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An irrelevant speech effect on incidental memory

Jan Philipp Röer [a,b] and Sabine J. Schlittmeier[c,d]

[a]Witten/Herdecke University, Alfred-Herrhausen-Straße 44, Witten, 58455, Germany; [b]Heinrich Heine University Düsseldorf, Düsseldorf, Germany; [c]Work and Engineering Psychology, RWTH Aachen University, Aachen, Germany; [d]Work, Environmental and Health Psychology, Catholic University of Eichstätt-Ingolstadt, Eichstätt, Germany

ABSTRACT

In most irrelevant speech experiments, the key dependent variable is intentional memory (i.e. participants encode items with the clear instruction to remember them later). Here, we investigated the irrelevant speech effect on incidental memory (i.e. participants encoded items without any expectation of a later recall). We used the survival processing paradigm. Participants rated words according to their fitness relevance or pleasantness, followed by a surprise memory test. In Experiment 1, we found the typical survival processing memory advantage in quiet, but not when irrelevant speech was played during encoding, retention and recall. In Experiments 2 and 3, irrelevant speech was played only during the rating task (encoding), but not during the intermediate task (retention) or the surprise memory test (recall). The survival processing effect persisted, suggesting that incidental memory is rather robust against irrelevant speech when played during encoding, but not during the retention and retrieval of information.

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Irrelevant speech; auditory distraction; incidental memory; survival processing; adaptive memory

Introduction

Task-irrelevant, to-be-ignored background speech is known to disrupt serial short-term memory for verbal information (e.g. Colle & Welsh, 1976; Jones & Morris, 1992; Salamé & Baddeley, 1982). Experimental designs do differ, but there is one common feature shared by almost all experiments: Participants are presented with information and are explicitly instructed that they should try their best to remember as much of that information for subsequent recall. This type of task is a classic example of an *intentional* memory task. In everyday life, however, we often encode information without knowing whether or not we need to remember this information at a later point in time. In the present study, we used an *incidental* memory task to explore whether irrelevant speech also disrupts memory for information that was encoded in the context of an immediate rating task without the necessity to retain that information for later recall (i.e. participants did not know that a surprise memory test would follow).

The most common experimental paradigm to study the irrelevant speech effect is the serial recall task, in which participants are presented with a series of items one after the other, and they are asked to maintain them in the order of presentation for a short period of time. Sometimes these items have to be recalled immediately after presentation (Elliott, 2002; Marsh et al., 2024; Röer et al., 2022), sometimes there is a short retention interval between the presentation of the last item of a sequence and the recall phase (Kattner et al., 2024; Schlittmeier et al., 2011; Wöstmann & Obleser, 2016). When task-irrelevant sound is presented during the presentation or the retention of the to-be-remembered items, serial recall performance suffers – a phenomenon typically referred to as the irrelevant sound effect or the irrelevant speech effect, respectively, when the to-be-ignored sound is a speech sequence (Ellermeier & Zimmer, 1997; Jones & Macken, 1995; Röer et al., 2017; Schlittmeier et al., 2012; Vachon et al., 2020).

It is generally assumed that the disruptive effect mainly concerns the short-term maintenance of information in memory. Miles et al. (1991) presented irrelevant speech at one of three different stages of the experiment: (1) only during the presentation of the to-be-remembered items (encoding), (2) only during a retention interval between presentation and recall (maintenance), or (3) only during item recall (retrieval).

CONTACT Jan Philipp Röer jan.roeer@uni-wh.de Witten/Herdecke University, Alfred-Herrhausen-Straße 44, Witten, 58455, Germany Heinrich Heine University Düsseldorf, Düsseldorf, Germany

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There was a significant drop in performance relative to a quiet control condition at the presentation and retention stages, which has been replicated many times since (e.g. Hughes et al., 2005; Körner et al., 2019; Macken et al., 1999). When irrelevant speech was played only during item recall, however, it had no effect, leading Miles et al. (1991) to conclude that the disruption occurs during the input and retention of information and not during the output of information.

Although the serial recall task is just one example of the disruptive effect of irrelevant sound on intentional memory. Other examples include free recall (Banbury & Berry, 1997; Beaman & Jones, 1998; LeCompte, 1994), text comprehension (Martin et al., 1988), item-context binding (Bell et al., 2013), paired associates learning (LeCompte, 1994), mental arithmetics (Banbury & Berry, 1997), probed recall (Beaman & Jones, 1997), the running memory span task (Samper et al., 2021), face memory (Bell et al., 2019), and the missing item task (Hughes et al., 2007; Kattner & Ellermeier, 2018). While task requirements can play an important role in how disruptive a particular sequence is (for a discussion, see Marsh et al., 2008; 2009), irrelevant speech appears to be generally disruptive for a wide range of intentional memory tasks. Applied to everyday life outside the laboratory, this means that if background speech is present while we are intentionally trying to memorise something, we probably will not be able to remember it as well later on.

Arguably, however, most of the information we encounter every day is encoded without the explicit intention of retaining it. Whether irrelevant speech has an effect on this type of information is difficult to determine, because–to our knowledge–there are no studies yet available that have systematically addressed this issue. This was one of the main motivations for the present study, in which we turned to the survival processing paradigm (Nairne et al., 2007; Nairne & Pandeirada, 2010; see Scofield et al., 2018 for a meta-analysis) as a well-established and robust method to test this.

The survival processing effect refers to the phenomenon that information processed according to its fitness relevance is better remembered relative to other encoding manipulations. In a typical experiment, participants imagine themselves being stranded in the grasslands of a foreign land, shelterless, hungry, thirsty, and in danger of predators. A list of words is then presented and rated according to how relevant each of these words would be in such a scenario. After a short intermediate task, a surprise memory test follows, in which participants are asked to write down all previously presented words they can recall. Words that were rated according to their fitness relevance are remembered much better than words that were encoded using alternative procedures, even compared to those that are usually associated with mnemonic benefits, such as rating words according to their pleasantness or self-relevance (Nairne et al., 2007). This survival processing memory advantage has been replicated many times with a number of different control conditions and to-be-remembered materials (e.g. Bell et al., 2015; Kang et al., 2008; Otgaar et al., 2010; Soderstrom & McCabe, 2011; Weinstein et al., 2008; Wöstenfeld et al., 2020).

