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# STRUCTURED OBSERVATION TO SUPPORT INTERACTION DESIGN

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# Structured Observation to Support Interaction Design

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**ABSTRACT**

The structured observation method combines elements of a controlled experiment to facilitate comparison, with a realistic composition task to enhance external validity. Rather than test hypotheses, per se, we observe behavior in a systematic way, which helps us identify and better understand the similarities and differences that obtain among users and thus better inform the design of interactive systems.

**INTRODUCTION**

Hypothesis testing experiments (Cook & Campbell, 1979) are designed to determine cause and effect, by eliminating (or controlling for) extraneaous causes. We begin with an explicit hypothesis and test whether it holds.

However, many of the great discoveries in science stem from surprises, from experiments that "went wrong". But they went wrong in a particular way. Alexander Fleming famously discovered penicillin when he left the lid off of a Petri disc containing a Staphylococcus bacterial culture, which was then contaminated with a blue-green mold. He also noticed a sort of halo of inhibited bacterial growth around the mold and concluded that the blue-green mold released a substance that killed the bacteria. Through careful additional experiments, he identified that substance, which we call penicillin. What is important, though, is not just that this was a surprise, but that he was prepared to see that it was surprising and draw appropriate conclusions. He had what Louis Pasteur had earlier refered to as a "prepared mind". In 1854, Louis Pasteur said "Dans les champs de l'observation le hasard ne favorise que les esprits préparés", which can be translated as: "In the fields of observation, chance favors only the prepared mind".

Yet when we learn to perform 'scientific' experiments in the context of HCI, we usually go in the other direction… We talk as though we start with a clear hypothesis and test it. But sometimes, we need to discover the phenomenon — and we are far more likely to discover something if we have an idea of what to expect and what is, in contrast, surprising.

Here, I'd like to propose a technique that I call "structured observation", in which the goal is to benefit from the rigor of experiment design, but apply it to the problem of discovering phenomena, rather than determining their causal characteristics.

Now, of course, this is not particularly new, in the sense that we often structure how we observe. Techniques such as Contextual Inquiry, etc. allow us to systematically observe and understand what people do, drawn from anthropology.

But here, our goal is not to "just" understand what people do, but to understand in the context of how to design something better. We need to be able to compare different situations and ....

One of the major problems we face in trying to understand messy, creative behavior is to uncover phenomena that we can study rigorously.

We have problems measuring creativity, we have problems verifying cause and effect, we have the benefits of high levels of external validity when we observe users "in the wild", but a correspondingly difficult time figuring out what is really going on.

If one is trained in a natural science such as experimental psychology, one starts with a relatively formal theory, which is operationalized into a set of tasks, with corresponding measures. We then conduct controlled experiments, in which we attempt to control, either through systematic variation of potentially relevant factors, or through randomization, the various factors that help us to establish cause and effect.

If we look at my graph of the "back-and-forth" progress between theory and empirical work (cite), this is the path that starts at theory and ends at empirical work, and then returns to verify the theory. These types of studies tend to focus on quantitative performance measures, deal with formal models such as Fitts law, and are the basis for predicting (and sometimes controlling) behavior.

However, what happens when we start at the other end of the graph, when we start from empirical observation? Ethnographers, archeologists, geologists, and astrophysicists all begin by observing naturally occurring phenomena, in a real-world setting, and then form theory, after which they conduct additional observations to test the theory.

The research methods in these fields, at least in the social sciences, tend to be viewed as "softer" and more qualitative. Researchers observe behavior "in situ" and offer theories to describe that behavior, which they then seek to see in other situations. They may also use "participatory design" methods that emphasize generating new ideas (or new theory).

What happens when we combine the research style of the controlled experiment to the observation-led style of research that we see in some parts of HCI? Basically, we can apply many of the same techniques as in an experiment to maximize the comparability of the different behavior being observed, but for a different goal. Instead of seeking cause-and-effect explanations, we're trying to identify new phenomena and to characterize them. If we can see that a particular result is systematically different in these different situations, even if the results are highly qualitative and we don't have a clean performance measure, we can articulate a hypothesis, which can then lead to a theory-driven style of experiment. Thus, using the techniques of counterbalancing, creating equivalent tasks, within-subjects designs, etc. we can create highly comparable, but qualitative, opporutnities to observe behavior.

This is somewhat like the "ethnography" vs. "ethnomethodology" argument … but using experimental methodology instead. We take advantage of the rigor of the methodololgy, but apply it for a different reason with different outcomes and research contributions.

