The Pennsylvania State University

The Graduate School

INTRODUCING AND TESTING THE BENEFITS OF VIDEORECORDING FOR THE ANALYSIS OF TASKS AND JOBS

A Dissertation in

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by

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ABSTRACT

There is an unprecedented growth in the use of digital videos in online settings. This is in part because video is a rich medium, capable of conveying direct and realistic information like no other medium. Nonetheless, the potentials of videorecording in human-centered design have not been sufficiently investigated. Particularly, there are various potentials for using video in task- and job-analysis. This set of research projects investigated how existing methods of task- and job-analysis can benefit from videorecording. Standardized videorecording methods are introduced, the methods are tested empirically, and it is shown how they can improve the task- and job-analysis. This attempt can have important consequences in theory and practice. Regarding task-analysis, the proposed videorecording method can improve the design of systems, particularly training-systems. Regarding job-analysis, the method can improve presenting accurate information about jobs and organizations with a particular use case in career counseling. Overall, by providing a realistic and accurate picture of human occupation, the results from this approach can have practical consequences in human-centered design, human factors and ergonomics, and applied psychology.

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Chapter 1

Introduction

Recording visual scenes and replaying them has been one of the most popular aspects of modern technology. Although the major use of videorecording has been entertainment (i.e., television, cinema), there are potentials of video to be used in the advancement of science and technology. Unfortunately, modern science has been overly reliant on easily-measured constructs, and because video is not among such "quantitative" modes of data, its potentials and use have been largely overlooked (e.g., Heath et al., 2010). As for a lay example of one of these potentials, when people are presented with a video to watch, nothing can replace their experience and the information they receive from seeing the video. The belief of this set of research projects is that, instead of ignoring this seemingly unscientific property, we can investigate the effects and potentials of videorecording within the boundaries of science. Broadly speaking, this research is thus an attempt to expand, formalize, and validate the use of video in the areas of science and technology that underused its potential.

Particularly, the analysis of tasks and jobs, and the way they can benefit from the videorecording, is the focus here. As the task- and job-analysis are widely used for designing systems and job descriptions, the ultimate goal is to design systems, products, and job descriptions that are informed by the use of videorecording, and we will see whether and how the proposed techniques will improve the design in respective domains.

The use of videorecording in research—also known as "video-ethnography"—has been occasionally practiced in some areas of research (e.g., Allen et al., 2004; Blomberg et al., 1993; Clancey, 2006; Engström & Medbo, 1997; Goldman et al., 2014; Gilbreth, 1911; Hall, 2000;

Heath et al., 2010; Jordan & Henderson, 1995; Mathiassen et al., 2013; Pink, 2013). Although observation and videorecording are considered as one of the traditional methods of data collection in task- and job-analysis (e.g., Flanagan, 1954; Stanton et al., 2005/2018), it has not been standardized and presented as a data-collection method in respective domains. The goal of this research is to fill some of the gaps in our knowledge in using videos. Specifically, in a set of studies, the plan is to show how videorecording can help us in system design (via task-analysis), and how it can be used in designing job descriptions that can be used for career counseling (via job-analysis).

The specific cases of studies that will be discussed are therefore in two sides of task- and job-analysis. On the task-analysis side, we will see how the videorecording of experts at work can provide us with a model of performance that can be used for designing training simulators, and this would then guide trainees in their practice. And, on the job-analysis side, we will see how the videorecording of employees at work can create a new type of job description (i.e., video job description) that can be used to inform job seekers about careers and employment. In fact task- and job-analysis are at the two sides of the same spectrum of human occupation and performance, and the difference is in their level of granularity: the task-analysis focuses on the details and skills in task performance, and the job-analysis focuses more broadly on the work, environment, culture, and responsibilities in a job. The goal here is to use the benefits of video, and its realism, to replace the traditional reliance on text-based media in task-analysis (e.g., Alliger, et al., 2012; Card et al., 1983; Militello & Hutton, 1998; Stanton, 2006) and job-analysis (e.g., Morgeson et al., 2019).

The results of this endeavor will have consequences both for technical and social aspects of technology use. In terms of technical aspects, the presented research can improve the design of systems and products that are used for purposes such as training. As such, the systems that interact directly with users will benefit from increased usability and higher human performance. Regarding social aspects, the results will provide information that potentially benefit important parts of the society, particularly those who need to be trained on certain skills, those that seek jobs, and organizations that need to present information about their employment. Additionally, the results will have practical implications for scientists and practitioners in human-computer interaction, human factors, and industrial and organizational psychology.

In short, the research objectives in the presented set of studies are:

- Assessing whether videorecording can benefit task- and job-analysis.
- If the videorecording had any influence, investigating how we should use the video in task- and job-analysis. This would lead to specific guidelines that can be readily used in practice.
- Regarding task-analysis, showing how an example of training-simulators can benefit from the videorecording of experts at work.
- And, regarding job-analysis, showing how the example of video job descriptions can influence job seekers' evaluations of the job description, jobs, and organizations.

Before presenting the studies, let us first see the literature review in the areas of interest to this research. Following the review, the studies that I have conducted in the PhD program and their results will be discussed. Finally, we will see the future directions of the research.

Chapter 2

Problem Statements and Literature Review

In this section, we will see the background research on using video in task- and job-analysis. Before presenting the literature on using video in task- and job-analysis, I would like to start this section with a brief version of a literature review that I conducted regarding training-system design. This was the background to my research toward using the videorecording methods, and therefore, although it might seem slightly tangential to the main topic, it can help showing the evolution of my interest and the focus of the proposed studies. This is also because, one of the main implications of my research on the task-analysis side is in designing training-simulators.

Training-system design

The primary question with which I started my PhD research was: how the realism of training materials in simulation (or simulation fidelity) could influence training outcome (or transfer of training)? With this question, I started a literature review to investigate the relationship between fidelity and transfer in three primary domains of training: maintenance and troubleshooting, aviation and driving training, and medical training. The following paragraphs summarize the literature review, and later, I will show how it led to my interest in using videorecording for training-system design.

The traditional theory

The experience of two world wars and the Cold War accelerated the use of complex technological devices and systems in the military. To work with and maintain those devices, operators needed special training. This is one of the main reasons that the decades following the 1950's saw investments in the research and design of training programs and devices (for a review, see Koonce, 1984). The growth and popularity of computational tools also facilitated the production of training systems (Smode, 1974). Digital computers enabled designers to simulate target environments in training systems (e.g., Abrahamson et al., 1969; Alluisi, 1991).

Designing training systems mostly revolved around how to simulate target devices and environments. Without questioning what details of the target environment to simulate and how, research and design projects assumed the effectiveness of realistic simulations and were mostly concerned with increasing the surface realism of training tools. This assumption, and the trend in using simulation in training, can be summarized in an exemplary report by Miller (1954). As shown in Figure 2-1, Miller formalized the relationship between the degree of simulation (or fidelity in today's terminology) and the effectiveness of training—or transfer. In Miller's view, more effective training systems were those with higher levels of simulation (see also Gagne, 1954; Povenmire & Roscoe, 1973).

Many studies of the time had similar messages as those of Miller in arguing for the higher training effectiveness of realistic simulation (e.g., Dougherty et al., 1957; Ornstein et al., 1954). The notion that higher similarities between training and target devices could result in effective training had its roots in psychological theories. In particular, the dominant theory of psychology on the subject was the "identical elements theory" of Thorndike and Woodworth (1901). The theory proposes that higher levels of similarity between the trained and the target task would lead to the increased transfer of training. Therefore, training systems should aim at creating realistic simulations that have high levels of shared elements with the target environments.

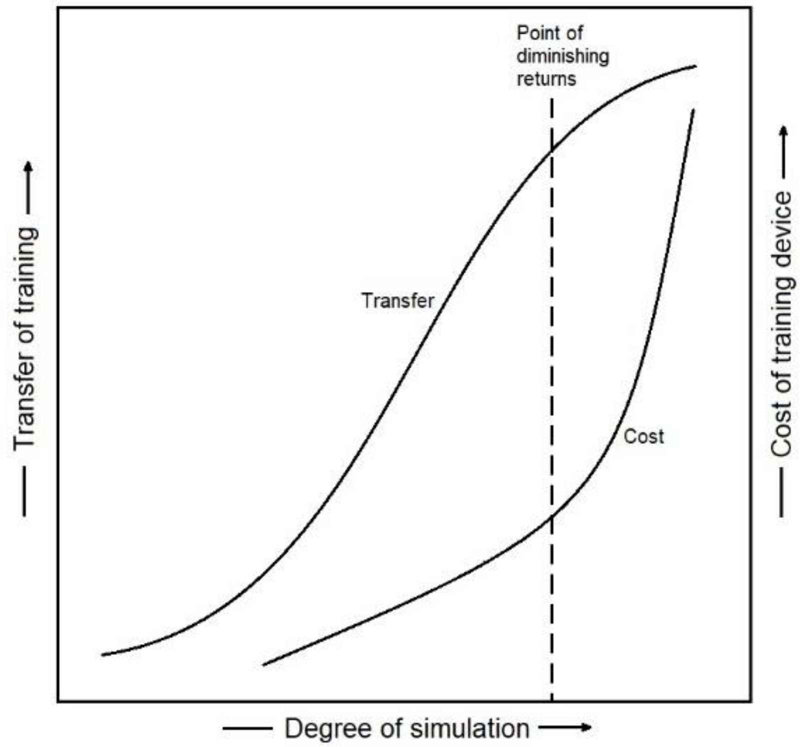

Figure **2-1**: Miller’s (1954) argument for the relationship between the degree of simulation and transfer of training

Note. The “point of diminishing returns” is the optimum point for building cost-effective training simulation.

There seemed to be a consensus in the effectiveness of higher levels of simulation in training systems. For the sake of discussion and future references, this article refers to this belief as *the traditional theory* in the design and evaluation of training systems. The traditional theory argued that more effective training systems needed to replicate the target environment as realistically as possible in training devices. The construct of “simulation fidelity” was introduced within the traditional theory and extensively used in research and design (Hays, 1980; Hays &

Singer, 1989). High-fidelity training systems were those that closely resembled the target environment in the eyes of designers and trainees. In this respect, fidelity refers to both *how much detail* of the target environment is included in the simulation, and *how realistically* those details are simulated (Smode, 1971).

In short, within this traditional notion it was widely assumed that higher levels of fidelity in simulation would result in more effective training (e.g., Lintern, 1991; Smode, 1971, p. 3). The dependence on high-fidelity simulation resulted in most of the existing training systems, many of which were effective in practice, especially for tasks that involved timing, motion, and physical structure of tools.

Should fidelity determine training success?

The review of literature showed that high-fidelity simulation can have training advantages for certain tasks and circumstances. Nevertheless, solely because of those advantages we cannot declare “success” for the traditional theory. This is because there are no objective criteria as to the desired state of training (Adams, 1979; Kirkpatrick & Kirkpatrick, 2006), and more importantly, because there are no alternative approaches or theories for comparison. Moreover, the studies and systems that were reviewed within the traditional theory tried to use high-fidelity simulation for training; many of those systems were not compared with low-fidelity simulations for the same tasks. In fact, except in some cases, those studies did not provide convincing reasons and evidence to use high-fidelity instead of low-fidelity simulation (see Moglia et al., 2016).

If it was to be used for designing training systems in various domains and tasks, and for multiple performance criteria, the traditional theory was not sufficient. What was needed as a theoretical backbone? We should first briefly consider what training systems need (for a more detailed discussion, see Adams, 1979). A training system aims to provide the opportunity of practice through which performance in the target task should be improved. In the training cycle, performance is manifested by actions and decisions that a human performer enacts in response to environmental stimuli. The training system is responsible for providing the environmental stimuli so that trainees can practice appropriate actions and decisions in response. In this respect, trainees' recognition of stimuli is needed to trigger actions and decisions. The question is whether this recognition can be enhanced or influenced by high-fidelity simulation. In other words, should it be important whether the environmental stimuli *look* and *feel* alike their target references? The same question applies to the medium through which trainees apply their actions and decisions. When trainees recognize stimuli, are their responses influenced by the form of input devices? Providing evidence to support a positive answer to these questions was what the traditional theory needed. Nonetheless, these questions were not addressed. Instead, it was assumed that training systems should present trainees with realistic stimuli and input devices.

Without going into the details of the literature, the traditional theory was not based on validated theoretical grounds that would show whether and how high-fidelity systems could necessarily have training advantages over low-fidelity systems. The effectiveness of past systems does not indicate the validity of the traditional theory. We currently do not have reasons to believe that, solely because of their realism, high-fidelity interfaces can facilitate the recognition of stimuli or trainees' control of systems. As a result, there is neither evidence nor reason to assume that fidelity can determine training outcome. Notwithstanding this deficiency in providing evidence from the traditional theory, there is a growing body of research that has touched on this issue. The following section reviews a sample of findings that challenged the traditional theory by comparing the benefits of high- and low-fidelity simulators.

Challenging findings

The primary assumption of the traditional theory was that increased fidelity could improve the training outcome. One way to challenge this assumption was by showing how low-fidelity systems could be as effective in training as high-fidelity systems for the same or similar tasks; numerous research tried to show this possibility as well as other disadvantages of high-fidelity simulators in training.

For example, in one of the early critical articles, Fink and Shriver (1978) reviewed training systems that were used in the military during the 1950's and 1960's, and questioned the trend toward realistic simulations that the nascent computers of that time could provide. With a focus on maintenance and troubleshooting tasks, their review emphasized the effectiveness of low-fidelity systems in training, especially for trainees with minimal skill. The unnecessary details and tools in the interface of high-fidelity systems created further confusions for trainees and slowed up their progress. As a result, Fink and Shriver argued, despite many instructors' assumption in the effectiveness of high-fidelity systems, mock-ups and low-fidelity interfaces could be more effective than high-fidelity systems to create initial familiarity with tasks and prepare trainees for advanced training with high-fidelity systems or actual devices (see also Reiter, 1987; Rouse, 1981; Swezey et al. 1991).

As another example, after years of experience in flight simulation research, Roscoe (1991) challenged the widely held reliance on fidelity, and instead, offered measuring training benefits for evaluating simulators. Similarly, Salas et al. (1998) questioned the assumption that high-fidelity simulation is necessarily effective in aviation training and proposed to focus on important aspects of training such as trainees' characteristics. Similar messages were given by other reviews and theoretical works such as Noble (2002), Lintern (1991), and Stewart et al. (2008). The same evidence against the reliance on high-fidelity simulation was provided in medical training (e.g., La Rochelle et al., 2011; Matsumoto et al., 2002; Norman et al., 2012).

In short, it seems that the traditional theory and the belief in the necessary benefits of high-fidelity simulation did not withstand the critical analyses and challenging evidence that subsequent authors presented. The studies mentioned above are among a growing number of reports that are challenging the traditional theory. These studies showed how low-fidelity simulators could surpass high-fidelity simulators in certain aspects of training benefits.

Summary

The birth of training simulators was concurrent with the belief in high-fidelity simulation. This traditional belief guided the design and evolution of training-simulators for years. In the last few decades, however, there have been a growing number of empirical investigations that did not find a necessary relationship between fidelity and training success. This has created a confusion in design, because designers need to replace fidelity with an alternative construct that can guide the research and development of training-simulators. Figure 2-2 shows an overall result that can be derived from reviewing the literature. In chapters 3 and 4, we will see the lessons that can be gained from the review, and the proposal to use alternative sources for design guidelines.

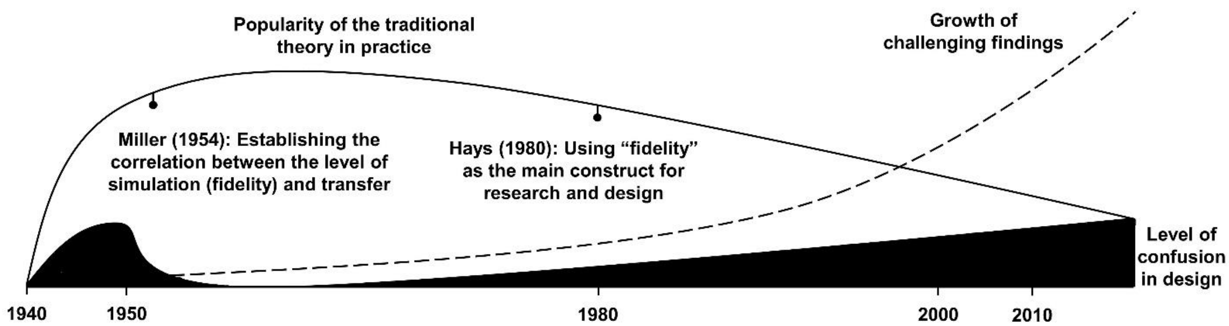

Figure **2-2**: A historical perspective on training-system design as presented in this research

Note. The current state of the field represents a large number of findings that are challenging the traditional theory (dashed line), the diminishing popularity of the traditional theory (solid line), and the resulting growth in the confusion for designers (solid dark color).

Task-analysis

It was briefly mentioned above that attempts at task- and trainees-analysis were not sufficient in filling the void of simulation fidelity in providing design guidelines. Here, let us open this discussion briefly—specifically regarding task-analysis—that leads to using the videorecording of experts for task-analysis and training-system design.

Deficiencies of task- and trainees-analysis

Although task-analysis has been successful in informing designers about tasks, it suffers from serious problems when applied to training-simulator design. First, in training, knowing about the skills in performance—i.e., *how* a task should be performed—is more important than the goal of the task and the steps in performance (e.g., Proctor & Vu, 2006; Schraagen, 2009; Van Merrionboer & Boot, 2009). However, traditional task-analysis methods are too rational to catch the skills, as they tend to reduce the skills to the steps that need to be taken to achieve a goal (e.g., Alliger et al., 2012; Card et al., 1983; Militello & Hutton, 1998; Stanton, 2006). This problem is aggravated by the conventional use of text-based media in task-analysis (i.e., questionnaires, sheets, verbal protocol) because it is difficult, if not impossible, to record and model the skills through words (e.g., Nisbett & Wilson, 1977).