Given the robustness of the survival processing effect, it seems to be a useful paradigm to investigate the influence of irrelevant speech on incidental memory. Examining whether the survival processing advantage persists under auditory distraction allows us not only to assess the generalisability of the irrelevant speech effect, but also to explore its potential association with adaptive memory. If irrelevant speech disrupts both intentional and incidental memory, this would extend the irrelevant speech effect past classic short-term memory tasks involving intentional memory, and once again demonstrate the ecological relevance of the phenomenon.

The present study is somewhat different from the usual collaboration in that the two authors independently came up with the idea of investigating the irrelevant speech effect on incidental memory. Hence, the first two experiments were conducted in parallel at our respective laboratories independently of one another and without prior coordination. Experiment 1 was conducted at the Catholic University of Eichstätt-Ingolstadt and Experiment 2 at Heinrich Heine University Düsseldorf. While the underlying research question and the paradigms were the same, there were some methodological differences, reflecting laboratory-specific preferences when it comes to the survival scenario and the auditory distractor material. Interestingly, the results were quite different at first glance, as there was an irrelevant speech effect in Experiment 1, but not in Experiment 2. When we found out about each other's results, we decided to investigate this discrepancy and conducted a third experiment in which we combined our methods. Experiment 3 reconciled the findings of Experiment 2 by showing that the survival processing advantage returned when background speech was restricted to encoding, highlighting that retrieval is most probably the critical phase.

Experiment 1

Experiment 1 was conducted at the Catholic University of Eichstätt-Ingolstadt.

Participants were exposed to either irrelevant speech in a familiar language (German), in an unfamiliar language (Japanese), or to silence during the rating task (encoding) and the subsequent surprise memory test (recall).

Method

Participants

A total of 72 students (56 women) from the Catholic University of Eichstätt-Ingolstadt between 18 and 36 years ($M = 21$ years) participated in Experiment 1 in return for course credit or a small honorarium. All participants reported normal hearing and were native German speakers. They were randomly assigned to one of the three experimental groups ($n = 24$ per group).

Materials

The experiment was conducted on a MacBookPro using Psyscope X software, Version B57 (Cohen et al., 1993), except for the surprise memory test, which was administered using paper and pencil.

Altogether, 32 words were taken from Nairne and Pandeirada (2010) for the rating task, with four words being replaced due to semantic ambiguity and fit (see Appendix). The to-be-rated words were arranged into two lists of 16 words each that were counterbalanced across conditions. Participants rated the words of one list according to their fitness relevance in a zombie-city scenario taken from Soderstrom and McCabe (2011) and the words of the other list according to their pleasantness. Although rating words for their pleasantness is also associated with a mnemonic benefit, it is a typical condition that has been used in many classic studies on the survival processing effect (e.g. Nairne et al., 2007; Nairne & Pandeirada, 2010; Otgaar et al., 2010; Soderstrom & McCabe, 2011). The rating instructions were translations of those used by Soderstrom and McCabe (2011).

Survival processing

In this task, we would like you to imagine that you are stranded in New York City without any money due to special/certain circumstances. Over the next few weeks, you'll need to secure your survival and protect yourself from zombies. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be for you in this survival situation. Some of the words may be relevant and others may not – it's up to you to decide. Please rate each of these words on a scale from 1 to 5 how relevant or irrelevant you subjectively judge this word. Here, 1 represents "irrelevant" and 5 "relevant".

Pleasantness

In the following task, words are presented one after the other for 5s each. Please rate each of these words on a scale from 1 to 5 regarding how pleasant or unpleasant you subjectively judge this word.

Here, 1 represents "unpleasant" and 5 "pleasant".

There were three sound conditions: (1) familiar speech (German), (2) unfamiliar speech (Japanese), and (3) silence. In the familiar speech condition, isolated German sentences spoken by a male voice were presented. The background sentences were grammatically correct and semantically coherent. However, they did not contain any of the to-be-rated words, and care was taken to avoid any direct semantic association between the sentences and the rating task. In the unfamiliar speech condition, Japanese sentences spoken by a male voice were presented.

None of the participants were familiar with the Japanese language. The inclusion of both familiar and unfamiliar speech reflects a laboratory-specific practice and was not theoretically motivated within the context of the present research question.

Irrelevant speech sequences were presented diotically with Leq = 55 dB(A) via Sennheiser HD600 headphones. Sound pressure level was measured by a Brüel & Kjær 2231 sound level metre and a Brüel & Kjær 4153 artificial ear.

Procedure

Participants were only informed about the rating task. No mention was made of a subsequent memory test. The two experimental groups with background speech were informed at the beginning that they would hear background speech that they should try to ignore. Background speech was played continuously throughout the experiment. The order of the two rating conditions (survival processing, pleasantness) was counterbalanced across participants, as was the assignment of the two lists to the rating conditions. The order of word presentation within each list was randomised for each participant. Each word was presented centrally on the screen for 5 s, with a five-point rating scale displayed directly below. A response did not terminate word presentation. After 5 s the word disappeared, and if no rating had been given, a brief prompt to provide the rating remained on screen until a response was given. Each rating condition was preceded by two practice trials using words not included in the main experiment.

Following the rating task, participants completed six trials of a serial recall task, in which the digits 1–9 were presented visually one at a time on the screen, followed by a 10-second retention interval. Participants recalled the digits by clicking on the number block of the computer keyboard.

Afterwards, participants completed a surprise memory test. They were asked to write down, in any order, all the words that had been presented during the rating task. A blank response sheet and a pen were provided only after the intermediate task, thus avoiding any cue that a memory test would follow. Participants were given 10 min for recall.

Design

We used a 2 × 3 design with rating scenario (survival processing, pleasantness) as the within-subject variable and sound condition as the between-subjects variable (quiet, familiar speech, unfamiliar speech). Given the total sample size of $N = 72$ and an alpha level of .05, a sensitivity analysis showed that the design was sufficiently powered ($1 - \beta = .95$) to detect possible interaction effects of size $f = .24$ or larger.

The key dependent variable was the number of correctly recalled words in the surprise memory test.

Data availability

All data are publicly available and can be accessed via the OSF project page at https://osf.io/bsx9a.

