Swiss Journal of Psychology *54* (4), 289–302 (1995)

Investigations into the Organization of Scripts

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We examined three hypotheses concerned with typical and atypical script actions by means of an association technique called the phrase completion task. The first hypothesis states that script-typical actions are sequentially organized. This hypothesis could not be confirmed unequivocally. The second hypothesis states that typical script actions are part of superordinate scenes or categories. The results distinctively support this hypothesis. The third hypothesis states that atypical script-relevant events are part of the generic knowledge structure. The data confirm this hypothesis, too. Finally, possible disadvantages of the phrase completion task are discussed.

Schemata are knowledge structures the influence of which on episodic memory performance has been examined variously (e. g., Alba & Hasher, 1983). According to Schank & Abelson (1977), the simplest of these knowledge structures is the script which "can be thought of as a schema for a frequently occuring sequence of events" (Rumelhart & Norman, 1988, p. 539). Whereas many studies deal with the influence of scripts on episodic memory (e. g., Graesser & Nakamura, 1982; Bredenkamp & Vaterrodt, 1992; Grube-Unglaub, Bredenkamp, Vaterrodt-Plünnecke & Fischer, 1995), the question how these knowledge structures are organized has not been answered yet. The results of the experiments concerned with this question are contradictory. This applies especially to the assumption of a dimensional organization of script knowledge (cf. Barsalou & Sewell, 1985) as it is, for example, implied by Schank & Abelson's (1977) postulate of a sequentially organized representation of script events. Contradictory results can be found in Galambos (1986), Galambos & Rips (1982), Nottenburg & Shoben (1980), and Pohl & Schumacher (1991). Additionally, the discussions of several authors (e.g., Abbott, Black, & Smith, 1985; Barsalou & Sewell, 1985; Mandler, 1984; Wyer & Gordon, 1984) suggest to take the feature of a hierarchical organization of script knowledge into account. Considering the fact that different features of script representation were examined by different experimental tasks and retrieval conditions, the heterogeneity of the results is not a surprise. Thus, the available results indicate the possibility of a flexible use of script knowledge based on several organizing criteria. One further aspect is a critical one in most of the experiments: If script items are presented to participants before the relevant memory test is conducted, an interaction of the (newly established) episodic memory trace with (pre-experimentally existing) semantic memory cannot be excluded. If, however, we assume such an interaction, the results do not allow any conclusion concerning the generic knowledge structure. The methodical approach underlying the four experiments reported in this paper takes account of this problem.

In the following discussion, the terminology proposed by Abbott et al. (1985) is used. In their model of script representation the authors differentiated three levels of hierarchical organization: A "script header" on top of the hierarchy, "scene headers" indicating superordinate actions on the next level, and a set of "scene actions" at the bottom of the hierarchy (cf. Fig. 1).

Our experiments refer to this model which postulates a sequential organization of scene headers and scene actions within the same category as well as a hierarchical relation between scene headers and scene actions. The script headers, scene headers, and typical scene actions used in Experiment 1a, 1b, and 2 are shown in the Appendix.

To illustrate our method assume that Cue A1 is presented to a participant. He or she is re-

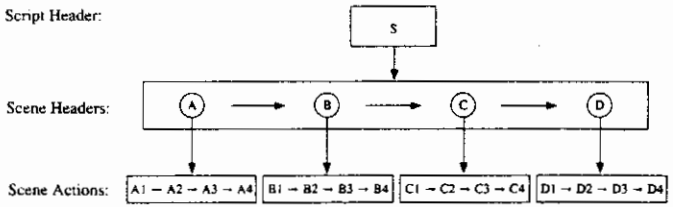

Figure 1: Schematized version of the script representation model proposed by Abbott et al. (1985)

quired to complete Phrase Fragment A2 of which only one letter is presented. If he or she does not succeed within five seconds, a further letter is shown. The number of trials needed to complete the phrase is compared with the number of trials needed to complete the same phrase given another cue. On the assumption that a script is sequentially organized, Cue A1 should facilitate the completion of Fragment A2 compared to any other cue. This hypothesis of a sequential organization was tested in Experiment 1a and 1b. Concerning the hypothesis of a hierarchical relation between scene and action, Cue A should facilitate the completion of Fragment A1, A2, A3, and A4 compared to Scene Header B, C, or D. The hypothesis of a hierarchical organization was tested in Experiment 2. Our experiments are based on the assumption that, for all participants, scripts are organized according to the tested hypotheses. If these hypotheses are correct, specific experimental results will be expected, as, for example, that Cue A3 compared to Cue A2 and Cue A1 facilitates the completion of Phrase Fragment A4. Such a result can occur also, if the psychological hypothesis is false, because of interindividual differences referring to script organization. Thus, there is only an connection by implication between psychological hypothesis and data. From this point of view, hypotheses concerning the organization structure of scripts are refutable, possibly confirmable with more or less evidence, but not provable. This situation, however, is not unlike the situation in other experiments (cf. Erdfelder & Bredenkamp, 1994; Bredenkamp & Erdfelder, 1996). Furterrore, a confirmation of the hypotheses tested in our experiments is only a necessary, but not a sufficient condition for the confirmation of the model of Abbott et al. (1985) from which further hypotheses can be derived which we, however, have not tested.

Our experiments do not focus on typical scene actions only. Results of Bredenkamp & Vaterrodt (1992) and of Grube-Unglaub et al. (1995) gave support to the assumption that also atypical information is part of a script. If this could be confirmed, a model such as that proposed by Abbott et al. (1985) should be supplemented accordingly.

