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# Pairgrams: Understanding Collaborative Analysis Behavior with Visualization

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## ABSTRACT

We report on our work towards understanding analytic reasoning processes in face-to-face collaborative analysis using visualization techniques. How analysts reason is an active topic of research and in our community we know even less about how a group forms an understanding, insight, and reasons about data. We report on our effort in capturing the richness of reasoning activities through mixed-method approaches and show how Pairgrams—a visualization of interactions with an analytics workspace by pairs of participants—helped us to understand collaborative analysis and reasoning.

## Author Keywords

Collaborative visual analytics, analytic provenance

## INTRODUCTION

Collaborative reasoning is a complex and subtle process that is difficult to analyze with statistical methods. In collaborative reasoning activities, we not only have to understand how each individual arrives at meaning, insight, and what this insight entails; we also have to understand how the collaboration influences this process. Deriving a better understanding of collaborative reasoning activities is critical if we want to build better data analysis tools which support not only taskwork but also better teamwork around visual analytics tasks. We need tools that will help us understand both how individuals reasoned, but also how their reasoning processes influence each others' work. In this paper we report on a visualization tool, Pairgrams, which we designed to help us answer the following main questions: what were the temporal processes of search and analysis activities of two analysts sharing a workspace and how did their analysis activities build on each other.

## COLLABORATIVE ANALYSIS SCENARIO

Pairgrams were developed as part of the analysis of a user study on collaborative visual analytics [3]. In this user study 15 pairs of analysts solved the VAST 2006 challenge [1].

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They used Cambiera [2], a collaborative visual analytics tool, and searched for and read the contests' documents on a Microsoft Surface multi-touch tabletop display. From the perspective of this research, Cambiera is much like a query interface: users search for documents, and then read the documents that they find. In the VAST challenge some documents are helpful to solving the analytics task as "key" documents; others are "distracters." It is interesting to understand when team members found critical documents and how this information influenced the team's solution to the task. To understand the collaborative analysis behaviors of team members in this study, we collected a wealth of data including field notes from direct observation, video+audio data, and system logs. The Pairgram visualization was developed to form a better understanding of search and analysis activities and was used in conjunction to a two-pass video- and audio-coding in which the analysis activities were further categorized [3].

## PAIRGRAMS

Pairgrams were designed to help us visually understand log files in the context of observational data. We specifically analyzed the patterns of reading and searching in the process of the collaborative analysis. Observational data alone was not sufficient to understand which documents participants searched for, read, and passed to each other. Yet, the log file data alone did not provide sufficient context to understand the questions that teams were attempting to solve at any given moment. For example, during the study, some users read documents two or three times and passed documents to each other; the log files did not provide us with details of whether participants were re-visiting a hypothesis, verifying data, or asking a partner for help. We wanted a visualization that would help us understand participants' behaviors, would let us tease them apart, and help us understand the ways that pairs worked together on their tasks. The design was influenced by several major criteria. We wanted Pairgrams to help us see:

- temporal trends of document search and read activities
- distinguishable encodings of each person's activities
- repeated actions—were documents re-read and searches re-issued and when?
- which documents and keywords were successful in finding key documents, rather than distracters?

As the Cambiera study covered pairs of people working together, Pairgrams are meant to visualize two users, working together. We refer to these two users as Bob and Gina.

