

Effects of Schema on Memories of Incomprehensible Events

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This study examined the role of schema in facilitating memory for schema-relevant information experienced prior to the acquisition of the schema. Participants watched a video clip with no sound (to make it more incomprehensible), with or without a short description given before or after the video. Immediately, one week, or one month later, participants were asked to recognize the scenes by choosing familiar pictures out of schema relevant or schema irrelevant picture pool. Results showed that schema gained subsequent to specific events have positive and negative effects on the memory of the events. Implication to delayed recall for traumatic events, recovered memory of previously unrecallable events, and plausibility of planting false memory were discussed.

Key words : Event memory, Schema, Picture recognition, False memory

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Numerous research studies involving memory have demonstrated the importance of the relationship between to-be-remembered information and cognitive structures such as schema activated during both encoding and retrieval (see Bartlett, 1932; Brewer & Nakamura, 1984; Besken & Gülgöz, 2009). This research addressed an intriguing question relevant to the role of schema in affecting memory for schema-relevant information experienced prior to the acquisition of the schema.

Although the current study was not designed to address children's memory for incidents of sexual abuse in their history, this domain presented a good example of the situation addressed by this research. Consider this example. Assume that a child has been frequently inappropriately touched in a sexual manner at a young age *prior* to understanding that there is a range of types of physical touches that can be categorized as "sexual." To such a young child, a sexual touch might not initially be experienced as discriminably different from other types of touches such as diaper changing, bathing, dressing, cuddling, etc. However, if the child later develops the schema for "sexual touches," will this facilitate their ability to recall these prior incidents that were not comprehensible and would not have been recallable otherwise?

Recently, many researchers have questioned

the possibility of recalling traumatic events that were not recallable before, and tried to define and characterize "false memory" and "recovered memory." There have been abundant research that supported the possibility of planting of false memory: False memory is not only for the change of the features of events, but it includes creation of false memories of self-involving and emotional events (see Loftus, 2000; Hyman & Loftus, 2002; Loftus & Polage, 1999; Bruck & Ceci, 1999; Ceci, Kulkofsky, Klemfuss, Sweeney, & Bruck, 2007; Stark, Okado, & Loftus, 2010).

Nevertheless, other research redefined false memory and recovered memory, through discussion of plausibility of false events, familiarity of the original events, consistency with expectations and credibility, and adults' inaccurate discernment on children's false memory reports (Block et al., 2011; Pezdek & Hodge, 1999; Pezdek, 2001; Underwood & Pezdek, 1998).

Although the current study did not directly address the debate of false memory and recovered memory of traumatic events, it investigated how and to what extent the subsequently acquired schema affected the memory of previously incomprehensible, unrecallable events. Several studies have addressed the effect of schema on language comprehension and memory for prose (Anderson & Pichert, 1978; Anderson, Pichert, & Shirey,

1983; Bransford & Johnson, 1972; Davidson & Hoe, 1993; Hess & Flannaga, 1992; Kardash, Royer, & Greene, 1988; Pichert & Anderson, 1977), and tested the effects of schema on the accuracy of memory for real-life stimulus events (i.e. Wynn & Logie, 1998), few studies, however, have addressed the effect of schema on memory and comprehension for specific real life incidents that would be expected to have been incomprehensible prior to learning the relevant schema.

Bransford and Johnson (1972) reported substantial memory facilitation when a schema-evoking context was furnished prior to a difficult-to-understand passage, but not when presented after the passage. This demonstrated the effect of schema on the encoding process only.

However, it has also been reported that the conceptual relationship between retrieval schema and the to-be-recalled information determined memory performance, independent of encoding processes. Anderson and Pichert (1978) reported that subjects could retrieve previously unrecalled information when encouraged to adopt a retrieval schema that was conceptually relevant to the new information. For example, about a story of two boys playing hooky used in Anderson and Pichert (1978), participants remembered items that were related to home buyer's interest and were not originally recallable, when they

switched their perspectives from burglar's to homebuyer's perspectives they were asked to take before retrieval.