Within schema theory, the term "atypical" has been used in different ways (cf. Fischer, 1992). In their partial-copy-model, Bower, Black, & Turner (1979) differentiated between two types of schema-incongruent information: "interruptions" and "irrelevancies". "Irrelevancies" do not influence the flow of the script and therefore are not considered further in the present paper. "Interruptions" are thought of as atypical and unexpected script events. They are processed more deeply than schema-congruent typical actions, because they appear to be subjectively more important. Following Schank & Abelson's (1977) classification, Bower et al. (1979) discussed three types of script interruptions: "obstacles", "errors", and "distractions".

> In obstacles, some enabling condition for an imminent action is missing.... In errors, a script action leads to an unexpected or inappropriate outcome. ... Distractions are unexpected events or states which set up new goals for the actor, taking him temporarily or permanently outside the script (Bower et al., 1979, p. 210).

The authors speculated that for "obstacles" and "errors" special slots are provided in the representation structure, but not for "distractions".

In their schema-copy-plus-tag-model, Graesser & Nakamura (1982) gave another definition of atypical items. They defined atypical items as script-irrelevant or script-inconsistent, though in a later paper (Nakamura, Graesser, Zimmerman, & Riha, 1985) they only referred to irrelevant items which rarely occur in a script and are not inconsistent. According to Graesser & Nakamura (1982) atypical script information becomes a distinguishable part of the memory trace, as it is tagged during encoding. The authors did not provide further ideas concerning the representation of atypical information in the knowledge structure.

This discussion about the term "atypicality" indicates that an additional dimension has to be taken into consideration: the schema-relevance and -irrelevance of atypical items (cf. Davidson, 1994; Maki, 1990; Mandler, 1984). As far as we know, it has not been tested yet whether schema-relevant atypical items ("interruptions" as defined by Bower et al., 1979) are part of the generic knowledge structure. However, taking into account the results of Bredenkamp & Vaterrodt (1992) and of Grube-Unglaub et al. (1995), it seems necessary to investigate this aspect. Both studies examined memory for previously presented versus not presented script-typical and script-atypical information in order to gain evidence either for the schema-copy-plus-tag-model of Graesser & Nakamura (1982) or for the partial-copy-model of Bower et al. (1979). Based on direct as well as on indirect measures of memory performance, the results concerning highly typical script items were compatible with the theory of Graesser & Nakamura (1982). Additionally, the results of an anagram solution task (Bredenkamp & Vaterrodt, 1992) as well as the results of a sentence/non-sentence decision task (Grube-Unglaub et al., 1995) indicated indirect effects due to a general script activation, that is, conceptually driven influences for previously not presented atypical script items.

The question whether schema-relevant atypical events are part of the generic knowledge structure was examined in Experiment 3. The method applied is the same as in the preceding experiments. "Book lies in bed" (Buch liegt im Bett) is an atypical event of the script "in the morning". It should be completed faster in the context of this script header than in the context of any other script header, if it is part of the morning script. The script headers and atypical scene actions used in Experiment 3 are also shown in the Appendix.

Experiment 1a

Based on the previous discussion, Experiment 1a focused on the question whether a sequential organization of typical script actions within a scene could be demonstrated by a phrase completion task. Participants were asked to complete a semantic target item as fast as possible after being cued with either a relevant or an irrelevant semantic cue. It was expected that relevant cues would lead to less trials during phrase completion.

Method

Participants. Thirty undergraduate students participated to fulfill a course requirement or to receive DM 10. They were randomly assigned to one of two experimental groups.

Materials. The experimental materials were taken from the studies of Klein (1990) and Vaterrodt (1992) which provide German typicality ratings for the actions of various scripts. In the current experiment a selection of typical items (typicality-rating >3.5, 6-point scale from (1) very atypical to (6) very typical) of the four scripts "in the morning", "going to a dentist", "going to a restaurant", and "going to a cinema" was used (see Appendix). In addition, some typical items of the script "calling from a public phone-box" served as material in four practice trials. As shown in Figure 1, each script was split into four scenes (A, B, C, D) with four actions each (A1–A4, ..., D1–D4). The implied sequential order of the script items corresponds to chronological criteria and was judged by five independent raters; the classification in categories corresponds to the results of a pilot study on this subject. To avoid trivial effects of facilitation it was assured that cue and corresponding target neither consisted of the same homophones nor contained morphological similarities. Every target item could be completed unambiguously.

Design. The left part of Table 1 shows the experimental design which was applied to each of the four scripts. The abbreviations concerning semantic cues and targets (Scene action A1, ..., D4) follow the terminology used in Figure 1.

As can be seen from Table 1, the identification of the cued target items requires forward and backward associations of one or more steps. According to our assumption of a sequential organization on the level of "scene actions", those targets which imply only a one-step forward association are expected to be completed more easily. Therefore Cue A1 rather than Cue B3, for example, should facilitate the completion of Item A2. The experimental design is balanced in such a way that for one half of the item-specific comparisons Group 1 is expected to show better results (Target A2, B4, C4, and D2); for the complementary half of the items Group 2 is predicted to perform better (Target A4, B2, C2, and D4). The experimental design also balances the distance-direction-combinations between the groups, that is, the position of the cues in relation to their target items. In the following, those cues will be classified as "relevant" which facilitate the phrase completion task according to our hypothesis to be tested. All other cues will be classified as "irrelevant".

