

Project

Title

Replication of changing state effect and auditory deviant effect

Contributors

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AsPredicted Registration

1. Have any data been collected for this study already? (optional)

No, no data have been collected for this study yet.

2. What's the main question being asked or hypothesis being tested in this study? (optional)

The study has two purposes.

One purpose of the present study is to perform a preregistered replication of the so-called changing state effect and the auditory deviant effect for the Benchmarks project (Oberauer et al., 2018). In this project, a set of benchmark findings was defined that theories of short-term memory and working memory have to be able to explain. Both the changing state effect and the auditory deviant effect have been included in this list of benchmark findings.

The changing state effect refers to the finding that “[s]ound that changes acoustically from one token to the next (i.e., changing-state sound) is more disruptive to serial recall than repetitive, steady-state sound” (Oberauer et al., 2018, p. 906). Usually, a repetitive steady state sequence consisting of word repetitions (e.g., A A A A A A A) is compared to a changing state sequence consisting of different words (e.g., A B C D E F G H).

The auditory deviant effect refers to the finding that a steady state sequence with a single auditory deviant that differs from the rest of the list (e.g., A A A A B A A A) disrupts serial recall more than a steady-state sequence without such an auditory deviant (e.g., A A A A A A A A). While the changing state effect is well established, the auditory deviant effect “constitutes a relatively novel finding in the WM literature that is of high theoretical leverage but for which robustness and generality still needs to be ascertained.” (Oberauer et al., 2018, p. 945).

A long-term goal of the Benchmarks team is to collect a set of reference data for each of the phenomena on the benchmarks list, and make this data available on an open data repository. Preferentially, these data sets should “use large samples of participants and

trials to provide the basis for precise estimates of model parameters” and be “pre-registered replications of benchmark findings; such replications are desirable because, despite our efforts to ensure that all benchmarks are robust and replicable, we cannot rule out that the available evidence is compromised by publication bias” (Oberauer et al., 2018, p. 889).

The purpose of the present preregistration is to be able to provide a reference data set for the changing state effect and the auditory deviant effect that fulfills the criteria stated above and can be made available to the Benchmarks project.

In addition to the mere replication of two standard effects of auditory distraction that have been previously reported, the study serves to examine a novel research question that will be published in a separate publication (see 6. Any secondary analyses?).

3. Describe the key dependent variable(s) specifying how they will be measured. (optional)

A standard serial recall paradigm is used (see, for example, Röer, Bell, Marsh, & Buchner, 2015). Participants are seated in separate cubicles with sound-absorbing walls. The instructions emphasize that anything presented over the headphones is to be ignored. Participants start the trial by pressing the space bar. After a 1000 ms blank screen, eight digits (randomly sampled without replacement from the set [1, 2, 3, ... , 9]) are successively presented at the center of the screen, each for 1000 ms, in 80 pt Monaco font. Then eight question marks appear on the screen that have to be replaced by the digits. Participants use the number pad of the keyboard to recall the digits in forward order. They are not allowed to correct their responses. After each list, they receive feedback about how many digits they have remembered correctly. Then the next trial can be started by pressing the space bar.

During the encoding of the digits, three types of auditory distractor sequences have to be ignored. *Steady State*: The same word is repeated 10 times (e.g., *Berg, Berg, Berg, Berg, Berg, Berg, Berg, Berg, Berg, Berg*). *Auditory Deviant*: The steady state sequence is disrupted by a deviant word presented at the 7th position (e.g., *Berg, Berg, Berg, Berg, Berg, Berg, Chef, Berg, Berg, Berg*). *Changing State*: Ten different words are presented (e.g., *Dank, Berg, Zeug, Chef, Wind, Gold, Typ, Ruf, Haut, Mund*). The distractors will be played for 500 ms with a 300 ms inter-distractor-interval. In all conditions, the distractors are randomly drawn from the set {Berg, Chef, Dank, Gold, Haut, Hof, Mund, Rand, Ruf, Typ, Wind, Zeug}. All words are spoken by the same female voice. The distractors will be played at about 65 dB(A) through headphones (beyerdynamic DT-150) that are directly plugged into the Apple iMac that controls the experiment.