Additionally, task-analysis acquires information from human subjects in working with systems. However, it is not clear *who* those subjects should be. For example, in Card et al. (1983) and Diaper (2004) subjects are “users”, and in Annett and Duncan (1967) and Kirwan and Ainsworth (1992) subjects are “operators”. Although some authors assumed that subjects should be experts in the task (e.g., John, & Kieras, 1996), this has never become a condition in recruiting subjects. In short, insufficient attention to the qualification of subjects is evident in task-analysis in general (e.g., Annett, 2004) and in training-simulator design in particular (e.g., Cream et al., 1978). In training, it is important to have criteria for selecting subjects as those subjects are indirectly instructing the trainees in their practice, and shortcomings in their performance can misguide the training.

These problems had consequences for the design and effectiveness of training-simulators. For the designer, in the lack of proper informational resources about skills, target environments and the “task” became the subjects of simulation, and this has engendered lingering design problems such as the fidelity question (e.g., Hays & Singer, 1989) and the part-whole training dilemma (e.g., Wickens et al., 2013). And for trainees, the result was a lack of guidance on how to perform tasks, and as a remedy, practicing with simulators were often accompanied with experts who provided guidance and feedback (e.g., Goode et al., 2013; Mahmood & Darzi, 2004). Although some authors argued against the sole reliance on conventional task-analysis in training (see Hays and Singer, 1989, p. 56; Schraagen, 2009), there has not been a systematic attempt to address the challenges and standardize a method specifically for training-simulator design.

In a broader sense, although considering the two elements of task and trainees can provide important information for training-system design, it is not sufficient in creating design methods. The presented resources and techniques mostly tell us what to train, but not how to train them via simulation. In fact, if we consider the training cycle, trainees and the task are only one side of the training cycle and as such, they are not sufficient in guiding the design (e.g., Adams, 1979). This deficiency is evident in considering the studies that focused only on trainees and task for training-system design.

For example, Sticha et al. (1990) created a model (Optimization of Simulation-Based Training Systems, or OSBATS) to produce design methods for developing cost-efficient training systems, and authors tested their model to address design decisions of the training systems that were used in the military (e.g., Army rotary-wing aviation tasks, troubleshooting M1 Abrams tank). The OSBATS model used device- and task-analysis to determine the elements of the target system that could present designers with the choice of varying degrees of fidelity. Although much can be learned from their modeling approach, due to the excessive use of task- and device-specific knowledge, Sticha et al. recognized the problem of OSBATS in generalizing it to various tasks. For example, fidelity specifications of the model would vary significantly between tasks and domains, and it is not clear how the model or the designer should make technical decisions for each task and domain. These problems of the OSBATS approach in generalizability to other tasks and domains were stressed by subsequent studies from the same line of research (e.g., Singer, 1993; Willis et al., 1990).

Similarly, Smode (1971, 1972) aimed to specify the technical requirements of training devices through a standardized design method that was mostly based on needs- and task-analysis. Although Smode’s and similar analyses are helpful and informative, they suffer from the lack of specificity in addressing design decisions (see Hays and Singer, 1989). And in an attempt at proposing a developmental strategy for training system design, Cream et al. (1978) provided suggestions for designers that, albeit informative, does not exceed what was known in trainees- and task-analysis (see also Salas et al., 2006).

In short, the aforementioned attempts, when considered together, do not present a comprehensive resource to guide the design in a specific and practical sense. To put the problem in perspective, training-system design needs to consider important elements of training. Trainees and the task are only two elements in training. Because other important elements have not been considered in detail, most recommendations from the past research are insufficient for creating practical design methods. The following paragraphs discuss studying expert performance as an important resource for design that has the potential to resolve many of the current confusions in the field.

Videorecording

To resolve these shortcomings, we first need a medium that would inform us of the skills and presents us with an accurate picture of performance. And we need criteria to select subjects to study their performance. To resolve the first problem, the medium that can overcome the shortcoming of traditional task-analysis is videorecording; in other words, the videorecording of performance in target task environments. This is simply because video can provide a direct picture of how a task is performed. This method—also known as "video-ethnography"—has been occasionally used by researchers in some areas of research (e.g., Blomberg et al., 1993; Clancey, 2006; Engström & Medbo, 1997; Goldman et al., 2014; Gilbreth, 1911; Hall, 2000; Heath et al., 2010; Jordan & Henderson, 1995; Mathiassen et al., 2013; Pink, 2013).

For example, Blomberg et al. (1993) explored how the standard methods of videorecording and ethnography could be related to design. In fact, the two major academic disciplines that used ethnographic methods were anthropology (e.g., Malinowski, 1944; Miller, 1995) and sociology (e.g., Garfinkel, 1967; Mead, 1934). However, researchers with technical and design concerns, such as Blomberg et al. (1993), Suchman (1987), and Pink (2013), could not directly adopt the ethnography of social sciences for the design purposes, and as such, modifications and special considerations should have been dedicated to prepare an ethnography usable for design purposes.

The efforts of these researchers in using ethnographic methods for design purposes have been well-documented in HCI studies. However, many of such attempts were left at a broad level, and this has made it difficult for designers and engineers to readily adopt videorecording methods in design practice. In fact, there was no such videorecording method, as they were mostly considerations and recommendations of using video in technical domains.

As a result, videorecording and ethnographic methods in HCI have mostly remained well-known because of a handful of studies to improve workplace and working stations (e.g., Suchman et al., 1999). And due to this lack of elaboration of methods for design purposes, videorecording has never become a standard design method. This is one of the motivations behind this research: to formalize and present videorecording methods that can be validated and readily used in practice by designers and practitioners.

Studying expert performance

To resolve the problem of not having a point of reference in performance, we need to study the performance of skillful individuals—or experts. Because the goal of most training programs is to make trainees perform like experts, modeling experts provides the criteria of performance and a direction that can guide trainees in their practice (e.g., Davids et al., 2008; Klein & Borders, 2016). The importance of studying experts and their characteristics has a long history in psychology (e.g., de Groot, 1965; Ericsson & Charness, 1994), and this research will use expert performance as a resource in design.

Unfortunately, the importance of expert performance has largely been ignored in the research and design community. From one side, studying experts has been the subject of considerable research in psychology (e.g., de Groot, 1965; Ericsson, & Charness, 1994). From the other side, there have been only scant efforts in using the knowledge of expert performance for training-system design (e.g., Willis et al., 1990). For example, Ward et al. (2006) discussed the two issues of expert performance and training simulation almost independently, disregarding the potentials that studying expert performance has in resolving design decisions of training systems. Similarly, when discussing “Person Analysis” for training design, Salas et al. (2006) merely identify trainees as “Person” (pp. 477–478) and repeat the well-known emphasis on trainees-analysis. It seems necessary to establish experts as an important human element of the training cycle whose performance should be the direction and goal of training programs and systems.

One reason behind paying insufficient attention to experts is the notion that because most experts are not training specialists, they should not be directly involved in the design process. It is argued that experts do not often consider trainees’ characteristics and they would often suggest using high-fidelity training simulation with unjustified reasons (e.g., Hays & Singer, 1989, p. 36; Lintern & Naikar, 2000; Smode, 1971). Nonetheless, using experts should not be limited to asking their opinion in evaluating the design process or the final products of training systems. Rather, we can study their performance and use the knowledge in training-system design. Expert individuals experienced prolonged practice, and this experience is often represented in how they perform the task, not necessarily in their judgments (Robinson, 1974; Rouse & Morris, 1986).

Although using the knowledge from expert performance in training-system design has not been formalized, we can use past research and existing tools that emerged from other related disciplines. For example, in addition to the studies that were mentioned earlier, to derive the shared behavioral characteristics among the recordings of experts’ performances, we can use computational video analysis tools (e.g., U.S. Patent No. 10,482,613, 2019). Moreover, the proposed method of studying expert performance in target environments reminds us of past attempts such as studying naturalistic decision making (Klein, 2008), verbal protocol analysis (Ericsson & Simon, 1980), and ethnographic studies of work (Clancey, 2006; Luff et al., 2000) in which researchers tried to study individuals during task performance and in natural settings. Although those attempts were not directed toward addressing the training-system design problems, we can use their experience in studying experts, characterizing expertise, and using them in design.

In summary, although the use of videorecording has occasionally been practiced for design purposes, it has never been formalized and validated, and the subject of recording was mostly unclear. Because of these findings from the literature, the current research is motivated to formalize a videorecording method of design, validate the method in an example of designing training-simulator, and use experts as the subject of recordings.

Job-analysis

Broadly speaking, the topic of this section is job-analysis with the specific focus on career counseling. The key question is: how to create online career pages to present an accurate and informative picture of jobs and organizations. Organizations need workforce to accomplish certain tasks, and people need jobs to provide for their necessities. Traditionally, organizations used mediums such as fliers, newspapers, campus job fairs, and public announcements to advertise and inform job seekers of their open positions. However, with the widespread use of the internet in recent years, the nature of presenting job information has changed. This change has reached a point that the default medium of creating and presenting job descriptions has become the internet (e.g., Braddy et al., 2009; Dineen et al., 2002).

Currently, career counseling for most people equals to scouring the web and reading online job descriptions. An internet job description typically consists of a webpage with text-based descriptions that provides information about the position and its responsibilities. Figure 2-3 shows an example of an online job description that is commonly used nowadays.

If we control for variables such as prior familiarity with organizations, because what job seekers see from organizations is through web pages, the amount of information that job seekers receive is limited to text-based descriptions on the web. In fact, what happens in the reality of many job seekers—especially college graduates—is to gather information for positions based on online labels and text descriptions. With the lack of professional online career counseling websites that present and show accurate information about careers, job seekers are likely to be misinformed about jobs and organizations which can lead to bad career decisions.

Assistant Professor

Job details

Job Type
Full-time

Full Job Description

Position Description

Assistant Professor of Inbred Rice Breeding and Genetics

Position: Assistant Professor of Inbred Rice Breeding and Genetics, Texas A&M AgriLife Research Center, Beaumont, Texas, USA

Appointment and Evaluation: This is a 100% budgeted research position. Salary will be highly competitive and commensurate with experience. Promotion decisions are the joint responsibility of the Center Director, the Head of TAMU Soil & Crop Sciences Department, and the Director of Texas A&M AgriLife Research, and will conform to the policies and procedures of the agency, the Department, and the College of Agriculture and Life Sciences for the Texas A&M University System.

Qualifications: A Ph.D. or equivalent degree in plant breeding, genetics, or a closely related field is required. Preference will be given to applicants who a) document significant involvement in cultivar releases, b) demonstrate an ability to integrate advanced phenotyping, ideotype breeding, and marker-assisted selection, c) have a record of outstanding scholarly research and professional accomplishments related to cultivar development and releases, and d) have strong verbal and written communication skills. Evidence of strong analytical skills is expected. Expertise with the development and use of DNA markers, genomic methods and process-based crop models for the improvement of grain yield, quality, nutritional composition, and disease resistance is desirable.

Figure **2-3**: An example of a typical online job description

The internet revolution in job-seeking and career counseling provided benefits such as facilitating the searching of information for job seekers. Additionally, because of the nature of the internet as a world-wide medium, organizations can present information about jobs in a nationwide scale, and even across the world (see Breaugh, 2013). However, internet-based career counseling poses two major challenges. The first is on the job seekers' side, and the second on the organizations' side.

On the job seekers' side, all career information from advertised positions and organizations are reduced to text descriptions, and this often does not provide sufficient information for job seekers in their decision-making. A cursory look at online job descriptions show that most of them are standardized and follow a text-based template in providing information about positions and organizations. This has the unfortunate consequence of hiding important information about careers, responsibilities, and expectations of the role as well as values and culture of an organization. These important factors, if provided, could change job seekers' decision of whether to consider certain careers.

On the organizations' side, because their online job descriptions are standardized and might look like similar descriptions from other organizations (e.g., Figure 2-3), and also because the internet is a world-wide medium, one job description can result in attracting many job seekers. Often, the number of applicants to a job description that is used for recruitment is much more than organizations' capacity to review them (Dineen et al., 2002, 2007). Without having sufficient information, applicants might become interested in positions that are not suitable for them, but because of the insufficient information available in the online job description, they nonetheless consider that career. This will put the burden on organizations in distinguishing between talents and choosing the appropriate candidate.

The aforementioned problems are aggravated with the emergence of career websites such as Indeed and ZipRecruiter. These websites that post online job descriptions have a standard text-based template that provide similar amount of information for each job posting, and this can make it more difficult for job seekers to distinguish between organizations and positions. In fact, because of the standardized text-based online job posting and the resulting lack of sufficient information both for job seekers and organizations, online career counseling as currently used can increase the chance of displacements. This is acknowledged by experienced HR specialists (e.g., Cappelli, 2019).

One reason behind this problem can be that the emergence of online job descriptions and recruitment has occurred faster than the research and scientific validations thereof. One of the motivations of this research is to evaluate the current state of online job descriptions, and find ways to improve them and take steps to address these problems. This can not only improve the practice of online career counseling, but also can increase the likelihood of having an accurate understanding of online job posting for applicants. The following paragraphs review the relevant literature from researchers in industrial and organizational psychologists on the topic, and then, specific hypotheses of the study will be presented.

Recruiting websites and media richness theory

Media Richness Theory argues that there is an outcome for every communication, and those outcomes depend on the level of appropriateness—or match—between the capacity of media and the required characteristics of the communication (Daft & Lengel, 1986). In plain terms, richer media (video, face-to-face) is only more effective than leaner media (audio, text) when there is a reason for their use. When applying this principle to the context of career counseling, the question of this research is: do job seekers need to see the job and organization before they make career decisions? If yes, can a short video provide for this need? And if yes, how should the video message be?

The most relevant line of research in this respect comes from works on recruitment communication media (e.g., Allen et al., 2004, 2007; Breaugh, 1992). Specifically, Allen et al. (2004) investigated the influence of the media of the recruitment message on recruitment decisions. The media in Allen et al.'s (2004) research was defined in the four categories of face-to-face, video, audio, and text. With controlling for the content of the message, Allen et al. found the influence of the media, with face-to face being the richest medium followed by video, text, and audio.

Despite finding the influence of media, Allen et al. found low to moderate effect sizes for the effect of media. As such, their conclusion was not decisive and instructive for creating online career counseling. This might be because Allen et al. was the first study to investigate this effect, and so, the research and suggestions remained at a broad and abstract level. Additionally, it is not clear from their research that if job seekers had the choice, would they watch the video in a job description. Because the message of the job in the text format and video was only provided through text or video, participants did not have the choice to know about the job without reading or watching the video. For example, one question is, what if the video is embedded in the text-based traditional job description to maximize the information content?

And, the content and structure of each medium as used in Allen et al. is not clear. For example, we do not know what kind of video was used, and whether the effect was the result of the specific video. Because these media (i.e., face-to-face, video, text, audio) are qualitative, it is difficult to control for the type of message, and it seems that Allen et al. did not intend to get involved in the complexity of analyzing those media and their contents.

Although Allen et al. (2007) concluded that a recruitment website is important and would influence job seekers' attitude toward organizations' image and their decision to pursue employment, they did not investigate what the website should have and how it should look like. So, the current research is assuming the findings of Allen et al. (2007) in believing that modifications in websites can influence the decision of job seekers in applying. In plain terms, former relevant research is too abstract and academic to be used and be instructive for those who intend to create online job descriptions, and the current research intends to take a step towards testing actual implementations of job descriptions and their effects.

We will see that this research will use information from Allen et al. (2004) in designing the experiment, particularly in defining outcomes and study measures. However, the focus of this proposed research is different in attempting a thorough investigation of the effect of video. In other words, the main unanswered questions are whether embedding the video in a job description has any effect, and if yes, how the video should be. Because this investigation is related to two well-established lines of research, it is important to describe the research and current knowledge in Realistic Job Preview and Fit.

Realistic job preview

It was mentioned earlier that one problem with current text-based online job descriptions is the uniformity of the content of careers. Also, organizations often try to present a favorable picture of themselves in an attempt to attract applicants. This can lead to misinforming job seekers and the possibility of displacements.

To resolve this sort of misrepresenting a position and organization in the eyes of job seekers, researchers started a line of research with the belief that organizations should also inform applicants of the negative sides of careers. The result was a proposal in presenting both positive and negative aspects of a position to job seekers, or Realistic Job Preview (RJP, see Breaugh, 1992; Phillips, 1998; Wanous, 1978, 1989).

According to the proponents of RJP, presenting the reality of a job with all of its negative aspects can moderate job seekers' expectations, and this would result in an informed and meaningful pool of applications (e.g., Earnest et al., 2011). As a result, the organization can be more certain that applicants are aware of what they are applying to. It is argued that RJPs can create a sense of trust in job seekers in what they learn from a job posting (Saks, 1989). In the terminology of research on this topic, RJPs can improve the credibility and believability of the message, simply because it seems to be telling the truth about a job and organization (Maio & Haddock, 2007; see also Premack & Wanous, 1985).

Although the approach of RJP was promising at the beginning, it faced many challenges. The biggest challenge of RJP was in discouraging applicants to apply, even those who were the most qualified for the position (e.g., Bretz & Judge, 1998). It is argued that negative characteristics of a job can immediately repel job seekers. A famous example is a job advertisement message to hire caseworkers from New York City's Administration for Children's Services:

> Wanted: men and women willing to walk into strange buildings in dangerous neighborhoods, be screamed at by unhinged individuals—perhaps in a language you do not understand—and, on occasion, forcibly remove a child from the custody of a parent because the alternative could be tragic consequences (Santora, 2008).

This advertisement was seemingly the result of the organizations' runover of their new caseworker hires due to the lack of knowledge in the reality of the job. But, as is clear from the message, it is difficult to imagine interest in people who would like to consider such a career.

Some researchers argue that, under certain conditions, job seekers might not pay attention to the negative sides of a job and apply anyway (e.g., Breaugh, 2008). For example, as long as job seekers do not experience the negative aspects of the job, they are unaware of those aspects, and providing descriptions of negative sides is not sufficient to change job seekers' decisions (see also Dobson, 1989).