The cue-target pairs of each script were presented in random order for the participants of Group 1. The material was adjusted for Group 2 regarding the succession of "relevant" and "irrelevant" cues. Thereby aspects of contents were taken into account, too. These experimental controls were considered to be necessary in order to keep the semantic significance of the cues comparable for both groups and in order to minimize intergroup differences in experimentally induced conceptually driven processes. The presentation sequence of the four scripts was the same for both groups ("going to a cinema", "going to a restaurant", "going to a dentist", "in the morning").

Procedure. The experimental procedure was run computer-aided. Participants, who were tested individually, could make themselves familiar with the experimental task in four practice trials.

First, to activate the corresponding script context, the script header was presented in the upper third of the monitor (4 sec). Subsequently, the semantic cue, a typical script action, was shown in the center of the monitor (6 sec). Participants were instructed to read the cue aloud. While the cue was presented, the script header remained on the monitor (serving as context information). Then cue and script header were faded out and the "incomplete" target consisting of more than one word was presented. In a first step the first letter of the first word was given. At the same time the total number of letters of each word was indicated (e.g., T_ _ _ _ _ _ _ _ _ _ _ _ _ for the target item "Trinkgeld geben" [give tip] from the restaurant script). Every five seconds a further letter was automatically added, first the missing first letters of the words, then the other missing letters, in the same randomized order for every participant. Participants were asked to complete the target item as soon as possible. The number of letters needed to complete a target correctly was registered by the experimenter. After that the next task was presented. Participants worked on all targets of one script before a new script was started.

Table 1: Design and results of Experiment 1a

Cue		Target	Script: Going to a cinema		Going to a restaurant		Going to a dentist		In the morning	
G1	G2		G1	G2	G1	G2	G1	G2	G1	G2
A1	B3	A2	5.67	7.27	6.93	5.39	2.67	3.93	5.93	8.87
B3	A1	B4	3.13	5.33	9.53	10.60	7.53	10.80	4.80	5.13
C3	D1	C4	9.67	10.00	7.00	7.73	9.07	9.73	8.27	7.80
D1	C3	D2	7.67	8.67	2.60	3.67	8.40	11.00	2.33	2.93
			R^2=0.27*		R^2=0.31*		R^2=0.65*		R^2=0.22*	
B1	**A3**	A4	11.27	8.20	4.53	3.07	12.87	10.87	4.13	2.87
A3	**B1**	B2	8.00	6.60	9.20	4.40	7.73	5.20	3.13	2.07
D3	**C1**	C2	6.27	4.60	5.47	5.87	10.80	10.40	3.93	2.60
C1	**D3**	D4	6.27	4.87	7.80	5.07	7.67	6.60	6.07	3.53
			R^2=0.34*		R^2=0.38*		R^2=0.40*		R^2=0.44*	

Note. "Relevant" cues which according to our assumption are expected to facilitate the phrase completion task are printed in bold letters. The mean numbers of trials needed to complete the targets are shown in the right part. G1 and G2 are abbreviations for Group 1 and Group 2.
* $p < 0.10$

It should be noted that in the present as well as in the following experiments the settings of time for presenting script headers, cues, and single letters of the target items were chosen in such a way that they neither tired the participants nor were too short.

Dependent variables. Each dependent variable in this and the subsequent experiments is the number of trials needed to complete a target item correctly. As each experiment contains more than one dependent variable and these variables are not comparable because of the different length of the target items, we consequently tested the effects of the relevant cues in comparison to the effects of the irrelevant cues by multivariate statistical tests.

Results and Discussion

The mean numbers of trials needed to complete the target items are shown in the right part of Table 1. In 29 out of 32 cases the completion of the target cued by the preceding item was faster.

As the left part of Table 1 shows, an advantage of Group 1 compared to Group 2 is expected four times (dependent Variable *A2, B4, C4,* and *D2*) for every script. So we performed a multivariate comparison of Group 1 and Group 2 for each script concerning these dependent variables. Regarding dependent Variable *A4, B2, C2,* and *D4*, an advantage of Group 2 compared to Group 1 is expected. To test this hypothesis, we again performed a multivariate comparison for each script concerning these four dependent variables. In the special case of two experimental groups, these comparisons are equivalent with multiple regression analyses, where the dependent variables are the "predictors" and group membership is the criterion. Given $N=30$ participants, the probability to detect a squared multiple correlation of 0.34 between the dependent variables and group membership (ρ^2) is $(1-\beta)=0.90$, with $\alpha=0.10$ (cf. Bredenkamp & Erdfelder, 1985; Erdfelder, Faul, & Buchner, 1996). In the current and the following experiments α was set equal to 0.10 in order to guarantee a reasonable power of the statistical tests, and H_0 was tested with the following statistic:

$$F = \frac{R^2 / df_1}{(1-R^2) / df_2}$$

with $df_1 = p$, $df_2 = N - k - p + 1$, N = sample size, k = number of experimental groups, p = number of dependent variables, R^2 = squared multiple correlation coefficient in the sample (cf. Bredenkamp & Erdfelder, 1985).

The results of the statistical tests confirm the impression gained from the inspection of the means in Table 1. Seven out of eight comparisons were significant. The values of R^2 were between 0.27 and 0.44. One comparison concerning the script "in the morning" ($R^2=0.22$) was insignificant. In spite of that result which may be due to a ß error the hypothesis of a sequential organization of typical script actions seems to be confirmed. However, because the comparison of the results of this experiment with that of Experiment 2 to which we will turn later showed that the influence of the scene header is as large as the influence of the preceding item, we performed a further experiment to test the hypothesis of a sequential organization more strictly. The reason for this further experiment is that the "relevance" and "irrelevance" of the cues in Experiment 1a is confounded with scenic membership, because the "irrelevant" cues were taken from other scenes than the "relevant" cues. Therefore, additionally to the influence of the preceding item as a cue, the scenic membership of this item may be responsible for the results of Experiment 1a.