Following 16 steady-state training trials (which will not be analyzed), the experimental trials (consisting of 8 steady-state trials, 8 auditory deviant trials, and 8 changing-state trials) will follow in random order. After having completed all serial recall trials, the participants are required to fill out a personality questionnaire (these data will not be made available as part of the Benchmarks project).

To be able to examine retest reliability of the distraction effects, participants will be invited to take part in a second session in the subsequent week in which the experiment described above will be repeated in the exact same way.

4. How many and which conditions will participants be assigned to? (optional)

A repeated-measures 3 (distractor condition) x 2 (experimental session) x 8 (serial position) design is used. The distractor conditions are steady state, auditory deviant, and changing state. The exact same experiment will be completed two times in two sessions separated by approximately 1 week (Session 1, Session 2). This will allow us to examine the retest-reliability of the distraction effects.

5. Specify exactly which analyses you will conduct to examine the main question/hypothesis. (optional)

Serial recall will be scored according to a strict serial-recall criterion: Only digits recalled at the correct serial position will be scored as correct.

For the Benchmarks project, the most important question is whether or not the changing-state effect and the auditory deviant effect can be replicated. The following analyses will be performed to test this.

First, we will run a 3 x 2 x 8 repeated-measures MANOVA with distractor condition (steady state, auditory deviant, changing state), session (Session 1, Session 2), and serial position (1-8) as independent variables and serial-recall performance as dependent variable. We expect to find a significant main effect of auditory distraction. We will use orthogonal contrasts on the distractor condition variable and expect performance in the steady state condition to be better than in the other two conditions combined. Based on previous studies, we expect that changing state sequences disrupt performance more than auditory deviant sequences even though this finding is not strongly predicted based on any working memory model.

In a first supplementary 2 x 2 x 8 repeated-measures MANOVA with distractor condition (steady state, changing state), session (Session 1, Session 2), and serial position (1-8) as independent variables and serial-recall performance as dependent variable, we expect to find a main effect of distractor condition, representing evidence for a changing-state effect.

In a second supplementary 2 x 2 x 8 repeated-measures MANOVA with distractor condition (steady state, auditory deviant), session (Session 1, Session 2), and serial position (1-8) as independent variables and serial-recall performance as dependent variable, we expect to find a main effect of distractor condition, representing evidence for a deviation effect.

This procedure is similar to previous studies on auditory distraction (see, for example, Röer, Bell, Marsh, & Buchner, 2015).

6. Any secondary analyses? (optional)

For the Benchmarks project, it is interesting whether two standard auditory distraction effects (changing state effect and auditory deviant effect) can be robustly replicated in a preregistered replication. However, the study also serves to test novel hypotheses about the relationship between auditory distraction and personality. These analyses and data will not be made available as part of the Benchmarks project because we plan to report them in a separate publication.

7. How many observations will be collected or what will determine the sample size? No need to justify decision, but be precise about exactly how the number will be determined. (optional)

We plan to collect as many data sets as possible in the six weeks the laboratory is available to us. In the first five weeks, we will advertise the study on campus and try to find as many participants as possible. In the sixth week, we will only invite those participants who have completed their first session in the previous week to complete data collection for the second session.

8. Anything else you would like to pre-register? (e.g., data exclusions, variables collected for exploratory purposes, unusual analyses planned?) (optional)

We will only analyze complete data sets (i.e., data sets of those participants who have completed both sessions). Data sets will be assigned to participants using individual codes. We will only analyze those data sets that can be unambiguously assigned to individuals based on these codes. The codes will be deleted before the data is published.

References

Oberauer, K., Lewandowsky, S., Awh, E., Brown, G. D. A., Conway, A. R. A., Cowan, N., Donkin, C., Farrell, S., Hitch, G. J., Hurlstone, M. J., Ma, W. J., Morey, C. C., Nee, D. E., Schweppe, J., Vergauwe, E., & Ward, G. (2018). Benchmarks for Models of Short Term and Working Memory. *Psychological Bulletin*, 144, 885-958. <http://dx.doi.org/10.1037/bul0000153>

Röer, J. P., Bell, R., Marsh, J. E., & Buchner, A. (2015). Age equivalence in auditory distraction by changing and deviant speech sounds. *Psychology and Aging*, 30, 849-855. <http://dx.doi.org/10.1037/pag0000055>