Finally, one can argue that except for certain extreme characteristics, the positivity or negativity of many characteristics are, to a large extent, subjective. For example, working in a remote area or state might not be favorable to many, but may attract some other job seekers. Therefore, there is a debate of the extent of the beneficial effects of RJPs (e.g., Breaugh, 2008; Phillips, 1998). In short, what we can learn from the approach of RJP is the importance of providing both positive and negative information about a career and organization. This should be to an extent to improve job seekers' attitude regarding the credibility of the information and the believability of the job description.

Person-organization (P-O) and person-job (P-J) fit

With the same goal of trying to increase the proportion of informed applicants to the total applicants, a group of researchers followed a path different from RJP. Instead of having information that might be unfavorable to many applicants in job descriptions, researchers decided to evaluate the level of match of job seekers' characteristics with the requirements of the position. However, because the number of job seekers is often much more than an organization's capacity to do evaluations case by case, they proposed to embed an automatic test to check job seekers' level of fit with the organization (P-O fit) and the position (P-J fit). In fact, the suggestion was to give job seekers a quick "fit-check" test in the form of questions, and give them their fit results before they make career decisions (see Barrick & Parks-Leduc, 2019; Dineen et al., 2002, 2007; O'Reilly et al., 1991).

In this research, job seekers read general information about a position in a job description and if decided to proceed, they should take a fit-checker test. The fit-checker would ask certain questions from job seekers to assess their characteristics. After the test, the job seeker is given the result of the test that would indicate how fit they would be for a specific career in a specific organization. It is only after providing this feedback that job seekers can decide whether to apply for the position (e.g., Dineen et al., 2002, 2007).

This suggestion had the advantage of encouraging those that were fit for a career to become more serious in their pursuit of the career, because when job seekers saw a high fit feedback, they were assured of their decision of applying from the organization. In other words, the test results would ascertain job seekers' belief of what the organization is looking for. Another advantage is that, because job seekers would have to read questions and provide information, it is more an interactive process—compared to the passive process of reading a job description—that would encourage applicants to be more aware of what they are applying to. Also, if the low-fit feedback is effective in discouraging applicants to consider a career, it can save time from organizations in reviewing applications that have low match with the position (to review the benefits, see Barrick & Parks-Leduc, 2019).

An important distinction between providing fit results with traditional job descriptions is that the fit-checker puts the first evaluation on the side of the career counseling service or the recruiting organization. In other words, it is their side that evaluates whether a job seeker can be a good candidate for a career, not the job seeker. So, job seekers might be discouraged to think and decide on their own, because regardless of what they think about their fit, the career counseling or the organization would make the judgment of whether they should apply or not. This might not be a pleasant experience to many job seekers as it seems to take away the right of job seekers to independently evaluate whether they are fit for a career, and whether they should apply.

Additionally, creating the fit-checker test is often not an easy undertaking for career counseling websites and recruiting organizations. It is well-known in various areas of I-O psychology that it is difficult to formalize the expectations and evaluations in the form of a test, and so, relying on the test is a risky leap of faith for many positions. In technical terms, the validity of the test, and job seekers' answers, will always be in doubt. For example, when asked to answer a question about the fit, applicants might not answer the questions accurately and try to present themselves as a candidate that the organization wants, and not who they really are. This can be the reason that many organizations still require in-person and unstructured interviews for recruitment (see Breaugh, 2013; Hoffman & Woehr, 2006; Kristof-Brown et al., 2005).

Finally, when job seekers received a poor fit, it created a negative attitude in job seekers toward a career or the organization that could remain with them for a long time (e.g., Dineen et al., 2002, 2007). This is in contrast to what organizations need, which is a positive image (e.g., Lievens & Slaughter, 2016).

In short, to the extent of encouraging qualified job seekers to apply and discouraging unfit job seekers from applying, providing fit feedback can be useful. However, due to various problems such as ignoring job seekers' independent decision, creating the test, validity, and possible negative effects, providing fit results is not deemed to be a solution for career counseling and recruitment researchers and professionals (see Barrick & Parks-Leduc, 2019).

Theory and hypotheses for the study on job-analysis

The theoretical context of this part of the study can be divided in two sections: whether job seekers react to the existence of the video in online job descriptions, and how the characteristics of the video can moderate its effectiveness. This section discusses these two issues and presents study hypotheses. Note that the primary study questions and measures are introduced in the next Chapter ("Chapter 3: Methods and Results") as the "primary analysis", and here we discuss broader issues and the hypotheses. We will address these hypotheses in Chapter 3 as the "secondary analysis". Because this is the first study of the kind, the hypotheses as presented here are directed toward an exploratory investigation with a particular focus on video characteristics.

Job seekers' reaction to video

Video of jobs and organizations may be effective in conveying richer information to job seekers compared to text. However, a preceding question is: to what extent are job seekers willing to watch a video if they see it in online job descriptions?

Media richness theory argues that richer media (e.g., video, face-to-face) is only more effective than leaner media (e.g., audio, text) when there is a reason for their use (Daft & Lengel, 1986). When applying this principle to the context of career counseling, the question is: do job seekers need to see how the job and organization look before they make career decisions? The literature tends to provide a positive answer to this question (Allen et al., 2004; Cable & Yu, 2006). This is because having richer information about a job and organization can lead to an informed job application which is more likely to result in a successful employment. Such an expectation, however, might not always be realized in practice. For example, there have been studies that showed how little time job seekers are willing to spend on traditional online job portals before making career decisions (e.g., Jones et al., 2006: Singh & Dangmei, 2016). Moreover, some researchers have argued that adding peripheral aesthetic information to websites might repel applicants or reduce the likelihood of reading important job-related information for job seekers (e.g., Cable & Turban, 2001; Lievens & Harris, 2003; Petty & Cacioppo, 1986). It is not clear whether including the video can attract job seekers' attention and would encourage them to learn more about the job through the video. So, in addressing this issue, the first hypothesis of the study is:

- *Hypothesis 1*: Job seekers watch the videos embedded in online job descriptions.

Before addressing the effect of video on job seekers' decision-making, it is important to assess whether the videos can affect organizational image. This is because a job seeker might find a particular job unsuitable for employment, but might still see the presence of video that can leave a favorable attitude in the job seeker toward the career and organization. In this respect, the video might help in creating a favorable image of the organizations for job seekers and this can have short- and long-term benefits for the organizations (Lievens & Slaughter, 2016). This study will investigate this issue.

- *Hypothesis 2*: Regardless of the structure and content of videos, job seekers' evaluation is better for organizations that use video compared to those with traditional text-based job descriptions.

Probably the most important issue to address is whether the videos are likely to affect job seekers' decision-making. This issue has practical importance to organizations in various sizes and reputations. Smaller and less known organizations often look for ways to attract more applicants to increase the chance of finding better talents, but this is not necessarily the case for large organizations who receive too many applications. If embedding videos in online job descriptions can attract job seekers and increase their likelihood of applying, organizations can have a strategy of whether and how to use videos in their job descriptions. Therefore,

- *Hypothesis 3*: Regardless of the structure and content of videos, job seekers are more likely to pursue careers in organizations that embedded videos compared to those that did not.

Another important factor to consider in testing the effectiveness of videos is the moderating effect of organizations' reputation. For example, Walker et al. (2011) argued that the design of websites can help small and unknown organizations influence job seekers' image perception, but this is not easily possible for larger and well-known organizations. So, the effect of video might vary based on the organization's prior reputation.

- *Hypothesis 4*: The effect of video on job seekers' evaluations is more visible for unknown organizations compared to well-known organizations.

Regardless of whether an organization needs more online applications for a job, increasing the rate of informed applicants has been a long-standing problem for all organizations. Informed applicants are those who are not only aware of their own knowledge, skills, and abilities, but they also have an accurate understanding of the job and organizations to which they are applying. This is a well-known problem, and strategies to attract informed applicants have been extensively studied under topics such as realistic job preview, or RJP (e.g., Earnest et al., 2011; Premack & Wanous, 1985; Phillips, 1998; Wanous, 1989) and person-organization fit, or P-O fit (e.g., Barrick & Parks-Leduc, 2019; Dineen et al., 2002; O'Reilly et al., 1991). However, the proposed strategies have significant shortcomings that were discussed earlier.

Those shortcomings are largely because the interpretation and judgment of fit was on the side of career counseling services and recruiting organizations; in RJP it is the organization that categorizes favorable and unfavorable characteristics of a job, and in P-O fit, it is the organization that informs job seekers of the level of their fit with the job. To address the problems of RJP and P-O fit, we need to find a way to present the reality of the job and organization to job seekers as directly as possible without interpretations.

Video can provide such direct and rich information about the job and the organization. Video as a medium is rich in a sense that it can convey several different aspects of information concurrently (i.e., employees, environment, responsibilities, culture, dress code, etc.), and it is direct as it does not leave much room for organizations' interpretations about jobs. So, video has the potential to increase the pool of informed and confident applicants. If the video can encourage or discourage job seekers to apply for a job, it should be reflected on job seekers' confidence in their decisions. Therefore,

- *Hypothesis 5*: Regardless of the structure and content of videos, job seekers are more confident in their career decisions with video in the job description.

The characteristics of the video

If the video has any effect on job seekers' evaluation of jobs and organizations, a question of practical importance is: are all videos better than text in terms of job seekers' evaluations? Or are the evaluations influenced by the structure and content of the videos?

With regard to creating the content, a broad issue is whether the videos should contain information about a specific job and organization, or can they be about a type of occupation in general irrespective of the organization? This question might be directly related to job seekers' occupational and educational experience. Those with little or no experience might find general and unspecific videos informative, and so, the specificity of the videos might not matter. But for those with more experience, general videos might not contain useful information and they might only look for specific information about a job that can distinguish one job from others. So, specific videos might be on average more effective than general videos. However, because creating a specific video for each advertised job might be costly and burdensome for organizations, the practical question is whether the specificity is worth the effort. So, the extent of the difference in evaluations between specific and general videos will be tested as:

- *Hypothesis 6*: Videos from specific jobs will have more impact on job seekers' evaluations than video from general (type) of jobs.

A relevant practical concern is the quality of making and structure of videos. Does a simple visual demonstration of the jobs and organization improve the evaluations, or should the videos be professionally made to be effective? This is regarding filmography, editing, timing, lighting, and other technical details involved in creating the videos. Although the literature on designing online recruitment websites points to the importance of aesthetics (e.g., Dineen et al., 2007), it does not discuss how to make short videos to be effective in recruitment. On the other hand, research also shows that professional and organization-oriented videos might not be as effective as personal and amateur videos as viewers can better relate to amateur and personal content (e.g., Eubanks, 2017). The goal here is not to go through the details, but simply to test whether this is a factor that should be considered by organizations.

- *Hypothesis 7*: Professional and highly-structured videos have more impact on job seekers' evaluations than amateur and less-structured videos.

From the perspective of the media richness theory, a video with voice is richer than a video without voice (Daft & Lengel, 1986). With respect to our discussion, videos that have narrators or employees' voices can convey more information about jobs than videos without voice. However, there is a question of whether the voice is needed. This is particularly because the proposed video job description already has text-based descriptions; adding voice to the video may not only be redundant, but can also add extra mental load to viewers that would reduce their focus on visual information.

- *Hypothesis 8:* Speaking videos are more effective than silent videos in improving job seekers' evaluations.

Length of the video is the last factor in this study that we consider to have practical importance. If online career counseling services and recruiting organizations would want to create video content about jobs, how long those videos should be? Because prior studies show the reluctance of job seekers to spend long time on job descriptions (e.g., Jones et al., 2006; Singh & Dangmei, 2016), shorter videos are more likely to be effective than linger videos. So,

- *Hypothesis 9*: Shorter videos are more effective in influencing job seekers' evaluations compared to longer videos.

Summary

Although there have been attempts at using the potentials of the video in conducting task-analysis and job-analysis, those attempts seem scant and too broad to be readily used by the designers of systems, online career counseling services, and recruiting websites. Therefore, we still do not know the details about how, and the extent to which, the videorecording can help us in task- and job-analysis. Addressing this concern is the main goal of this research. The next section discusses the findings of this set of research.

Chapter 3

Methods and Results

The previous section outlined the background to my interest in the topic. This section describes the results of my respective investigations up to this point. Particularly, I have conducted a literature review on training-system design, and conducted a study on proposing a videorecording method to design training-simulators. This section briefly describes the results that I have gained in those areas.

Results in training-system design

In addressing the question of the relationship between fidelity and training success, the following broad lessons were learned from the review:

- because of the growing number of studies that challenged the traditional theory, fidelity can no longer be the central design construct for training-systems,
- if the belief in high-fidelity simulation still exists, it is because fidelity is an easy, well-known, and intuitive construct, and also because there are no existing alternatives to fidelity,
- due to the reduced dependence on fidelity by the mainstream research and design community, a conspicuous void exists in providing design guidelines and as a result, confusion in design is the current state of the field.

So, the review of literature did not result in a clear answer to the fidelity question, and this should reduce the validity of fidelity as a construct in design. This would create a void in design, as designers would ask for what to focus on when designing training simulators.

In filling the void of fidelity, we need methods that can provide us with specific design guidelines. In creating design methods, one lesson that is clear from the review is that we should not focus on simulation technology, and instead, should focus on training elements such as experts, trainees, the task, tools, and other important elements in training.

Prior research has shown how traditional task- and trainees-analysis could be used for training-system design. For example, to learn about tasks, standard methods of work/task-analysis have been used for decades (Smith, 1965; Stanton et al., 2018). The importance of such analyses in technical specifications of training systems is well-established, as researchers showed how the knowledge from the task-analysis can inform designers of the required fidelity level and other aspects of the training devices and programs (e.g., Hays & Singer, 1989; Smode, 1971, 1972).

And as an example of trainee-analysis, we now know that training systems with higher levels of fidelity are more likely to be useful for more advanced trainees, and those with little to no prior skill can often benefit more from low-fidelity simulation (e.g., Alessi, 1988).

However, although considering the two elements of task and trainees can provide important information for training-system design, it is not sufficient in creating design methods. In short, the aforementioned attempts in task- and trainee-analysis, when considered together, do not present a comprehensive resource to guide the design in specific and practical sense. As Hays and Singer (1989, p. 56) wrote, “no systematic guidance exists to translate task analysis information into a form which can facilitate fidelity decisions”. The outstanding evidence of the deficiency of the decades of past attempts in trainees- and task-analysis is in the current confusion in design and problems with fidelity. This deficiency can also be found in the lack of attention from practitioners to the research community and the long-standing gap that stands between theoretical research and design practice (Campbell, 1971; Cannon-Bowers et al., 1991; Goldstein, 1978).

In summary, the literature review has taught me that fidelity could not be used as a resource in training-system design, and the traditional attempts at task- and trainees-analysis could not replace fidelity for providing design guidelines. This conclusion has led me to look for a more dependable resource that could resolve many of the confusions in design: expert performance.

Method and results in videorecording for task-analysis

Because experts can define the criteria of performance, they can be a source of information for training. However, the information should not explicitly ask experts of how to perform, because as it was mentioned earlier, explicit information of experts can hide important information of their performance. As a result, we need to formalize a method to videorecord experts in natural settings, model their performance, and use the model to guide the design of training-simulators. The following paragraphs describe my proposed method and the validation of the method with an example of truck-driving training-simulators.

The videorecording method

The details of the videorecording method are divided in five phases that are discussed toward the rest of this section: Identification of Elements, Recording Performance, Analyzing the Recordings, Validation of Behaviors, and Implementation.

Identification of elements

The following paragraphs describe the four essential elements that are needed in the design method.

Task. Often, the designer is provided with the task to be trained. What is important on the designer's side is to clearly define the goal of the task as it tells us what should be trained by the simulator and what aspects of performance are important. This is not task-analysis, but a clear specification of the task and its goal. This would inform and guide our recordings and analysis in later phases. Therefore, it is important to clearly identify the task and its goals.

Experts. Experts and their performance are the focus of our recordings. Experts are individuals who have the experience of practicing tasks over an extended period of time in various conditions, and are recognized as having skills in performance. Despite attempts at defining general qualifying criteria (e.g., 10-year-rule of practice: Ericsson & Charness, 1994), the qualifications of an individual as expert for our recording does not follow fixed criteria. Rather, the experts' level of skill depends on the goal of the training-simulator and should be relative to the trainees' level of skill (Vygotsky, 1978). Because we will model their performance, the identified experts will determine and define the criteria of performance and practice in simulators.

Tools. Devices, interfaces, and systems with which experts operate during performance are tools. For instance, for a pilot, tools can be the interface of a cockpit (e.g., hardware and software systems in the control panel) and the airplane as a whole. What distinguishes experts from novices is largely in their relationship with tools, and how tools become a part of experts' performance (e.g., Polanyi, 1966). Thus, if the goal is to derive behaviors that represent the expertise, we should identify and record tools and other environmental details that are important in performance.

Trainees. Trainees are the users of the simulator and similar to the task, they are often determined by factors outside of the designer's control. The central characteristic that we need to know about trainees is their level of skills when they start using the simulator. This might directly affect our choices in the method such as what to record and how to record them. For example, recording a certain micro-scale behavior might only be important to design a simulator for highly-skilled trainees.

Recording performance

The goal of this phase is to record the performance of experts via video. Ideally, all experts should be given the same task in similar environmental conditions. For example, all expert drivers should be asked to drive in the same itinerary, traffic, weather, and visibility conditions. To record their performance, for each expert, we need one or multiple video pieces—each taken from one camera—from their performance (as shown in Figure 3-1).

What to Record. Except for trainees, the elements that were identified in the previous phase (i.e., task, experts, tools) as well as additional relevant factors (e.g., time) should be recorded. The specific focus of recordings depends on the task and the goal of the expert in performance. For example, in marksmanship, it is important to record the complete body posture of the marksman, but in driving this might not matter. It is also important to include all relevant task environments. For example, maintenance technicians might work in more than one location where they should be recorded.