Ethics and consent

All research was conducted in accordance with the Declaration of Helsinki. In compliance with the conventions at Catholic University of Eichstätt-Ingolstadt, the research project was not reviewed by an ethics committee, because we did not expect any risks or harm to the participants. Written informed consent was obtained from all participants prior to participation. All research was conducted in accordance with the Declaration of Helsinki. In compliance with the conventions at Heinrich Heine University Düsseldorf, the research project was not reviewed by an ethics committee, because we did not expect any risks or harm to the participants. Written informed consent was obtained from all participants prior to participation.

Results

The left panel of Figure 1 shows the mean proportion of correctly recalled words as a function of sound condition and rating condition in Experiment 1. A 2 × 3 ANOVA revealed a significant main effect of rating scenario, $F(1, 69) = 17.67$, $p < .001$, $\eta p^2 = 0.20$, indicating the typical survival processing memory advantage. There was no main effect of sound condition, $F(2, 69) = 1.80$, $p = .17$, $\eta p^2 = 0.05$, but a significant interaction between rating scenario and sound condition, $F(2, 69) = 8.30$, $p = .001$, $\eta p^2 = 0.19$, indicating a modulation of the survival processing effect by background speech. Paired samples *t*-tests were conducted for each sound condition. A significant mnemonic benefit emerged only in the quiet condition, $t(23) = 5.56$, $p < .001$, two-tailed, $\eta p^2 = .57$, indicating that participants in this group recalled significantly more words rated in the survival processing condition than in the pleasantness condition. No such benefit was observed in the familiar speech group, $t(23) < 1$, two-tailed, or in the unfamiliar speech group, $t(23) = 1.66$, $p = .11$, two-tailed, $\eta p^2 = .11$.

To further clarify the nature of the significant interaction, we tested whether it reflected impaired recall of survival-rated words or altered recall of pleasantness-rated words across the different sound conditions. We therefore compared recall performance across sound conditions within each rating scenario (pleasantness, survival processing) using independent-samples t-tests (two-tailed). For pleasantness-rated words, recall was significantly higher under both familiar speech, $t(46) = 2.28$, $p = .027$, $\eta p^2 = .10$, and unfamiliar speech, $t(46) = 3.52$, $p < .001$, $\eta p^2 = .21$, compared to silence. For words rated in the survival processing condition, however, recall in silence differed neither from familiar speech, $t(46) = 1.97$, $p = .055$, $\eta p^2 = .08$, nor from unfamiliar speech, $t(46) < 0.1$, $\eta p^2 < .01$.

Discussion

Experiment 1 provides first evidence that there is no longer a survival processing effect when familiar and unfamiliar speech is played. This absence of the effect was not due to impaired recall of survival-rated words but rather to a selective increase in recall for pleasantness-rated words under irrelevant speech compared to silence, while recall of survival-rated words remained unaltered by sound conditions. Task-irrelevant speech thus eliminated the mnemonic benefit typically associated with the survival-processing effect without producing the performance decrement usually observed in intentional memory tasks during background speech. In.

Experiment 1, background speech was presented during all three phases of the experiment: (1) during the encoding of information (rating task), (2) during the intermediate task, and (3) during the retrieval of information (surprise memory test). Although the

intermediate task does not constitute a maintenance or retention phase in the sense used in intentional short-term memory paradigms, the continuous presence of background speech leaves open the question at which stage the effect occurred.

Experiment 2 was conducted independently and in parallel at Heinrich Heine University Düsseldorf with the same underlying research question, but a few methodological differences, the most important of which, as it would turn out, being the timing of the background speech presentation.

Experiment 2

Experiment 2 was conducted at Heinrich Heine University Düsseldorf using the original grasslands survival scenario from Nairne et al. (2007). Participants rated the words in silence or while irrelevant speech in a familiar language was presented.

Background speech was only presented during the rating task, and not during the surprise memory test.

Method

Participants

A total of 76 students (48 women) at Heinrich Heine University of Düsseldorf received a small monetary compensation or course credit for participating in Experiment 2. Participants were between 18 and 39 years old (M = 25) and reported normal hearing.

Materials and procedure

Materials and procedure were more or less the same as in Experiment 1, except that the grasslands survival scenario from Nairne et al. (2007) and to-be-rated words from the Mannhaupt (1983) norms were used. Throughout the experiment, participants wore high-insulation hearing protection headphones that were plugged directly into an Apple iMac computer. Standard written instructions informed participants to ignore any sound they might hear. In line with established methodological practice in this laboratory, familiar speech was contrasted with silence. Auditory distractors were spoken texts in a language all participants were familiar with (German) that had reliably disrupted short-term memory in previous studies (Bell et al., 2012; Röer et al., 2014). The texts were spoken by a male voice and were presented binaurally at approximately 63 dB(A). There was no overlap between the to-be-rated words and words that were played as auditory distractors.

Participants rated 16 words each according to their fitness relevance in a survival situation and to their pleasantness. For each participant, the to-be-rated words were randomly assigned to the rating scenario (survival processing, pleasantness). In half of the trials, irrelevant speech was played during the rating task. The order of the two rating scenarios (survival processing, pleasantness) was blocked, and counterbalanced across participants. Quiet and irrelevant speech trials were presented in random order within blocks. After the rating task, participants completed an intermediate task, in which they validated the correctness of mathematical equations (taken from Röer et al., 2013). This task lasted for approximately 3 min, after which the recall instructions appeared on the screen, prompting the participants to write down all previously presented words. As in Experiment 1, ten minutes were provided for recall, during which no sound was played.

Design

A 2×2 design with sound condition (quiet, irrelevant speech) and rating scenario (survival processing, pleasantness) as within-subject variables was used. Of primary interest was a possible interaction of the sound condition and the survival processing effect. Given the total sample size of $N = 76$ and an alpha level of .05, a sensitivity analysis showed that the design was sufficiently powered ($1 - \beta = .95$) to detect an effect of size $f = .21$ or larger. The key dependent variable was the number of correctly recalled words in the surprise memory test.

Data availability

All data are publicly available and can be accessed via the OSF project page at https://osf.io/bsx9a.

Ethics and consent

All research was conducted in accordance with the Declaration of Helsinki. In compliance with the conventions at Heinrich Heine University Düsseldorf the research project was not reviewed by an ethics committee, because we did not expect any risks or harm to the participants. Written informed consent was obtained from all participants prior to participation.

