The use of video source in analogical problem solving in two experimental studies

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Abstract

Two experiments were designed to find out effectiveness of dynamic visuals (videos) in analogical transfer when solving social interaction problems. In experiment 1, 70 subjects read a story (source analogue) and solved a social interaction problem under two conditions (with and without cues to the source analogue). In experiment 2, 70 subjects watched a video and solved a social interaction problem under the conditions of with and without cue to the video source analogue. These experiments provided findings that the use of dynamic visual representation in analogical transfer learning fostered accessibility to both surface and relational similarities, and enabled abstraction of problem schema for effective mapping of schema to solve new target problem. The improved quality of the induced schema brought about by videos is highly predictive of transfer performance.

Keywords: Source analogue, analogical problem solving, ill-defined problem, video.

1. Introduction

Analogies can facilitate the generation of new ideas by drawing on the past and the familiar (Gick and Holyoak, 1980). Similar structures and processes can bring about creative generative process. The use of instructive clues further facilitate the generation of creative solution. (Casakin & Goldschmidt, 1999; Ward, 1994). Most studies on analogical transfer use stories as the source analogue to induce solution schema (Gick & Holyoak, 1983, Thompson, Gentner & Loewenstein, 2000). While research has suggested that visual and kinesthetic analogues can be effective (Beveridge & Parkins, 1987, Mayer & Anderson, 1991, Schank, 1980), few studies have been done to examine the use of video to depict the source analogue. The use of appropriate visual representations can facilitate cue retrieval in the problem-solving process. Video offers a rich collection of visual representations which encompass the attributes of spoken language, animation and kinesthetic. Through a combination of graphics, text, motion and animation, video presents new opportunities for analogical learning and can regulate students’ self-learning (Azevedo, Cromley, & Seibert, 2004; Beveridge & Parkins, 1987; Casakin & Goldschmidt, 1999). These studies suggest that video has the potential to serve as an effective source in analogical transfer to generate both attribute and relational mappings to induce solution schema for customer service.

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2. Experiments

A Hotel Check-in Story was developed as the target problem. The story depicted the situation of a typical room reservation errors resulting in an angry guest who arrived at the hotel in the night after a long flight, and asked about his reservation for a Super Deluxe Room for 3 nights. There was a mistake in the room reservation booking and there was no record of this guest’s room reservation in the system. There wasn’t a Super Deluxe room available for 3 straight nights. When informed that there was no record of his reservation and that there was no such room for 3 consecutive nights, the guest turned angry and was raising his voice to express his unhappiness towards you. At any point in the week, there were some other rooms available for 1 night but no Super Delux room was available for 3 straight nights. The subjects were asked to solve a set of transactional problems, and provide their reasons for the responses and decisions.

2.1. Participants

Students with age ranged from 17 to 20 years participated in two experimental studies. All subjects were first year students at the School of Business and Services at a vocational training college in Singapore. Each experiment and control group comprised 35 subjects. The two experiments were: Source (story) analogue and source (video) analogue. In each experiment, two conditions were introduced: without cueing the subjects to the source story or video, with cue given to the subjects to the source story or video. The control group did not read the source analogue or receive cue to it.

2.2. Procedures for the Experimental Groups

The Hotel Check-In target problem was used to test subjects in all experiments and conditions. The Salmon Delivery Story served as the source story which is given to the subjects in the form of a story to be read or a video to be watched. The story is enacted and recorded on video. The video was uploaded onto video annotation software to enable the subjects to watch and learn from the set of scaffolding annotations in the video. The annotations provided comments on the interactions between the characters in the video.

The different groups of subjects were assigned to each condition of the experiments. They were instructed to read the Salmon Delivery story, and told to gain sufficient familiarity to be able to recall it in their own words. The subjects in the group which were assigned to Salmon Delivery Video Analogue condition were seated in a classroom with video projection equipment and instructed to watch the video clip carefully, and told to gain familiarity with the video shown to be able to retell in their own words. Next, all subjects were given the target Hotel Check-in problem story. They were instructed to read the target story and to solve the problem. A distractor story with no similarities to the target problem was also given to the subjects to read. After a one week’s break, the subjects were given the target problem to solve within 20 minutes under each of the three conditions.