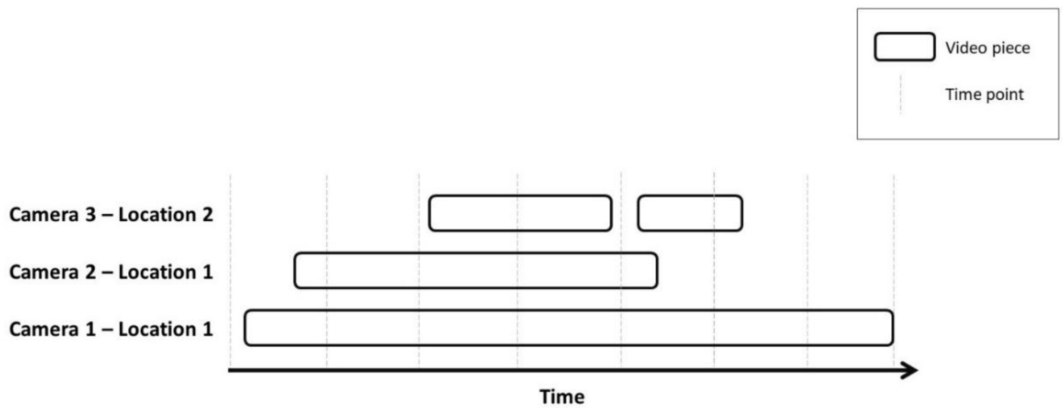

Figure **3-1**: An example of the output of the recording performance phase

Note. Video pieces from different cameras are synchronized relative to the performance time. Each video piece is used to show the task environment from a unique perspective or location.

How to Record. We need to set up our recording equipment to capture important aspects of experts' performance. To do this, we should pay attention to the key technical details of the recording such as cameras' point of view, focal point, and audio recording devices (if needed). Such technical considerations can also inform us of what type of recording devices we need. In setting up our recording equipment, we should minimize the chance of interfering with experts' performance (see Aiello & Kolb, 1995).

Analyzing the recordings

We now should have one or multiple pieces of recording from the performance of each expert. The goal of this phase is to produce a single video piece of performance for each expert, with highlights over specific behaviors (as shown in Figure 3-2). To do so, we should first compile all video pieces into one, and later, highlight specific behaviors in that piece.

Creating a single piece of video. Suppose we have more than one video piece for each expert. To create a single video piece, we often need to see multiple camera inputs in a single screen during analysis. Figure 3-3 shows two examples of the compilation of multiple camera inputs in a single screen (see Advance Driving School, 2016).

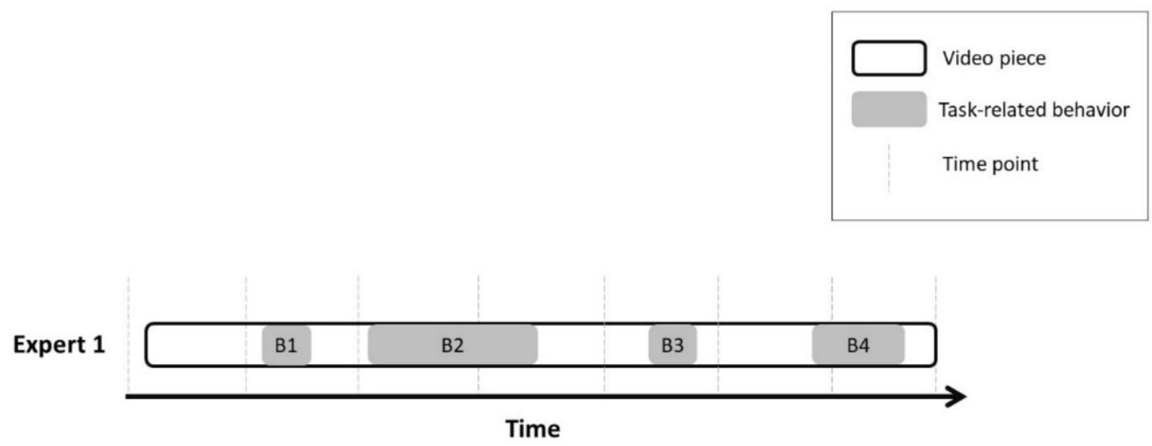

Figure **3-2**: An abstract depiction of the output of analyzing the recordings phase
Note. Each expert's performance should be represented by a single video piece with specified behaviors (highlighted areas in grey).

Specifying behaviors. Each behavior has a duration within an expert's entire performance (gray boxes in Figure 3-2). For example, in landing an airplane, checking if the wheels are fully open can constitute one behavior. By consulting with subject-matter experts, we can ensure that the specified behaviors are relevant to task performance. And, to increase the validity of our analysis, we can ask multiple individuals (preferably subject-matter experts) to analyze the videos independently and in parallel (e.g., Mathiassen et al., 2013). The aggregation of their analysis can reduce the subjectivity in behavior specification.

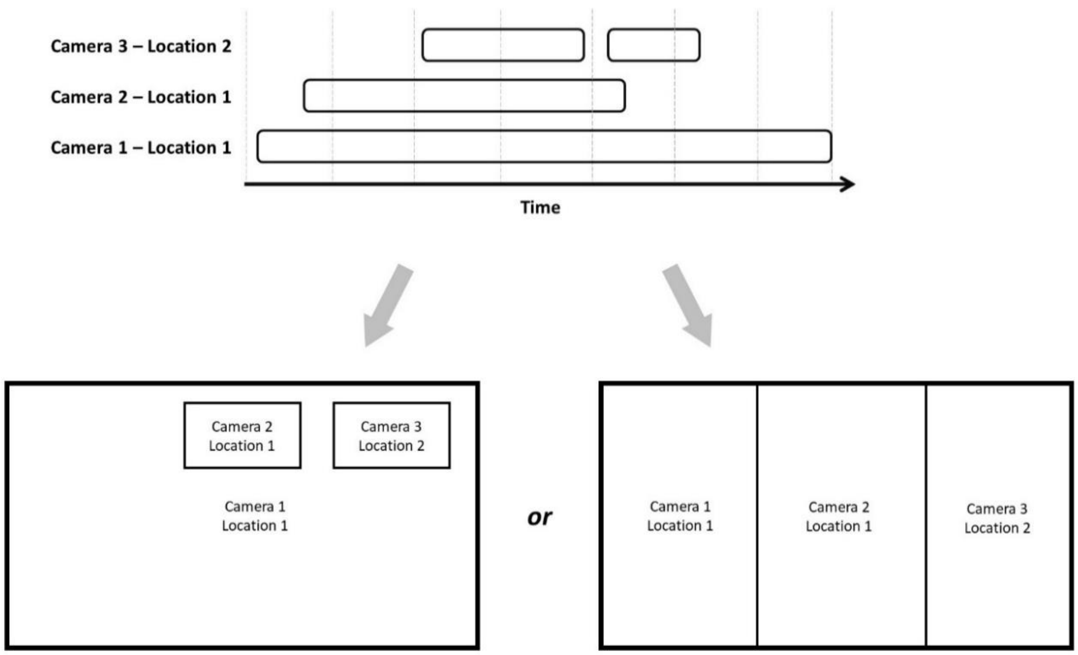

Figure **3-3**: Two different compilations of a display to show the video pieces from multiple cameras.

Behaviors can be defined and specified in various levels of abstraction. For example, a macro-level behavior can be parallel parking of an automobile as it contains many details, and a micro-level behavior can be pressing the brake pedal in the same task. Choosing the level of abstraction depends on the task and what skills should be trained.

To highlight behaviors, we can observe the video pieces and manually specify single behaviors. Another option is to use available computational video-processing tools to help us in behavior specification. Such tools are currently used for human performance analysis in various domains (e.g., Loukas, 2018).

Validation of behaviors

By now we should have one piece of video for each expert. In this phase, we need to review the recordings to see how experts perform the same behavior to average their performance in that behavior. This averaging leads to a model of *average expert behavior (AEB)*. This model represents the expertise in this context and will be used in design. Figure 3-4 shows an abstract depiction of the process in this phase.

The first step in averaging is to choose the criteria of comparison between behaviors. This is an important advantage of this method compared to the traditional task-analysis methods, as we would have the freedom to review the recordings and choose and test the criteria of performance; if one criterion was not satisfactory (e.g., not shared among experts), we can choose another. An example of a quantitative criterion that often distinguishes experts from novices is timing in performance (e.g., Beek & Turvey, 1992). The temporal analysis can include measuring the duration of performing a behavior (the width of gray boxes in each expert's performance in Figure 3-4), the delay between two behaviors (the distance between two gray boxes in Figure 3-4), and the entire duration of performance. This will also help us in creating a temporal dimension for the AEB (the bottom of Figure 3-4) that can be used for further quantitative or qualitative comparisons between behaviors.

In addition to timing, we can use other quantitative criteria in performance such as degree, length, and force that experts represent in their performance. We might also need to use qualitative criteria in comparisons. For example, one qualitative criterion that can be used for a variety of tasks is the order of behaviors in task performance (e.g., Carroll & Olson, 1988). In this case, averaging is what sequence of behaviors were followed by the majority of experts.

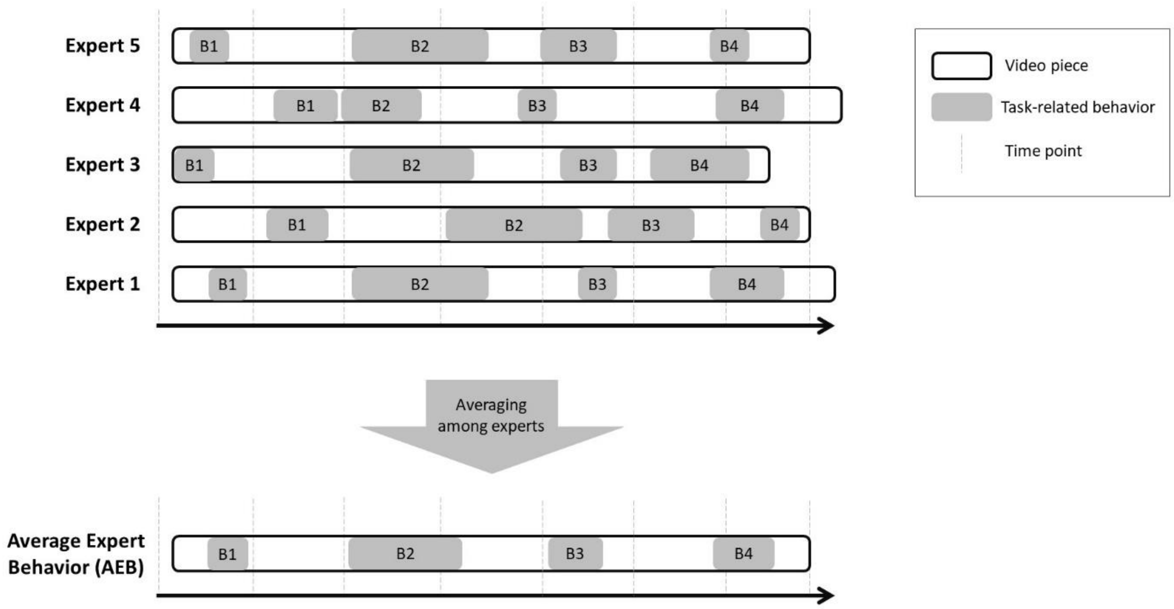

Figure **3-4**: Producing the model of average expert behavior

Once we averaged each behavior, the result can be in the form of numbers and statistics, shapes, prototypes, figures, animations, or any other form that can inform us of how, on average, experts performed a behavior. Having this information for multiple or all behaviors creates the general model of AEB (Figure 3-4, bottom). By now, it is clear that this approach is in stark contrast to conventional task-analysis, as the model of expert behavior comes from reviewing the videos of experts, not from the logical steps needed for a goal.

Implementation

Generally, there are two ways the AEB can be used: designing new systems and improving existing systems.

Designing new systems. In this case, we first need to have a minimal simulation of the target task environment (i.e., a low-fidelity simulation) that would provide the possibility for trainees to practice the task in a similar environment in which we recorded the experts. We will later supply this minimal simulation with the information that we have in the AEB as well as the videos.

For example, the information about each behavior in the AEB can be used as a condition in the system that monitors trainees' practice and informs them of the proper performance. This monitoring and feedback would then require additional tools in the simulator (e.g., eye-tracker, cameras). Also, reviewing the videos informs us of what tools were used by experts, and this can inform the decisions of hardware and software configurations in the simulator.

It is important to remember that designing a new simulator for a task would not only need an extensive consultation with subject-matter experts, but would also require comprehensive information about many aspects of the target environment, tools, and the task-relevant behaviors of experts that need to be included in our recordings. As such, special care must be taken in implementing the method and testing the final system.

Improving existing systems. A simpler way that the AEB can be used is to modify existing systems. This is simpler than designing from scratch because if we have a set of recordings that are incomprehensive, unstandardized, and may violate many of the conditions in the method, it would still be possible to derive information that can be used to bring small improvements to the existing systems. And even if we have comprehensive recordings, it might not always be efficient to design new systems if there are existing systems in use. For example, if we can verify and average only one behavior from the recording of experts, we can use the information as a condition in the system that can monitor and guide trainees' performance. Additionally, we can first review the working of an existing system, derive a scenario of practice, and ask how experts would perform that scenario (e.g., Cannon-Bowers et al., 1998). We can use this question to inform our method, initiate the recordings, and use the recordings for improving simulators.

Summary

The relationship between the four elements and the five phases of the method is depicted in Figure 3-5, and the phases of the method are summarized in Table 3-1. Reviewing the phases of Validation and Implementation tells us an important advantage of this method versus traditional task-analysis: because the video provides a direct picture of performance, it gives us the freedom to choose the performance criteria of comparisons among experts. As such, hidden aspects of the expertise that might go unnoticed by experts can be discovered by analyzing the videos. The following paragraphs presents an example that shows how the method works in a real-world situation with unstructured data.

An experimental example

In this example, the videorecording method is used to provide design suggestions for heavy-truck driving simulators. Such simulators are used to train the essentials of what is needed to drive a truck and pass the driver's license test (see Figure 3-6). This example is provided to show how important aspects of the method (i.e., analyzing and validating behaviors) can be used.

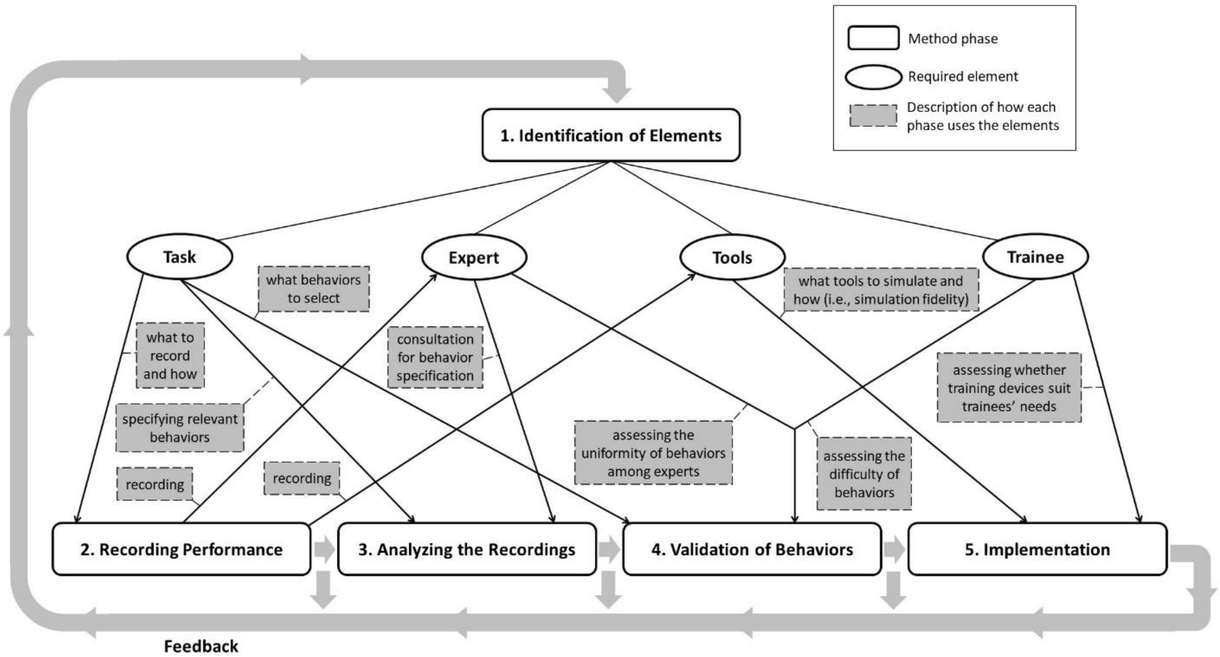

Figure **3-5**: An abstract depiction of the videorecording method

Table 3-1

A summary of the input and output of each design phase

	Phase	Input	Output
1	Identification of Elements	Task-analysis, interview, observation, etc.	Specification of task, experts, tools, and trainees.
2	Recording Performance	Observation of performance including the specified elements.	Piece(s) of video of the expert and tools during performance.
3	Analyzing the Recordings	(Output of Phase 2)	For each expert, a single piece of video with highlights over single behaviors.
4	Validation of Behaviors	Video pieces of the performances of all experts.	A validated model of average expert behavior.
5	Implementation	The average expert behavior.	Hardware and software specifications for the design and improvements of simulators to guide trainees in practice.

Identification of elements

The *task* in this example is heavy-truck driving—i.e., moving the truck from one location to another in a city or highway. After conducting a comprehensive search to identify *experts*, it was fortunate to find three experts who uploaded the videos of their performance online for public access. The videos satisfied the basic requirements to be used in the method (i.e., similar recordings, road, visibility, traffic, time-of-day). There were four videos from the three experts; general information of the experts and videos is summarized in Table 3-2 and sample snapshots of videos are shown in Figure 3-7.

Figure **3-6**: Two examples of truck-driving simulators used for training

Note. Derived from Veterans Health Administration (2009).

