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Research Methods: Process and Methods

Hans Gellersen

Learning Goals

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- Understand
  - What's involved in the process from a research idea to an outcome
  - Why questions and methods are central to research, and that methods follow questions
  - The characteristics of surveys, case studies, ethnography and experiments as four fundamental methods in empirical research
- Be able to
  - Describe different methods for empirical research
  - Choose an appropriate method for a study

Research Process

Something you want to research

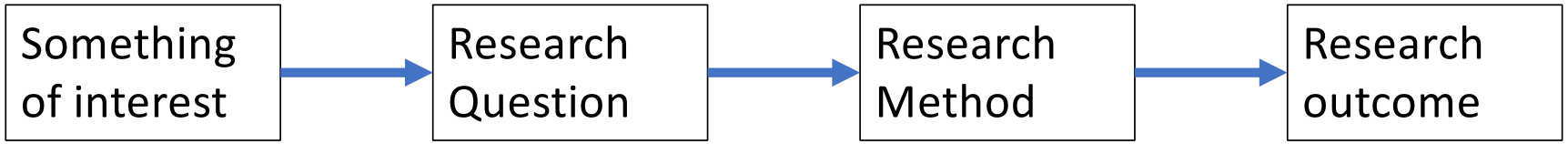
An issue, a problem, an idea, …

A research outcome

New knowledge about the issue
An improvement of something

- Research problems or ideas are usually vague and open-ended at the start
  - Most problems are too big to be completely solved and need breaking down
  - Many problems are wicked: they never go away but we want improvement
  - The initial questions that describe what we want to research are usually far too broad to be put into action

Research Process



Problem, idea, General aim

Must be specific *Operationalisable*

Systematic way of addressing a RQ

New knowledge Improvement of sth.

- Research questions define <u>what</u> will be studied
  - Given a larger problem or aim, what specific knowledge do we seek?
- Research methods define <u>how</u> something will be studied
  - Given a question, what is an appropriate method to generate the knowledge?

Questions and Methods

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- Research questions are central to research as they define the specific knowledge that we seek
  - A project or study can have one or more RQs that address a general aim
  - They provide focus on a specific contribution in the context of a larger problem
- Research methods are central to research as they define how a question will be addressed
  - Methods provide rigour and ensure that knowledge is generated in a systematic way
  - For any question, this means choosing an appropriate method

Recap: Types of Questions

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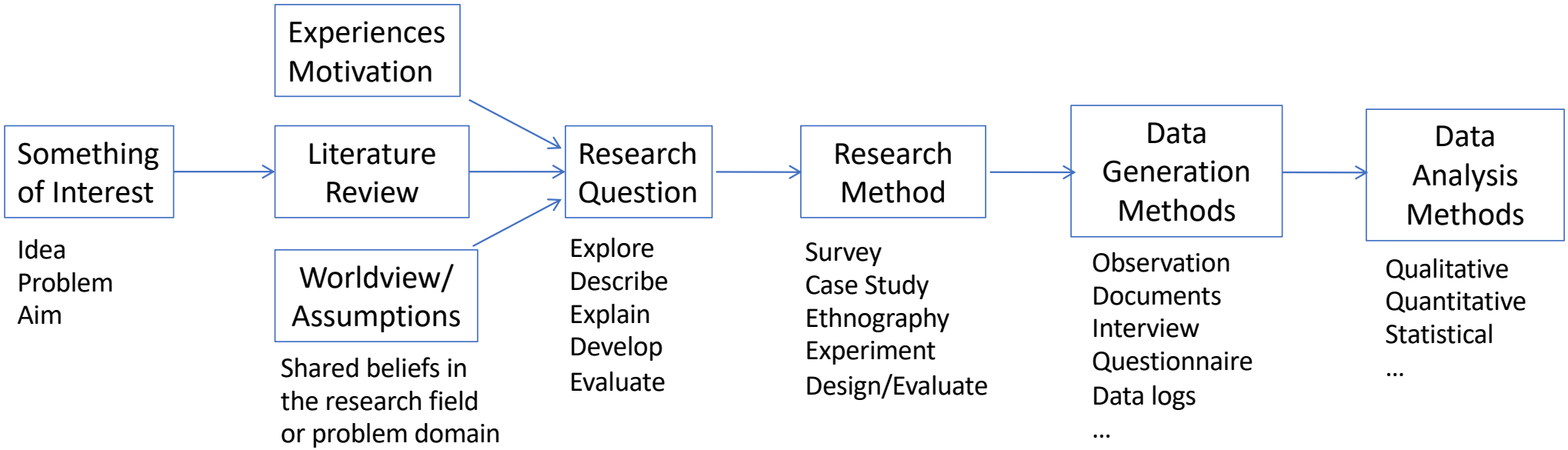
Type of Study	Type of Question	Examples
Descriptive	Exploratory	Existence: Does X exist? Description: What is X like? What are properties of X? Classification: What are categories of X?
	Base-rate	Frequency/distribution: How often does X occur? Process: How does X normally work?
Relational	Relationship	Co-occurrence: does X occur when Y occurs? Correlation: are X and Y related?
Causal	Causality	Specific: Does X cause Y? Does X prevent Y? General: What causes Y? Comparison of causes: Does X or Z cause more Y? Interaction of factors: Does X or Z cause more Y, when A but not when B?