Experiment 1b

In Experiment 1b we wanted to examine the hypothesis of a sequential organization of typical script events more strictly than in Experiment 1a. In contrast to Experiment 1a, the "relevant" and "irrelevant" cue as well as the corresponding target belonged to the same scene or category.

Method

Participants. Thirty undergraduate students participated to fulfill a course requirement or to receive DM 10. They were randomly assigned to one of three experimental groups.

Materials. The script items used in this experiment were taken from the item pool described in Experiment 1a. Again, they belonged to the four scripts "in the morning", "going to a dentist", "going to a restaurant", and "going to a cinema" (see Appendix). Furthermore, some typical items of the script "calling from a public phone-box" served as material in four practice trials.

Design. Table 2 provides the complete experimental design. The abbreviations concerning semantic cues and targets (Scene action A1, ..., D4) follow the terminology in Figure 1.

As shown in Table 2, the identification of the target items requires a one-, two-, or three-step forward association. According to our assumption of a sequential organization on the level of "scene actions", again those targets are expected to be completed more easily which imply a one-step rather than a two- or three-step forward association. Therefore Cue A3, for example, should facilitate the completion of Item A4 compared to Cue A2 or Cue A1. The experimental design is balanced in such a way that each of the three groups will be superior to the others in one third of the item-specific comparisons, provided our hypothesis is valid (Group 1: Target B4, C4, A4, and D4; Group 2: Target D4, A4, C4, and B4; Group 3: Target A4, B4, D4, and C4; as can be seen in Table 2, the target items determined for each group are assigned to the four scripts). The experimental design also balances the distance-direction-combinations between the groups.

Table 2: Design and results of Experiment 1b

	Cue			
Script	Group 1	Group 2	Group 3	Target
Going to a cinema	A1	A2	**A3**	A4
	B3	B1	B2	B4
	D2	**D3**	D1	D4
Going to a restaurant	A2	**A3**	A1	A4
	B1	B2	**B3**	B4
	C3	C1	C2	C4
Going to a dentist	**A3**	A1	A2	A4
	C2	**C3**	C1	C4
	D1	D2	**D3**	D4
In the morning	B2	**B3**	B1	B4
	C1	C2	**C3**	C4
	D3	D1	D2	D4

Note. "Relevant" cues which according to our assumption are expected to facilitate the phrase completion task are printed in bold letters.

The sequence of the targets of each script was randomized, thereby determining the presentation sequence of the corresponding cues for each group. In order to minimize differences in conceptually driven processes induced by the material, the randomized sequence of the four scripts was the same for all groups ("going to a cinema", "going to a restaurant", "going to a dentist", "in the morning").

Procedure. The experimental procedure was analogous to that of Experiment 1a.

Results and Discussion

In Experiment 1b the hypothesis of a sequential organization of typical script events should be examined more strictly than in Experiment 1a. This request was taken into account by the fact that the "relevant" and "irrelevant" cues as well as the targets belonged to the same category. If the experimental results show an advantage for targets preceded by a "relevant" cue, this will give strong evidence for the organization assumption.

In this experiment again, the dependent variable was represented by the number of trials needed to complete the target item correctly. With regard to the statistical analysis, 3 (advantage of Group 1, 2, or 3)×2 (cue-target distance: one vs. two and three steps, two vs. three steps) orthogonal multivariate comparisons with four dependent variables each *(B4, C4, A4, D4; D4, A4, C4, B4; A4, B4, D4, C4)* were conducted (cf. Bredenkamp & Erdfelder, 1985). To clarify the statistical procedure, let us have a look at those items in Table 2 which should show an advantage for Group 1 compared to Group 2 and Group 3 (Target B4 of the script "going to a cinema", Target C4 of the script "going to a restaurant", Target A4 of the script "going to a dentist", and Target D4 of the script "in the morning"). The first statistical comparison concerning these dependent variables contrasts Group 1 with Group 2 and Group 3, whereas the second comparison, which is linearly independent of the first one, contrasts Group 2 with Group 3. It is assumed that in the first comparison the item next to the target is the most relevant cue. Neglecting this cue in the second comparison, the item which is next to the target is assumed to be the most relevant cue. Given $N=30$ participants, the probability to detect an effect of $\rho^2=0.38$ in a special comparison is $(1-\beta)=0.90$, with $\alpha=0.10$ (cf. Erdfelder et al., 1996).

None of the R^2-values reached the critical value of $R^2=0.30$ although four of them ranging from $R^2=0.26$ to $R^2=0.28$ were almost significant. It is interesting to note that for these almost significant results 11 out of 16 mean differences were in the direction predicted by the hypothesis, for the other two comparisons 5 out of 8 mean differences turned out to be in the predicted direction. So 16 out of 24 mean differences were in the direction predicted by our hypothesis. If there is no tendency in the predicted direction, one would expect the probability of those differences to be 0.5. Applying a one-tailed binomial test to test H_0: $\pi=0.5$ against H_1: $\pi>0.5$, with $\alpha=0.10$, the probability under H_0 of obtaining 16 or more differences in the predicted direction is 0.076. We conclude that there is a tendency in the direction predicted by the hypothesis which is not detected by the multivariate statistical tests. We shall come back to this point in the general discussion section.