Results

A 2×2-ANOVA revealed the typical survival processing effect, which can be seen on Figure 2. Words that were rated according to their fitness relevance were

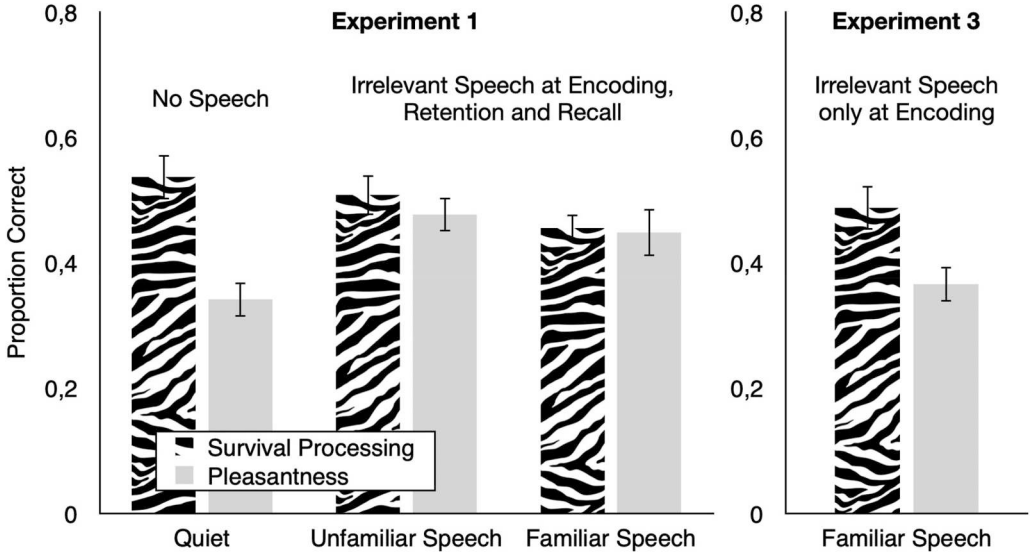


Figure 1. Mean proportion of correctly recalled words as a function of rating condition (survival processing, pleasantness) and sound condition. The left panel shows all sound conditions from Experiment 1, in which irrelevant speech was presented during the rating task (encoding), the intermediate task (retention) and the surprise memory test (recall). The right panel shows results from Experiment 3, in which irrelevant speech was restricted to the rating task (encoding). Error bars represent standard errors of the means.

remembered significantly better than words that were rated according to their pleasantness, $F(1,75) = 79.68$, $p < .001$, $\eta p^2 = .52$. There was a main effect of sound condition on the number of words recalled, $F(1,75) = 4.05$, $p = .048$, $\eta p^2 = .05$, with performance being worse in the irrelevant speech condition than in the quiet condition. However, there was no interaction between rating scenario and sound condition, $F(1,75) < 0.01$, $p = .966$, $\eta p^2 < .01$. Post-hoc analyses confirmed a survival processing memory advantage both in the quiet condition, $t(75) = 6.90$, $p < .001$, $\eta p^2 = .39$, and in the familiar speech condition, $t(75) = 7.67$, $p < .001$, $\eta p^2 = .44$.

Discussion

The results of Experiment 2 show that rating words according to their relevance in a fictional survival scenario enhances memory even when task-irrelevant to-be-ignored speech is presented during the rating task. Unlike in Experiment 1, in which no mnemonic benefit was observed, background speech was not present during the surprise memory test, which seems to suggest that auditory distraction during encoding alone is insufficient to eliminate the survival processing effect. However, since there was no prior coordination, there were other methodological differences. First and foremost, the scenario (zombie-city scenario in Experiment 1, original grasslands survival scenario in Experiment 2) and the irrelevant speech sequence should be mentioned here, if we disregard location-specific reasons for the time being.

While we do not expect any of these differences to be responsible for the discrepancy in the results, we cannot rule it out either, which is why all conclusions must remain tentative. This was the main motivation for Experiment 3, which is a conceptual replication of the familiar speech group of Experiment 1 with one important difference: In Experiment 3, background speech was restricted to the rating phase only, as it was the case in Experiment 2.

Experiment 3

Experiment 3 was conducted at the Catholic University of Eichstätt-Ingolstadt under the same conditions and with the same materials as in Experiment 1, except that only familiar speech was used. This adjustment reflected the fact that familiar speech was the distractor type employed in both Experiments 1 and 2 and ensured that the follow-up study focused specifically on the phase during which the irrelevant speech was presented.

Method

Participants

A total of 20 students (18 women) from the Catholic University of Eichstätt-Ingolstadt between 17 and 36 years ($M = 20$ years) participated in Experiment 3 in return for course credit or a small honorarium. All participants reported normal hearing and were native German speakers.

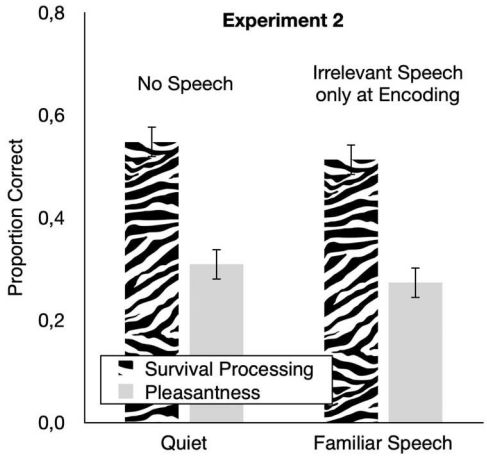


Figure 2. Mean proportion of words recalled as a function of auditory distractor condition (quiet, irrelevant speech) and rating scenario (survival processing, pleasantness) in Experiment 2. The error bars depict the standard error of the mean.

Materials

The materials were identical to those used in Experiment 1 with the exception that there was only one sound condition (i.e. familiar speech).

Procedure

The procedure followed that of Experiment 1. However, background speech was presented only during the rating task and was discontinued immediately afterwards. Thus, both the intermediate task and, most importantly, the surprise memory test were conducted in silence.