Model of a Research Process

(based on B.J. Oates, “Researching Information Systems and Computing”)



“Methodology”

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- “A system of methods used in particular area of study or activity” (Oxford Dictionary)
- Philosophy of research: “how we come to know”
  - The systematic way which we can gain knowledge
  - Different expectations in different fields (community of practice)
- In (the design of) research projects: how the research will be done
  - Choice of overarching approach and research methods
  - Details of procedure, and of data collection and analysis

“Research Method”

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- Principally different approaches or frameworks for carrying out research
- “Classic” empirical research methods
  - Surveys
  - Case studies
  - Ethnography
  - Experiment
- There are other general types of research approach
  - e.g. “Action Research”, “Design Research”
- The term is often also used for specific methods used in research
  - e.g. Focus Group, Experience Sampling, Sentiment analysis, …

Process and Methodology - Key Points

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- Questions and methods are central to the design of research projects
  - Questions define what will be studied, and methods define how
  - Method follows question: first choose your question, then an appropriate method for addressing it
  - For any question, choose one research method; if you think you need to combine different research methods, you probably have diff. questions
- Methodology and method are not the same
  - Method refers to different types of research approach
  - Methodology refers to how the research in a project will be done, including the choice of research method, and all details of study design

Empirical Research Methods

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Method	Focus
Survey	getting the same data for many individuals/instances
Case studies	understanding one instance in depth
Ethnography	people and practices in specific settings
Experiment	causes and effects

Survey Research

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- Examples?

Survey Research

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- Purpose
  - Study characteristics of a broad population of individuals
  - Getting same kind of data from large number of people
  - Usually to answer base-rate questions
    - what are normal patterns of occurrence of something we are interested in
- Defining characteristics
  - Selection of a representative sample from a well-defined target population
  - Data collection from individuals in standardised manner
  - Quantitative data analysis

Survey Research: Example

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Online Everywhere: Evolving Mobile Instant Messaging Practices

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ABSTRACT
In this paper we report on the results of a large scale user survey investigating the status setting and interruption management behavior of *mobile* instant messaging (IM) users with *existing* systems. The motivation for this study was to inform the design of interface tools that support users by setting contextually appropriate awareness messages. Our results demonstrate that many desktop IM practices have been appropriated by mobile laptop users, but in the face of increasingly situated computer usage and an "always online" culture, several frictions are emerging between desktop and mobile practices. We find that common assumptions about IM users and the established awareness cues are failing and users are frequently embarrassed and interrupted with negative and sometimes threatening consequences.

Author Keywords
Instant Messaging, IM, Mobile Computing, Presence, Online Status, Awareness, Location Disclosure, Privacy

their buddies. Different implementations, extensions, and services often modify aspects of this basic framework.

IM is not the first example of a system that provides awareness cues. Similar systems have been providing insight into the physical context of distributed communities of practice [20] since at least 1971 [18]. Early examples include the Unix

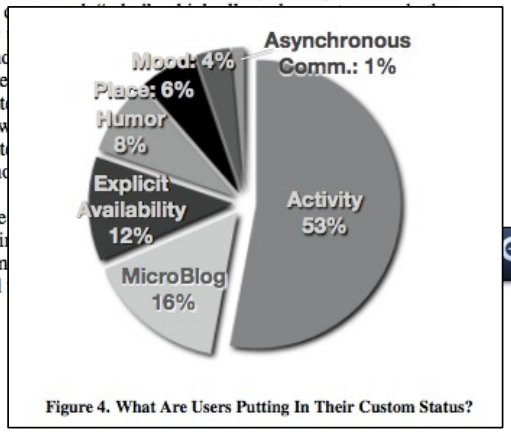

Figure 4. What Are Users Putting In Their Custom Status?

