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News from the field

REPLICATION

Replication in Psychological Science

Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science*, *349*. DOI: 10.1126/science.aac4716

The issue of replication in psychology has garnered increasingly more attention with conversations occurring at conferences on topics such as the "file drawer problem" in which scientists allegedly file away, or hide, null or inconvenient results without reporting or reconciling the findings. A recent paper in Science attempted to replicate 100 psychology experiments as part of the Reproducibility Project. Experiments targeted for replication were published in 2008 in three leading journals for research in social and cognitive psychology. While the authors examined replication in a number of ways (e.g., p values, effect size), their subjective assessment of whether the experiments replicated showed that only 39 out of 100 experiments replicated. In other words, over 60% of the studies failed to replicate. While this has generated a considerable amount of alarm, it is not a prescriptive paper. The authors conclude with an assertion of truth seeking, rather than recommendations for the field, leaving one to wonder what journals and the peer review process can do to defend against such replication problems. First, the paper does not examine within paper replications. Specifically, one of the major arguments about writing multiple experiment papers is to demonstrate replication. One suspects that failures to replicate commonly come from papers that did not involve multiple experiments. Perhaps journal requirements of multiple experiment papers can temper replication problems. Second, while the conversation about replication is of course an important one, it does not assess the validity of a study. In their discussion, the authors acknowledge that even direct replication does not translate into validity of the theoretical claims of the paper. Rather, replication assesses the reliability of the results. In the realm of peer reviewing, one suspects that reviewers are rarely attempting to assess whether the results would replicate. Peer reviews are often more concentrated on examining issues such as whether the measurements are valid and there is a larger theoretical implication for the work beyond the specific experiments. Given that the findings must be novel in order to be published in top-tier journals, the publishing process precludes the opportunity for replication in other labs. Perhaps failures to replicate can in part be caught by journals requirements of within paper replications, but some degree of reproducibility issues is simply the cost of being on the cutting edge of science. –Dr. Ashleigh M. Maxcey

MENTAL ROTATION

Capacity for Visual Features

Xu, Y., & Franconeri, S. L. (2015). Capacity for visual features in mental rotation. *Psychological Science*, *26*(8), 1241–1251.

Mental rotation is a core component of scientific reasoning, but still, some important aspects of its underlying mechanisms remain largely unknown – for example, can multiple visual features be mentally rotated simultaneously? Previous studies (e.g., Huang & Pashler, 2007) suggested a very severe capacity for this function but have not directly examined the nature of this capacity. Xu and Franconeri (2015) aimed at directly measuring the capacity of features (e.g., colors) in mental rotation. The answer turns out to be a strikingly low number of only 1 feature.

The experiments used a cross consisting of four legs with four different colors as a critical stimulus. In the object-

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rotation condition, a cueing wheel spun for the first 2400 seconds (i.e., cueing phase). Then a static object appeared for 500 ms and after the offset of the object, the participants were asked to imagine the object spinning at the constant rate as the wheel previously shown. After a while, a test-object appeared and the participants were asked to judge whether the test-object was in the correct rotated orientation with no colors swapped to different parts. In Experiment 1a, a control condition was also conducted in which no rotation was shown in cueing phase and the participants were asked to judge whether a test object had no color swaps compared to the initial object. The results showed that in the control condition, where no mental rotation was needed, the capacity of colors was approximately 2, whereas in the object-rotation condition, the capacity decreased dramatically to 1. This points to the conclusion that human observers are capable of maintaining only 1 feature attached to an object part in mental rotation.

In Experiment 1b, the control condition was substituted by a needle-rotation condition to explore whether the limitation was due to rotation per se or to the rotation of the object that is feature-relevant. The needle-rotation condition was the same as the non-rotation condition except for that the participants had to imagine the rotation of a needle attached to a static object. The participants' capacities in both the object-rotation and needle-rotation condition were approximately 1. The participants' capacity is limited to only 1 feature as long as mental rotation is involved, regardless of whether the rotation is required for a feature-relevant object or not. In Experiment 1c, the rotation task was replaced by an expanding/shrinking task and the 1-feature limit was not repeated, suggesting that the limit is imposed specifically by mental rotation rather than generally by any difficult task.

Having shown that participants can only maintain one feature part of the object in mental rotation, Experiment 2 intended to determine which part, out of the four, is selected during rotation. Eye-tracking data showed that participants tended to select the top part of the object before the mental rotation started and tracked that part as mental rotation progressed.

To sum up, these experiments suggest that the capacity of features in mental rotation is strikingly limited to only 1 feature, and that feature is likely to be attached to the top part of the object. This finding bridges the gap between the abstract and pictorial views of mental rotation, suggesting that mental rotation may rely on a very abstracted form of object shape with features filled in on demand. More generally, this finding suggests that mental rotation seems to belong to the category of "serial" visual functions which is enabled by the strict one-by-one operation of conscious focus. On the other hand, this finding also offers important support for the view (e.g., Huang & Pashler, 2007) that the visual data which underlies the conscious focus seems to operate in a "Boolean" manner and is fundamentally incapable of representing more than one feature. –Dr. Liqiang Huang.

Additional References:

Huang, L.Q. & Pashler, H. (2007). A Boolean map theory of visual attention. *Psychological Review*, *114*(3), 599–631.

ATTENTION

Attention and Cell Phone Notifications

Stothart, C., Mitchum, A., & Yehnert, C. (2015). The attentional cost of receiving a cell phone notification. *Journal of Experimental Psychology*: *Human Perception and Performance*, (4), 893–897. http://dx.doi.org/10.1037/xhp0000100

It is well established that mobile phone use can have deleterious effects on attentional control while performing complex tasks such as driving. As a consequence, mobile phone companies routinely introduce advances intended simplify use and reduce demands on the user. For example, hands-free calling was intended to reduce the physical demands required to operate a phone though research has demonstrated that the negative effects of cell phone used are based on cognitive load, meaning that attention deficits are still observed in individuals using a hands-free device. Relatedly, many cell phones offer auditory and/or tactile notifications to inform the user of recent developments which, in theory, cut down the amount of attention one needs to direct towards their phone. New research published in the Journal of Experimental Psychology: Human Perception and Performance by Stothart et al., however, demonstrate that there are attentional consequences of merely receiving a cell phone notification, even when individuals do not interact further with their device. Participants completed a sustained attention task while an experimental program sent calls or text messages to their phone four times throughout an experimental block (every 90 trials). Both the likelihood of errors and speeded responses increased significantly following mobile phone notifications (relative to a control group receiving no notifications and relative to an initial session in which no experimenter-driven notifications were sent), even if participants did not look at or interact with their phone in any way following the notification. The mere act of hearing (or feeling) a notification was sufficient to pull attention away from a primary task. –Dr. Michael M. Dodd.