Design

The experiment employed a one-factorial design with the within-subject factor rating condition (survival processing, pleasantness). Given the total sample size of $N = 20$ and an alpha level of .05, a sensitivity analysis showed that the design was sufficiently powered ($1 - \beta = .95$) to detect an effect of size $f = .42$ or larger. The key dependent variable was the number of correctly recalled words in the surprise memory test.

Data availability

All data are publicly available and can be accessed via the OSF project page at https://osf.io/bsx9a.

Ethics and consent

All research was conducted in accordance with the Declaration of Helsinki. In compliance with the conventions at Catholic University of Eichstätt-Ingolstadt, the research project was not reviewed by an ethics committee, because we did not expect any risks or harm to the participants. Written informed consent was obtained from all participants prior to participation.

Results

Successfully replicating the results from Experiment 2, there was a significant survival processing effect. Words that were rated according to their fitness relevance were remembered significantly better than words that were rated according to their pleasantness, $t(19) = 3.20$, $p = .01$, two-tailed, $\eta p^2 = .35$. The right panel of Figure 1 shows the mean proportion of correctly recalled words as a function of rating condition in Experiment 3. Compared with the familiar speech condition from Experiment 1 on the left panel, it can be seen that the presence or absence of irrelevant speech during the intermediate task and the surprise memory test seems to have been the decisive factor, because this was the only difference between these two conditions.

General discussion

Usually, when we remember something from our everyday life – such as the newspaper's headline from this morning or yesterday's dinner – this information has been encoded and stored without the explicit intention to recall it later. In three experiments, we explored whether background speech affects incidental memory. To this end, we used the survival processing paradigm for assessing memory under non-intentional encoding conditions. In this paradigm, participants rate the words in a survival scenario regarding fitness relevance and in a control condition according to their pleasantness, unaware that their memory for these words will later be tested.

This surprise memory test typically reveals a robust survival processing advantage in that words that were previously rated according to their fitness relevance are better remembered than those rated for their pleasantness (e.g. Nairne et al., 2007; Scofield et al., 2018; Soderstrom & McCabe, 2011; Weinstein et al., 2008).

In Experiment 1, the typical survival processing memory advantage was found only in the quiet group and was absent when background speech was played continuously throughout the experiment during encoding, the intermediate task, and retrieval. This absence was not caused by impaired recall of survival-rated words, which remained stable across sound conditions, but arose because pleasantness-rated words were recalled better under both familiar and unfamiliar speech than in silence. In contrast, Experiment 2 –

which was conducted independently in a different laboratory without prior coordination – showed a robust survival processing effect both in the silent and the familiar speech condition. Since a critical methodological difference between Experiment 1 and 2 was that in the latter, background speech was only played during encoding, we ran Experiment 3, which was identical to the familiar speech condition of Experiment 1 with the exception that background speech was now played only during the rating task (encoding), and not during the intermediate task (retention), and the surprise memory test (recall). As a result, the survival processing advantage reappeared, once again pointing to retrieval as the vulnerable stage at which incidental memory is susceptible to the effect of irrelevant speech.

Importantly, this overall pattern of results was consistent across laboratories despite differences in the survival processing scenario, word lists, and speech sequences. In both labs, the survival processing advantage was replicated in a quiet control condition (Experiment 1 and 2), as well as in a condition where irrelevant speech was present only during the encoding phase (Experiment 2 and 3). The survival processing memory advantage only disappeared when irrelevant speech was played during retention and retrieval, after the items had already been encoded (Experiment 1). The overall pattern of results suggests that irrelevant speech can interfere with incidental memory by eliminating the mnemonic benefit of survival processing, but only when it is presented after encoding, including during an intermediate phase and retrieval. Importantly, although an intermediate phase separated encoding and recall, this interval does not constitute a retention phase as it is typical in intentional memory tasks. Participants had no reason to maintain the previously rated words, because they were unaware that a memory test would follow. At this point, we cannot say whether speech effects consolidation-like processes in the intermediate phase or whether retrieval mechanisms were responsible. This remains unsolved because we did not include a condition in which background speech was presented only during the intermediate phase, and neither during the rating task nor the surprise memory test, which is a limitation of the present study.

Future research should address this open question to determine whether incidental memory is also vulnerable to disruption when irrelevant speech exposure occurs during maintenance/consolidation, or whether retrieval-specific mechanisms are responsible for the elimination of the survival processing effect.

Another potentially interesting idea for a follow-up study would be an active listening condition, in which participants would have to engage with the background speech in the form of a secondary task. Kroneisen et al. (2014) demonstrated, for example, that the survival processing memory advantage is mediated by working memory load. Participants either performed the rating with or without a secondary task, which required them to press a button when one of two different tones was presented three times in a row. When participants engaged in the secondary task there was no longer a recall advantage for words that were rated according to their fitness relevance. The authors concluded that the survival processing effect relies on cognitively demanding processes during encoding (see also Kroneisen & Erdfelder, 2011) and disappears when the availability of these resources is restricted (see also Kroneisen et al., 2016). It would be interesting to see whether an active listening condition would fall into the former or latter category.

The survival processing memory advantage refers to the phenomenon that words that are rated according to their fitness relevance are better remembered *relative* to other encoding manipulations. This advantage was eliminated when irrelevant speech was played during the intermediate task and the surprise memory test. An interesting aspect of our results is that, whereas intentional tasks typically show reduced recall under irrelevant speech, our incidental memory paradigm revealed improved recall for pleasantness-rated words during background speech compared to silence, while recall for survival-rated words remained stable. For now, we can only speculate as to the reason for this. Note, however, that both the survival processing condition and the pleasantness condition are associated with a memory benefit. Under irrelevant speech, the relative benefit of survival over pleasantness typically observed disappears, which could be taken to suggest that the irrelevant speech effect on incidental memory may rely on different mechanisms than that on intentional memory. Then again, the irrelevant speech effect on intentional memory is not uniform either. Perham et al. (2007), for example, were able to demonstrate that category-based retrieval in the context of an applied memory task was more or less unaffected by irrelevant office noise, while free and serial recall were (see also Salamé & Baddeley, 1990; LeCompte, 1994). Further work is needed to clarify these mechanisms and to examine how incidental memory operates in more ecologically valid learning contexts.

The results presented here seem to indicate that the irrelevant speech effect on intentional memory cannot simply be generalised to incidental memory tasks.