- How do mobile IM users use status settings to manage interruptions?
  - Base-rate questions to inform design of new tools
- Online survey
  - Advertised locally
  - Questionnaire with 53 questions
  - 604 respondents
  - 447 eligible
  - N=384 completed the survey

Survey Research: Use in Computing

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- Primary method in research areas concerned with practice and use
  - Technology adoption, use of information systems
  - Software engineering and management practices
  - Application fields with broad populations, e.g. Computing in Education
- Common in ‘support roles’
  - Survey existing situation to inform development of novel system
  - Not to be confused with literature review (often called lit. survey)
- Cheap to do but also often poorly designed
  - Tagged on to projects to collect user feedback
  - Poorly designed questions

Survey Research: Sampling

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- Sampling = selecting units for a study, from a larger population of interest
- Central concern in the design of Surveys, as the aim is to generalise to a broader population
- Probabilistic sampling
  - Maximise chances that the sample will be representative
  - Random, systematic, stratified
- Non-probabilistic sampling
  - Pragmatic choice when probabilistic sampling not feasible or necessary
  - Purposive ('hand-picked'), self-selection, convenience
- What sample size?
  - Target population size, accuracy range, confidence level

Survey Research: Data Collection

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- "Survey instrument"
  - The method for data collection from individuals
  - Typically a questionnaire
  - Can be other data collections methods (interviews, documents)
- Questionnaire design
  - Such that all respondents understand questions in the same way
  - Closed and open questions
  - Rating scales
  - Validation before actual use in a survey

Survey Research: Pros and cons

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+ Wide and inclusive coverage of people (or other units of analysis)
+ Produce a lot of data in short time at low cost (e.g., survey monkey)
+ Good for what can be counted and measured and reliably asked

- Lack of depth (instead focused on breadth of coverage)
- Snapshot in time
- What people say they do is not necessarily what they actually do (people often have poor introspection on their practices)
- Survey data can only show associations, but not establish cause-effect

Case Study Research

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- Purpose
  - Study one instance of the ‘thing’ we are interested in, in depth
  - Getting a lot of data for one specific case
  - Answer questions of *how* and *why* phenomena occur in situations, where the *context* is expected to play role
    - The complex relationships, processes and mechanisms in a real-life case
- Defining characteristics
  - Purposive sampling: select cases that are most relevant to the study
  - Focus on depth rather than breadth
  - Holistic study, using different sources of data

Case Study Research: Example

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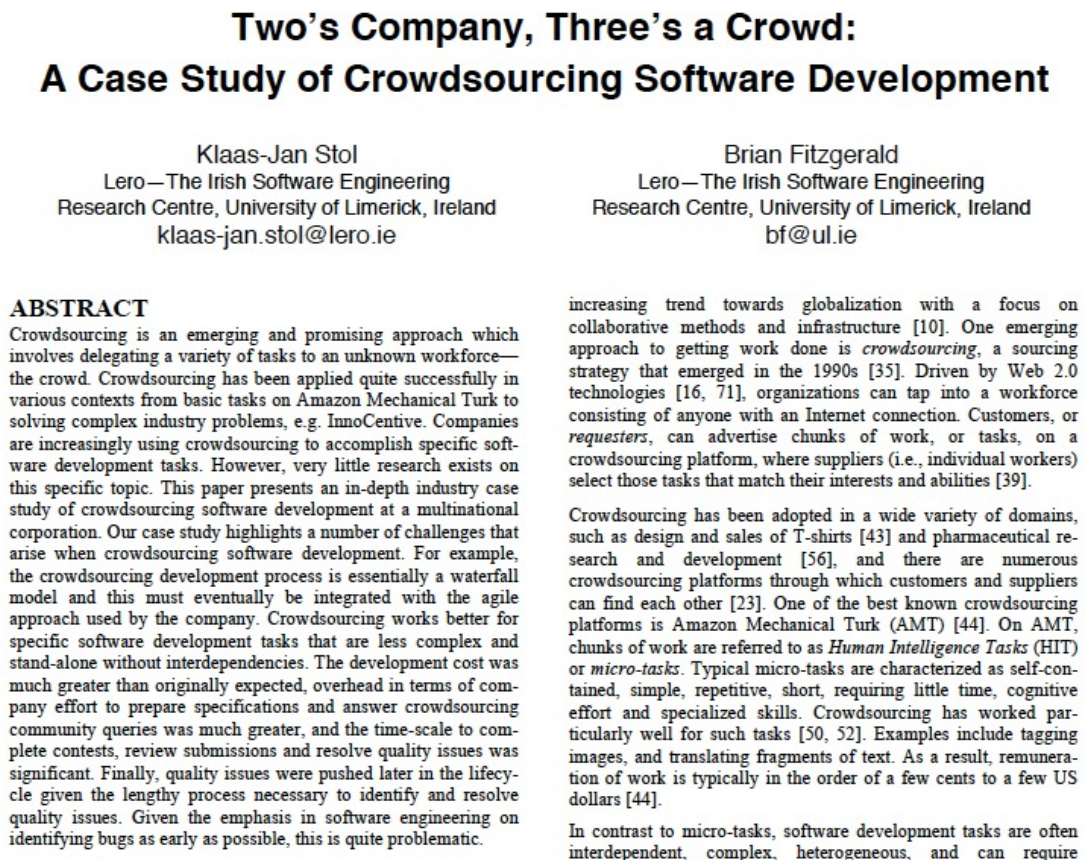

Two's Company, Three's a Crowd:
A Case Study of Crowdsourcing Software Development