Table 3-2

Information of experts and their videos

Expert	Estimated age of the expert	Total video length in minutes	Reference
1	60	17	Logan (2016)
2	60	28	West Side Transport (2016)
3	40	18	CDLTestTruck (2012)
		15	CDLTestTruck (2011)

Figure **3-7**: Sample snapshots of videos used in the study

Note. The video of Expert 1 is shown on the left, Expert 2 in the middle, and Expert 3 on the right.

The main *tool* in this task is the truck and its performance-related devices (e.g., steering wheel, mirrors). The trucks that the experts used are regular 18-wheelers (i.e., Class 8 trucks in the US Gross Vehicle Weight Rating classification). The streets and the incoming traffic are performance-related environmental details that are included in the videos. *Trainees* are individuals whose goal is to pass the Class A Commercial Driver's License (CDL) Skills Test that is officially required to drive heavy trucks (Class 7 and Class 8 trucks, more than 26,001 pounds of weight) in the US. The minimum age requirement for this type of license is 18 years in most states in the US.

Recording performance

The driving performance is recorded with a camera that is either installed or manually held inside drivers' cabin, showing the front of the vehicle and the road ahead through the windshield (see Figure 3-7). The driving of one of the experts is recorded with a wide-angle lens that helped including more details of the road (i.e., Expert 1), and the other two experts were recorded with normal lenses. The side mirrors can also be seen in the recordings of two of the experts that show the two sides of the truck (i.e., Expert 1 and Expert 2). The videos were recorded in similar road, traffic, visibility, and climate conditions, and the mean length of the videos was about 20 minutes. All videos underwent minor editing as they simply showed a continuous driving session.

Analyzing the recordings

Because for each expert there was one camera that produced one video stream of performance, there was no need to combine different video sources and create a single piece of recording. So, each performance-related behavior was specified during the performance of each expert. To do this, each video was replayed and each behavior was manually identified and temporally highlighted. Table 3-3 shows the result of the analysis and the specified behaviors. To facilitate the validation, labels for behaviors (e.g., "Turn left") were standardized between the three experts.

Validation of behaviors

For the sake of brevity, two behaviors were chosen for validation. The first is Turning Right at an Intersection (i.e., "turn right inters." in Table 3-3). This behavior is a 90-degree turning of the truck to the right at an intersection. As shown in Table 3-3, Expert 1 has three, Expert 2 has two, and Expert 3 has five instances of this behavior which makes ten instances in total. The second behavior is Lane Change that moves the truck from one lane to another in a multi-lane road. There are seven instances of this behavior in total: four in Expert 1, one in Expert 2, and two in Expert 3.

Quantitative Averaging. One important advantage of using the video is in giving us the freedom to choose the performance criterion in averaging the behaviors. Here, because it is a familiar measure in performance-analysis, the timing in performance was chosen as a quantitative criterion of comparison. For the turning-right behavior, the videos showed that the mean time for all ten instances of this behavior among the three experts was 18.30 seconds with the standard deviation of 4.47 seconds. In other words, the data shows that it takes 18.30 seconds for experts to turn right at an intersection. This finding will be implemented in the simulator to guide trainees in practice. For the lane change, averaging all seven instances of the behavior resulted in the mean time of 10.00 seconds and the standard deviation of 1.29 seconds. In averaging of the two behaviors, the timings in Table 3-3 were used, and Figure 3-8 summarizes the results. It is important to note the advantage of the method compared to conventional task-analysis in directly using experts' data in tabulating Table 3-3, without any rational analysis of their performance or relying on their own reports.

Qualitative Averaging. The advantage of video in providing freedom for analysis is greater regarding qualitative averaging as most qualitative aspects should be chosen after reviewing the videos. Task-analysis methods do not provide such a freedom as performance criteria must be decided beforehand. Here, the order of the sub-task performance was chosen as a qualitative criterion. The question is what specific steps experts followed in performance for each of the two behaviors. For the turning-right behavior, Expert 1 suggested in his video that the performance can be broken into four steps that should be completed in order: Approach, Stop, Turn Through, and Completion. Reviewing the videos from the other two experts showed that this suggestion helped to analyze this behavior, and this sub-task classification was used here to

Table 3-3
The specified behaviors during the performance of the three experts

Expert 1		Expert 2		Expert 3	
03:16 - 03:46	Turn left	00:42 - 01:11	Turn left	First video	
04:20 - 04:40	Turn right inters.	01:48 - 02:05	Turn right inters.	01:38 - 01:54	Turn right inters.
04:50 - 05:09	Curve right	07:00 - 07:39	Curve right	02:47 - 02:59	Lane change
05:55 - 06:16	Curve right	08:50 - 09:05	Curve right	04:00 - 04:20	Turn left
06:29 - 06:45	Merge to highway	09:45 - 10:00	Merge to highway	04:56 - 05:16	Turn left
07:10 - 07:20	Lane change	12:45 - 13:00	Exit highway	05:28 - 05:54	Roadside stop
07:39 - 07:48	Lane change	13:38 - 13:52	Merge to highway	08:21 - 09:18	Parallel parking
08:37 - 08:56	Exit highway	14:05 - 14:13	Lane change	11:30 - 11:45	Turn left
09:05 - 09:32	Pass traffic circle	14:43 - 15:00	Exit highway	12:33 - 12:50	Turn right inters.
10:39 - 11:07	Turn right inters.	15:15 - 15:37	Turn left	12:51 - 13:11	Curve right
11:40 - 12:00	Turn left	16:02 - 16:16	Turn left	13:32 - 13:48	Merge to highway
12:09 - 12:38	Turn Left	16:30 - 16:41	Merge to highway	14:35 - 14:48	Exit highway
13:00 - 13:13	Curve right	17:05 - 17:18	Exit highway	15:58 - 16:18	Turn left
13:47 - 14:06	Turn left	18:03 - 18:16	Merge to highway	17:16 - 17:38	Turn left
14:38 - 15:04	Curve left	21:30 - 21:39	Exit highway	18:11 - 18:26	Roadside stop
15:34 - 15:45	Lane change	22:39 - 22:53	Turn right inters.	Second video	
15:45 - 15:55	Lane change	25:15 - 25:30	Turn left	07:33 - 07:50	Turn right inters.
16:05 - 16:16	Exit highway	27:54 - 28:04	Turn left	09:19 - 09:37	Turn left
16:30 - 17:14	Pass traffic circle			10:39 - 10:49	Lane change
17:20 - 17:38	Pass traffic circle			12:32 - 12:47	Turn right inters.
18:27 - 18:52	Turn left			13:43 - 13:56	Merge to highway
18:53 - 19:09	Roadside stop			14:37 - 14:47	Exit highway
20:12 - 20:36	Turn right inters.			14:53 - 15:06	Turn left
				15:06 - 15:19	Turn right
				15:38 - 15:53	Turn right inters.
				17:10 - 17:31	Turn right
				19:50 - 20:07	Turn left

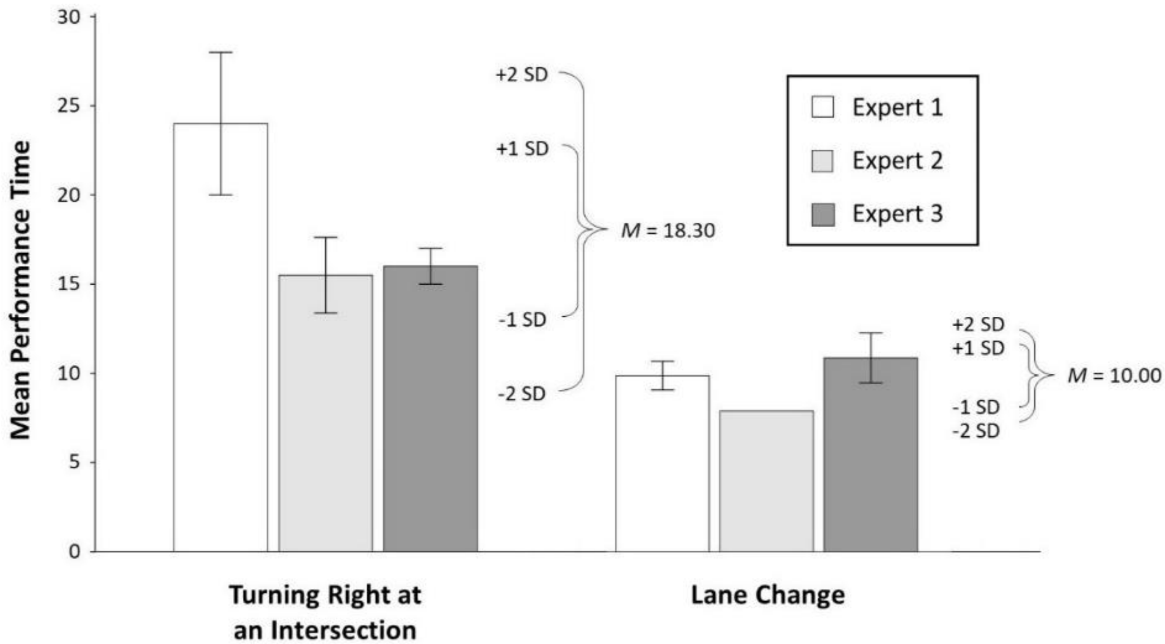

Figure **3-8**: The results of the temporal averaging for the two behaviors

Note. M is mean and SD is standard deviation.

make the qualitative averaging. Table 3-4 describes how each expert turned right according to each of these four steps. By aggregating the results in Table 3-4 it was found that that the following steps were taken by at least two of the three experts:

- Approach: Activate the turn signal and reduce speed 100 feet ahead. Detect the stop sign.
- Stop: Complete stop two feet before the stop sign.
- Turn Through: First, move forward a bit to have a better view on the traffic. While turning slightly, drive to the extended space. Look at the right-side rear mirror; when the trailer wheels are cleared, make a sharp turn.
- Completion: Return to the right lane quickly. Cancel the signal. Continue.

Table 3-4

A general description of how each expert followed the four steps when turning right

	Approach	Stop	Turn Through	Completion
Expert 1	Activate the turn signal 100 feet before the intersection, reduce speed.	Completely stop two feet before the sign.	Before the main turn, move the truck forward a bit to have a better view. If no traffic, drive to the extended amount of space (second 12-foot lane from the right), sharp turn after the tires are cleared on the right. Check the side rear mirrors.	Check the side mirrors to ensure there is no car coming from the back, return your vehicle to the correct lane, continue, cancel the turn signal.
Expert 2	Detect the stop sign, scan the intersection, reduce speed, activate the turn signal.	Completely stop, look at the incoming traffic, wait for a big gap in traffic.	First, move forward a bit to have a better view. Sharp turn after the tires are cleared on the right rear mirror.	Return to the right lane quickly to prevent the following vehicles to enter the right lane during the turn.
Expert 3	From 100-125 feet ahead turn on the signal, reduce speed, detect the stop sign.	Completely stop two feet before the stop sign.	Move forward a bit. While turning, look at the side rear mirrors to see if no car entered the gap while you were turning.	Return to the right lane quickly, cancel the signal.

Note. The text in the table is derived from the experts' verbal descriptions as well as the author's analysis of experts' performance.

The same qualitative averaging can be applied to the lane change behavior as follows:

- Initiate: Road should be straight and not curving. Turn on the turn signal well in advance of lane change (at least 400 feet ahead).
- Check traffic: Check the traffic behind before changing lane by looking at the side mirrors.
- Change: Slowly turn the steering wheel (can be quantified). Position the truck and trailer properly in the new lane.
- Completion: Cancel the signal.

Implementation

Now, the quantitative and qualitative information of experts' performance should be used in simulators to guide trainees in practicing the two behaviors. The information should be presented to trainees in the form of feedback, and there are many decisions that should be made in providing feedback (e.g., different types of feedback are possible, such as concurrent vs. terminal, visual vs. auditory, etc.). The details of these decisions highly depend on the task and would go beyond our discussion (for a review, see Sigrist et al., 2013). So, below we present a simple suggestion of how to use the results of experts' performance in design in this example.

We can adopt concurrent feedback (i.e., feedback during practicing with the simulator) provided through visual cues on the screen of the simulator. Before practicing with the simulator, trainees are instructed that their performance will be monitored and matched against the performance of experts that are embedded in the simulator, and that they will receive respective feedback during practice to improve their performance.

Now, we need to implement the performance results in the simulator. Regarding the quantitative analysis, the curly brackets in Figure 3-8 shows how the timing windows for the two behaviors were defined. Specifically, if during practicing in the simulator, a trainee's performance time was close to the mean (i.e., less than 1 standard deviation from the mean, or within the smaller brackets in Figure 3-8), the system would inform the trainee of the good performance timing. If the trainee's performance took between 1 and 2 standard deviations from the mean (i.e., between the small and big brackets in Figure 3-8), the system would indicate acceptable performance with guidance to further improve their timing. And if the trainee's timing was far away from the experts' mean (i.e., more than 2 standard deviations from the mean, or outside of the larger brackets in Figure 3-8), the system would inform the trainee that they took too long (or short) to perform the behavior and they need to accelerate (or decelerate) their performance.

The same conditional checking applies to qualitative averaging. For example, in the Turn Through step of the turning-right behavior, the system can monitor trainees to see if they visually check the clearance of the trailers' wheels in side mirrors before making a sharp turn. Similarly, the system can check if trainees change lanes in curvy or straight roads.

To check trainees' performance, monitoring systems should be included in the simulator (e.g., eye-tracker). Additionally, only the tools and gauges that experts used in performance are necessary to be included in the simulator (e.g., odometer, tire pressure gauge, brake valves). As a result, the videos can provide hardware and software suggestions for design. With a similar but more comprehensive analysis of all behaviors, the method can shape the hardware and software characteristics of the simulator.

The above suggestion was one way to provide feedback to trainees; in reality, researchers and designers of truck-driving simulators should determine how to administer the feedback. What was presented in the example was respecting the limited space, and the analysis of experts' behaviors could be more sophisticated. For example, averaging the performance time for all instances of a behavior among the three experts might have oversimplified the details of their performance because, for example, different experts might perform their behaviors with different speeds, and this might be a part of their style of performance. Nonetheless, the direction for more sophisticated analysis is obvious by now.

Summary

There are indeed limitations to the presented method, the most important of which is regarding the inability to represent mental skills. Due to the space limitations, we do not discuss the limitations in detail. Suffice it to say that the method provided normative information of performance—how the task *should* be performed. This "should" was derived from reviewing the performance of multiple experts through videos. Traditional task-analysis, however, is logically descriptive by telling us how the task *can* be performed. This highlights the difference between studying experts in this method versus "users" or "operators" as commonly practiced in task-analysis. The presented method received performance information directly from experts via video, but task-analysis breaks down a task into steps.

There is an important distinction between focusing on experts' skills rather than steps, as insufficient attention to experts shifted the focus of design to simulating target task environments (e.g., simulation fidelity) and other trivial aspects of a task. This negligence resulted in confusion for researchers and designers (e.g., Hamstra et al., 2014; Wickens et al., 2013) and prevented trainees from practicing the expertise. Using expert performance in the presented method provided a direction that helped to resolve this confusion.

The next section intends to extend the benefits of the videorecording method to the realm of job-analysis. Specifically, we have seen how the proposed method of design went beyond the limitations of the traditional task-analysis in having a rational picture of performance toward an actual picture of how experts perform tasks. Similarly, when job-analysis is used to design traditional job descriptions, job seekers are presented with a rational picture of a job. Seeing how the job looks through the videorecording of current employees can go beyond this limitations and present the job seekers with a rich qualitative data. So, the next section is dedicated to the extension of the videorecording method in job-analysis and designing job descriptions.

Method and results in videorecording for job-analysis

To resolve the traditional problems of online job descriptions, video job descriptions are proposed as an alternative to current text-based online job descriptions. Figure 3-9 shows an example of a video job description as used in this study. The rest of this section presents the results of a comprehensive study on whether and how video job descriptions can affect job seekers’ evaluations of careers, organizations, and the message.

Method

This section describes study design and procedure regarding the experiment on job-analysis and creating video job descriptions. The main goal of the study is to compare video job descriptions with traditional text-based descriptions in terms of job seekers’ evaluations.

Figure **3-9**: An example of video job description

A behavioral experiment was designed using the online surveying tool, Qualtrics, to create online job descriptions for the experiment. So, participants finished the experiment entirely online with computers. Participants first filled the consent form, and then entered their biographic information. Each participant then saw six job descriptions in total, three in the *video condition*, and three in the traditional *text condition*. At the end of each job description, participants answered questions to evaluate the message and its informational content, the job, and the organization. Therefore, the study design is within-subject as it makes it easier for us to detect changes in each participant's judgment between the two conditions compared to a between-subject design. An abstract depiction of the experimental design is shown in Figure 3-10.