Although background speech can affect both types of memory, this influence appears to occur at different

stages of information processing. When it comes to intentional memory, the largest disruptive effect can be found when the distractor sequence is played during the presentation of the item list – especially at the end of the presentation (for a detailed overview, see Macken et al., 1999) – or during the retention interval between presentation and recall (e.g. Campbell et al., 2002; Jones & Macken, 1993; Schlittmeier et al., 2008a, 2008b). During the beginning of item presentation and during recall, the irrelevant speech effect is typically less pronounced or absent (Miles et al., 1991). This pattern of results is commonly thought to mean that irrelevant speech primarily interferes with consolidation and rehearsal processes or, more broadly, with the maintenance of information in working memory. Given the absence of active maintenance in an incidental memory task, it is perhaps not too surprising that background speech during the rating task (encoding) did not influence the survival processing effect.

While we also cannot exclude the possibility that irrelevant speech affected passive maintenance to some degree, it appears to be a rational assumption that irrelevant speech interferes with what most participants would probably describe as the most demanding aspect of the experiment – to recall the previously rated items in the surprise memory test. However, the association between the difficulty of the primary task and the amount of interference caused by background speech in previous studies is not as unambiguous as one might initially assume (e.g. Hughes, 2014; Hughes et al., 2013; Mandal, Liesefeld, et al., 2024; Mandal, Röer, et al., 2024; Sörqvist & Marsh, 2015), and it would be premature to draw definitive conclusions about the effect of irrelevant speech on incidental memory processes on the basis of three experiments.

In summary, the present study provides first evidence that irrelevant speech eliminates the survival processing effect – one of the classic and most robust incidental memory phenomena. In contrast to what is typically observed when people are asked to consciously memorise information for later recall, this effect is time-sensitive, in that it occurs only when background speech is played after the encoding stage during the retention of information and the retrieval from memory. This is relevant both from a theoretical and applied perspective, because it demonstrates that task-irrelevant, to-be-ignored speech does not only affect learning as it is typically studied in the psychological laboratory using intentional memory tasks – in this type of task, participants are explicitly instructed to try their best to remember something for subsequent recall – but also learning under more ecologically valid conditions with incidental memory tasks, in which no explicit intention to memorise is present.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Jan Philipp Röer http://orcid.org/0000-0001-7774-3433

References

Banbury, S., & Berry, D. C. (1997). Habituation and dishabituation to speech and office noise. *The Quarterly Journal of Experimental Psychology*, *3*, 181–195. https://doi.org/10.1037/1076-898X.3.3.181

Beaman, C. P., & Jones, D. M. (1997). Role of serial order in the irrelevant speech effect: Tests of the changing-state hypothesis. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *23*(2), 459–471. https://doi.org/10.1037/0278-7393.23.2.459

Beaman, C. P., & Jones, D. M. (1998). Irrelevant sound disrupts order information in free recall as in serial recall. *The Quarterly Journal of Experimental Psychology Section A*, *51*(3), 615–636. https://doi.org/10.1080/713755774

Bell, R., Mieth, L., Röer, J. P., & Buchner, A. (2019). Effects of auditory distraction on face memory. *Scientific Reports*, *9*(1), 10185. https://doi.org/10.1038/s41598-019-46641-7

Bell, R., Röer, J. P., & Buchner, A. (2013). Irrelevant speech disrupts item-context binding. *Experimental Psychology*, *60*(5), 376–384. https://doi.org/10.1027/1618-3169/a000212

Bell, R., Röer, J. P., & Buchner, A. (2015). Adaptive memory: Thinking about function. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *41*(4), 1038–1048. https://doi.org/10.1037/xlm0000066

Bell, R., Röer, J. P., Dentale, S., & Buchner, A. (2012). Habituation of the irrelevant sound effect: Evidence for an attentional theory of short-term memory disruption.. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *38*(6), 1542–1557. https://doi.org/10.1037/a0028459

Campbell, T., Beaman, C. P., & Berry, D. C. (2002). Auditory memory and the irrelevant sound effect: Further evidence for changing-state disruption. *Memory (Hove, England)*, *10*(3), 199–214. https://doi.org/10.1080/09658210143000335

Cohen, J. D., MacWhinney, B., Flatt, M., & Provost, J. (1993). Psyscope: An interactive graphic system for designing and controlling experiments in the psychology laboratory using Macintosh computers. *Behavior Research Methods, Instruments, & Computers*, *25*(2), 257–271. https://doi.org/10.3758/BF03204507

Colle, H. A., & Welsh, A. (1976). Acoustic masking in primary memory. *Journal of Verbal Learning and Verbal Behavior*, *15*(1), 17–31. https://doi.org/10.1016/S0022-5371(76)90003-7

Ellermeier, W., & Zimmer, K. (1997). Individual differences in susceptibility to the "irrelevant speech effect". *The Journal of the Acoustical Society of America*, *102*(4), 2191–2199. https://doi.org/10.1121/1.419596

Elliott, E. M. (2002). The irrelevant-speech effect and children: Theoretical implications of developmental change. *Memory*

& Cognition, *30*(3), 478–487. https://doi.org/10.3758/BF03194948

Hughes, R. W. (2014). Auditory distraction: A duplex-mechanism account. *PsyCh Journal*, *3*(1), 30–41. https://doi.org/10.1002/pchj.44

Hughes, R. W., Hurlstone, M. J., Marsh, J. E., Vachon, F., & Jones, D. M. (2013). Cognitive control of auditory distraction: Impact of task difficulty, foreknowledge, and working memory capacity supports duplex-mechanism account. *Journal of Experimental Psychology: Human Perception and Performance*, *39*, 539–553. https://doi.org/10.1037/a0029064

Hughes, R. W., Vachon, F., & Jones, D. M. (2005). Auditory attentional capture during serial recall: Violations at encoding of an algorithm-based neural model? *Journal of Experimental Psychology: Learning Memory and Cognition*, *31*, 736–749.