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ABSTRACT

Crowdsourcing is an emerging and promising approach which involves delegating a variety of tasks to an unknown workforce—the crowd. Crowdsourcing has been applied quite successfully in various contexts from basic tasks on Amazon Mechanical Turk to solving complex industry problems, e.g. InnoCentive. Companies are increasingly using crowdsourcing to accomplish specific software development tasks. However, very little research exists on this specific topic. This paper presents an in-depth industry case study of crowdsourcing software development at a multinational corporation. Our case study highlights a number of challenges that arise when crowdsourcing software development. For example, the crowdsourcing development process is essentially a waterfall model and this must eventually be integrated with the agile approach used by the company. Crowdsourcing works better for specific software development tasks that are less complex and stand-alone without interdependencies. The development cost was much greater than originally expected, overhead in terms of company effort to prepare specifications and answer crowdsourcing community queries was much greater, and the time-scale to complete contests, review submissions and resolve quality issues was significant. Finally, quality issues were pushed later in the lifecycle given the lengthy process necessary to identify and resolve quality issues. Given the emphasis in software engineering on identifying bugs as early as possible, this is quite problematic.

increasing trend towards globalization with a focus on collaborative methods and infrastructure [10]. One emerging approach to getting work done is *crowdsourcing*, a sourcing strategy that emerged in the 1990s [35]. Driven by Web 2.0 technologies [16, 71], organizations can tap into a workforce consisting of anyone with an Internet connection. Customers, or *requesters*, can advertise chunks of work, or tasks, on a crowdsourcing platform, where suppliers (i.e., individual workers) select those tasks that match their interests and abilities [39].

Crowdsourcing has been adopted in a wide variety of domains, such as design and sales of T-shirts [43] and pharmaceutical research and development [56], and there are numerous crowdsourcing platforms through which customers and suppliers can find each other [23]. One of the best known crowdsourcing platforms is Amazon Mechanical Turk (AMT) [44]. On AMT, chunks of work are referred to as *Human Intelligence Tasks* (HIT) or *micro-tasks*. Typical micro-tasks are characterized as self-contained, simple, repetitive, short, requiring little time, cognitive effort and specialized skills. Crowdsourcing has worked particularly well for such tasks [50, 52]. Examples include tagging images, and translating fragments of text. As a result, remuneration of work is typically in the order of a few cents to a few US dollars [44].

In contrast to micro-tasks, software development tasks are often interdependent, complex, heterogeneous, and can require

- What are the challenges when companies use crowdsourcing in software development?
  - Studying complex situation
- Case study in one company
- Collecting diverse data
  - Workshops at the company
  - Interviews
  - Document analysis

Case Study Research: Example

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From User-Centered to Adoption-Centered Design: A Case Study of an HCI Research Innovation Becoming a Product

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ABSTRACT

As we increasingly strive for scientific rigor and generalizability in HCI research, should we entertain any hope that by doing good science, our discoveries will eventually be more transferrable to industry? We present an in-depth case study of how an HCI research innovation goes through the process of transitioning from a university project to a revenue-generating startup financed by venture capital. The innovation is a novel contextual help system for the Web, and we reflect on the different methods used to evaluate it and how research insights endure attempted dissemination as a commercial product. Although the extent to which any innovation succeeds commercially depends on a number of factors like market forces, we found that our HCI innovation with user-centered origins was in a unique position to gain traction with customers and garner buy-in from investors. However, since end users were not the buyers of our product, a strong user-centered focus obfuscated other critical needs of the startup and pushed out perspectives of non-user-centered stakeholders. To make the research-to-product transition, we had to focus on *adoption-centered design*, the process of understanding and designing for adopters and stakeholders of the product. Our case study raises questions about how we evaluate the novelty and research contributions of HCI innovations with respect to their potential for commercial impact.

its findings are generalizable. Yet there are numerous debates and disagreements within HCI about what constitutes an adequate systems evaluation [8,22]. Some scholars have even claimed that the bar for evaluation at UIST, CHI, and other HCI publication venues is increasingly unrealistic for systems papers [1,14] by insisting on having results from controlled studies or large cohorts of representative users.

Since HCI is still an evolving field that is striving to bridge multiple disciplines, debates and disagreements about adequate system evaluation and what makes a system successful

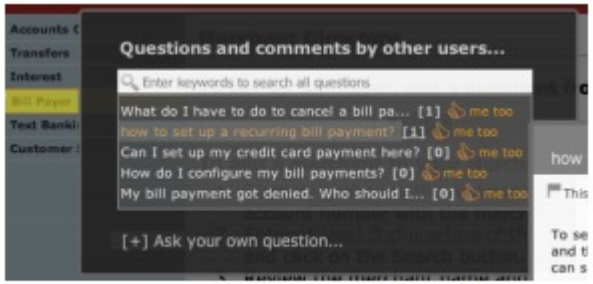

Figure 1. The LemonAid retrieval interface.

