomenon from the perspective of emotional impression; the symmetrical pattern is preferred explicitly and implicitly (e.g., Makin, Pecchinenda, & Bertamini,

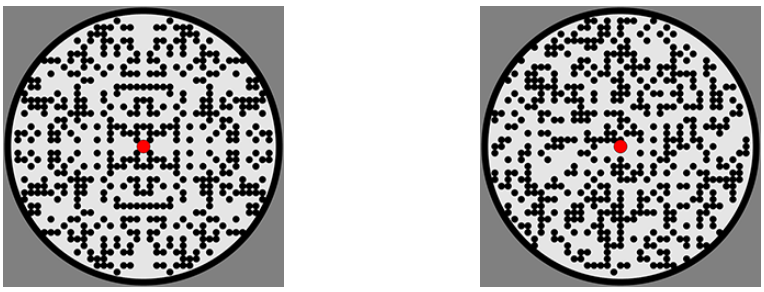

Figure 1. Examples of stimuli used in studies addressing the effect of symmetry on time perception (Makin et al., 2020; Ogden et al., 2016; Palumbo et al., 2015). These stimuli were created using the program code utilized by Makin et al. (2020), which is available at https://osf.io/a3u6e/.

2012) and low-arousal positive stimuli are perceived as lasting longer (e.g., Angrilli, Cherubini, Pavese, & Mantredini, 1997). Furthermore, Palumbo et al. (2015) speculated that less attending to asymmetrical stimuli may shorten their perceived duration. However, Makin et al. (2020) recently failed to replicate this effect, consequently inferring that this effect may be small. In this regard, their self-correcting replication is quite reasonable.

However, for some reason, when Makin et al. (2020) referred to their own previous studies on symmetry, they additionally cited the study conducted by Sasaki and Yamada (2017). Our previous study examined whether regularity of dot patterns (Figure 2) would influence time perception, and it found that the perceived duration of high-regular patterns was longer than that of moderate- and low-regular patterns (Sasaki & Yamada, 2017). We discussed this finding based on a neural mechanism underlying visual texture processing for dot patterns. Previous studies on visual adaptation have suggested that regularity perception involves the filter-rectify-filter (FRF) mechanism (Ouhnana, Bell, Solomon, & Kingdom, 2013; Yamada, Kawabe, & Miyazaki, 2013). In the FRF mechanism, linear filters detect local luminance-defined orientation and spatial frequency at the first stage. The outputs from these first-order filters are then rectified at the second stage. Finally, orientation-selective second-order filters, which have larger receptive fields than first-order filters, sum the rectified outputs from the second stage. Thus, the signals of second-order orientation are involved in pattern regularity perception; high-regular patterns have more second-order orientation signals than do random patterns. This idea was supported by a functional magnetic resonance imaging study (Yamada, Kadota, Funai,

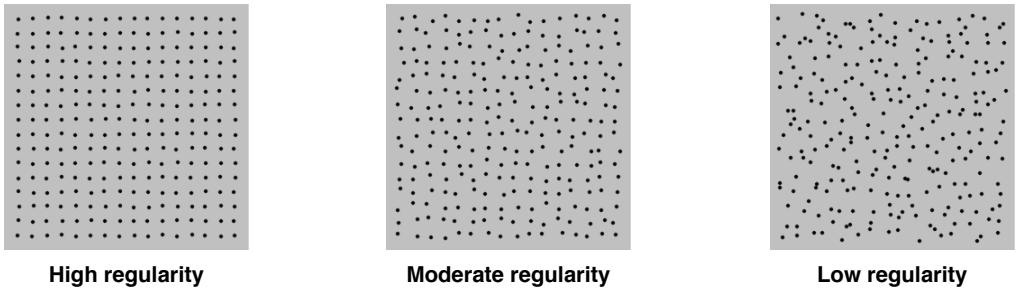

Figure 2. Stimuli used in the study conducted by Sasaki and Yamada (2017)

Iwata, Kochiyama, & Miyazaki, 2020), indicating that the lateral occipital complex, which is related to the spatial integration of orientation signals, is activated more when judging high-regular rather than low-regular patterns. Given that perceived duration is possibly based on neural processing involved during the encoding of a stimulus (Eagleman & Pariyadath, 2009), Sasaki and Yamada (2017) suggested that large amounts of second-order orientation signals in high-regular patterns extend the perceived duration.

Makin et al. (2020) may have misunderstood our previous study (Sasaki & Yamada, 2017); the effects of regularity and symmetry cannot be jumbled. Specifically, our previous study stemmed from a completely different context with reference to studies addressing the effect of symmetry on time perception. First, our previous study (Sasaki & Yamada, 2017) never referred to studies addressing symmetry (e.g., Makin et al., 2012; Ogden et al., 2016; Palumbo et al., 2015). Second, the visual characteristics of stimuli used in Sasaki and Yamada's study (2017) are qualitatively and quantitatively different from those used in studies addressing the effect of symmetry (Makin et al., 2020; Ogden et al., 2016; Palumbo et al., 2015; refer to these studies for details of stimuli used). Accordingly, it is unclear whether the same visual filtering mechanism (i.e., the FRF mechanism) would play a key role in stimulus processing. Third, we never explained the effect of regularity on time perception based on the cognitive processing of symmetry patterns. Finally, we never assumed that emotion, valence, arousal, and attention, which may affect the perception of symmetry (Ogden et al., 2016; Palumbo et al., 2015), could account for the effect of regularity; indeed, these words and the synonymous terms never appear in our article (Sasaki & Yamada, 2017). As explained above, we assumed that second-order orientation processing was involved with the effect of regularity on time perception. Evidently, the stimuli and hypothetical mechanism involved in the effects of regularity and symmetry are different, and therefore, lumping these findings may lead to a flawed scientific discussion.

Studies addressing the effects of regularity and symmetry on time perception stem from different methods and rationales. Therefore, Makin et al. (2020) should not jumble these effects based

on the superficial similarity of these phenomena. If they discuss both effects together, they should rigorously consider the differences in the stimuli and hypothetical mechanisms involved in these studies. Over-generalization of experimental findings of original or replication studies should be avoided because it can lead to interpretive bias. Finally, note that it is currently unclear if the effect of regularity on time perception would be robust because there is no direct replication study has been conducted yet. If the results of an appropriate direct replication are reported, even if they are null, we will be glad to consider them and move forward with an appropriate understanding of the time perception mechanism.

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Yuki Yamada: Conceptualization, Data Curation, Formal Analysis, Funding Acquisition, Methodology, Supervision, Resources, Software, Visualization, Writing—Original Draft, and Writing—Review & Editing