Hughes, R. W., Vachon, F., & Jones, D. M. (2007). Disruption of short-term memory by changing and deviant sounds: Support for a duplex-mechanism account of auditory distraction.. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *33*(6), 1050–1061. https://doi.org/10.1037/0278-7393.33.6.1050

Jones, D. M., & Macken, W. J. (1993). Irrelevant tones produce an irrelevant speech effect: Implications for phonological coding in working memory.. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *19*(2), 369–381. https://doi.org/10.1037/0278-7393.19.2.369

Jones, D. M., & Macken, W. J. (1995). Organizational factors in the effect of irrelevant speech: The role of spatial location and timing. *Memory & Cognition*, *23*, 192–200. https://doi.org/10.3758/BF03197221

Jones, D. M., & Morris, N. (1992). Irrelevant speech and serial recall: Implications for theories of attention and working memory. *Scandinavian Journal of Psychology*, *33*, 212–229.

Kang, S. H., McDermott, K. B., & Cohen, S. M. (2008). The mnemonic advantage of processing fitness-relevant information. *Memory & Cognition*, *36*(6), 1151–1156. https://doi.org/10.3758/MC.36.6.1151

Kattner, F., & Ellermeier, W. (2018). Emotional prosody of task-irrelevant speech interferes with the retention of serial order. *Journal of Experimental Psychology: Human Perception and Performance*, *44*(8), 1303–1312. https://doi.org/10.1037/xhp0000537

Kattner, F., Föcker, J., Moshona, C. C., & Marsh, J. E. (2024). When softer sounds are more distracting: Task-irrelevant whispered speech causes disruption of serial recall. *The Journal of the Acoustical Society of America*, *156*(5), 3632–3648. https://doi.org/10.1121/10.0034454

Körner, U., Röer, J. P., Buchner, A., & Bell, R. (2019). Time of presentation affects auditory distraction: Changing-state and deviant sounds disrupt similar working memory processes. *Quarterly Journal of Experimental Psychology*, *72*(3), 457–471. https://doi.org/10.1177/1747021818758239

Kroneisen, M., & Erdfelder, E. (2011). On the plasticity of the survival processing effect. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *37*(6), 1553–1562. https://doi.org/10.1037/a0024493

Kroneisen, M., Rummel, J., & Erdfelder, E. (2014). Working memory load eliminates the survival processing effect. *Memory (Hove, England)*, *22*(1), 92–102. https://doi.org/10.1080/09658211.2013.815217

Kroneisen, M., Rummel, J., & Erdfelder, E. (2016). What kind of processing is survival processing?. *Memory & Cognition*, *44*(8), 1228–1243. https://doi.org/10.3758/s13421-016-0634-7

LeCompte, D. C. (1994). Extending the irrelevant speech effect beyond serial recall.. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *20*(6), 1396–1408. https://doi.org/10.1037//0278-7393.20.6.1396

Macken, W. J., Mosdell, N., & Jones, D. M. (1999). Explaining the irrelevant-sound effect: Temporal distinctiveness or changing state? *Journal of Experimental Psychology: Learning, Memory and Cognition*, *25*, 810–814.

Mandal, A., Liesefeld, A. M., & Liesefeld, H. R. (2024). The surprising robustness of visual search against concurrent auditory distraction. *Journal of Experimental Psychology: Human Perception and Performance*, *50*(1), 99–118. https://doi.org/10.1037/xhp0001168

Mandal, A., Röer, J. P., & Liesefeld, H. R. (2024). Auditory distractors are processed but do not interfere with visual search of any difficulty when sound is irrelevant. *Visual Cognition*, 1067–1083. https://doi.org/10.1080/13506285.2024.2397825

Mannhaupt, H.-R. (1983). Produktionsnormen für verbale Reaktionen zu 40 geläufigen Kategorien. *Sprache und Kognition*, *4*, 264–278.

Marsh, J. E., Hughes, R. W., & Jones, D. M. (2008). Auditory distraction in semantic memory: A process-based approach. *Journal of Memory and Language*, *58*(3), 682–700. https://doi.org/10.1016/j.jml.2007.05.002

Marsh, J. E., Hughes, R. W., & Jones, D. M. (2009). Interference by process, not content, determines semantic auditory distraction. *Cognition*, *110*(1), 23–38. https://doi.org/10.1016/j.cognition.2008.08.003

Marsh, J. E., Hurlstone, M. J., Marois, A., Ball, L. J., Moore, S. B., Vachon, F., Schlittmeier, S. J., Röer, J. P., Buchner, A., Aust, F., & Bell, R. (2024). Changing-state irrelevant speech disrupts visual–verbal but not visual–spatial serial recall.. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *50*(11), 1772–1790. https://doi.org/10.1037/xlm0001360

Martin, R. C., Wogalter, M. S., & Forlano, J. G. (1988). Reading comprehension in the presence of unattended speech and music. *Journal of Memory and Language*, *27*(4), 382–398. https://doi.org/10.1016/0749-596X(88)90063-0

Miles, C., Jones, D. M., & Madden, C. A. (1991). Locus of the irrelevant speech effect in short-term memory.. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *17*(3), 578–584. https://doi.org/10.1037/0278-7393.17.3.578

Nairne, J. S., & Pandeirada, J. N. S. (2010). Adaptive memory: Ancestral priorities and the mnemonic value of survival-processing. *Cognitive Psychology*, *61*, 1–22.

Nairne, J. S., Thompson, S. R., & Pandeirada, J. N. S. (2007). Adaptive memory: Survival processing enhances retention.. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *33*(2), 263–273. https://doi.org/10.1037/0278-7393.33.2.263

Otgaar, H., Smeets, T., & van Bergen, S. (2010). Picturing survival memories: Enhanced memory after fitness-relevant processing occurs for verbal and visual stimuli. *Memory & Cognition*, *38*(1), 23–28. https://doi.org/10.3758/MC.38.1.23

Perham, N., Banbury, S. P., & Jones, D. M. (2007). Reduction in auditory distraction by retrieval strategy. *Memory (Hove, England)*, *15*(4), 465–473. https://doi.org/10.1080/09658210701288244

Röer, J. P., Bell, R., & Buchner, A. (2013). Is the survival processing advantage due to richness of encoding? Journal of experimental psychology: Learning. *Memory, and Cognition*, *39*, 1294–1302.