2.3. Measures

The performance of the subjects in the solving the target problem was captured by total score achieved ("testscore"). The subjects provided their reasons for their solution to the target problems. The reasons were scored quantitatively ("reasoning" scores) on appropriateness. The reasoning score reflected the ability of the subjects to detect relational similarities between the source and target. In each of the experiments, subjects were asked to elaborate on the responses which they had selected. From these qualitative inputs, surface attributes which are similar to the source analogue are coded for the surface attributes ("surfaceresponse") which the subjects were able to relate to the source. Independent samples t-test were conducted to compare the experimental group and the
control group on the subjects’ performance in solving target problem (as measured by the “testscore”), the subjects’ ability to detect relational components (as measured by “reasoning”) and the subjects’ ability to detect surface attributes (as measured by “surfaceresponse”).

2.3.1. Experiment 1

Experiment 1 was designed with reference to conceptual framework of Gick and Holyoak (1980) and the study of Holyoak and Gick (1980). It attempted to demonstrate that the use of an analogy from remote domain could function as a hint for solving problem involving social interaction. The experiment aimed to test that source analogue written in a dialogue format could serve as an effective source for transfer. The subjects in the experimental group read the source story and its solution. The subjects in the control group did not. It was hypothesized that the source story would increase the frequency of the analogous solution to the target problem.

2.3.2. Experiment 2

Experiment 2 was designed by considering the use of analogues with dynamic visuals with rich kinesthetic information which can invoke memory recall (Mayer & Anderson, 1991, Schank, 1980). The subjects were given a video of an enactment of the Salmon Delivery story, and a distracter video. It was hypothesized that the use of video would facilitate the generation of a converging schema to solve the target problem.

2.4. Second order head

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3. Results

3.1. Experiment 1

Findings from the one-way analysis of variance (ANOVA) yielded between-groups significant differences for testscore, F(2, 102) = 45.75, \( p = .002 \); and surface response, F (2, 102) = 19.47, \( p = .008 \); but not for reasoning, F(2, 102) = 4.84, \( p = .06 \). Table 1 summarizes means and standard deviations of scores for experiment 1 in three conditions: Without cue, with cue and control. Post-hoc Scheffe tests showed that significant findings were observed between with cue and control conditions (2-3) for testscore and surface similarity score. The findings supported partially our hypothesis that the use of textual story as a source analogue with cue generated more converging solution (testscore) and surface mapping (surfaceresponse) in analogical transfer than did the control condition.

<table>
<thead>
<tr>
<th></th>
<th>Without cue (1)</th>
<th>With cue (2)</th>
<th>Control (3)</th>
<th>(1-2)</th>
<th>(1-3)</th>
<th>(2-3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testscore</td>
<td>18.97</td>
<td>20.17</td>
<td>17.89</td>
<td>-</td>
<td>-</td>
<td>.002</td>
</tr>
<tr>
<td>Reasoning</td>
<td>2.97</td>
<td>3.31</td>
<td>2.57</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Surfaceresponse</td>
<td>2.74</td>
<td>3.60</td>
<td>2.11</td>
<td>-</td>
<td>-</td>
<td>.008</td>
</tr>
</tbody>
</table>

Table 1: Mean and Standard Deviation of Scores for Source Analogue (textual story) without Cue, with Cue, and Control Conditions
3.2 Experiment 2

Findings from the one-way analysis of variance (ANOVA) yielded between-groups significant differences for testscore, \( F(2, 102) = 18.58, p = .000 \); reasoning, \( F(2, 102) = 5.23, p = .037 \); and surface response, \( F(2, 102) = 51.77, p = .000 \). Table 2 summarizes means and standard deviations of scores for experiment 2 in three conditions: Without cue, with cue and control. Post-hoc Scheffe tests showed that significant findings were observed between with cue and control conditions (2-3) for testscore, reasoning and surface similarity score. Significant differences in testscore and surfacescore were observed between without cue and with cue conditions (1-2). The findings supported our hypothesis that the use of video as a source analogue with cue generated more converging solution (testscore), structural (reasoning) and surface mapping (surfacescore) in analogical transfer than did the control condition.