ers usually lack the knowledge, resources, connections, expe-

- How does an innovation in HCI become a product?
  - Studying a complex process
- Case study of one specific innovation
  - LemonAid interface for retrieval of contextual help
  - Retrospective analysis of the process from idea to product

Case Study Research / Grounded Theory

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- Researchers working on case studies sometimes use a *Grounded Theory* approach
  - Instead of starting with a theory about the phenomena that are studied, researchers start by collecting data
  - Iterative coding of categories, themes, and concepts
  - Rigorous process to form theories (explanations) that are grounded in the data that was collected
- Warning: just collecting data and seeing what emerges is not research
  - Some researchers claim to use grounded theory to try and justify ill-formed research that has not been though through

Case Study Research: Use in Computing

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- Widely used in areas of computing that research development, implementation and use of systems in organisations
  - Information systems, software engineering
  - Studies in specific application fields (education, health etc)
- Computing research often has case study characteristics
  - Use of a concrete case to demonstrate or evaluate a system
  - Deployment of systems into a complex situation to understand how it works ‘in context’
  - This is not really case study research: the focus is not on the specific cases as exemplar; cases serve as means to focus the research

Case Study Research: Pros and cons

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+ Insight into complex situations, where it is difficult to study different factors in isolation
+ Appropriate for situations where the researcher has little control over events
+ Can provide in-depth understand of how phenomena occur
+ Can reveal cause-effect relationships

- Methodologically open-ended: no set rules or standards to follow
- Data collection and analysis more open to interpretation
- Access to case studies can be difficult and time-consuming

Discussion

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- General aim: to understand transmission of coronavirus
- Question 1: How many people are currently infected in the UK?
- Question 2: What is the role of in-flight transmission on long-haul flights in the spread of the virus?

- How can we study these questions?

Ethnography

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- Purpose
  - Study people and their practices
  - Observing what people do in a particular setting / community
  - Answer questions about cultural practices and how people make sense of their situation
- Defining characteristics
  - Observation in the field, taking part in the life
  - Researcher is the instrument: interviews, observations and field notes
  - Avoid pre-existing theory and focus on how people themselves make sense of their interactions and practices

Ethnography: Roots in Anthropology

- B. Malinowski, Argonauts of the Western Pacific (1922)
- the goal of the ethnographer is "to grasp the native's point of view, his relation to life, to realize *his* vision of *his* world"

Ethnography: Example

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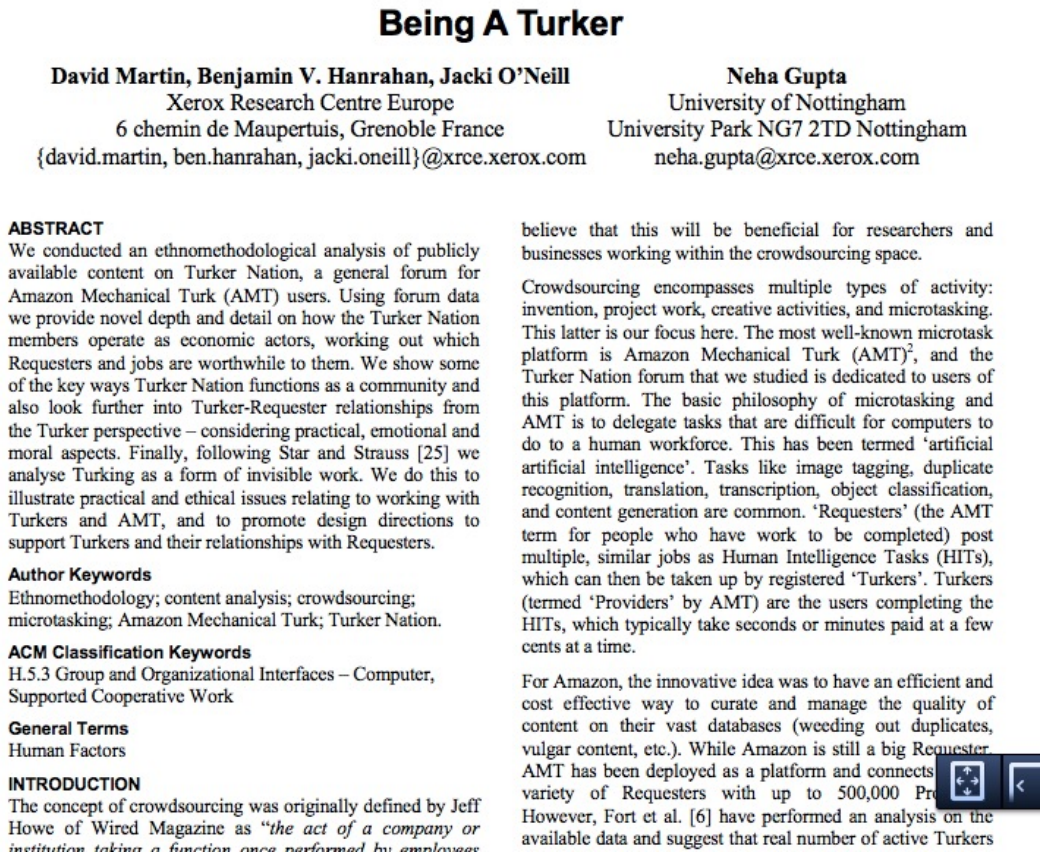