Experiment 2

The discussions of several authors (e.g., Abbott et al., 1985; Barsalou & Sewell, 1985; Mandler, 1984; Wyer & Gordon, 1984) indicated that it seems not to be sufficient to consider scripts as sequential representations of events. Rather, it appears to be more adequate to consider the feature of a hierarchical organization, too. Therefore Experiment 2 examined whether script-typical events, apart from a sequential organization, are part of a scene or category.

Method

Participants. Thirty undergraduate students participated to fulfill a course requirement or to receive DM 10. They were randomly assigned to one of two experimental groups.

Materials. The script items used in this experiment were taken from the item pool described in Experiment 1a. Again, the four scripts "in the morning", "going to a dentist", "going to a restaurant", and "going to a cinema" were chosen (see Appendix). As in the preceding experiments, the items of the four practice trials belonged to the script "calling from a public phone-box".

Design. The left part of Table 3 gives the experimental design which was applied to each of the four scripts. The abbreviations concerning cues (Scene header A, ..., D) and targets (Scene action A1, ..., D4) follow the terminology in Figure 1.

According to our assumption of a superordinate/subordinate-relation between scenes and typical actions, the completion of those targets is predicted to be faster which belong to the scene specified by the preceding cue. Therefore Cue A rather than Cue B, for example, should facilitate the completion of Item A1. As in Experiment 1a, the experimental design is balanced in such a way that for one half of the item-specific comparisons Group 1 is expected to show superior results (Target A1, A4, B2, B3, C2, C3, D1, and D4), for the other half of the item-specific comparisons Group 2 (Target A2, A3, B1, B4, C1, C4, D2, and D3) is predicted to be superior, provided that our hypothesis is correct.

The presentation sequence of the cues and the corresponding target items for Group 1 and Group 2 was fixed according to the criteria mentioned in Experiment 1a. The presentation sequence of the scripts was the same for both groups and corresponded to that of the preceding experiments ("going to a cinema", "going to a restaurant", "going to a dentist", "in the morning").

Procedure. The procedure was analogous to that of the preceding experiments.

Table 3: Design and results of Experiment 2

Cue		Target	Script: Going to a cinema		Going to a restaurant		Going to a dentist		In the morning	
G1	G2		G1	G2	G1	G2	G1	G2	G1	G2
A	**B**	A1	10.93	10.80	2.20	3.67	5.13	6.93	4.73	6.47
A	**B**	A4	10.00	13.07	2.60	4.67	12.33	13.07	1.47	4.20
B	**C**	B2	7.53	6.53	8.73	8.40	6.40	7.93	1.73	3.33
B	**C**	B3	5.07	6.47	4.13	4.33	4.80	9.13	1.53	3.47
C	**D**	C2	4.87	6.07	6.67	4.73	10.80	9.07	2.73	3.33
C	**D**	C3	4.47	8.73	9.80	11.40	4.13	6.27	2.60	2.47
D	**A**	D1	8.93	9.53	9.33	8.00	9.67	13.80	3.73	4.40
D	**A**	D4	4.00	6.20	6.47	5.73	4.53	6.80	2.00	4.80
			R^2=0.63*		R^2=0.51*		R^2=0.65*		R^2=0.80*	
B	**A**	A2	7.47	4.27	7.67	5.67	4.33	2.73	11.00	10.07
B	**A**	A3	11.27	10.67	7.00	5.53	5.47	3.73	7.80	5.00
C	**B**	B1	12.33	12.73	6.87	6.60	8.53	6.13	8.00	6.53
C	**B**	B4	5.67	3.00	11.20	9.87	9.93	8.53	5.93	2.67
D	**C**	C1	13.20	12.40	8.87	6.07	12.13	12.53	4.40	3.60
D	**C**	C4	10.07	9.53	8.40	8.00	9.80	8.80	9.27	5.87
A	**D**	D2	9.67	3.60	3.80	1.73	11.00	9.47	3.20	2.13
A	**D**	D3	16.40	13.80	4.73	3.27	12.47	10.00	8.07	8.07
			R^2=0.76*		R^2=0.68*		R^2=0.49*		R^2=0.67*	

Note. "Relevant" cues which according to our assumption are expected to facilitate the phrase completion task are printed in bold letters. The mean numbers of trials needed to complete the targets are shown in the right part. G1 and G2 are abbreviations for Group 1 and Group 2.
* $p < 0.10$

Results and Discussion

Experiment 2 should examine whether typical script actions are part of categories or scenes. According to our hypothesis, an advantage for those targets is predicted which are scenically related to the cue. The mean numbers of trials needed to complete the targets (right part of Table 3) seem to support this hypothesis.

The statistical analysis of Experiment 2 was analogous to that of Experiment 1a. For each script two multivariate comparisons with eight dependent variables each (*A1, A4, B2, B3, C2, C3, D1, D4* and *A2, A3, B1, B4, C1, C4, D2, D3;* cf. Table 3) were conducted. Given N = 30 participants, the probability to detect an effect of $\rho^2=0.43$ is $(1-\beta)=0.90$, with $\alpha=0.10$ (cf. Erdfelder et al., 1996). As the statistical analysis revealed, all multivariate comparisons reached significance at the specified α level. The R^2-values were between 0.49 and 0.80. An examination of the item-specific means showed that 53 out of 64 group differences were in the direction predicted by the hypothesis.

Thus, our results support the assumption that script-typical events are part of scenes.

Experiment 3

As already mentioned in the introduction, Bredenkamp & Vaterrodt (1992) as well as Grube-Unglaub et al. (1995) found conceptually driven influences for previously not presented atypical script items which are due to a general script activation. These results, however, are incompatible with the theoretical implications of Graesser & Nakamura (1982),

> ... except one assumes that not presented atypical items which are untagged are also part of the memory trace: as unlikely events, they belong to the script and differ from irrelevant information which is unrelated to the script (Bredenkamp & Vaterrodt, 1992, p. 25; translated by SGU).

