Solving Goals in a Virtual Environment: Interactions between Context, Planning, and Creativity

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Introduction

When do objects in the environment spontaneously remind us of pending goals that may be solved by those objects? Patalano and Seifert (1997) found that noticing potential solutions to object-based pending goals was influenced by how those goals were initially encoded in memory. In their study, planning (storing potential solution objects along with the goal) increased participants' later likelihood of being reminded by solution objects. In addition, functional plans (e.g., "find something sticky" for a poster hanging goal) led to participants noticing a wider variety of solution objects (e.g., tape, glue, and even gum!) than specific plans (e.g., "find some tape"), which facilitated only noticing the specified solution object. In the current study, we further explored the contexts under which objects in the world remind us of unsolved goals in memory. Specifically, we examined the roles of planning, object context, and divergent thinking on participants’ ability to notice unconventional solutions for pending goals

Noticing Unconventional Solutions to Pending Goals

Role of Context

Typically, people are biased towards typical functions of objects. The inability to overcome this bias is called *functional fixedness* (Duncker, 1945). This bias is greater when the conventional function of an unconventional solution object is highlighted than when it is presented in a neutral fashion. For example, in Duncker's Candle Box problem, when the box was used as a container with tacks (highlighting its containing function) rather than by itself, participants had difficulty solving the problem. Therefore, physical context may influence whether potential solution objects remind us of pending goals.

Role of Individual Divergent Thinking

Whether one is reminded of "hanging a poster" by a creative solution like "gum" may depend on one's willingness to use conventional objects in unconventional ways. Individuals may vary in their ability to recognize alternate uses of objects (Torrance, 1966). This may lead to better noticing of conventional solutions to problems. Further research suggests that differences in the ability to view objects beyond their conventional uses may "immunize" people to functional fixedness (German & Defeyter, 2000).

Goals For The Present Study

1. Determine if the physical context in which an unconventional solution object is encountered can affect its ability to remind participants of pending goals.
   - Place solution objects near other benign objects (Neutral), or in contexts that highlight their conventional use (Biased Away)
   - **Prediction**: Contextual bias will decrease correct solution rate.

2. Determine whether creative participants will be more easily reminded by unconventional solution objects (like "gum").
   - Measure creativity using the Unusual Uses Task.
   - **Prediction**: High creativity will increase correct solution rate.

3. Embed task in a computer-based virtual environment (GEMS) to facilitate visual contextual processing (Seymour et al., 1996 unlike previous studies using paper & pencil paradigms).

Procedure

1. **GEMS Practice**
   - Participants (Mean Age: 20; 67% Female) practice navigating the computer-based virtual environment

2. **Goal Presentation**
   - Participants study 10 object-based goals (e.g., hang fallen poster, cut string, scoop ice-cream) and recall each verbally

3. **Planning Manipulation** (random assignment)
   - **Planning Condition**: participants make tentative solution plans
     Prediction: Planning should facilitate performance (Seifert & Patalano, 1997)
   - **No-Planning Condition**: participants just reintroduced to goals
     Prediction: Lack of planning should impede performance (Seifert & Patalano, 1997)

4. **Retention Interval**
   - Participants play classic card matching game for 10 min.