This approach can lead us to:

- figure out what is 'surprising'
- identify new, replicable phenomenon
- identify new measures of that phenomenon
- lead to definitiions of tasks (operationalizations) that can be used to systematically study cause-and-effect relationships (in a subsequent experiment)

For example, in Adrien's graphic design experiment, we create an artifical task that we give to people, but in a realistic setting, with a real jury. We build in a set of activities that are similar in type and time, but are varied systematically according to what we think might make a difference. We use a basic within-subjects design, with a control condition to establish basic behavior for each subject, and introduce some

Fleming recounted that the date of his discovery of penicillin was on the morning of Friday, September 28, 1928.[19] It was a fortuitous accident: in his laboratory in the basement of St. Mary's Hospital in London (now part of Imperial College), Fleming noticed a Petri dish containing Staphylococcus plate culture he mistakenly left open, was contaminated by blue-green mould, which formed a visible growth. There was a halo of inhibited bacterial growth around the mould. Fleming concluded the mould released a substance that repressed the growth and lysing the bacteria. He grew a pure culture and discovered it was a Penicillium mould, now known to be Penicillium notatum.

On December 7, 1854, as dean of the brand new Faculty of Sciences at Lille, Louis Pasteur gave the opening speech in which he said, "in the fields of observation, chance only favours the mind which is prepared..." Pasteur was speaking of Danish physicist Oersted and the almost "accidental" way in which he discovered the basic principles of electro-magnetism.

Much scientific experimentation occurs in the realm of half-knowns. The scientist conducts physical experiments in an attempt to prove a genuine hypothesis. It is at the point when none of the experiments prove accurate that the chance of making an accidental discovery is amplified. However, it is not during this accidental moment that an actual discovery occurs: the scientist must be able, with prepared mind, to interpret the accidental observation and situate the new phenomena within his existing work.

#### Chance Favoured Louis Pasteur's Mind

Louis Pasteur's statement, "chance only favours the mind which is prepared" was not only a scientifically clever phrase, it was a principle that would define his career. In the summer of 1856, M. Bigo, a beetroot alcohol manufacturer from Lille approached Pasteur for advice on failures he had been experiencing at his factory. Acknowledging the ability to play an important role in the community, as well as acquiring new knowledge to share with his colleagues, Pasteur gladly offered his services. For the next period he would visit the factory daily, returning to his laboratory to view the beetroot juice globules with the microscope and conduct experiments with the stove. Initially he had thought there was some significant difference between the filtered and non-filtered beetroot juice. Later in his notes he would write "error" and "erroneous," criticizing himself.

Pasteur then "by chance" came upon a significant observation: through the microscope: he observed that healthy fermentation produced round globules and they lengthened as alteration began, becoming very long and slender at the point they became lactic. This allowed manufacturers to observe the health of fermentation during their manufacturing processes and helped avoid common failures during fermentation.

Pasteur wondered if this new observation was a general fact and was applicable to all types of fermentation. His work here became the driver for decades of investigation and experiments. Unknown to him at the time, Pasteur had begun down a path that would develop the new science of Microbiology and at the same time revolutionize Chemistry.

We benefit from using the principles of control from controlled laboratory experiments, but not with the goal of establishing cause & effect relationships but rather to aid in our observation, to help us see phenomena when they emerge, to have some idea of what is correlated with what.

### STRUCTURED OBSERVATION METHOD

We describe our collaboration with a professional composer to create an hour-long composition task for expert composers. We then describe *Polyphony,* a unified interface to interactive paper and professional music composition software that supports all phases of the composition process.

We describe our structured observation study in which 12 professional composers and musicians use *Polyphony* to create a complete electronic accompaniment to a well-known composition. We present our results, both on the composition process and the *Polyphony* user interface, and discuss how the structured observation method helps us understand real-world, expert-level creative processes. We conclude with a discussion of directions for future research.

We conducted a *structured observation study* of 12 expert composers who each composed an electronic accompaniment to Webern's well-known instrumental piece. We focused on: similarities and differences in composition practices, reflections about their own composition processes, and feedback as to the benefits of integrating interactive paper with their usual computer-based composition tools.

### CONCLUSION

We introduced a structured observation method that produced 12 comparable snapshots of the composition process, and enabled us to identify how composers both adapt and appropriate paper, pen-based interfaces and computer tools.

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