Being A Turker

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ABSTRACT
We conducted an ethnomethodological analysis of publicly available content on Turker Nation, a general forum for Amazon Mechanical Turk (AMT) users. Using forum data we provide novel depth and detail on how the Turker Nation members operate as economic actors, working out which Requesters and jobs are worthwhile to them. We show some of the key ways Turker Nation functions as a community and also look further into Turker-Requester relationships from the Turker perspective – considering practical, emotional and moral aspects. Finally, following Star and Strauss [25] we analyse Turking as a form of invisible work. We do this to illustrate practical and ethical issues relating to working with Turkers and AMT, and to promote design directions to support Turkers and their relationships with Requesters.

Author Keywords
Ethnomethodology; content analysis; crowdsourcing; microtasking; Amazon Mechanical Turk; Turker Nation.

ACM Classification Keywords
H.5.3 Group and Organizational Interfaces – Computer, Supported Cooperative Work

General Terms
Human Factors

INTRODUCTION
The concept of crowdsourcing was originally defined by Jeff Howe of Wired Magazine as "*the act of a company or institution taking a function once performed by employees*

believe that this will be beneficial for researchers and businesses working within the crowdsourcing space.

Crowdsourcing encompasses multiple types of activity: invention, project work, creative activities, and microtasking. This latter is our focus here. The most well-known microtask platform is Amazon Mechanical Turk (AMT)[2], and the Turker Nation forum that we studied is dedicated to users of this platform. The basic philosophy of microtasking and AMT is to delegate tasks that are difficult for computers to do to a human workforce. This has been termed 'artificial artificial intelligence'. Tasks like image tagging, duplicate recognition, translation, transcription, object classification, and content generation are common. 'Requesters' (the AMT term for people who have work to be completed) post multiple, similar jobs as Human Intelligence Tasks (HITs), which can then be taken up by registered 'Turkers'. Turkers (termed 'Providers' by AMT) are the users completing the HITs, which typically take seconds or minutes paid at a few cents at a time.

For Amazon, the innovative idea was to have an efficient and cost effective way to curate and manage the quality of content on their vast databases (weeding out duplicates, vulgar content, etc.). While Amazon is still a big Requester, AMT has been deployed as a platform and connects a variety of Requesters with up to 500,000 Pr
However, Fort et al. [6] have performed an analysis on the available data and suggest that real number of active Turkers

- Study community of people who take on microtasks in AMT
  - What is it like to be a turker?
  - Why do they turk? Etc.
- Fieldwork
  - Setting: Turker Nation (a virtual field setting)
  - Researcher participation 'in the life' of the community over 7 months

Ethnography: Example

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How Physicians 'Achieve Overview': A Case-based Study in a Hospital Ward

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ABSTRACT
Clinicians' work in hospitals is safety- and time-critical, and often stressful due to the number and complexity of patient cases they must attend to. Therefore, how clinicians gather information, identify problems and make decisions concerning patients is a crucial concern, a process that can be labelled 'achieving overview'. In the process, clinicians use various artefacts amongst which medical records are central. Decades of experience is embedded in the structure and use of paper-based records. However, the development of electronic patient records (EPR) will change both structure and use of medical records, including 'achieving overview'. We conducted an ethnographic study in a hospital ward using paper-based medical records in order to understand how clinicians achieve overview. Inspired by the approach of exnovation, we elicit the use of paper-based records in order to inform the design of EPRs. We propose five axes which span out the process of achieving overview and describe implications for design of EPRs.

Author Keywords
Electronic patient records, ethnography, distributed cognition, healthcare, narratives, overview, sensemaking

ACM Classification Keywords
H.5.3 Group and Organization Interfaces

of available information. However, gathering, presenting, and interpreting information and constructing a coherent assessment upon which to act are crucial in health care. This whole process can be labelled 'achieving overview'. As an initial working definition, achieving clinical overview is about *how health care professionals arrive at a sufficiently informed, accountable and coherent understanding of a situation, so that they are capable of acting consciously and with confidence.*

Because of the high-tension, safety-critical characteristic of health care work, health care staff are trained to work under stress, organisational routines have been established, and a variety of different artefacts have been developed to support health care professionals' information gathering, decision-making and coordination of work. As several studies within CSCW have shown, this is an inherently collaborative process, where health care staff communicate, collaborate, and move about [1; 19; 20]. Amongst the various artefacts used, the patient record is probably the most prominent [2], and it presents a well-known space within which health care professionals know how to act [32].