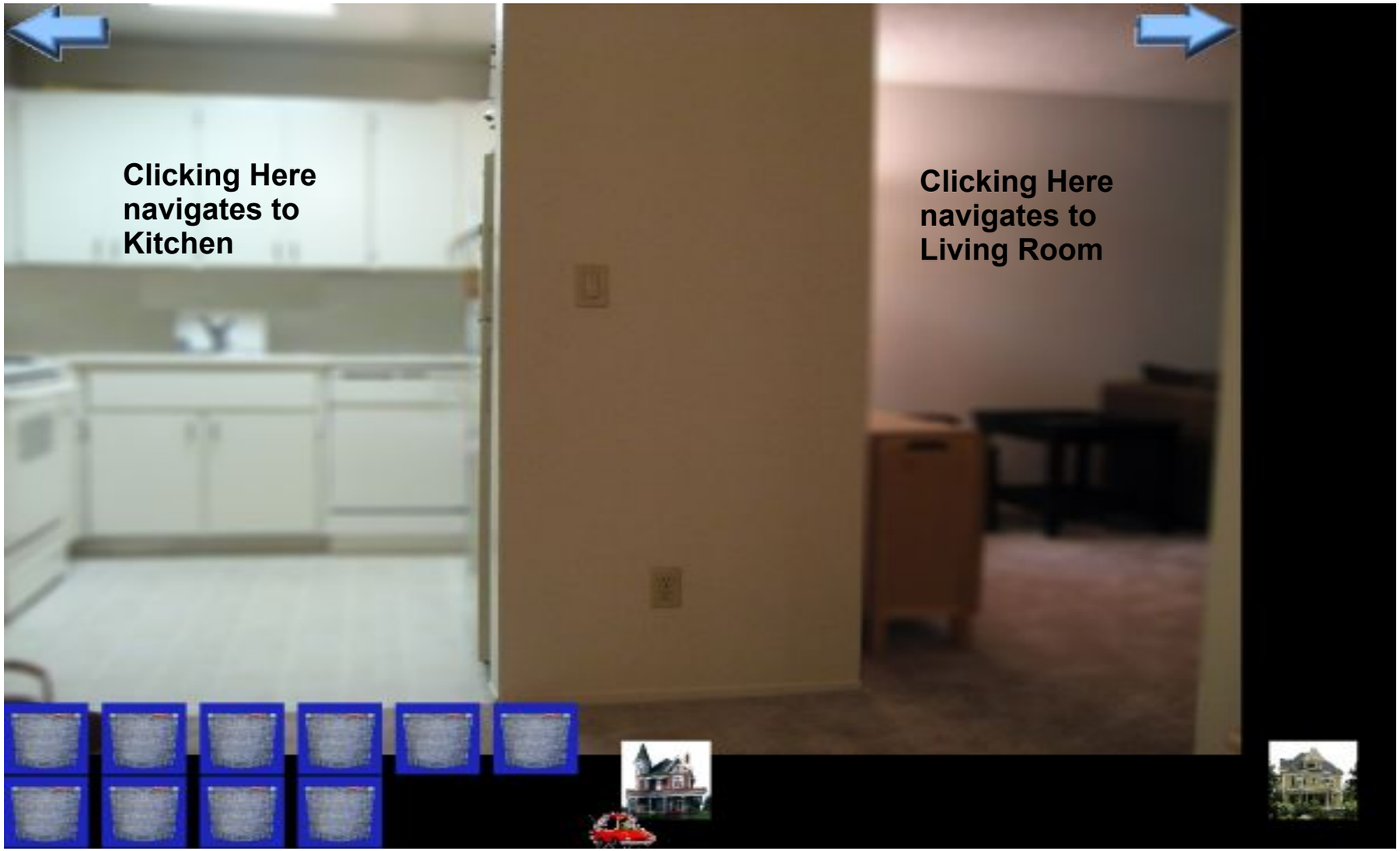
Procedure

5. **Reminding Task (19 min time limit)**
   - Random assignment to Away or Neutral contextual Bias conditions.
   - Participants navigate the environment and collect any object they believe will solve one of their goals; they drag the object to 1 of 12 pockets, then state the intended use verbally.

