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The Feeling of Going: Judgments of Learning (JOLs) for Maps and Directions

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Spatial metamemory is an unexplored topic, despite our knowledge of spatial memory. In the current study, Judgments of learning (JOLs) for maps (Experiment 1) and verbal directions (Experiment 2) were examined. The tasks were chosen to mirror real-world spatial learning situations. In both studies, participants studied for 60 seconds a map or a set of directions from one place to another. Following study, participants assessed JOLs on a 0 to 100 scale immediately after the map (Experiment 1) or the directions (Experiment 2) were removed. Participants then wrote or drew the directions from one place to another. These JOLs are immediate JOLs (Nelson & Dunlosky,1991), which tend to be low in accuracy (.3 to .4). For both maps and directions, the gamma correlations were above .8. Calibration of the magnitude of the judgments also closely matched performance. Various explanations for the strong gamma correlations are given.

Spatial memory has been studied intensively and extensively in the human cognitive literature (see Allen, 2004). Research has been directed at the location of objects in their environment (McNamara, 2003), memory for maps (Evans & Pezdek, 1980; Tversky, 1981), spatial working memory (Awh, Jonides, & Reuter-Lorenz, 1998), updating spatial representations (de Vega & Rodrigo, 2001; Mou, McNamara, Valiquette, & Rump, 2004), and memory for travel (Cornell, Sorenson, & Mio, 2003), to name and reference just a small portion of this literature. The current paper does not intend nor is the author competent to review this vast literature. Rather, the goal of the current paper is to introduce a new methodology into the metacognitive literature, namely that JOLs can be used to explore our metamemory for spatial memory. Spatial metamemory can therefore be defined as our knowledge and awareness of how we learn and remember spatial information. Although some studies on spatial memory have included a measure of retrospective confidence (e.g., Landsdale, Oliff, & Baguley, 2005), that is, a judgment as to whether or not the recalled spatial information was correct, there have been no studies examining prospective confidence, that is, if the person thinks an item will be remembered in the future. This study represents a preliminary inquiry in this new direction.

One of the most common techniques to assess prospective metamemory is the judgment of learning (JOL) (Dougherty, Scheck, Nelson, & Narens, 2005; Dunlosky & Nelson, 1994, 1997; Nelson & Dunlosky, 1991; Son & Metcalfe, 2005). JOLs are assessment of whether or not an item has been learned or a judgment as to whether or

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not the participant will remember that item at a later test (Nelson & Dunlosky, 1991). Methodologically, JOLs have been examined in many different contexts, including learning of paired associates (Dunlosky &Nelson, 1994; 1997; Weaver & Kelemen, 2003), answers to general-information questions (Benjamin, Bjork, & Schwartz, 19 98), learning of itemized lists (Matvey, Dunlosky, & Schwartz, 2006), and sentence comprehension (Thiede, Dunlosky, Griffin, & Wiley, 2005), and in both young adult and aging populations (Dunlosky, Kubat-Silman, & Hertzog, 2003; Hertzog & Dunlosky, 2004).

One of the striking findings with JOLs has been called the delayed JOL effect. This term refers to the high correlation between the JOL and recall response when the JOL is not made immediately after study, but rather after a delay during which other items are studied (Dunlosky & Nelson, 1994; Kelemen & Weaver, 1997). Indeed, when JOLs are made immediately after study, the gamma correlations tend to range from about .2 to .4 (see Nelson, 1984 for a discussion of gamma correlations). However, when there is a delay between the time of study and time of retrieval, gamma correlations range from .7 on up to sometimes close to 1. The delayed JOL-effect is robust and has been documented under a wide range of conditions (see Nelson, Narens, & Dunlosky, 2004).

Explanations for the delayed JOL have varied. Some researchers have postulated what has been called the Monitoring Dual Memories (MDM) hypothesis (Nelson & Dunlosky, 1991). This hypothesis states that during immediate JOLs, the target response is in working memory, allowing successful retrieval of the target. However, the judgment is a prediction of future retrieval from long-term memory. Thus, access in working memory interferes with the assessment of whether or not the item can be retrieved later from long-term memory (Nelson & Dunlosky, 1991). Others have argued that the explanation for the delayed JOL effect is transfer-appropriate monitoring (TAM) (Dunlosky & Nelson, 1997; Weaver & Kelemen, 2003). This model suggests that the high accuracy of the delayed JOLs occurs because the task at judgment is more similar to the task at retrieval. However, little data actually support this model. Finally, others have argued that the act of retrieval during a delayed JOL strengthens the representations of items retrieved, thus leading to stronger JOLs and subsequent better recall (Kimball & Metcalfe, 2003; Spellman & Bjork, 1991). Regardless of the explanation, the effect has been strong, immediate JOLs yield low correlations whereas delayed JOLs yield high correlations.