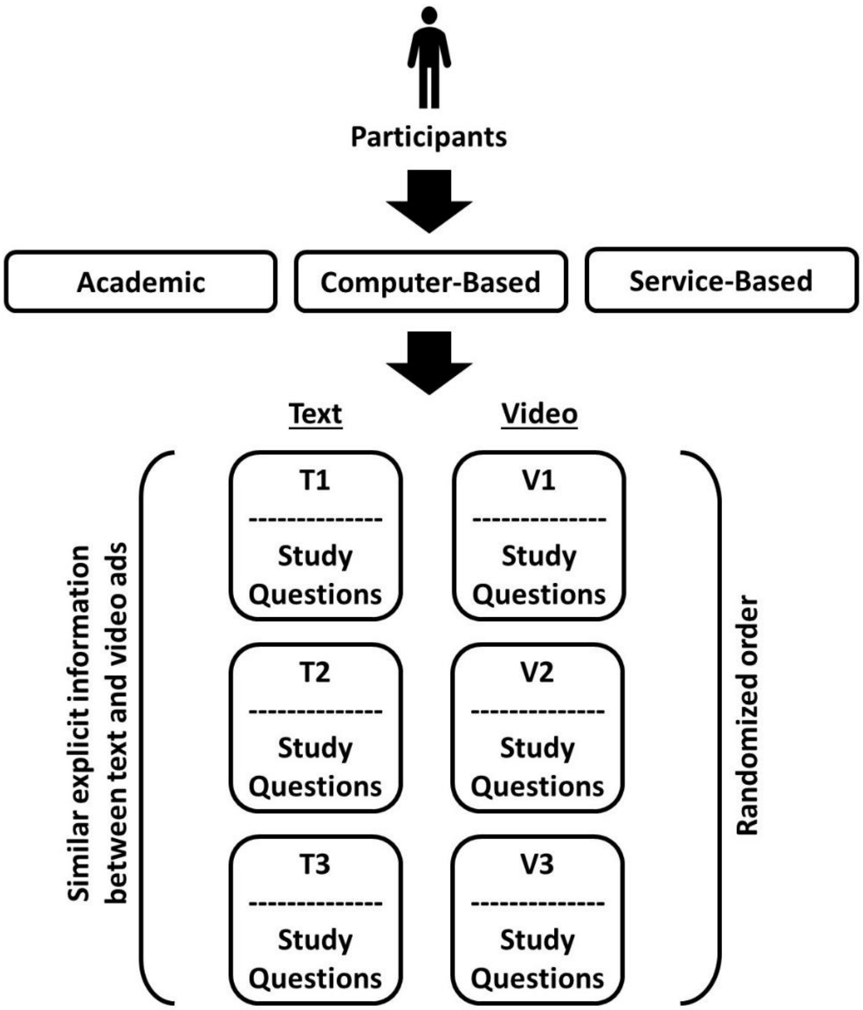

Figure **3-10**: An abstract depiction of the study design

Different job categories are used because we need to know, if there is any effect of video, whether the effect is particular to certain types of jobs, and whether the effect is limited to job seekers with certain interests and backgrounds. Moreover, there have been calls from some authors that criticized most empirical studies for using only college students as participants, particularly from psychology departments, and the limited spectrum of jobs that they may apply (e.g., Breaugh, 2013). Therefore, three categories of jobs are chosen: Academic, Computer-Based, and Service-Based. The choice of these specific categories is based on several reasons. First, differences between public expectations of these types of jobs might influence the effect of videos. For example, responsibilities, culture, environment, and tools in academic types of jobs are more well-known and predictable than the other two categories; this should make the videos more effective for non-academic jobs. Additionally, the educational requirements for these categories are different; academic jobs often require higher educational attainment from applicants than computer and information-related jobs, which requires higher education than service-based jobs. This difference in educational requirements can show differences both in applicants' technology use and their attention to online details which, in turn, can influence the effectiveness of videos. So, although some prior research defined certain types of jobs (e.g., Bureau of National Affairs, 1988: office/clerical, production/service, professional/technical, commission sales, and managers/supervisors) the focus of this study and available resources encouraged defining the following three categories that participants should choose from:

- "Academic (professor, lecturer, researcher). Often requires PhD."
- "Computer and information-related (software engineering, cybersecurity, data analysis, programming, user experience, etc.). Requires at least college degree."
- "Service-based (technician, driver, laborer, custodian, gardener, etc.). Requires high-school diploma or equivalent."

As mentioned earlier, each participant faced six job descriptions in a randomized order; three in the text condition and three in the video condition. If we observe differences between participants' evaluations between the text and video conditions, we cannot easily claim that the difference is because of the video because other details of the jobs might have caused the difference. Therefore, because the goal is to understand if the video is having an effect, we need to control the effect of information other than the video that exists in job descriptions. To overcome this difficulty, as Figure 13 shows, we paired each text-based job description with a video job description, and in each pair, the overall job characteristics are similar. For example, in each pair, jobs are in the same location, have the same or similar job title, and are similar in other respects; the main difference between each pair is that they are different positions in different organizations. Participants are unaware of this arrangement because they see all six job descriptions in a random order, but this arrangement can help us factor out the effect of non-video information of jobs on participants' evaluations.

Similarly, for all videos, the videos were reviewed and explicit information were extracted from the videos and transcribed into text to be used in the paired text-based job description. This does not mean that all details of the videos were transcribed; only the important job-related information. This would help control for the effect of the amount of explicit information and would allow a more meaningful comparison between the video and text as media.

Finally, to ensure the validity of design in measuring the effect of videos, a strategy is used that divides the data collection into two phases. In the Phase 1 of the study, participants will see the job descriptions as described above. In the Phase 2 of the study, the videos will be removed from the job descriptions in the video condition and placed in the corresponding jobs in the text condition in each pair. Everything else remains the same except the videos that will be placed in the text condition in each pair. These strategies can ensure if the video is having (or not having) any effect with minimizing the influence of contextual factors and other details of the jobs.

Videos

In the video condition, participants see a video embedded within a job description. Figure 3-9 shows an example of how a typical job description in this condition looks like when viewed by participants in a computer screen. The location of the video within each job description might be different; it may be on the top, middle, or bottom of the page, but in all job descriptions in the video condition, there are text descriptions that accompany the video.

By default, when a participant plays a video, it is played within the video frame as shown in Figure 3-9. On average, the video frame occupies 50% of width and 15% of the height of participants' computer display. Participants have the option to maximize the size of the videos to see it in full screen.

Prior research shows that participants are more likely to pay attention to videos if they show people (i.e., current employees and managers), and not just the organization itself (e.g., Eubanks, 2017). As a result, all of the videos we are using in this experiment are focused on an employee, talking about or performing the job in an organization.

In choosing the videos for the experiment, it is important to know what aspects of a job are important for most job seekers. Although this is a challenging question to address, some researchers tried to derive the key attributes of a job that most job seekers are interested to know. For example, the importance of information about co-workers and the physical environment of a job is shown by multiple research (e.g., Powell, 1984; Lock, 1976). Such findings from past research were used both to find appropriate videos for the experiment, and to replicate the results and learn what today's job seekers need to know from a short video in online career counseling.

One issue to consider is that organizations might attempt to portray a favorable picture of themselves through the videos, and hide the work environment and details of the job as it is. Although it is difficult to define and delineate favorable and unfavorable characteristics of a video in an objective sense, this study considers this issue by presenting participants with videos with a varying range of characteristics. Additionally, the question of whether job seekers would recognize some organizations as dishonest and biased is itself an important question that would partially be reflected with the result of this study through participants' evaluations.

The specific videos that were used in the study were found by a comprehensive search of the internet and using video-sharing services such as YouTube and Vimeo. Although there were many videos in video-sharing websites that show employees in their jobs, there were few videos that satisfied the conditions of our study in terms of job type, length, and focus on the job and employees. The result of our search was 24 videos as listed in Table 3-5.

Here is a description of how the characteristics of videos are categorized.

Job specificity (Specific versus General jobs):

- Specifics provide information about a particular job as distinguished from other employers and descriptions, but generals provide information about the type and title of a job.
- The content and people shown in specific videos are all real employees and environment of an advertised position, but generals show jobs just to increase viewers' knowledge.

Table 3-5
Brief information about the videos used in the study

Video ID	Job Title*	Specificity	Professionality	Speech	Duration (m:ss)
A1	Lecturer	Specific	Professional	Talking	6:57 (long)
A2	Professor (all levels)	General	Professional	Talking	1:25 (short)
A3	Assistant Professor	Specific	Amateur	Talking	6:13 (long)
A4	Assistant Professor	Specific	Professional	Talking	6:55 (long)
A5	Professor (all levels)	Specific	Professional	Talking	5:26 (long)
A6	Assistant Professor	Specific	Amateur	Talking	4:53 (short)
C1	Cybersecurity Specialist	General	Amateur	Silent	4:49 (short)
C2	Software Engineer	Specific	Amateur	Silent	6:17 (long)
C3	User Experience Designer	General	Professional	Talking	4:45 (short)
C4	Data Analyst	General	Amateur	Silent	4:19 (short)
C5	Software Engineer	Specific	Amateur	Silent	4:13 (short)
C6	Cloud Architect	General	Professional	Talking	5:54 (long)
C7	Web Designer	General	Professional	Talking	5:40 (long)
C8	Computer Programmer	General	Professional	Talking	4:23 (short)
C9	Information System Security Manager	Specific	Professional	Talking	1:10 (short)
S1	Automotive Technician	Specific	Professional	Talking	4:45 (short)
S2	Construction Craft Labourer	General	Professional	Talking	4:03 (short)
S3	Animal Care Attendant	General	Professional	Talking	4:20 (short)
S4	Automotive Service Technician	General	Professional	Talking	4:35 (short)
S5	Mail Delivery Driver	Specific	Amateur	Silent	8:33 (long)
S6	Custodian	General	Professional	Talking	4:30 (short)
S7	Entry Level and Lateral Police Officer	General	Professional	Talking	4:20 (short)
S8	Gas Fitter	General	Professional	Talking	5:45 (long)
S9	Landscape Gardener	General	Professional	Talking	4:45 (short)

* Job title is the title that is used in the job description that contains the video. It is not necessarily the job title of the video. In the column of Video ID, A, C, and S refer to academic, computer-based, and service-based respectively.

- Specifics show employees as the focal subject of videos, and show their position and responsibilities within the organization, but generals may or may not focus on employees, and if they do, employees' positions and organization is not the main subject of the video.

Professionality (Amateur versus Professional videos):

- Amateurs are self-made, professionals are made by professional filming groups.
- Amateurs do not have a comprehensive depiction of locations, but professionals often do.
- Amateurs have minor to no editing, but professionals are heavily edited (cuts, picture vibration, soundtrack, etc.).
- Amateurs often contain unnecessary and personal information (e.g., personal preferences, hobbies), but professionals are more focused on information about the job.
- Amateurs are often made by employees, and so, they are often recorded by employees' mobile devices; there are more movements of the camera. For professionals, the camera tends to be stationary.
- Amateurs are often made with employees' mobile devices, but professionals are of higher quality of sound and image as they use separate microphones to record voices and use professional lenses to capture light and the environment.

Speech (Silent versus Talking videos):

- Silents do not have people's speech, and instead, may contain background music. Talking videos contain the speech of employees and/or a narrator.

Duration (short versus long videos):

- Short videos are shorter than five minutes; long videos are five minutes or longer.

Organizations and job descriptions

For creating job descriptions, similar to Allen et al. (2007), online samples of job descriptions were used. So, in terms of length, language, and format, the presented job descriptions in the experiment looked like an average job description that can be found online.

Certain measures were taken to prevent the brand and fame of organizations from confounding the results. Most organizations' brands in the experiment were fictitious. However, if there was any well-known organization in the video condition, another organization with similar fame was used in the corresponding text condition in the same pair. For example, if the video job description was from FedEx, the corresponding job in the text condition was from UPS. Similarly, Twitter Inc. was paired with Facebook. Additionally, having the Phase 2 of the study helps us to alleviate this confounding factor.

Regarding the Academic type of jobs, the problem was in what academic discipline to choose for faculty hiring to make it suitable for most participants. So, the decision was that universities would be hiring in multiple majors across schools (e.g., Engineering, Arts and Sciences, Humanities), and this would increase the chance that participants' interested majors would fall into one of these categories.

An important factor is the location of jobs. Because job seekers often have strong preferences about the location of their employment, having location information can easily change their evaluations (e.g., Turban et al., 1995). To prevent the location information from affecting the results, locations are neutral for most jobs. This means that the location information of all of the descriptions was in one of the three forms:

- the job was available in multiple branches of the organization in the US, or

- if a job in the video condition was in a specific location, the corresponding job in the text condition would also be in the same location, or
- the job location was not specified.

Additionally, to distract curious participants of the study goals, other visual and aesthetic elements of job descriptions were manipulated. For example, elements such as pictures, length of text, and text formatting were manipulated between the job descriptions. This can help in hiding the variables of interest, and can thus increase the validity of the responses.

Study measures

Participants' evaluations were measured based on a battery of seven questions that were asked at the end of each job description. The questions were designed to measure participants' evaluation of the advertised position, the organization, and the message. The recruitment-related questions were partially derived from Allen et al. (2004), and the questions of organization attractiveness questions were derived from Highhouse et al. (2003) and Turban and Keon (1993). The questions were presented in random order to control for the order effect. The questions were as follows:

Interest in the position (*intentions to pursue employment, and confidence*)

- Q1: How likely are you to apply for this job now or in future? (not at all, very likely)
- Q2: How confident are you in your decision about applying (or not applying) for this job? (not at all, very confident)

Interest in the organization (*organizational attractiveness or image*)

- Q3: This place is attractive to me for employment. (strongly disagree, strongly agree)
- Q4: A job at this place is very appealing to me. (strongly disagree, strongly agree)

Interest in the message

Credibility

- Q5: The message of the web-page was believable. (strongly disagree, strongly agree)

Symbolism

- Q6: The web-page told me about the values, beliefs, and culture of the organization and the job. (strongly disagree, strongly agree)

Amount and quality of information

- Q7: The web-page taught me something new about this career that I did not know before. (strongly disagree, strongly agree)

After these questions, participants rated their prior familiarity with the organization by answering this question:

- Q8: How familiar were you with this organization from before? (never heard the name, very familiar)

The scale of response for all questions was 1 to 7. Except for Q8 that was asked to assess the validity of responses and was always asked as the last question, other questions were presented in a randomized order.

Results

The results of the analysis on the collected data are presented here. Note that we mentioned earlier that the study had two phases; in Phase 1 we presented the text and video conditions as originally designed, and in Phase 2, we removed the videos from the video condition and placed it in the corresponding text condition to create new video and text conditions. This was to ensure that differences in participants' ratings between the text and video conditions were not due to particular jobs but is only the effect of videos. Here we combined the results of both phases of the study, and the presented results cover all included participants.

Participants

Participants were mainly recruited by campus announcement in a large public university in the northeast of the United States. Most participants were senior undergraduate students, recruited through an extra credit opportunity in a course. Because the link to the study was also shared publicly and online through the university's website, some participants who were recruited were not students. Originally, there were 114 entries in our database which indicates 114 participants. However, 49 entries did not satisfy our conditions for various reasons such as:

- completing the experiment in much shorter time than the average of about 30 minutes (i.e., less than 3 minutes),
- not seeing some of the job descriptions, and
- not finishing the experiment.

As a result, there remained 65 participants that we included in the analysis of this study. Of 65, 42 of the participants were enrolled in Phase 1, and 23 participants were enrolled in Phase 2. Because the vast majority of participants were university students, their average age was about 23 years and they were senior university undergraduates. Before starting the experiment, participants answered this question:

"What is your job status?

- Active job seeker (You currently do NOT have a job, and you are, or soon will be, looking for a job.)

- Passive job seeker (You currently have a job, but are open to consider changing to other jobs or organizations.)
- No job seeker."

Because most participants were in their last semester in university, the majority indicated that they were active job seekers (N = 29) and passive job seekers (N = 24), and for various reasons such as having a job, some indicated that they were not job seekers (N = 11). They came from various majors, but the majority were in technical majors such as information sciences, cybersecurity, and some other engineering disciplines. Mean job experience of participants was 1-2 years. Twenty of the participants were females and the remaining 45 were males. Of the three job categories that we originally defined, the majority of participants chose "Computer and information-related" (N = 55), some chose "Academic" (N = 9), and only one participant chose "Service-based". Therefore, the results will mostly be applicable to jobs related to computer and information sciences.

Primary analysis: study measures

The paragraphs below present the results of the statistical analyses on the data.

Results of Study Measures. Figure 3-11 summarizes the results of the study with respect to the study measures. In all of the seven main study measures, the mean participants' rating was better in the video condition than the text condition. Because of the within-subject nature of the experiment, we conducted paired-samples t-test to investigate the significance of the differences for each study measure. Only in two of the seven study measures, the difference between the text and the video conditions were not significant; Q1: $t(194) = 1.65$, $p = .05$; Q2: $t(194) = .87$, $p = .19$. In all other measures, mean participants' ratings for the video condition was significantly

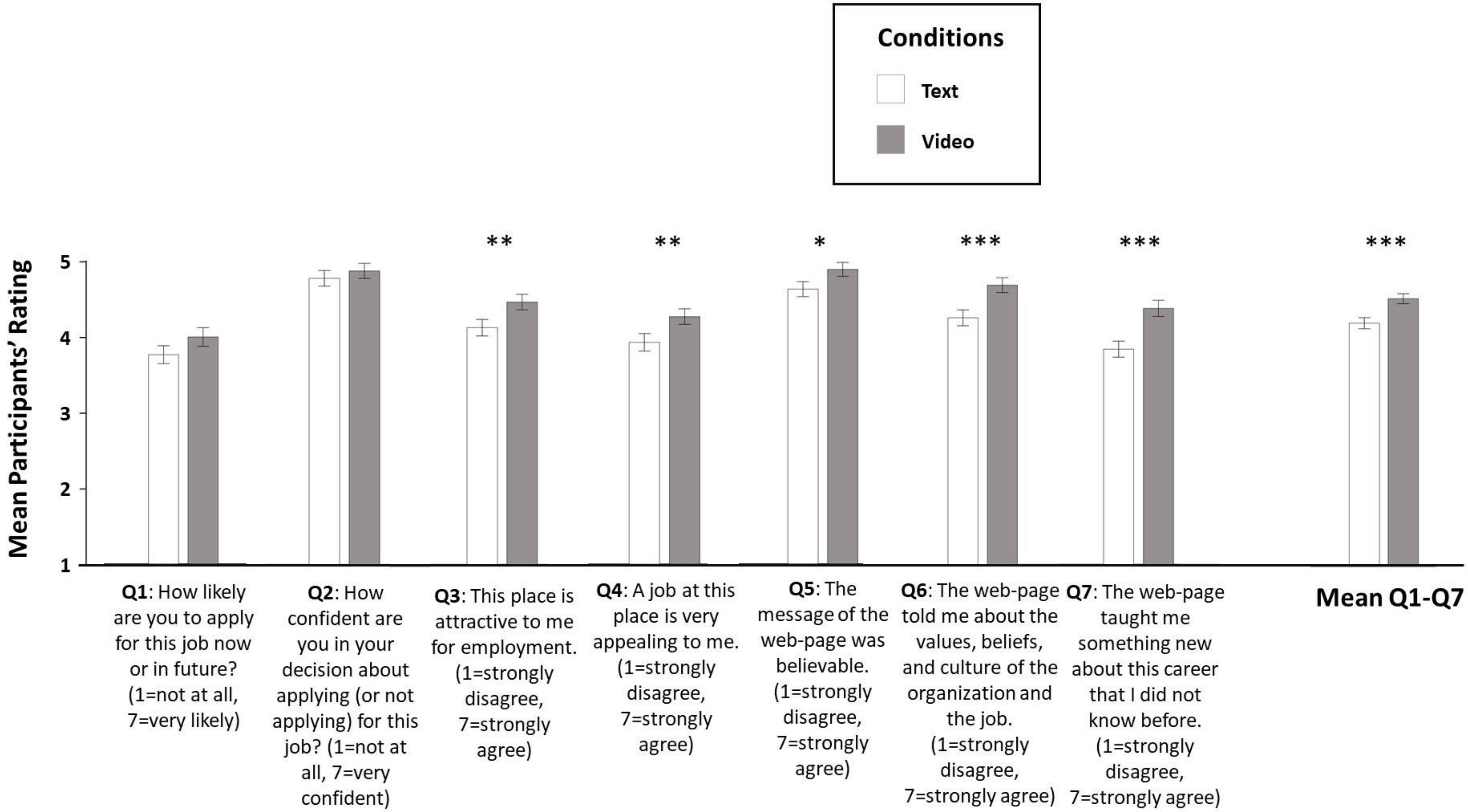

Figure **3-11**: Overall results of mean participants' ratings with respect to study measures (Q1 – Q7)

Note. The signs *, **, and *** indicate *p* values less than .05, .01, and .001 respectively. Error bars are +/- 1 standard error.

better than the text condition; Q3: $t(194) = 2.62$, $p < .01$; Q4: $t(194) = 2.53$, $p < .01$; Q5: $t(194) = 2.13$, $p = .02$; Q6: $t(194) = 3.47$, $p < .001$; Q7: $t(194) = 4.62$, $p < .001$. The effect size of Hedge's g for Q1 to Q7 was .12, .06, .19, .18, .15, .25, and .33 respectively.