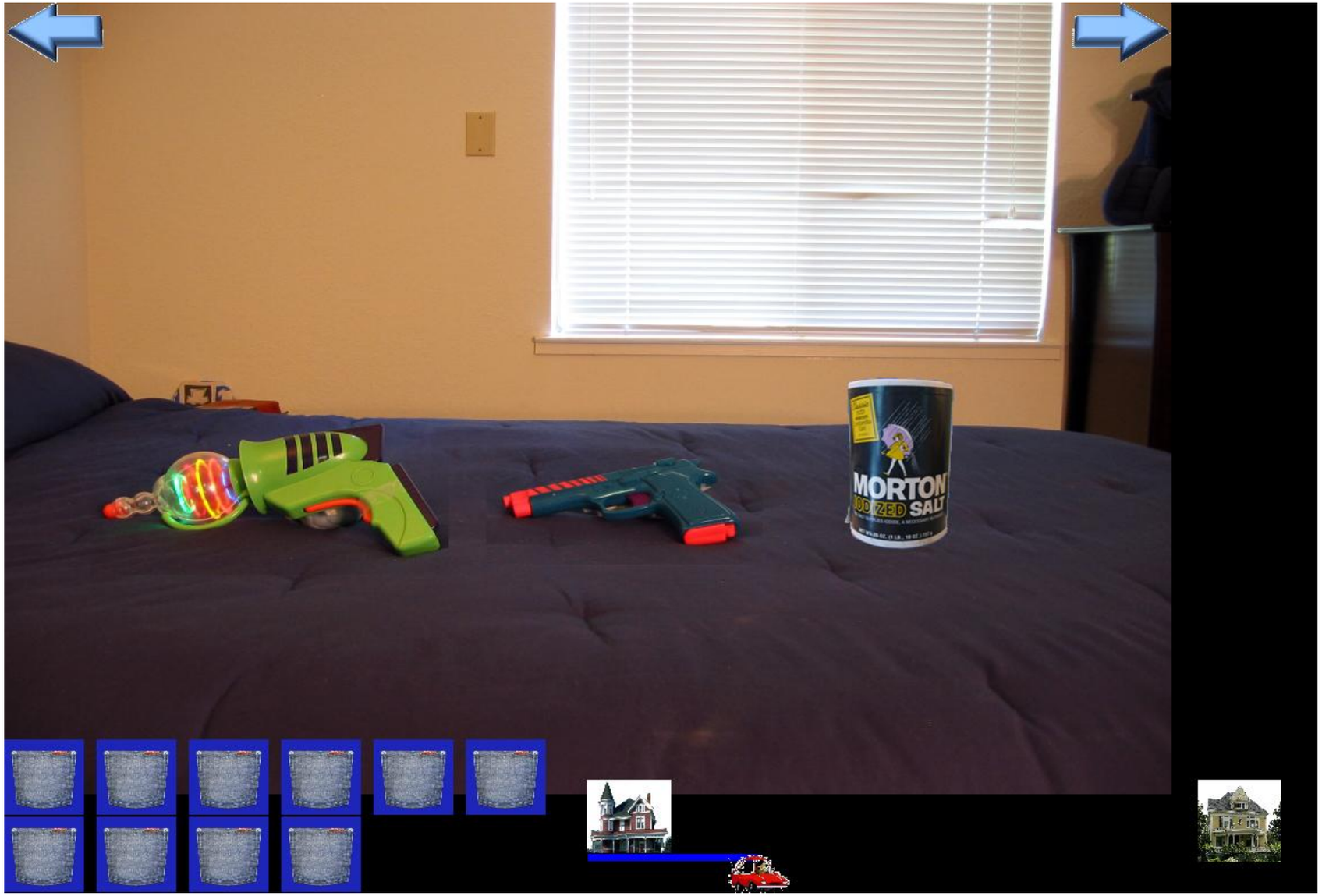
6. **Recall Task**
   - Participants recall as many of the original goals as they can.

7. **Unusual Uses Task (Creativity/Functional-Fixedness)**
   - Participants shown cup, knife and string, then asked to identify different ways each object could be used.
   - Higher number of unconventional uses for each object led to higher creativity score (Harrington et al., 1983; Torrance, 1966).