The current study represents an attempt to borrow the methodology of JOLs and apply them to a new stimulus domain, namely spatial memory. JOLs are predictions as to whether or not some target item will be remembered. There is nothing inherent about JOLs that implies that the to-be-remembered material must be verbal or constrained to a single response. Thus, in the current study, rather than learn simple paired associates, participants were required to remember directions and read and extract information from maps (and then remember directions). After study, they made immediate JOLs concerning their likelihood of recalling those directions. After the JOL was made, participants then preceded to recall the directions. In Experiment 1, the participants were required to read maps, remember the directions from Town A to Town B. In Experiment 2, they were given direction to places, such as laundromats and movie theaters.

The fundamental question for these studies is whether or not JOLs for spatial directions would follow the patterns observed in studies on more strictly verbal materials.

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Although it was possible to recode the directions in verbal terms, many participants maintained spatial representations, even drawing maps themselves during the recall phase. A priori, there was no reason to suspect that JOLs here would be any different from other kinds of JOLs. Nonetheless, these experiments were designed to explore metacognition with a new class of stimuli.

EXPERIMENT 1

In Experiment 1, participants studied a list of six maps for a test of memory for diections from one town to another (see Appendix A). Participants were expected to determine the route from one town to the other and then remember how to get there. The maps were of real, but unfamiliar rural locations in Canada and the United States. Following study of each map, participants made a JOL concerning their memory for those directions. The participant then recalled the directions for that map. The participants were then shown the next map. Our goal here was to see the degree to which the participants spatial JOLs would be accurate.

METHOD

Participants

The participants were 61 Florida International University students who received course credit for their participation (11 men and 50 women). The mean age of the participants was 21.8, and ranged from 19 to 34.

Materials

Six maps were downloaded from Mapquest. The maps were from rural areas in the United States and Canada. They were chosen by the author to be places about which the participants would not be familiar. For example, one map called for participants to learn the roads that connected Upper Peanut, Pennsylvania to Ohiopyle, Pennsylvania. Alternate routes were possible on all maps, so all reported remembered routes were verified by the authors (see Appendix A). To accurately report the directions, participants had to remember the road numbers and whether they should be taken east, west, north, or south. In some cases, landmarks (turn north at Farmington) could substitute for road numbers. Participants were asked to indicate on their answer sheet if they were familiar with any of the towns or locations in the map. No participants indicated that they knew the area or towns displayed in the maps.

Procedure

Participants were tested in a large group. First participants were given instructions as to what they were supposed to do. They were told that they would have to find and remember the way from one place to another. That is, they were to examine the map and to determine the way from a starting town, indicated by a camera sign under the name of the town on the map to a town marked by a star, indicating the destination town. Participants were given 60 seconds to examine the map, determine the way from one town to another, and then remember those directions. Prior to the first trial, they were then told that they would have to assess a JOL for that map. JOLs were defined as "At the end of that minute, you will be asked to assess your confidence that you have learned the directions. If you are not confident at all that you have learned the directions, you may choose 0 – not confident at all. If you are completely confident that you have learned the direction, indicate that with 100. You may also choose

intermediate values (20, 40, 60, and 80) to express less than complete confidence in your memory or lack of it." Participants were then instructed that they would have an opportunity to recall the way from Point A to Point B. They could write or draw the directions on their answer sheet. They were told the directions must be specific enough so that someone who did not know the way could use those directions to get to the destination.

Each participant was given an answer sheet. On the first page, they indicated their age and gender. The experimenter then started the PowerPoint presentation. Each map was projected on a screen in front of the classroom. Participants saw each map for sixty seconds. After they had viewed the map for sixty seconds, the map was removed, and they were asked to assess their JOL. They were given 20 seconds to assess the JOL. They circled the number corresponding to their JOL on the appropriate page on the answer sheet. Following the JOL, they wrote or drew the directions on their answer sheet. They were given 30 seconds to recall the directions. At that point, they were given a 20 second break and then they were given the next map. Six maps were presented. It took about 20 minutes total for each group.