Patient records, paper-based or electronic, structure information in various ways: chronologically, problem-oriented, according to profession (physician and nursing patient records) and according to source (results from x-ray

- Study of how clinicians gather information
  - What do they do to achieve the overview they need for their decision-making
- Fieldwork
  - Hospital ward
  - 60 hours of observation, following physicians
  - Spread over 12 days / 5 months

Ethnography:
Use in Computing

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- Widely used in research areas concerned with how computing effects people's practices, at work and in everyday life
  - Computer-supported collaborative work (CSCW)
  - Ubiquitous computing
- 'Support role' to inform design and evaluation in research projects
  - Informing design: understanding the subtleties of a setting
    - Insights that would not be revealed by just asking people
  - Evaluation: understanding how people make sense of a new system, and of how it effects them

Ethnography: Pros and cons

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+ Gives rich and detailed picture of a particular situation
+ Access to insights that other methods may fail to provide
  - E.g. what people do and why, not just what they say they do
+ Good for studies where the topic of interest is embedded in a social system
  - Work organisation, community, group, family

- Time-consuming
- Quality highly dependent on the researcher's skills
- Challenging for the researcher to avoid preconceptions and bias
- Outcome not straightforward to use: more like 'stories' than 'hard answers'

Experiments

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- Purpose
  - Study how one thing has an effect on another
  - Get specific evidence of cause-effect relationships
  - Answer causality and comparative questions

- Defining characteristics
  - Reduction to observation of specific variables
  - Control to limit confounding factors
  - Repetition: repeated runs/trials to gain sufficient evidence

Experiments: cause-effect relationships

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- Cause-effect relationships
  - “When metal is heated it expands.”
  - “Because the moon has gravitational pull, the oceans have tides.”
  - “When the price increases, the sales go down.“
- Experiments are used answer questions of comparison and causality
  - Does X cause Y?
  - Does X prevent Y?
  - Does X cause or prevent more Y than Z?
  - Does X or Z cause more Y, under condition A but not condition B?

Experiments: Characteristics

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- Reduction to observation of specific variables
  - Reducing a question about cause and effect to specific variables that can be manipulated and observed
- Repetition: repeated runs/trials to gain sufficient evidence
  - Experiments study a relationship between variables
  - Repetition is necessary to build up evidence of the relationship
  - “Was it just chance that this piece of metal expanded when I heated it ?”
- Control to limit confounding factors
  - Experiments are controlled to minimize the influence of other variables on the observed effect.

Experiments: Variables

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- Independent variable: what we manipulate, representing causes
  - Also called factor, that gets tested at different levels
  - Test conditions are defined by the combination of factors and levels
  - Dependent variables: what we observe for each test condition, representing effects
- Control variables: variables that are controlled so that there influence is the same in all conditions
- Random variables: variables that are allowed to introduce random noise into observations; makes results more generalisable
- Confounding variables: factors that change systematically with the independent variable

Experiments: Example

- XKCD ran a study to see what men and women call different colours
- Factors:
  - Gender (levels: man, woman)
  - Colour they were shown (RGB)
  - Gender is controlled
  - Colour is manipulated
- Dependent variable
  - The colour name typed in by participants

Experiments: Design

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- *Design* is the central concern in experiments
  - The factorial design: choice factors and levels
  - Apparatus and experimental setup
  - In experiments with people, their grouping
    - Between-subject design: different groups for each test conditions
    - Within-subjects: the same group tests the different conditions
  - Procedure
    - Tasks to be performed
    - Repetition and counterbalancing (avoiding order effects)
    - Timing

Experiments: Example

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Hot Packets: A Systematic Evaluation of the Effect of Temperature on Low Power Wireless Transceivers

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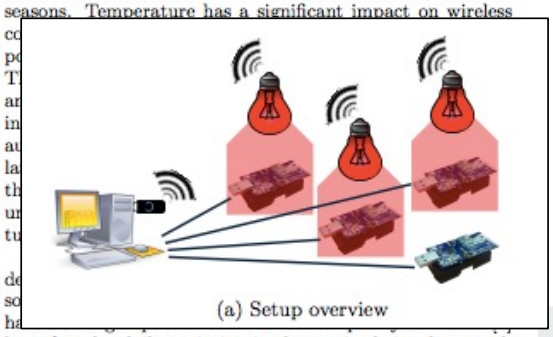
ABSTRACT

Temperature is known to have a significant effect on the performance of radio transceivers: the higher the temperature, the lower the quality of links. Analysing this effect is particularly important in sensor networks because several applications are exposed to harsh environmental conditions. Daily or hourly changes in temperature can dramatically reduce the throughput, increase the delay, or even lead to network partitions. A few studies have quantified the impact of temperature on low-power wireless links, but only for a limited temperature range and on a single radio transceiver. Building on top of these preliminary observations, we design a low-cost experimental infrastructure to vary the on-board temperature of sensor nodes in a repeatable fashion, and we study systematically the impact of temperature on various sensornet platforms. We show that temperature affects transmitting and receiving nodes differently, and that all platforms follow a similar trend that can be captured in a simple first-order model. This work represents an initial stepping stone aimed at predicting the performance of a network considering the particular temperature profile of a given environment.

