

# Investigating the Impact of Table Size on Collaborative Problem-Solving

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## ABSTRACT

As interactive tabletop systems become commercially available, questions remain regarding the appropriateness of different design characteristics for different task and user settings. A key open issue, which has ramifications for commercial production and deployment, relates to the appropriateness of different table sizes for different task and user contexts. To address this, a study was conducted of collaborative problem solving involving different table sizes, tasks, and seating arrangements. Preliminary findings reveal important differences in how groups used available space on small and large tables that have implications for the design of digital tabletop interfaces.

## AUTHOR KEYWORDS

Tabletops, User study, Observational study, Table size

## ACM CLASSIFICATION KEYWORDS

[H.5.3]: Collaborative computing — Computer-supported cooperative work.

## INTRODUCTION

Commercially available interactive tabletop systems are beginning to appear. However many open questions remain related to the appropriateness of each of these technologies for different user contexts. The tabletop literature offers some advice on understanding the strengths and limitations of different hardware and software capabilities and different physical form factors for different tasks and user contexts [2, 5]. Yet, few empirical studies exist of these different systems or their design characteristics to provide a solid understanding of the system tradeoffs.

A particularly important design characteristic of a tabletop system, which has important ramifications for both businesses and users, is the size of a table. From the business perspective, a smaller table is cheaper to manufacture and deploy. From the user's perspective, a smaller table occupies less space, and would likely cost less given the business issues discussed above.

However, a small table may not be appropriate for all user contexts. In our experiences studying tables, we have noticed qualitative differences in how people collaborate on large and small tables. People often complain of feeling "crowded" on smaller tables. Our anecdotal findings are in contrast to Ryall et al.'s [2] investigations of collaboration

on different sized DiamondTouch digital tables (80cm and 107cm diagonals). They found little impact of table size on the group activity (a "magnetic poetry" creative task). However, both tables in their study were much smaller than the tables we have used in our work (the largest was 198cm diagonal). Also, the DiamondTouch tables were likely sufficiently large for the number and size of the task materials (i.e. small images containing words or phrases) used in their study. Scott et al. [4] observed that these factors impact the size of tabletop territories established during tabletop collaboration; these factors may have a similar effect on the required table size.

To resolve these issues, we are conducting a multi-part study exploring the impact of table size on collaboration during problem solving tasks. The first phase of this work involves collaboration on different sized conventional tabletops, while the second phase involves collaboration on different sized digital tabletops. This paper discusses preliminary findings from the first phase of the study.

## THE STUDY

To understand how the amount of available tabletop workspace impacts collaboration during open-ended problem solving tasks involving traditional, paper-based media, we conducted an observational study in a laboratory setting.

### Participants and Setting

Thirty-two university students, all paid volunteers, participated in the study. Participants completed the study in pairs. Participants in 9 of the 16 groups were previously acquainted.

The study took place in a office-like laboratory at the University of Waterloo, in which the experimental table (small or large) was placed in the centre of the room. The experimenter sat in the corner of the room to observe and to give instructions as necessary. A video camera was setup beside the experimenter to record the trials.

### Experimental Design

The study used a 2 (table size) x 2 (task) x 2 (seating configuration) mixed design. All groups experienced both table sizes and tasks, but only one seating configuration. The two table sizes used were: small (77cm x 124cm,

146cm diagonal) and large (154.5cm x 124cm, 198cm diagonal). In the different seating configurations, participants either sat across the table from one another, across the 124cm side (across), or they sat at adjacent sides of the table (adjacent). The two tasks used in the study are described below.

### Experimental Tasks

Each group completed two types of collaborative problem solving tasks: storyboarding and travel planning.

**Storyboarding:** In this task, pairs were asked to create a story using a set of 56 photos (9x9 cm each) depicting different people and scenes from one of two popular American television shows: Seinfeld or Friends. Groups were also provided an information sheet with five possible themes upon which they could base their story. A cardboard storyboard (45x45 cm) was provided upon which pairs could build their story. The small table was sufficiently large to accommodate all task materials without overlap.

**Travel planning:** In this task, pairs were asked to create a three-day itinerary for a family visiting a city based on a set of 37 small (12.5x13.5cm), medium (21x21cm), and large (28x22cm) information sheets of attractions, maps, and driving distances. Blank paper and pens were also provided for recording the itinerary. Materials could be accommodated without overlap on the large table, but required overlap on the small table.

### Procedure

Each pair completed two trials during the study, two of one task type (travel planning or storyboarding) followed by two of the remaining task type. Each task was performed on both small and large tables. The order of presentation of the task type and table size was counter-balanced across groups. Pairs were given approximately 20 minutes to complete each trial; however, more time (3-5 minutes) was typically given for the travel planning task, as pairs had difficulties finishing their itinerary in the time allotted. After completing the four trials, pairs participated in a post-experiment interview with the experimenter, which gathered information on their space usage strategies and on their satisfaction with the task processes and outcomes.

### PRELIMINARY FINDINGS

This section presents some preliminary findings of an initial review of the video data. These findings are currently being used to help focus a more in-depth video analysis.

On both tables, participants were very opportunistic in their use of space. Most groups took advantage of the extra space available on the large table to spread the materials out on the table, and often spatially grouped items into different tabletop areas based on some characteristic, such as similar venues in travel planning (e.g., museums, parks, etc.) or people in storyboarding. Most groups often moved items around on both the large and small tables as the task progressed, grouping, piling, categorizing, and discarding.

This manipulation of materials on the table appeared to serve as a form of external cognition, and in particular as a form of cognitive tracing, which refers to the manipulation of objects in the physical (or computational) environment to assist in cognition [4]. For example, one pair created an entire draft of their three-day itinerary on the table before committing it to paper by establishing three columns of information sheets on the table, one for each day of the visit. They shuffled the information sheets around; swapped in and out sheets from a pile of extra materials as they discussed the feasibility and their opinions of the itinerary, and then finally wrote down the plan once they were satisfied. Though no other pair created the entire travel plan on the table, many smaller episodes of such ordering, reordering and categorization were observed on both tables. This type of ordering of the problem directly on the table was (not surprisingly) more common in the storyboarding task, as the final solution had to be created using the photos themselves. In both tasks however, the video review indicated that manipulation of items directly on the table was more prevalent on the large table. We are currently exploring this issue further in our in-depth video analysis.

The video review also indicated that cognitive tracing may manifest differently on the small table: participants appear to do much of their manipulation of task materials above the table. Such in-hand use of materials and the use of piling on the table surface appeared to be coping strategies for the insufficient space on the small table: participants appear to take advantage of the three-dimensional space above the table for managing the large amounts and sizes of the information provided in the travel planning task.

In summary, people used and coped with the available table space differently on each table. The lack of space on the small table resulted in more above-the-table interactions, which has implications for the design of digital table, which typically provide two-dimensional interfaces.

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