RESULTS

Statistical reliability was measured at $p < .05$ in this experiment. There were two independent variables in each analysis. Neither age nor gender predicted any of the outcomes. Therefore, there is no need to report it for each individual analyses.

Recall

Participants averaged 49% correct recall on these maps. The range was from 0 (3 participants) to 100% (3 participants). Participants reported a mean of 3.5 steps to get from Point A to Point B in their reports of which a mean .41 were inaccurate.

Confidence

The mean confidence across participants was 59 with range of mean as low as 3 for one participant and a mean as high as 100 for another. Confidence was positively correlated with recall ($r = .50$). As recall improved, so did the average confidence, $z(61) = 4.16$. Thus, more confident participants recalled more directions. The mean confidence (59) was higher than the mean recall (49). Indeed, given that these participants had never participated in a JOL experiment before, this is good calibration, despite the small overconfidence.

Judgment Accuracy

Gamma correlations could not be computed on 8 participants because they had either gotten all the answers incorrect or correct (6) or because they had given the same numeric judgment on all JOLs (2). Across the remaining 53 participants, the mean gamma correlation between correct recall and confidence was .81. This was significantly different from chance guessing (gamma = 0), $t(52) = 15.8$.

DISCUSSION

In Experiment 1, gamma correlations (.81) were much higher than they typically are in immediate JOL paradigms, in which they tend to be in the .3 to .4 range (Nelson & Dunlosky, 1991). Why would this experiment yield such high gamma correlations? One possible explanation relies on both the monitoring-dual-memories hypothesis and the transfer-appropriate monitoring hypothesis. First, it is likely that if the directions

were accessible in working memory at the time of judgment that they were also still accessible at the time of retrieval, consistent with monitoring-dual memories (Nelson & Dunlosky, 1991). Second, transfer-appropriate monitoring suggests that accuracy should be high when the judgment task closely mirrors the retrieval task (Weaver & Kelemen, 2003). In Experiment 1, recall occurred immediately after the judgments were made. Thus, both theories predict that gammas will be high when recall immediately follows a immediate JOL.

This situation would be hard to replicate in a typical JOL experiment with paired associates because if participants were allowed to recall the target while it was still in working memory, there would be almost no variability in recall (that is, recall would be at ceiling). In this experiment, because participants had to remember multiple aspects of the directions, there was sufficient variability in whether or not the material was in working memory. The variability in memory allowed for the JOLs to distinguish between those that would be recalled and those that would not be recalled.

EXPERIMENT 2

In Experiment 2, I sought to replicate the findings from the first study that gamma correlations would be high when the stimulus material was partially spatial rather than wholly verbal. In Experiment 2, however, we gave verbal directions to participants. These verbal directions were driving directions to get to common destinations such as movie theaters, bowling alleys, and hardware stores. Thus, like Experiment 1, participants were expected to remember a set of road directions, but they did not have to read the map and figure out the directions first.

An experimental variable was also introduced into this study. Half of the directions were accompanied by one redundant landmark, whereas the other half were accompanied by three redundant landmarks. Thus, for example, one set of direction used in the study was as follows, "Take I-34 north for 11 miles before exiting just past the garbage dump. At the traffic light, turn east onto Fowler Way. The paint store is on the left next to the gas station." Information about the "garbage" dump is redundant with the directions to go for 11 miles. Information about the "traffic light" is redundant with the instructions to turn east on Fowler Way. And the "gas station" is redundant with directions to the paint store.

The original hypothesis in this experiment was that redundant information would lead to a false sense of confidence. People would interpret having more information to mean that they would more likely remember the correct way to get to the destination. Thus, redundant information would boost confidence and hurt accuracy. As it turned out, this hypothesis was completely wrong.

METHOD

Participants

The participants were 51 Florida International University students who received course credit for their participation (8 men and 43 women). The mean age of the participants was 22.1, and ranged from 18 to 33.

Materials

The author constructed 8 sets of fictional direction (see Appendix B). These directions required remembering 4 items of information, usually 2 street name or number and 2 direction cues (e.g., west, left, etc). 4 of the directions had one additional redun-