Anderson et al. (1983) elaborated on the previous research, and found strong evidence for retrieval in that the retrieval perspective greatly increased the recall of information that was relevant to that perspective. They also found evidence to support the influence of schema on the encoding process. Even when a text was recalled under a retrieval perspective, the recall of information that was relevant to the encoding perspective was superior to recall of information that was irrelevant to both the encoding and the retrieval perspectives. Another research also demonstrated that expectations presented after encoding could affect the memory of past information, and expectations that were externally provided could bias recall (Kirt, Lynn, Rayne, Krackow, & McCrea, 1999).

The stimuli used in the previous research was an ambiguously written prose about washing clothes (Bransford & Johnson, 1972), or a passage about two boys playing hooky from school (Pichert & Anderson, 1977; Anderson & Pichert, 1978; Kardash et al., 1988; etc.). These previous studies did not examine the influence of the subjects' prior knowledge of the stimuli on encoding and retrieval. This study controlled the prior knowledge by giving incomprehensible stimuli to participants before receiving schema,

and addressed incongruent findings of encoding and retrieval effects in previous studies.

Inferential reconstruction has been proposed in the previous studies as one explanation for the effect of schema on retrieval (Bartlett, 1932; Loftus, 1979, 1993; Payne, Elie, Blackwell, & Neuschatz, 1996; see Costanzo & Krauss, 2012). This study investigated the effects of schema on recognition for schema-relevant and irrelevant information experienced prior or subsequent to the acquisition of the schema. This also investigated the possibility and nature of negative effects of schema on memory through inferential reconstruction, along with the major question of schema effects on the comprehension and memory for schema-relevant material experienced prior to learning the schema. The major differences between the current study and the previous studies are the use of real life incidents (instead of written prose) as stimuli for memory, the control of previous knowledge about the events to be remembered, and the use of picture recognition as realistic scene memory performance for schema relevant and schema irrelevant events in this study.

Methods

Participants A total of 144 college students (55 male and 89 female students) at La Sierra University in Southern California participated in

order to fulfill general psychology requirements. Forty-two (13 male and 29 female) students participated in an immediate interval condition and another 42 (16 male and 26 female) students participated in a one week interval condition, and 60 (26 male and 34 female) students participated in one month interval condition. One third of the participants in each interval condition were randomly assigned to one of three groups: schema before, no schema, and schema after groups.

Materials Video-taped events of the “Babysitters and Boy-sitters,” based on the old book series *The Babysitter Club* were used. All participants have not seen this video before. Pieces of events from the video were combined in the order of the same sequence as original tape, and they were shown without sound to make the segment difficult to understand. Total length of edited tape was 13 minutes.

For the recognition test, 80 pictures were presented: 20 “old” pictures from the schema-relevant portions of the segment, 20 schema-irrelevant “old” pictures, 20 schema-relevant “new” pictures, and 20 schema-irrelevant “new” pictures. All of the pictures were 5 inches x 7 inches, and were taken from the frozen scenes of video “Babysitters and Boy-sitters.”

Procedures Three participants took part in this study as a group. In the presentation phase, each participant viewed an edited, incomprehensible, new 13-minute video-taped segment. The test phase consisted of a picture recognition test where participants were asked to sort 80 pictures into the familiar and unfamiliar picture piles. There was no time limit and resorting was not allowed. One group of participants performed the test phase immediately, second group was tested one week later, and the last group was tested one month later.

The major intervention was the presentation of the schema either prior to, subsequent to each segment (just prior to the test), or not at all. The schema was presented in a written form, consisting of a title and a short description about the segment. Here is the schema. “Babysitters and the Boy-sitters. This is a short story based on the book sequel, *The Babysitter Club*. In the Babysitters and the Boy-sitters, the original babysitters (girls) find themselves in a tough position when they become too popular. When they cannot handle all their jobs, they look for temporary help to cover some of the extra work, and they decide to ask two boys from their local school. After some initial training, these two boys try to take care of some of the regular children on their own. They were a success and the children loved

them, but the secrets were to let them do fun, but bad and messy things. Boy-sitters later found that babysitting was not always easy.”