The scale for each study measure was the same (1 to 7), and higher participants' ratings indicated more favorable assessment for each study measure. Because of this, we also averaged participants' responses among Q1 to Q7 to present a holistic result (right side of Figure 3-11) with the video condition doing significantly better than the text condition; $t(194) = 3.99$, $p < .001$, $g = .29$. In short, the result in this section shows that, except for participants' interest in jobs, video significantly improved participants' ratings of messages, career, and organizations.

Time on Page. Despite the significant difference in participants' rating between the text and video conditions, as Figure 3-12 shows, the time spent on job descriptions does not seem to be meaningfully different between the two conditions; $t(194) = .44$, $p = .33$. Mean time spent on job descriptions in the text condition was 71.07 seconds, and in the video condition was 75.48 seconds. This indicates that video cannot increase the time job seekers spend on job descriptions.

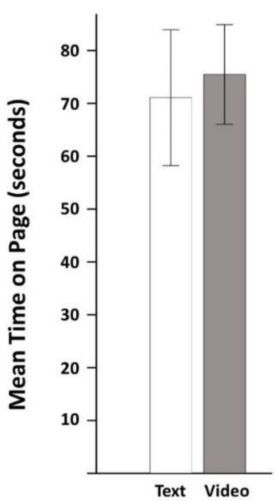

Figure **3-12**: Mean time spent on job descriptions

Note. Error bars are +/- 1 standard error.

Video Characteristics. As mentioned earlier, we categorized the videos based on four categories of job specificity, professionality, speech, and duration. Figure 3-13 shows the results with respect to video categories, and as is clear, videos in all categories resulted in a significantly higher participants' rating compared to their corresponding text condition. The effect sizes in Figure 3-13 can provide a basis of comparison between different categories of videos.

Both specific and general videos improved participants' ratings, with specific videos doing slightly better than general videos. It is interesting to see that amateur videos performed better than professionally-made videos, and the same can be said about the comparison between silent and talking videos. These results can have practical lessons for organizations as they can save costs in creating the videos. Finally, videos that were 5 minutes or longer did slightly better than the videos that were shorter than 5 minutes, even though average participants' time on page for the video conditions was 75.48 seconds.

Secondary analysis: hypothesis testing

Earlier, nine hypotheses were presented in which predictions were made based on the established knowledge from past research. Now, based on the results, we can see how the data address those hypotheses.

- *Hypothesis 1:* Job seekers watch the videos embedded in online job descriptions.

In short, the answer is: to some extent. This is because of the small difference in the mean time on page between the text and the video conditions (Figure 3-12). Additionally, we asked this question at the end of the online experiment from each participant:

"Did the videos increase your knowledge about jobs and careers?" (Yes, No)

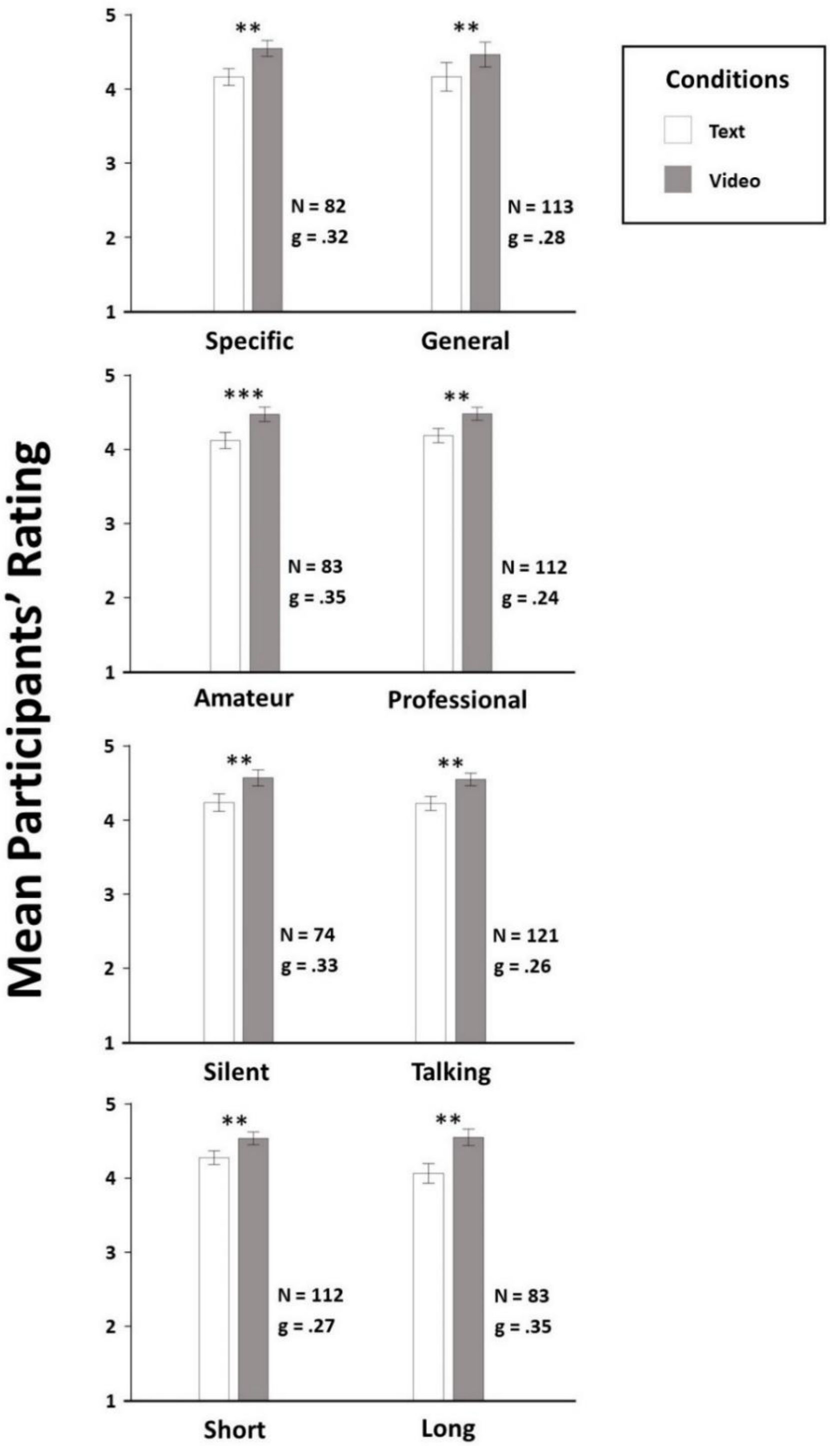

Figure **3-13**: Mean participants' ratings with respect to video categories

Note. The signs ** and *** indicate *p* values less than .01, and .001 respectively. The letters N and *g* indicate sample size (number of instances participants observed certain categories of videos) and the effect size of Hedges' *g* respectively. Error bars are +/- 1 standard error.

Although most participants (42 of 65 participants, or 65%) answered “Yes”, the time they spent on videos (~75 seconds) indicates one of these two possibilities, either they did not watch many of the videos, or they scanned them briefly and on the surface. So, although the presence of videos seemingly affected their judgments about jobs, organizations, and the messages, many of the participants did not seem to have watched the entire videos.

- *Hypothesis 2*: Regardless of the structure and content of videos, job seekers’ evaluation is better for organizations that use video compared to those with traditional text-based job descriptions.

Yes. Participants’ responses that were averaged between study measures Q1 and Q7 (Figure 3-11) shows that job seekers’ overall evaluation is better for organizations with video job descriptions compared to those without video. Additionally, as Figure 3-13 indicates, job descriptions with any category of video worked better than their corresponding text condition. So, the improvement that videos bring is regardless of the structure and content of videos.

- *Hypothesis 3*: Regardless of the structure and content of videos, job seekers are more likely to pursue careers in organizations that embedded videos compared to those that did not.

The analysis of participants’ responses to Q1 indicates that videos do not seem to affect participants’ decision of whether to pursue a career in a specific job.

- *Hypothesis 4*: The effect of video on job seekers’ evaluations is more visible for unknown organizations compared to well-known organizations.

The result indicates that this is not the case. For this hypothesis, an analysis was conducted and the results are summarized in Figure 3-14.

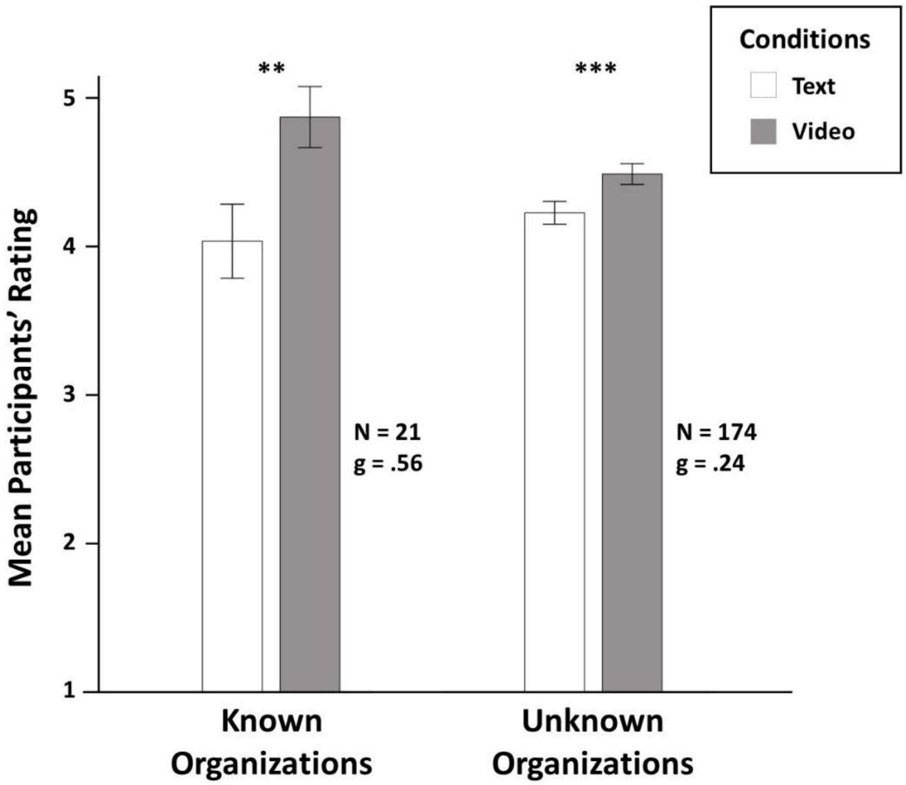

Figure **3-14**: Comparison of the effect of video job descriptions between known and unknown organizations

Note. The signs ** and *** indicate *p* values less than .01, and .001 respectively. The letters N and *g* indicate sample size and the effect size of Hedges' *g* respectively. Error bars are +/- 1 standard error.

As shown in the sample sizes in Figure 3-14, most participants saw unknown organizations. Known organizations comprised of:

Academic

- University of California – Riverside in the video condition and the corresponding University of California – Davis in the text condition,
- American University in the video condition and the corresponding George Washington University in the text condition,

Computer and information related

- Twitter in the video condition and the corresponding Facebook in the text condition,

Service-based

- FedEx in the video condition and the corresponding UPS in the text condition.

The result indicates the positive effect of video both for known and unknown organizations; known organizations: $t(20) = 2.60$, $p < .01$; unknown organizations; $t(173) = 3.18$, $p < .001$. Despite the prediction of the hypothesis, the effect size for the effect of video in the known organizations is larger (g = .56) than unknown organizations (g = 24). The larger standard errors in the known analysis of known organizations (the left side of Figure 3-14) are likely to be the result of the small sample size in the known organization (N = 21) compared to unknown organizations (N = 174).

- *Hypothesis 5*: Regardless of the structure and content of videos, job seekers are more confident in their career decisions with video in the job description.

Similar to Q1, the analysis of participants' responses to Q2 indicates that videos do not seem to affect participants' confidence in their career decisions.

- *Hypothesis 6*: Videos from specific jobs will have more impact on job seekers' evaluations than video from general (type) of jobs.

Results largely support this statement (see Figure 3-13). However, videos from general jobs also improved participants' assessments only with slightly smaller effect size (g = .28) than specific videos (g = .32).

- *Hypothesis 7*: Professional and highly-structured videos have more impact on job seekers' evaluations than amateur and less-structured videos.

The results indicate otherwise. Although both amateur and professional videos did better than their corresponding text conditions, the effect size for amateur videos was larger (g = .35) than professional videos (g = .24). This is an interesting finding that contradicts the findings of some of the past findings in the literature.

- *Hypothesis 8:* Speaking videos are more effective than silent videos in improving job seekers' evaluations.

This was also not the case. The results show that speech might be redundant in videos as silent videos were more effective (g = .33) than talking videos (g = .26) in improving participants' assessments.

- *Hypothesis 9*: Shorter videos are more effective in influencing job seekers' evaluations compared to longer videos.

Similarly, this was not the case. Both short and long videos were effective, but long videos were slightly more effective (*g* = .35) than short videos (*g* = .27).

Chapter 4

Discussions and Future Directions

This section discusses general issues that arise based on the results, with a particular focus on the research on job-analysis.

The research on task-analysis

The following paragraphs outline the strengths and limitations of the presented videorecording method in the design of training systems.

Contributions and strengths

The presented method brings the following contributions to the research community in general and training-simulator design community in particular:

- Relying on the performance of one expert can sway the training because one expert's approach to performance might be different from those of other experts. So, the method used a *society-of-expert* approach to minimize the problem of individual differences between experts' performance.
- The method standardized the guidance from experts to trainees. The guidance does not involve the presence of experts and their explicit judgments (see Hoffman et al., 1998) as doing so can distract trainees from practicing the task and might be inaccurate (e.g., Collins, 2010; Polanyi, 1966; Robinson, 1974). Recording experts during performance and using it to provide indirect guidance through feedback is presented as a solution.

- The method is generic as it can be applied to various domains that use training-simulators. Nonetheless, this genericity did not prevent the method from providing specific and low-level guidance for designers (as shown in the experimental example). This combination of genericity and practicality can help designers to use the method as a ready-to-use tool in a variety of domains.

The method provided normative information of performance—how the task *should* be performed. This "should" was derived from reviewing the performance of multiple experts through videos. Traditional task-analysis, however, is logically descriptive by telling us how the task *can* be performed. This highlights the difference between studying experts in this method versus "users" or "operators" as occasionally practiced in task-analysis. The presented method received performance information directly from experts via video, but task-analysis breaks down a task into steps. There is an important distinction between focusing on experts' skills rather than steps, as insufficient attention to experts shifted the focus of design to simulating target task environments (e.g., simulation fidelity) and other trivial aspects of a task. This negligence resulted in confusion for HFE practitioners, researchers, and designers (e.g., Fowlkes et al., 2009; Hamstra et al.,2014; Roberts et al., 2020; Wickens et al., 2013) and prevented trainees from practicing the skills. Using expert performance in the presented method provided a direction that helped resolving this confusion.

The videos of expert truck drivers in the experimental example provided an informative case because they all contained the verbal reports of drivers. Although the verbal reports were useful in analyzing the videos, the performance-related information that was derived from the videos was largely independent of verbal reports. Rather, the information came from observing drivers' behaviors in the videos. This shows how relying on verbal reports and other text-based media as commonly used in task-analysis cannot reveal certain important aspects of experts' behaviors.

In a relevant note, it has been shown that experts might be unaware and unconscious of their own approach and details to performance (e.g., Collins, 2010; Polanyi, 1966; Robinson, 1974). In other words, experts can perform implicitly, without the explicit knowledge of how they perform. As a result, there is skepticism toward asking for experts' explicit judgments to guide trainees and designing training-simulators. Rather, we need to see how experts perform the task in natural settings and without interference, and use their performance to characterize the skills. This was the central goal of the presented method, and unlike other research that use experts' explicit knowledge outside of the target environment (e.g., Hoffman et al., 1998; Jansson et al., 2015; Klein & Borders, 2016), the method prioritizes the natural performance of experts.