Therefore we tested in Experiment 3 whether script-relevant atypical events ("interruptions" as defined by Bower et al., 1979) are part of the generic knowledge structure.

Method

Participants. Thirty undergraduate students participated to fulfill a course requirement or to receive DM 10. They were randomly assigned to one of two experimental groups.

Materials. The materials for this experiment were also taken from the script standardizations of Klein (1990) and Vaterrodt (1992). For each of the following ten scripts two script-relevant atypical items were chosen (typicality-rating < 3.0, 6-point scale): "in the morning" (MO), "going to a dentist" (DE), "going to a restaurant" (RE), "going to a cinema" (CI), "buying a pair of trousers" (TR), "fixing a bicycle tube" (BI), "writing a text with computer" (TE), "painting a room" (RO), "calling from a public phone-box" (PH), "operating a coffee machine" (CO) (see Appendix). Moreover, some script-relevant atypical items of the scripts "frying eggs", "attending a lecture", "playing cards", and "filling a car up with petrol" served as material in four practice trials.

Design. The left part of Table 4 provides the complete experimental design for the ten chosen scripts. The abbreviations concerning the cues represent the level of "script headers", the abbreviations concerning the targets represent the level of "scene actions" according to the terminology of Abbott et al. (1985).

Table 4: Design and results of Experiment 3

Cue		Target	Means	
Group 1	Group 2		Group 1	Group 2
MO	**BI**	MO1	10.06	10.20
DE	**PH**	DE2	13.13	16.27
RE	**RO**	RE1	13.47	14.40
CI	**MO**	CI2	9.00	13.00
TR	**CO**	TR1	3.60	7.13
BI	**RE**	BI2	10.40	11.60
TE	**DE**	TE1	7.47	9.40
RO	**TE**	RO2	6.93	9.13
PH	**TR**	PH1	14.80	14.87
CO	**CI**	CO2	5.73	7.67
			R^2=0.72*	
BI	**MO**	MO2	5.73	5.87
PH	**DE**	DE1	13.67	11.07
RO	**RE**	RE2	12.13	8.73
MO	**CI**	CI1	8.73	9.20
CO	**TR**	TR2	12.87	12.67
RE	**BI**	BI1	14.06	9.93
DE	**TE**	TE2	14.93	13.53
TE	**RO**	RO1	10.60	10.60
TR	**PH**	PH2	23.33	18.87
CI	**CO**	CO1	12.40	9.47
			R^2=0.74*	

Note. "Relevant" cues which according to our assumption are expected to facilitate the phrase completion task are printed in bold letters. The mean numbers of trials needed to complete the targets are shown in the right part.
* $p < 0.10$

According to our hypothesis, script-relevant atypical items are also part of the generic knowledge structure. Thus, their availability should profit from a general script activation. Therefore it is Cue MO rather than Cue BI, for example, which should facilitate the completion of Item MO1. As can be seen in Table 4, the experimental design again is balanced in such a way that in one half of the item-specific comparisons Group 1 (Target MO1, DE2, RE1, CI2, TR1, BI2, TE1, RO2, PH1, and CO2), in the complementary half Group 2 (Target MO2, DE1, RE2, CI1, TR2, BI1, TE2, RO1, PH2, and CO1) will be in advantage, if our hypothesis is correct.

The presentation sequence of the cues and the corresponding target items for Group 1 and Group 2 again was fixed on the basis of the criteria mentioned in Experiment 1a.

Procedure. The experimental procedure was generally the same as that reported in the preceding experiments. In Experiment 1a, 1b, and 2 the "script header" was presented on the monitor (4 sec) for context activation before the critical cue appeared (6 sec). Now, in Experiment 3, the "script header" served as critical cue and was presented for eight seconds. After that – as in the preceding experiments – the cue was faded out and the "incomplete" target item was shown.

Results and Discussion

Experiment 3 examined whether script-relevant atypical events are part of the generic knowledge structure. An advantage in the completion task is predicted for those targets which are cued by the corresponding "script header".

For evaluation of data, two multivariate comparisons with ten dependent variables each (*MO1, DE2, RE1, CI2, TR1, BI2, TE1, RO2, PH1, CO2* and *MO2, DE1, RE2, CI1, TR2, BI1, TE2, RO1, PH2, CO1;* cf. Table 4) were conducted. Given $N=30$ participants, the probability to detect an effect of $\rho^2=0.48$ is $(1-\beta)=0.90$, with $\alpha=0.10$ (cf. Erdfelder et al., in 1996). As the statistical analysis revealed, both multivariate comparisons were significant at the specified α level. The R^2-values were 0.72 and 0.74. An examination of the item-specific means re-

vealed that the group differences supported our hypothesis in 17 out of 20 comparisons.

Thus, the results of the Experiment 3 give evidence for the assumption that script-relevant atypical information is part of the generic knowledge structure.

General Discussion

Two of the hypotheses implied by the model of Abbott et al. (1985) have been tested by the same technique of cued phrase completion: the hypothesis of a "predecessor relation" between script-typical items within the same category and the hypothesis of a "part of-relation" between scene and typical action. Confirmations of these hypotheses are necessary, but not sufficient conditions for the confirmation of the model proposed by Abbott et al. (1985). Whereas the hypothesis of a sequential organization could not be confirmed conclusively, findings referring to the hypothesis of a hierarchical organization were unequivocal.