Results

The percentage of accurate recognition of the pictures was analyzed with a mixed design ANOVA with an identification type and relevancy as within subject factors and interval, schema, and gender as between subject factors. The results showed participants performed better when tested immediately than one week later or one month later, $F(2,126)=45.92$, $p<.001$, $\eta^2=.422$, and a Tukey post hoc test showed all three pairs showed significant differences (M: 91.9%, 85.7, and 78.1, and SE: 0.64, 0.9, and 1.1, respectively: all means and SE’s are for the percentage of accurate recognition).

There was a significant interaction between interval and relevancy, $F(2,126)=6.0$, $p=.003$, $\eta^2=.087$. Correct recognition declined more over time when the pictures were relevant to the schema than when they were irrelevant to the schema. (for the relevant pictures, M: 92.68, 85.6, 75.29, and SE: 0.81, 1.16, 1.1, and for the irrelevant pictures, M: 91.19, 85.89, 80.96, and SE: 0.92, 1.24, 1.45, respectively) (Figure 1) There was also a significant interaction between interval and identification type, $F(2,126)=4.0$, $p<.05$, $\eta^2=.06$. When the pictures were familiar

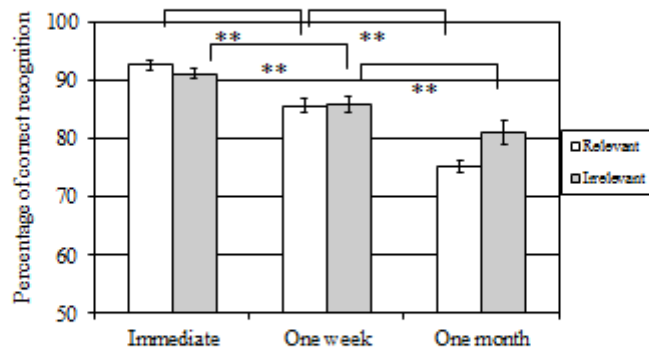


Figure 1. Percentage of accurate recognition for schema relevant and schema irrelevant events. (** $p < .01$)

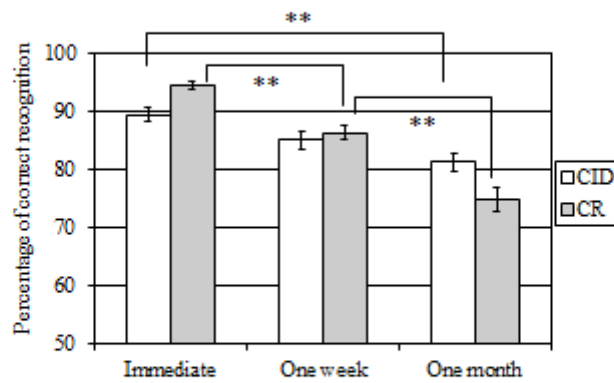


Figure 2. Percentage of correct identification (CID) and correct rejection (CR) for 3 interval conditions. (** $p < .01$)

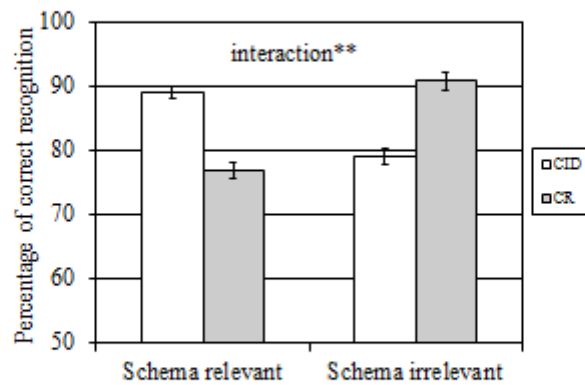


Figure 3. Percentage of accurate recognition for schema relevant and schema irrelevant events. (** $p < .01$)

(old), correct recognition declined less over time than when the pictures were unfamiliar (new). (for the old pictures, M: 89.4, 85.12, 81.33, and SE: 1.25, 1.51, 1.59, and for the new pictures, M: 94.46, 86.37, 74.92, and SE: 0.82, 1.29, 2.15, respectively) (Figure 2)

There was another significant interaction between identification type and relevancy, $F(1,126)=202.51$, $p<.001$, $b^2=.616$ (M: 89 for relevant and 79 for irrelevant events of correct identification (CID) and M: 77 for relevant and 90.8 for irrelevant events of correct rejection (CR)) (Figure 3).