Röer, J. P., Bell, R., & Buchner, A. (2014). What determines auditory distraction? On the roles of local auditory changes and expectation violations. *PLoS One*, *9*(1), e84166. https://doi.org/10.1371/journal.pone.0084166

Röer, J. P., Bell, R., Buchner, A., Saint-Aubin, J., Sonier, R. P., Marsh, J. E., Moore, S. B., Kershaw, M. B. A., Ljung, R., & Arnström, S. (2022). A multilingual preregistered replication of the semantic mismatch effect on serial recall. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *48*(7), 966–974. https://doi.org/10.1037/xlm0001066

Röer, J. P., Körner, U., Buchner, A., & Bell, R. (2017). Semantic priming by irrelevant speech. *Psychonomic Bulletin & Review*, *24*, 1205–1210. https://doi.org/10.3758/s13423-016-1186-3

Salamé, P., & Baddeley, A. (1990). The effects of irrelevant speech on immediate free recall. *Bulletin of the Psychonomic Society*, *28*(6), 540–542. https://doi.org/10.3758/BF03334073

Salamé, P., & Baddeley, A. D. (1982). Disruption of short-term memory by unattended speech: Implications for the structure of working memory. *Journal of Verbal Learning and Verbal Behavior*, *21*, 150–164.

Samper, J. R., Morrison, A., & Chein, J. (2021). Doubts about the role of rehearsal in the irrelevant sound effect. *Experimental Psychology*, *68*(5), 229–242. https://doi.org/10.1027/1618-3169/a000527

Schlittmeier, S. J., Hellbrück, J., & Klatte, M. (2008a). Does irrelevant music cause an irrelevant sound effect for auditory items? *European Journal of Cognitive Psychology*, *20*(2), 252–271. https://doi.org/10.1080/09541440701427838

Schlittmeier, S. J., Hellbrück, J., & Klatte, M. (2008b). Can the irrelevant speech effect turn into a stimulus suffix effect? *The Quarterly Journal of Experimental Psychology*, *61*, 665–673. https://doi.org/10.1080/17470210701774168

Schlittmeier, S. J., Weißgerber, T., Kerber, S., Fastl, H., & Hellbrück, J. (2012). Algorithmic modeling of the irrelevant sound effect (ISE) by the hearing sensation fluctuation strength. *Attention, Perception, & Psychophysics*, *74*(1), 194–203. https://doi.org/10.3758/s13414-011-0230-7

Schlittmeier, S. J., Weisz, N., & Bertrand, O. (2011). What characterizes changing-state speech in affecting short-term memory? An EEG study on the irrelevant sound effect. *Psychophysiology*, *48*, 1669–1680. https://doi.org/10.1111/j.1469-8986.2011.01263.x

Scofield, J. E., Buchanan, E. M., & Kostic, B. (2018). A meta-analysis of the survival-processing advantage in memory. *Psychonomic Bulletin & Review*, *25*, 997–1012. https://doi.org/10.3758/s13423-017-1346-0

Soderstrom, N. C., & McCabe, D. P. (2011). Are survival processing memory advantages based on ancestral priorities? *Psychonomic Bulletin & Review*, *18*(3), 564–569. https://doi.org/10.3758/s13423-011-0060-6

Sörqvist, P., & Marsh, J. E. (2015). How concentration shields against distraction. *Current Directions in Psychological Science*, *24*(4), 267–272. https://doi.org/10.1177/0963721415577356

Vachon, F., Marsh, J. E., & Labonté, K. (2020). The automaticity of semantic processing revisited: Auditory distraction by a categorical deviation. *Journal of Experimental Psychology: General*, *149*(7), 1360–1397. https://doi.org/10.1037/xge0000714

Weinstein, Y., Bugg, J. M., & Roediger, H. L. I. I. I. (2008). Can the survival recall advantage be explained by basic memory processes? *Memory & Cognition*, *36*(5), 913–919. https://doi.org/10.3758/MC.36.5.913

Wöstenfeld, F. O., Ahmad, S., Kroneisen, M., & Rummel, J. (2020). Does the survival processing memory advantage translate to serial recall?. *Collabra: Psychology*, *6*(1), 8. https://doi.org/10.1525/collabra.243

Wöstmann, M., & Obleser, J. (2016). Acoustic detail but not predictability of task-irrelevant speech disrupts working memory. *Frontiers in Human Neuroscience*, *10*, Article 538. https://doi.org/10.3389/fnhum.2016.00538

Appendix

Table A1. List of the words that were used in Experiments 1–3.

1	Experiments 1 and 3	Experiment 22
2	Ameise (Ant)	Bett (Bed)
3	Apfel (Apple)	Einbrecher (Burglar)
4	Arm (Arm)	Elektriker (Electrician)
5	Blut (Blood)	Gießkanne (Watering can)
6	Brett (Plank)	Glühbirne (Lightbulb)
7	Erschöpfung (Fatigue)	Kaugummi (Chewing Gum)
8	Fluss (River)	Lasagne (Lasagne)
9	Gebäude (Building)	Lineal (Ruler)
10	Geruch (Odour)	Lunge (Lung)
11	Idee (Idea)	Mais (Corn)
12	Junge (Boy)	Mikroskop (Microscope)
13	Karotte (Carrot)	Mühle (Mill)
14	Licht (Light)	Nagel (Nail)
15	Moos (Moss)	Papaya (Papaya)
16	Park (Park)	Ratte (Rat)
17	Reflex (Reflex)	Rosmarin (Rosemary)
18	Regen (Rain)	Rotkehlchen (Robin)
19	Rose (Rose)	Sahne (Cream)
20	Sauerstoff (Oxygen)	Schlittschuhe (Ice skates)
21	Schatten (Shadow)	Shampoo (Shampoo)
22	Schnur (String)	Skulptur (Sculpture)
23	Smaragd (Emerald)	Tasse (Cup)
24	Sonnenbrand (Sunburn)	Teich (Pond)
25	Stadtplan (City map)	Tonne (Barrel)
26	Staub (Dust)	Tür (Door)
27	Stechmücke (Mosquito)	Video (Video)
28	Straße (Street)	Waage (Weighing scale)
29	Strommast (Power pole)	Zahnarzt (Dentist)
30	Taube (Pigeon)	Zement (Cement)
31	Totenkopf (Skull)	Zimt (Cinnamon)
32	U-Bahn (Metro)	Zwirn (Yarn)
33	Waffe (Weapon)	Zylinder (Top hat)