Concerning the hypothesis of a sequential organization the results of Experiment 1a seemed to support it. After having finished the statistical analysis of Experiment 2, we compared the mean number of trials needed to complete a target of Table 1 cued by the preceding item with the mean number of trials for the same target cued by the relevant scene header (cf. Table 3). The more effective the preceding item compared to the scene header is, the more differences between these conditions should be negative, and vice versa. As a result of this comparison, 16 out of 32 mean differences were negative, the other 16 differences were positive. Both cues seem to be equally effective. Because in Experiment 1a the relevance of cues was confounded with scenic membership, we concluded that not only the influence of the preceding item as a cue but also that scenic membership was responsible for the results. In order to avoid the confounding we performed Experiment 1b. The results of this experiment showed a tendency in the direction predicted by the hypothesis. It is possible that the minimal experimental variations of Experiment 1b produced effects that were too small to be detected by a statistical test based upon 30 observations. Therefore, in subsequent experiments, this hypothesis should be further examined using more participants in order to be able to detect small effects. Furthermore, interpreting the results of Experiment 1a and 1b, the aspect of sequence strength of a script has to be regarded. A study of Hue & Erickson (1991) dealing with this subject showed that the probability that participants disagreed about the order of script actions was higher, if the actions were taken from the same scene rather than from different scenes. Moreover, the authors came to the conclusion that some scripts were to a higher degree sequentially organized than others. Thus, testing "strong" scripts should produce more evidence than testing "weak" scripts. Because of these considerations we do not reject the hypothesis of a sequential organization of script actions on the basis of our data but emphasize that further research must be done. In this context, a study of van der Meer (1993) appears to be interesting. Based on association and priming experiments, she examined the mental representation of everyday contexts. Van der Meer showed that usual and repeatedly experienced everyday contexts (for this classification see Bekerian & Conway, 1988), which are complex events comparable to scripts, are activated according to the temporal sequence in which they usually occur.

Focusing the hierarchy feature, in Experiment 2 a subordinate/superordinate relation between typical actions and scenes could be demonstrated. An integrated interpretation of the results of Experiment 1a, 1b, and 2 in the sense of a hierarchical-sequential organization of script-typical events, as it is, for example, supposed by Abbott et al. (1985) and by Wyer & Gordon (1984), cannot be given on the basis of the present data.

Another aspect to be considered in the current investigation was the typicality of script events. In Experiment 1a, 1b, and 2 we only used typical items to test structural features. In Experiment 3 we found conceptually driven influences due to a general script activation for atypical script items. This result corresponds distinctly to the findings reported by Bredenkamp & Vaterrodt (1992) and by Grube-Unglaub et al. (1995). The consistency of the available results supports the assumption that not only script-typical events but also script-relevant atypical events are part of the generic knowledge structure. Following this notion, an enlargement of the theory of Graesser & Nakamura (1982) as well as that of Abbott et al. (1985) seems to be necessary. Apart from that, an examination of the sequentiality and the hierarchy feature would also be interesting for those atypical script events for which Bower et al. (1979) suggested special slots within the representation structure – that is, for "obstacles" and "errors".

What more has to be considered at this point? Rumelhart & Norman (1988) characterize propositional representation theories, including script theories, as neo-associationistic. This term suggests conformity as well as distinction regarding classical association theory. Examinations concerning the structure of scripts should be conducted by procedures which test associative relations according to the underlying hypothesis. We did use such a procedure. The validity of this procedure can be criticized as it enables participants to use controlled strategies. Although such an objection does not explain the structure of our results, if it cannot be demonstrated that those strategies are confounded with the experimental conditions "relevant cue"/"irrelevant cue", we are going to design priming experiments in which the associations are cued automatically. In these experiments it has to be tested whether the short-time presentation of targets in the context of relevant cues leads to a better detection performance than in the context of irrelevant cues and whether the results reported in this article can be replicated.

Author Notes

The work on this paper was supported by a grant from the Deutsche Forschungsgemeinschaft (DFG).

We would like to thank Thomas Krüger for programming and Katja Ehrenberg, Ulrike Gleißner, Roland Hartmann, Nicole Junker, and Heike Martensen for conducting the experiments. Also, Susan Wall-Amft has to be mentioned because of her help in translating the manuscript.

Moreover, we thank two anonymous reviewers for their valuable comments on an earlier draft of the manuscript.

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Appendix

Items of Experiment 1a, 1b, and 2:

Script header: Kinobesuch (going to a cinema)
- A Karten kaufen (buy tickets)
  - A1 Eingangshalle betreten (enter lobby)
  - A2 an Kasse anstellen (get in line for tickets)
  - A3 Preisklasse wählen (choose price category)
  - A4 nach Ermäßigung fragen (ask for reduction)
- B In Zuschauerraum gehen (enter viewing room)
  - B1 Abschnitt abreißen lassen (have tickets teared)
  - B2 guten Platz suchen (look for good seat)
  - B3 Jacke ausziehen (take off jacket)
  - B4 sich hinsetzen (sit down)
- C Auf Hauptfilm warten (wait for movie)
  - C1 Raum wird abgedunkelt (room is darkened)
  - C2 Vorschau sehen (watch preview)
  - C3 Werbung anschauen (watch commercials)
  - C4 über Reklame ärgern (feel annoyed about commercials)
- D Film ist zu Ende (movie is over)
  - D1 Abspann gucken (watch closing sequence)
  - D2 vom Sitz aufstehen (stand up)
  - D3 warten bis Reihe hinausgeht (wait for seat neighbors to leave row)
  - D4 Saal verlassen (leave viewing room)