Overall, three schema group did not show significant difference on accuracy of recognition, $F(2,126)=.186$, $p=.83$, $b^2=.003$ (M: 84.7, 83.6, 84.7, SE: 1.2, 1.5, 1.1, respectively for the schema before, no schema, and schema after groups). There was no gender difference on memory accuracy found, $F(1,126)=.001$, ns .

There were no significant 3-way, 4-way, or 5-way interactions found, $F(1,126)=.785$, ns (5-way).

Further analysis didn't show significant differences among 3 groups: for correct identification for relevant events (CID-R), $F(2, 141)=.055$, $p=.947$, $b^2=.001$; for correct identification for irrelevant events (CID-IR), $F(2, 141)=2.774$, $p=.066$, $b^2=.038$; for correct rejection for relevant events (CR-R), $F(2, 141)=.946$, $p=.391$, $b^2=.013$; for correct rejection for irrelevant events (CR-IR), $F(2, 141)=1.952$, $p=.146$, $b^2=.027$. (Figure 4)

A separate analysis with schema, relevancy, and identification type variables showed a marginally significant 3 way interaction, $F(1,144)=2.564$, $p=.08$, $b^2=.035$, and a further analysis with no schema and schema after groups for one month interval condition showed significant differences between two groups.

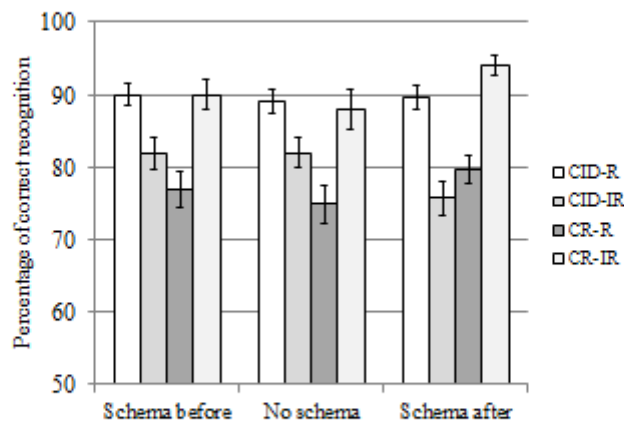


Figure 4. Percentage of accurate recognition in three schema groups

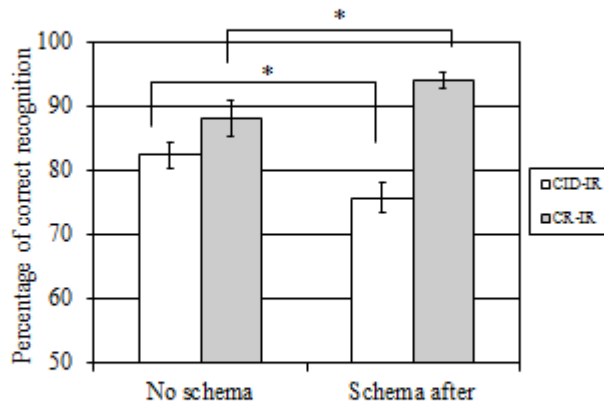


Figure 5. Comparison between no schema and schema after groups for one month interval condition (CID-IR: Correct identification for schema irrelevant events; CR-IR: Correct rejection for schema irrelevant events). (* $p < .05$)

Comparing to no schema group, schema after group was lower in accuracy in true identification for irrelevant event, $F(1,94)=3.65$, $p=.05$, $b^2=.04$ (M: 82.4 for no schema, 75.7 for schema after group and SE:2.0, 2.3), and higher in recognition accuracy in correct rejection for irrelevant events, $F(1,94)=4.71$, $p<.05$, $b^2=.048$ (M: 88.1 for no schema, 94 for schema after group and SE: 2.8, 1.3) (Figure 5).