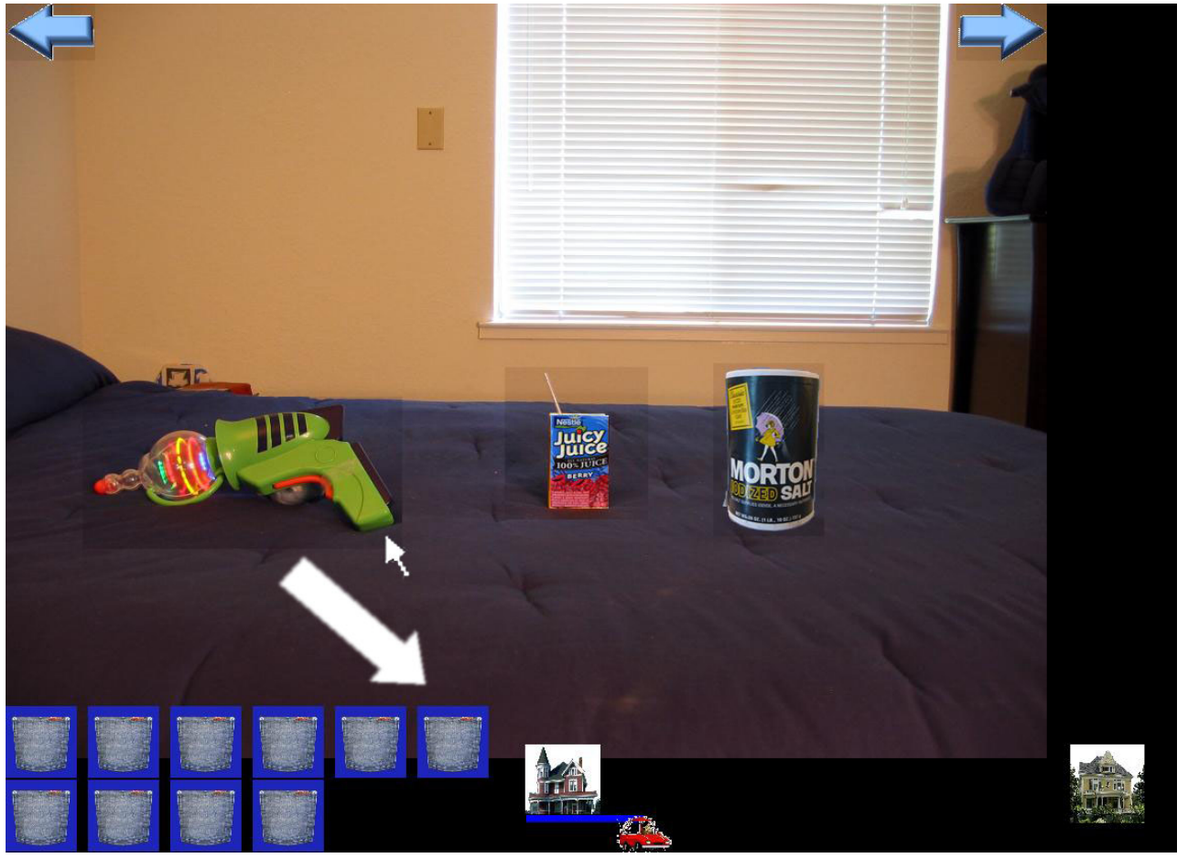
Graphical Environment Management System (GEMS)