Script header: Restaurantbesuch (going to a restaurant)
- A Eintreffen (arrival)
  - A1 Tür öffnen (open door)
  - A2 freien Tisch suchen (look for table)
  - A3 Garderobe ablegen (take off coats)
  - A4 Platz nehmen (sit down)
- B Bestellen (order meal)
  - B1 Karte studieren (look at menu)
  - B2 Preise vergleichen (compare prices)
  - B3 Menü auswählen (decide on food)
  - B4 Speisekarte zurückgeben (return menu)
- C Essen (eat food)
  - C1 auf Mahlzeit warten (wait for meal)
  - C2 etwas trinken (drink something)
  - C3 Gericht wird gebracht (meal arrives)
  - C4 Serviette benutzen (use napkins)
- D Bezahlen (pay bill)
  - D1 Kellner bringt Rechnung (waiter brings bill)
  - D2 Trinkgeld geben (give tip)
  - D3 vom Tisch aufstehen (stand up)
  - D4 Lokal verlassen (leave restaurant)

Script header: Beim Zahnarzt (going to a dentist)
- A Praxis betreten (enter doctor's office)
  - A1 sich anmelden (check in)
  - A2 Namen nennen (give name)
  - A3 Krankenschein abgeben (hand over doctor's certificate)
  - A4 Karteikarte wird herausgesucht (file-card is picked out)
- B Im Wartezimmer (in the waiting room)
  - B1 andere Patienten grüßen (greet other patients)
  - B2 Sitzplatz suchen (look for seat)
  - B3 in Zeitschrift lesen (read magazine)
  - B4 aufgerufen werden (name is called)
- C Im Untersuchungszimmer (in the examination room)
  - C1 Beschwerden beschreiben (describe problem)
  - C2 Stuhl wird zurückgekippt (examination seat is lowered back)
  - C3 Mund aufmachen (open mouth)
  - C4 Spritze bekommen (get injection)
- D Praxis verlassen (leave office)
  - D1 Verabschieden vom Arzt (say good-bye to doctor)
  - D2 aus Behandlungsraum gehen (leave examination room)
  - D3 neuen Termin erhalten (make another appointment)
  - D4 Mantel anziehen (put on coat)

Script header: Am Morgen (in the morning)
- A Wach werden (wake up)
  - A1 Wecker klingelt (alarm rings)
  - A2 Alarm abstellen (turn off alarm)
  - A3 nach Uhrzeit gucken (check time)
  - A4 aufstehen (get up)
- B Im Bad (in the bathroom)
  - B1 auf Toilette gehen (go to the toilet)
  - B2 sich waschen (wash)
  - B3 Zähne putzen (brush teeth)
  - B4 Haare kämmen (comb hair)
- C Frühstücken (have breakfast)
  - C1 Kaffee kochen (make coffee)
  - C2 Tisch decken (set table)
  - C3 Zeitung lesen (read newspaper)
  - C4 Geschirr abräumen (clear table)
- D Wohnung verlassen (leave apartment)
  - D1 Tasche packen (pack bag)
  - D2 Jacke anziehen (put on jacket)
  - D3 Radio ausschalten (turn off radio)
  - D4 Tür abschließen (lock door)

Note. A, B, C, and D denote the scene headers, whereas a letter-number combination denotes a typical scene action. The English translations of the items are given in brackets.

Items of Experiment 3:

- MO Am Morgen (in the morning)
  - MO1 Buch liegt im Bett (book lies in bed)
  - MO2 Gymnastik machen (do gymnastics)
- DE Beim Zahnarzt (going to a dentist)
  - DE1 Patienten zählen (count patients)
  - DE2 Schmerztablette nehmen (take painkiller)
- RE Restaurantbesuch (going to a restaurant)
  - RE1 Gericht nachwürzen (add extra spice to meal)
  - RE2 Kellner wirft Glas um (waiter upsets glass)
- CI Kinobesuch (going to a cinema)
  - CI1 Ton fällt aus (sound breaks down)
  - CI2 vor Filmende gehen (leave before movie is over)
- TR Kauf einer Hose (buying a pair of trousers)
  - TR1 Reißverschluß klemmt (zipper jams)
  - TR2 Preis herunterhandeln (beat down price)
- BI Fahrradschlauch reparieren (fixing a bicycle tube)
  - BI1 Speichen nachziehen (tighten spokes)
  - BI2 Sattel entfernen (remove saddle)
- TE Text mit Textverarbeitung schreiben (writing a text with computer)
  - TE1 Programm stürzt ab (program crashes)
  - TE2 Computer aufschrauben (open computer)
- RO Zimmer anstreichen (painting a room)
  - RO1 Pinsel aufhängen (hang up paintbrush)
  - RO2 Farbeimer kippt um (paint-bucket tilts over)

PH Aus öffentlicher Telefonzelle telefonieren (calling from a public phone-box)
- PH1 Gespräch wird abgebrochen (phone call is interrupted)
- PH2 Auslandsvorwahl heraussuchen (look up international dialling code)

CO Kaffeemünzautomaten bedienen (operating a coffee machine)
- CO1 Becher hat einen Riß (cup is cracked)
- CO2 Milch ist sauer (milk is sour)

Note. MO, DE, RE, CI, TR, BI, TE, RO, PH, and CO denote the script headers, whereas a letter-number combination denotes an atypical scene action. The English translations of the items are given in brackets.

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Swiss Journal of

Psychology

Schweizerische Zeitschrift für Psychologie
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Verlag Hans Huber
Bern Göttingen Toronto Seattle