4. Discussion

Does the use of source analogue written in dialogue prose facilitate analogous transfer? The findings of Experiment Study 1 found that there was no statistical difference in testscore, surfaceresponse, and reasoning scores between the control group and the experiment group under no cue condition for textual story source analogue. This was consistent with results from past experiments (Gick & Holyoak, 1980) where source analogue, without cue to either source or distractor story, did not perform much better than solving problem without a source analogue. Under cue condition, the source analogue on dialogue prose was significantly better than the control experiment in testscore and surfaceresponse, but not reasoning (or structural similarity). This was consistent with the findings of previous studies on the effect of cue. The introduction of cues enabled the retrieval of surface attributes as evident by the significant difference in surface response scores which represented the retrieval of the surface features of the source. While it did not yield significant outcome under without cue condition, converging solution to the problem was generated under cue condition for surface but not structural similarity. The challenge of using dialogue lies in ensuring that it serves as a realistic record of social situation context in narrative form to portray and convey the problem and the schema. The next experiment hoped to improve the source presentation in textual but in video; that latter modality likely helped the learners to establish structural similarity between source analogue and target analogue.

To what extent analogical transfer is facilitated by auditory visual analogues with or without cues? Experiment Study 2 showed that there was no significant difference in testscore, surfaceresponse, and reasoning scores between the cue and without cue experimental groups using auditory visual source analogue. When compared to the control, there was a contrasting observation: testscore, surfaceresponse and reasoning scores were all significantly different. Between the experimental group without cue to the source analogue and the control group, similar findings were observed except for the reasoning source (relational mapping). The auditory visual source was not sufficient to trigger recall of the schema to provide reasoning to the new problem. The external representations in the video did not translate into internal representation (Mayer, 2003). Without cue, the auditory visual source was not sufficient for the subject to have well-developed representations of the problem. The lack of alignment was evident as the subjects did not produce significantly higher level of structural similarities and problem solution. When the cue was introduced, the surface mapping was significantly more than that in the control. Significantly more structural similarities were identified by the subjects. The subjects were able to identify both the surface and structural similarities after the cue was introduced, and resulted in making explicit the schema previously latent in the no cue
condition (Gick & Holyoak, 1983). Cueing subjects to compare the source and target promote transfer as they derive mapping that facilitate access to schemas and solutions (Thompson, Gentner, & Loewenstein, 2000). This experiment showed that with cue, there was a goal relevance focus imposed on the subjects and the search became more goal oriented then incidental. This was consistent with the postulation by Gick and Holyoak (1983) that any process which focused people on the causal structure of the analogues would improve analogical transfer.

The explanation for the observed phenomena can be traced to the dual code theory (Clark & Paivio, 1991; Paivio, 1991). The auditory component of the video source analogue was encoded verbally and the visual component was encoded nonverbally. These two storages would require to be interconnected before they could support each other in recall and recognition (Mayer, 2003; Sternberg, Radeborg & Hedman, 1995). Under the without cue condition, it could be explained that the interconnection was not activated and hence, no recall of the source analogue. Another explanation is that connections in the visual and verbal stores may be unequally developed. Mayer & Anderson (1991) have postulated that presenting verbal and visual information must be coordinated in such a way as to ensure effective and creative use for problem solving. Effective understanding is brought about when visual and verbal information are coordinated for links to be built. Without these linkages being built, animations are not useful to students who cannot make up the representational and referential connections present in the animations. When cue was introduced, it served to prime the interconnection between the verbal and nonverbal storage bringing about recall and mapping. The resultant outcome was significantly better than the case of text-based source.

With explicit information about problem structure in the source presented in dynamic visual forms, relational features transfer contain less reasoning errors in transfer. Conversely, when learners are presented with less information about the source, more reasoning errors occur during problem solving. This reduction in reasoning errors will also be prevalent for transfer to non-isomorphic target as learner will make modification in the mappings when they are presented with rich explicit information in the source (Gholson, Smither, Buhrman, Duncan, & Pierce, 1992). With more information in video form, reasoning error in analogical transfer should be reduced.

From the two experiments, we learn that video source analogues improved analogous problem solving performance. Video, with its visual and auditory contents, likely served to alert learner to observe the attributes and relations present in the source, and produced higher level of mappings and hence transfer outcome. Cueing learners to the source video further helped transfer by providing memory recall to similarities in the source which they can latter mapped to target problem.

References