1. INTRODUCTION

Wireless sensor networks (WSNs) have proven to be an excellent monitoring tool and nowadays many installations exist. They are, for example, used to monitor natural phenomena such as glaciers, infrastructures such as bridges, or production processes on oil platforms. Many of these deployments are heavily exposed to the environment and experience extreme temperature changes within a day and over seasons. Temperature has a significant impact on wireless



(a) Setup overview

- Study impact of temperature on wireless sensor networks
  - Toward prediction of performance in fluctuating conditions
- Controlled Design
  - Testbed with sensor nodes that can be individually heated/cooled
  - Parameter variation
  - Characterisation of relationship

Experiments: Example

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The Effect of Edge Targets on Touch Performance

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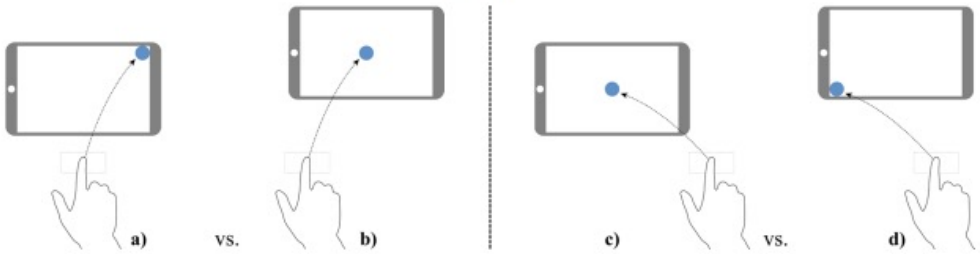

Figure 1. Edge-targets vs. Center targets on touch devices. Each pair shows a round target at a fixed distance from the user but at a different distance relative to the frame. In each pair, which target, if either, will have a faster reaction time?

ABSTRACT
Edge targets, such as buttons or menus along the edge of a screen, are known to afford fast acquisition performance in desktop mousing environments. As the popularity of touch-based devices continues to grow, understanding the affordances of edge targets on touchscreen is needed. This paper describes results from two controlled experiments that examine in detail the effect of edge targets on performance in touch devices. The results show that on touch devices, a target's proximity to the edge may have a significant negative effect on reaction time. We examine the effect in detail and explore mitigating factors. We discuss potential explanations for the effect and propose implications for the design of efficient interfaces for touch devices.

Author Keywords
Edge targets; target acquisition; human performance; touch

Figure 2. Apparatus for Experiment 1. An 18" touch-surface displays targets at known positions. A moveable 0.5mm 3D-printed frame simulates the boundaries of a 7.9" tablet.

- Study effect of targets presented at the edge of a touchscreen
  - Is there a negative effect on user reaction time?
- Controlled Design
  - First experiment with emulation of a touch device
  - Reduced to factors of interest
  - N=12 users; 5,960 trials
  - Experiment repeated on a mobile device (N=12; 4,543 trials)

Experiments: Use in Computing

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- Hypothesis-driven testing versus system evaluation
  - Experiments in computing are rarely derived from theories to be tested
  - However when researchers evaluate a system they usually do this based on a proposition (i.e. a theory of sorts), e.g. ‘is more efficient than X’.
- Experiments in many forms and shapes
  - User studies, network simulation, data-driven using ML
  - With real data or simulated input, or mixture of the two
  - With varying degree of control; lab experiments versus in-the-wild
  - Uncontrolled trials: ‘see what happens’ studies

Experiments: Pros and cons

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+ Can give specific evidence of causal and comparative relationships
+ Good for what can be reduced to a set of variables that are observable and controllable
+ Outcomes have predictive power

- Reduction leads to narrow findings
- Lab setups and simulations abstract from real-world situations
- Often impossible to control all relevant variables: Researchers have to settle for pragmatic choices but carefully assess how they may effect results

Empirical Research Methods – Key Points

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Method	Focus
Survey	getting the same data for many individuals/instances
Case studies	understanding one instance in depth
Ethnography	people and practices in specific settings
Experiment	causes and effects

- Four principally different methods for empirical research
- The methods differ in purpose and characteristics
- The choice of method depends on the nature of the research question

Reading Assignment and Quiz

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- Chapters 1-3 of “Researching Information Systems and Computing”, B. Oates
- E-book, linked from moodle

Next week

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- Methods in Design and Engineering
  - Design and evaluation
  - Experimental research
- Study design
  - Sampling, Measurement, Design and Analysis
  - Validity