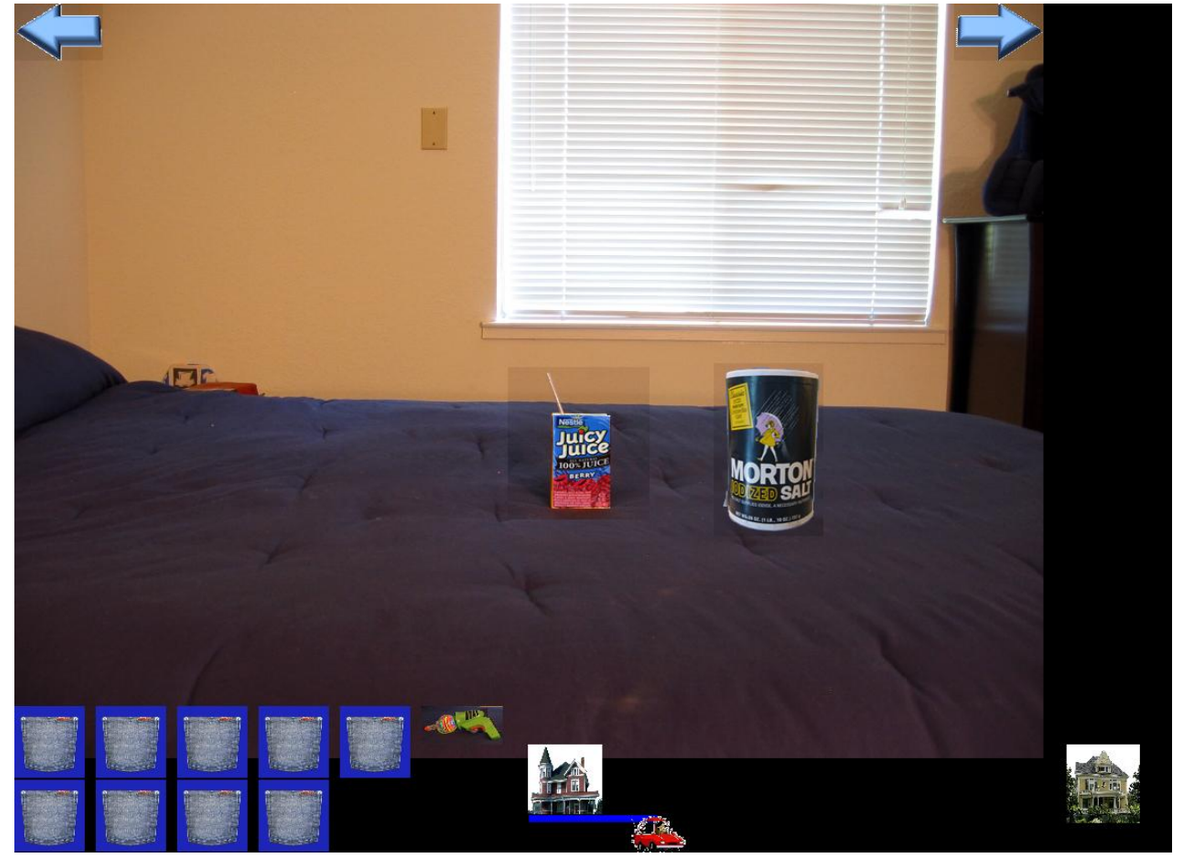


Users can click open entrances to move into different rooms (labels above did not appear in GEMS), and click the arrows to turn in specific directions.