Discussion

In our environments, we are surrounded with stimuli that could have contributed to our knowledge acquisition. Much of the eligible stimuli were not explicitly processed partly because we had limited cognitive capacity, and partly because the stimuli were beyond the realm of our comprehensibility. This experiment

showed how schema could affect comprehension and memory of information that was incomprehensible before, and showed significant positive and negative intrusion effects of schema on recognition of schema-relevant information experienced prior or subsequent to the acquisition of the schema.

The results showed that participants' memories were significantly better when they were tested immediately rather than one week or one month later. Participants' memories did not differ between schema relevant and irrelevant pictures. Nevertheless, the significant amounts of errors were found and they were due to false identification of schema-relevant events and to inaccuracy of true identification of the irrelevant events viewed. False identification was dramatically increased as the time passed, and creation of false memory of the events and items

that were not viewed was a lot higher than inaccurate memory and forgetting of schema-relevant events they have seen. This suggests inferential reconstruction and the intrusion effect of schema leading to false memory.

Although the recognition accuracies from the three schema groups were not significantly different, the difference among the three groups changed with time and the type of identification of the stimuli. With a longer interval, schema after condition showed an advantage of correctly rejecting the events and items that were not perceived if they were irrelevant to the schema. However, schema after group also showed a negative, intrusion effect of inaccuracy in memory of schema-irrelevant events and items that were perceived, meaning that even though they have seen the events, they thought they did not if the events were not relevant to the schema.

These findings differ from the results of Bransford and Johnson (1972), that showed that information which was incomprehensible at the time of encoding, was less likely to be encoded into memory, and information not encoded were not affected by subsequent schema acquisition. The events used in this experiment were more ecologically valid than the deliberately written prose and could contain greater real-life information than prose.

Schema after group showed the highest accuracy for recognizing the new events as new

and correctly rejecting them, although schema also made them to inaccurately miss the schema-irrelevant events. The recognition rate for the previously unseen events was comparatively low, relative to the events seen before. This overall low recognition rate might help reveal the positive effect of schema for the schema after group. Participants who had schema after were poor in recognizing false negatives (irrelevant previously viewed clips) and false positives (relevant unseen clips), which has implications for the intrusion effects of schema.

Although this study was not to address children's memory for incidents of sexual abuse, it involved several important characteristics of delayed memory for traumatic events. If incidents happened at a young age prior to understanding of sexual behavior, and later understood, the schema acquired at an older age could have affected the memory of those incidents that were previously unrecallable. This study showed facilitation and intrusion effects of subsequently acquired schema on the recognition of incomprehensible events. It is possible that the subsequent understanding of sexual behaviors could affect on retrieving unrecallable events that were experienced earlier in life.

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도식이 이해 난이한 사건 기억에 미치는 효과

김 인 경

라 시에라 대학교

심리학과

본 논문은 도식(schema)이 그의 획득 전에 경험한 도식과 관련된 사건에 대한 기억에 어떤 영향을 미치는 지를 연구하였다. 기존 연구의 서술형 자극과 다른 단막 편집된 동영상 자극으로 사용되었다. 동영상을 그의 내용을 이해하기 힘들도록 소리를 제거하고 그에 대한 간단한 설명을 동영상 전에 제시하는 그룹, 후에 제시하는 그룹과 설명 없는 그룹으로 나누어 피험자에게 보여주었다. 과제로 피험자로 하여금 자극 제시 직후, 일주일 후, 또는 한달 후에, 도식과 관련된 또는 관련 없는 사진들 중에서 재인하도록 하였다. 결과로 도식을 사건 전, 또 사건 후에 습득한 것이 기억에 정적인 효과뿐만 아니라 부정적 효과를 나타냄을 보였고, 충격적 사건에 대한 지연된 재생 기억, 사전에 기억 못했던 사건에 대한 추후 기억, 오류기억의 입력 가능성에 대해 논의 하였다.

주제어 : 사건기억, 도식, 사진재인, 오류기억