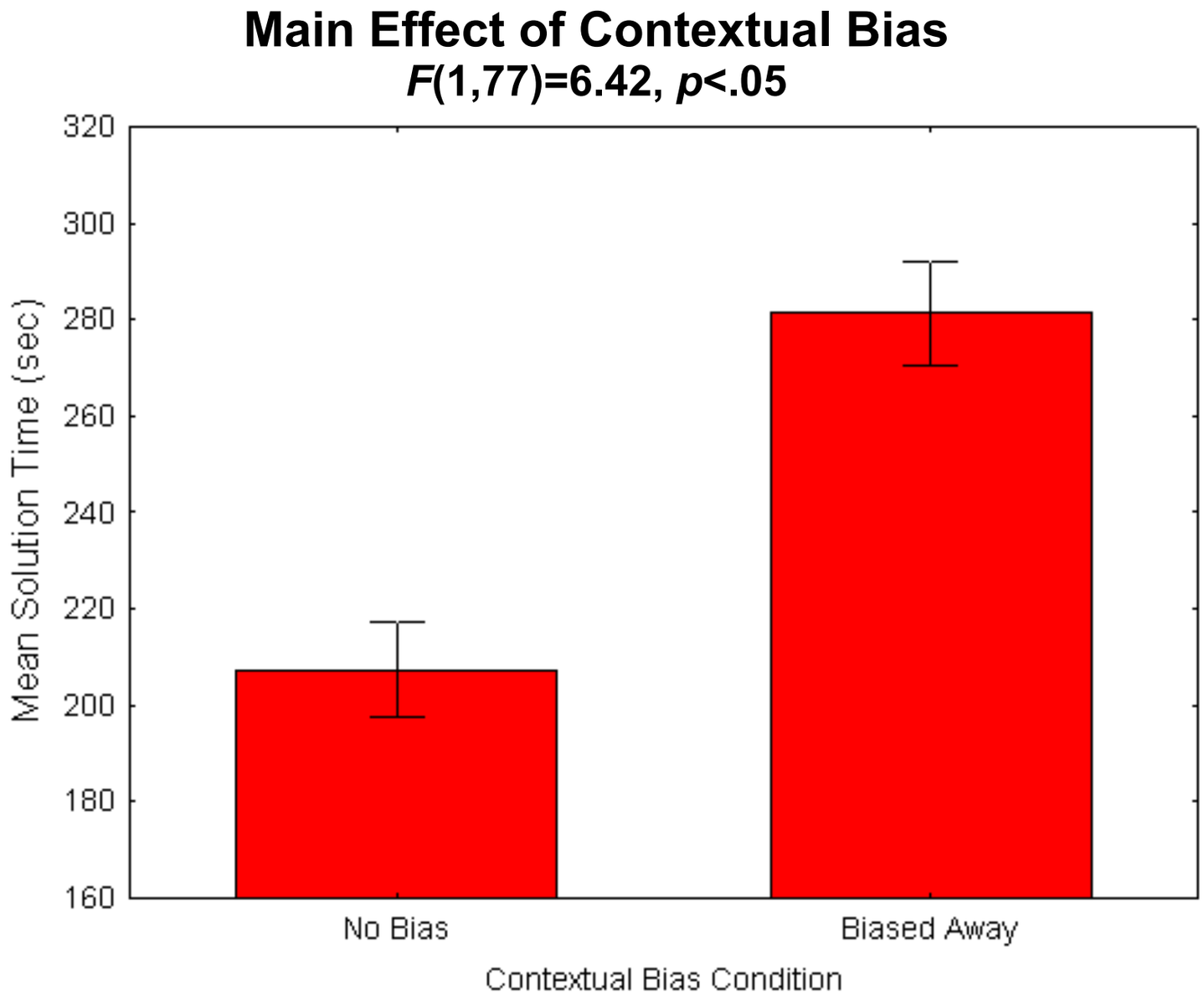


Bedroom, showing light-up gun solution object in the Away Contextual Bias Condition. The presence of another toy gun highlights gun-related properties rather than the lighting ability critical for the goal solution?





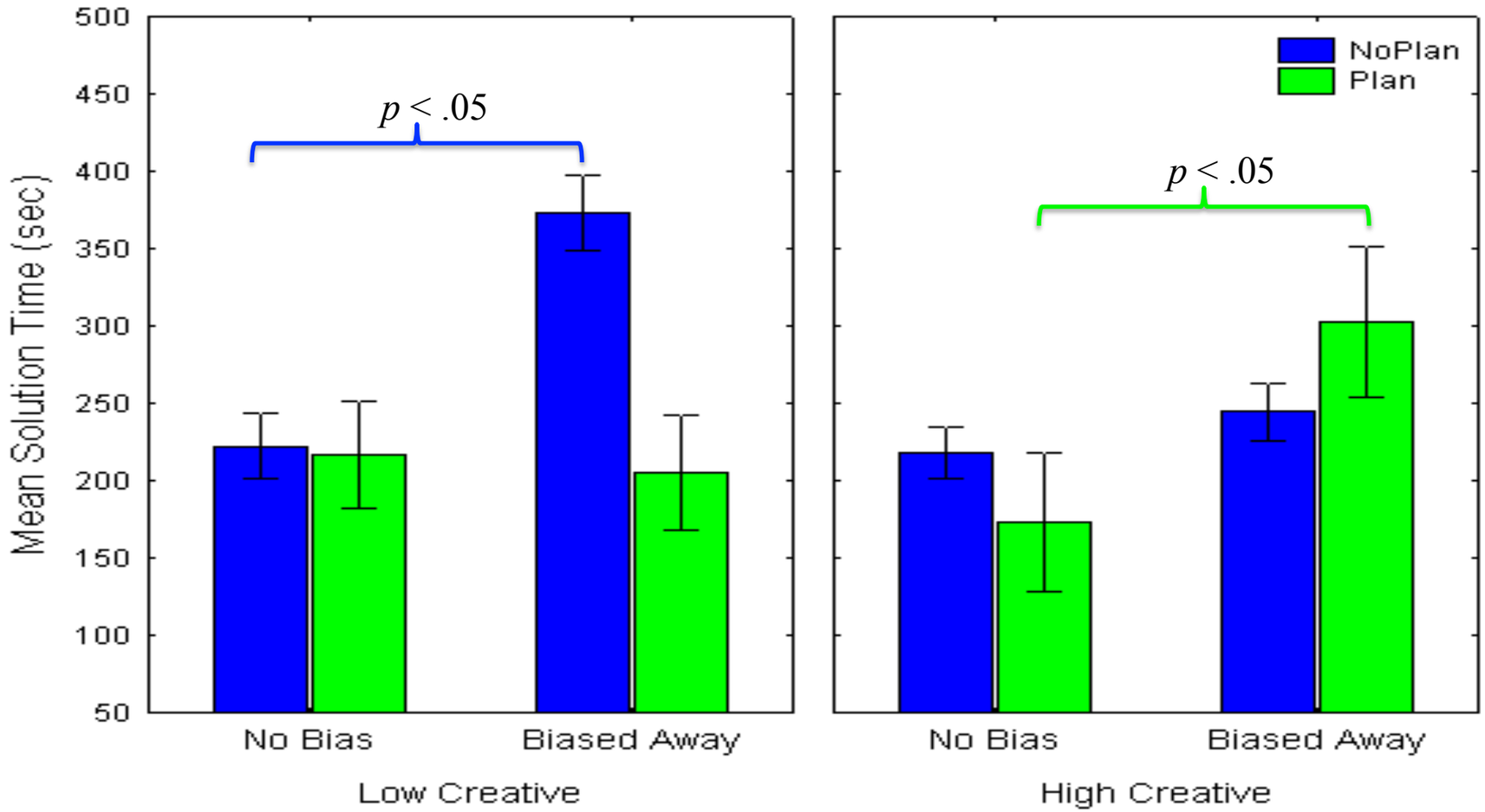
Bedroom (Neutral Bias Condition): Solution objects are selected by dragging them from the environment to one of the *pockets*. Time from object display to selection is recorded. Thus, we stored number of correct remindings and the average time it took to choose solution objects. A red car icon depicts the deadline; task ends when it reaches the right side.



- Participants took longer to notice objects as potential solutions when they were encountered in contexts that highlighted their conventional use (i.e., away from the intended solution in our task).

Contextual Bias X Planning Condition X Creativity Level

***F*(1,77)=5.11,*p*<.05**



- **Left Panel**: Participants who did not plan had slower solution times when the context was biased away. Those who planned were protected from this manipulation.

- **Right Panel**: More creative participants show a complementary pattern in which those who plan show a larger bias effect than those who do not.

Conclusion

- Goals required using objects in unconventional ways. Physical contexts that highlight solution objects' conventional use (Away Bias Condition) increased time needed for object to remind participant of relevant goal.

- Less creative participants that formed plans before the task were protected from the bias manipulation compared to those who did not plan (c.f., Patalano and Seifert 1997).

- But, more creative participants showed an opposite pattern: those who planned were more affected by the bias manipulation than those who did not plan!

- Unlike related studies (e.g., Patalano & Seifert 1997), accuracy effects were not observed. Manipulation affected solution times exclusively.

Conclusions

- Noticing object-based solutions to pending goals may involve an interaction between how goal is stored (e.g., planning type), the context in which objects are encountered, and how willing one is to use objects in unconventional ways.

- Although the present "creativity" (i.e., divergent thinking) measure may represent a personality trait (c.f. Harrington et al., 1983), it may also index one's experience with using objects in unconventional ways. Future training studies may help disambiguate these alternatives.

- Predictive Encoding theory predicts later goal remindings by focusing on how goals are stored (plan/no-plan). However, these results suggest that contextual and individual characteristics such as creativity may interact with goal encoding to predict when participants later notice opportunities to solve their goals.

References

Duncker, K. (1945). *Psychological Monographs, 58,* (5, Whole No. 270).

German, T.P., & Defeyter, M.A. (2000). Immunity to functional fixedness in young children. *Psychonomic Bulletin & Review, 7*, 707–712.

Harrington, D.M., Block, J., & Block, J.H. (1983). Predicting creativity in preadolescence from divergent thinking in early childhood. *Journal of Personality and Social Psychology*, *45*(3), 609-623.

Patalano, A.L. & Seifert, C.M. (1997). Opportunistic planning: being reminded of pending goals. *Cognitive Psychology*, 34(1), 1-36.

Seymour, T., Patalano, A.L., & Seifert, C.M. (1996). *Planning within a virtual environment*. Poster presented at the annual meeting of the Cognitive Science Society, San Diego, CA.

Torrance, E. P. (1966) *Torrance Tests of Creative Thinking: Norms-technical manual*. Princeton, N.J.: Personnel Press.