Aside from providing an accurate and direct picture of skills and other benefits of using the video as a medium (see Heath et al., 2010; Petersen et al., 2011), the advantage of video is in being a dynamic source of information. Often, it is difficult to predict what should be the focus of task-analysis in performance. The video can resolve this difficulty by providing the opportunity of unpredictable analyses with different criteria and goals that a designer might need at any step of the design, including environmental factors (e.g., tools, locations). On the contrary, text-based task-analysis should determine what should be known before conducting the analysis, and as such, the interpretation of performance is static and cannot provide new information after the analysis is completed.

One might argue that the results gained in the provided experimental example could also be gained without using video or by conventional task-analysis methods. Indeed. However, we should remember that the same recordings in the example could be used to gain different results. If we changed the performance criteria in analysis, we would get new information. Generally, the videorecording method, on its own, has the capacity to model experts' performance and provide valuable design information. Unfortunately, there were not many well-formulated design methods in the literature that could be used for comparisons, and so, we can only think of conventional task-analysis methods (e.g., verbal protocol, hierarchical task-analysis). From this perspective, if we put the videorecording method side-by-side of conventional task-analysis methods, it becomes clear that no other single method has the capacity of the videorecording method in terms of sufficiency and independence to guide the design in various tasks. This capacity comes from relying on the two key factors of experts and videorecording that provide necessary—if not sufficient—information for designing training simulators.

Also, the experimental example showed how the method can be flexible in working with unstandardized videos. In fact, the videos came from different sources, were recorded with different equipment, had different lengths, and experts practiced different orders of behaviors during their performance. Nonetheless, the method could still be used to present a model of their individual behaviors that proved to be useful in design.

In short, the video can resolve various problems and shortcomings of the traditional task-analysis. The arguments against the costs associated with using videorecording and observations (e.g., Stanton et al., 2005/2018, p. 43) are counterbalanced by the recent availability of recording devices and computational tools for video-analysis (e.g., Loukas, 2018; Shih, 2017).

Limitations

The premise of the method is that the information of skills is representable through video. However, the skills in many tasks cannot be easily observed, and so, the sole reliance on the method is limited to those tasks for which some or most skills can be externally observed. Table 4-1 shows examples of tasks and domains for which the method may or may not be applicable. One proposed solution is that for tasks that have unobservable aspects, the videos should be supplied with other modes of information such as verbal reports, information of physical force, description of goals and subgoals, and any other mode of data that can provide skill-related information regarding the actions and decisions in performance. Therefore, the method is not intended to replace all other existing methods of data collection and design, but can be used together with other methods and techniques such as verbal protocol.

Table 4-1

Examples of tasks and domains for which the method may or may not be applicable for training-simulator design

May be applicable	May not be applicable
Transportation (e.g., flying, sailing, driving)	Air traffic control
Surgery	Troubleshooting
Maintenance operations	Professional design
Sport	Computer programming
Drawing	Recognition tasks

Note. The classification is based on three criteria: observability, specifiability, and measurability of behaviors. This is not a definitive classification but an example of tasks and domains. The classification is partially derived from Ericsson, Hoffman, Kozbelt, and Williams (2018).

Additionally, the decision of how to implement the AEB in simulators can itself open contentious debates. For example, some authors supported the effectiveness of providing feedback during practice, but others supported the use of feedback after practice (for discussions, see Sülzenbrück, & Heuer, 2011; Walsh, Ling, Wang, & Carnahan, 2009). This decision should be made by reviewing previous research and considering the properties of the task and the training program (see Sigrist et al., 2013).

In a relevant note, it is one of the general assumptions of the current work that practicing expert performance through feedback is an effective strategy in training; an assumption that is well-supported in the literature (e.g., Huegel, Celik, Israr, & O'Malley, 2009; Klein & Borders, 2016). Therefore, the effectiveness of the simulators that would be built by using the method was not tested in this work. Nonetheless, before being adopted in practice, design methods need to be tested in practice and with real simulators within training programs. Therefore, for conducting a rigorous test, a longitudinal study may need to be conducted to measure the long-term training benefits of the simulators built upon the presented videorecording method.

Another difficulty can be in finding shared behaviors among multiple experts and averaging the performance among them to create the model of AEB. The difficulty is in situations in which we cannot find shared behaviors, or when averaging the behaviors does not yield a meaningful result. For example, suppose we have two expert troubleshooting technicians with similar levels of expertise. When their order of actions and decisions in the same troubleshooting problem is entirely different from each other, we cannot easily model their skills in the AEB. This problem is more likely to emerge for more complex tasks or if the number of available experts for recording is limited as different experts might have different approaches to performance which makes it challenging to derive a single performance model. In such cases, we either need to enroll more experts—that is not always feasible—or use a different approach for training the skills in those tasks (for further reading, see Duncan, 1985; Scardamalia & Bereiter, 1991).

Additionally, in using the video for deriving driver's behavior, the only coder was the author of this document (i.e., myself!). Often, there needs to be at least two coders to reduce the likelihood of mistake or bias in coding. Nevertheless, because the example was simply an example that was not to be used in designing an actual truck driving simulator, the validity of the coding is not a problem in the study.

There were also limitations in the extent and details of the experimental example. For example, it could have increased the validity of our model if experts recorded their driving under different scenarios and operational conditions (e.g., weather, environmental lighting). As a result, the conclusions in the provided example can only cover a narrow range of operational conditions in performance (e.g., day, light traffic, sunny, etc.). And as another example, timing is used as one of the main performance criteria in performance modeling of the example. However, in real-world cases, we will need to use other performance criteria (e.g., accuracy, movements, etc.). Indeed, to be used for designing real-world truck driving simulators, a more comprehensive study is needed, and as such, the example was simply used to show the practicality of the method.

Due to the nature of the method that works with qualitative data, additional challenges might also appear (e.g., Heath et al., 2010). Examples of these challenges are determining the required number of experts, finding and enrolling experts for recordings, efforts needed to record the videos, and subjectivity in analyzing videos and modeling the expertise (see Goldman et al., 2014). Although some of the challenges can be addressed by consulting with SMEs, the final decision of whether to use the method should depend on cost-benefit analyses and available resources.

Conclusion

The design of training-simulators is a difficult and ill-defined problem to solve. The lack of a unified approach, theory, or method to address the design problem is indicative of its difficulty as solutions have often been tailored to specific problems. Although the problem-specific approach in providing solutions was effective in practice, it prevented the creation of generic design methods. Such methods can bring researchers and designers under the same design problem so that experiences can be shared, and solutions can be scientifically tested and verified. This can accelerate the progress of training-simulators in future. The need for generic design methods is particularly important these days with the advance and availability of modern devices (e.g., virtual-reality tools) that can lead to growing confusions for designers. The current research proposed such a method in which it is argued that the performance of experts should be considered as the main informational resource for design. And it is shown how videorecording is the medium that can supply a rich and direct qualitative information of skills in performance.

The videorecording method as standardized here can be used for various goals. For example, the model of expert performance can be used for evaluating existing training-simulators. More importantly, we can use a similar videorecording method in studying the experience of trainees, as the video allows us to see what elements of a simulator are guiding trainees' attention, and what can help or distract them during practice. As such, future methods and techniques derived from the same approach can lead to addressing lingering design problems such as the fidelity requirements in the interface of training-simulators. The hope is to see more examples of design methods in future that would improve upon the experiences of the existing knowledge in the field.

Research on job-analysis

In this section, we discuss the practical implications of this research for job seekers and organizations as well as future research in the area. We also highlight the limitations and cautions that should be taken when interpreting the results.

Practical implications

The first and foremost prominent result is that embedding videos in job descriptions affected job seekers' evaluations of the job, organization, and the message. Particularly, job seekers showed that videos taught them something new about the career that they did not know before (Q7, see Figure 3-11). This can have important implications regarding the use of videos in online job counseling services, particularly for junior job seekers with no to limited knowledge and experience in careers.

The next prominent result showed the effect of videos in conveying information about the values, beliefs, and culture of the organization and the job (Q6, see Figure 4). One of the main reasons for our interest in testing the effect of video was the direct and uninterpreted nature of the information that videos can convey, and this characteristic of video could present certain information that text could not. This is particularly important in recent years as many job seekers and employers seek those that match their own values, political affiliations, and beliefs (e.g., Roth et al., 2020).

The next important results were those related to the attractiveness of the job and place to work. The results of participants' responses to Q4 and Q5 show that organizations with videos in their job descriptions are more likely to be appealing to job seekers. The consistent and similar results between Q4 and Q5 is also a sanity check that points to the validity of our results and data. The believability of the message was also improved as the result of the video in the job ad (Q5). As the old saying goes "seeing is believing", job seekers also believed in the content of videos more than text.

It is important to note that videos did not affect participants' assessment of their decision about whether to apply for a job, nor did they affect their confidence in applying for jobs. This is understandable and mainly due to experimental limitations because the decision of whether to apply for a position is highly dependent on the specific job title, location, and many other personal factors that could not be simulated accurately in our experimental setting. So, based on what we can learn from the results, we can argue that using videos can be a good strategy at least for organizations to improve organizational image in the eyes of job seekers.

It is interesting to see that the effects of video were despite the lack of a meaningful difference in the time spent on job descriptions between the text and video conditions. Many participants did not watch the entire videos because the mean duration of all videos was about five minutes. When we consider the fact that they were supposed to watch three videos (~ 15 minutes of video in total for each participant), it is impossible that most participants watched entire videos. So, the effect of videos can partially be attributed to merely the existence of a video in a job ad, and not necessarily the characteristics of the videos.

Indeed, our analysis on the effect of video characteristics reveal that any type of video performed better than text. Notwithstanding, important practical implications can be gained from analyzing the characteristics of videos. First, amateur videos performed better than professional videos. Those amateur videos were made by current employees of the organizations, and this might have made job seekers trust the content more than professionally-made videos from organizations. Likewise, silent videos worked better than talking videos which shows that job seekers were interested in seeing instead of listening to speech. Because one of the reasons that organizations do not use videos is due to the cost of video production, these results show that organizations can save costs by creating simple and amateur videos and using them in their job descriptions.

The results also show that videos about specific jobs worked better than videos about general (type) of jobs. This is also understandable because job seekers are interested in the specifics of the job and organization for which they are considering. In terms of the length of the video, the results indicate a slight improvement in the effect size for longer videos (i.e., longer than five minutes of length) compared to short videos.

Finally, the comparison between known and unknown organizations showed that videos are even more effective for known organizations than unknown organizations. This might be because job seekers are more willing to know about known organizations and compare what they see with what they already knew about those organizations. Therefore, known organizations can make a more effective use of videos in their online job descriptions.

It should also be noted that understanding organizational values and ideologies through the video is a subjective experience and we can never measure the match or mismatch outside of the perspective of the job seekers and the organization. The importance of this relativist understanding is appreciated in this research, as the goal is to show the organization through the lens of the video without interpreting the content of the video in terms of values, ideologies, and culture. Such interpretation is conducted by the job seeker, and the stance of the research is that the video can provide the opportunity of such interpretation, and as such, can increase the accuracy and richness of important information in job seekers' evaluations.

The following remaining paragraphs in this section discuss the implications of the study regarding more theoretical issues that might be of interest to researchers.

Theoretical implications

The following few paragraphs discuss the theoretical implications of this research that are more likely the interest of the research community. The particular focus of this section is on job analysis, and how the proposed videorecording can help researchers resolve many of the current problems and criticisms of job analysis.

In job analysis, data collection about jobs has been done mostly through text-based methods—i.e., surveys, interviews, and questionnaires—resulting in standardized forms, job descriptions, and narratives. For example, Morgeson et al. (2019) reviewed and outlined the standard methods of job analysis, and most of the methods and discussions revolved around text-based methods and job descriptions. Similarly, Sackett et al. (2012) analyzed the practice of job analysis to various choices and dimensions, most of which either used or assumed using standard text-based methods. In short, it seems that the term "job analysis" has become synonymous with methods and products that gather information and describe jobs though text and verbal reports such as interviews, ratings, surveys, and questionnaires.

At the same time, numerous criticisms have been directed toward job analysis. For example, Morgeson and Campion (1997) identified and discussed the sources of inaccuracy in job analysis such as limitations and biases in information processing systems (e.g., respondent carelessness, inadequate information, information overload) and limitations due to social factors (e.g., conformity pressure, social desirability, incumbent versus observer discrepancy), resulting in problems in interrater reliability, interrater agreement, completeness of job information, and other problems in the output of job analysis (see also Dierdorff & Wilson, 2003; Morgeson et al., 2016). These limitations reduced the rigor of job analysis, and as a result, there has been a diminishing interest in job analysis among some researchers (Sanchez & Levine, 2012).

The argument behind the current work is that many of the limitations of job analysis are due to the reliance on text-based methods. In other words, the limitations are the limitations of the specific methods of job analysis that have commonly been used, not the job analysis itself. Through presenting a meta-analysis, DuVernet et al. (2015) was among the few works that showed how different choices and methods in job analysis can result in different levels of reliability, validity, and accuracy of job descriptions. Similarly, this research argues that problems such as inadequate information, lack of interrater reliability, and subjective biases in data collection are the results of losing job information through written summaries and forms as well as the dependence on incumbents' or job analysts' written accounts.

The following paragraphs briefly discuss how the proposed method can address some of the problems that were mentioned in Morgeson and Campion (1997).

Carelessness: This problem occurs when incumbents' response to job analysts' questions and forms are given without sufficient care and attention. This is the problem of text-based methods, and this problem is simply removed by the videorecording of incumbents in their actual job setting.

Social desirability: This is the increased likelihood of reporting desirable job information and the reduced likelihood of undesirable job information. In other words, it is a form of subjective bias. The video-recording method can address this issue because the recorded videos speak of themselves, and the interpretation of "desirable" and "undesirable" is left to the eyes of the customer who uses the job model (i.e., organization or manager).

Information overload or insufficient information: This problem occurs when job analysts are either inundated with information, or conversely, cannot find sufficient job-relevant information. In the case of excessive information, indeed the human analyst has a limited capacity to observe, record, and document the information from the job. In the case of insufficient information, the analyst might argue that he/she could not find sufficient information. In either case, the video-recording method would mitigate the problem of the burden or insufficiency of information from the analyst as it simply captures the job in the video recordings. The recorded videos can later be analyzed with sufficient time and care to show how much information could be gained from the analysis. The excess or the insufficiency of the information would no longer be the analysts' responsibility, and so, the method would remove the burden, anxiety, and responsibility from analysts.

Conformity pressure: This problem arises when a group of job analysts are chosen to analyze a job, and each analyst tries to modify their report to be closer to the average of other analysts, resulting in the deliberate distortion of the collected data. The proposed video-recording method can mitigate this problem because even if there are differences in the job model between different analysts, it might be due to the difference in incumbents' sample. Additionally, the bigger the sample size of the recorded incumbents, the less would be the likelihood of the sample bias in the job model.

In short, the traditional criticisms of job analysis are not necessarily the problems of job analysis, but problems of the established methods of job analysis.

Limitations

There are a number of important limitations to this study that are briefly discussed in the next few paragraphs. First, the variety of participants that were enrolled in this study was limited. We do not know, for example, how middle-aged people with more job experience would react to the videos. One can argue that, as far as learning new information about careers is concerned, senior people are less likely to learn new information from videos than junior people. Nevertheless, more senior job seekers might be less reliant on online job searching because it is more likely for them to use other channels to find jobs (e.g., professional networks, employee referrals).

Additionally, some participants (N = 11) indicated they were not job seekers when they started to participate in the experiment. Those participants were included in the analysis because their judgment is also important and we can see how using video can improve an organization's image and increase job seekers' general knowledge about jobs. Nonetheless, even though the effort was made to enroll participants who were more likely to be in the job market and those in active need of career counseling (i.e., senior university students) the results could have more validity if we enrolled participants from a variety of backgrounds and characteristics who were active job seekers or those who were looking for career counseling.

The vast majority of participants (N = 55 of the total 65) selected only one of the three types of jobs (i.e., Computer and information-related) in their interest. As such, the results are mostly applicable only to this type of job, and we do not know whether other job types benefit from using video as much as this type of job. This was mainly because when we started designing the experiment (i.e., more than a year before starting to collect data), we supposed we could have access to a wider variety of participants, but ended up recruiting mainly from undergraduates in a limited range of majors.

In addition to limitations about participants, videos that were used in the study were also limited in terms of characteristics and specific content. Some of the effects that we see in the study and the improvements that videos are bringing in the results might be due to the specific videos that were used in the study. Because we did not create the videos and they came from third party producers from public domains, controlling numerous characteristics of the video was difficult. So, although the important result from this study showed that any of the videos we used was better than its corresponding text condition, understanding the exact effect of video requires an experiment that controls the details of video production and characteristics. This can also help video producers by guiding them specifically on how to create the video content.

Further, the comparison of the mean time spent on page shows that many participants did not watch the entire videos in the video condition. There is even a possibility that many of the participants' ratings for video job descriptions came from not watching the video altogether. But still, the results show a better overall rating for the video condition. As a result, we cannot attribute the differences in ratings to the videos and their content, but it seems that simply the presence of videos on the job description page influenced participants' ratings. This is an interesting observation that requires further investigations on how the simple presence of video frames can change participants' evaluations. This is also a caution of not attributing the results to the videos and their content.

Although we tried to include the text version of the information conveyed in videos in the corresponding text conditions to control for the information load and single out the effect of video (see Appendix A), not all text-based job descriptions had a comprehensive description of everything that could be seen on videos. To have a more accurate comparison, one needs to transcribe a video and describe other visual details in the corresponding text condition. However, because we swapped the videos between the conditions in the second phase of the study, this did not reduce the validity of our results.

An argument might exist regarding our method in the secondary analysis, hypothesis testing. The comparison of effect sizes was the main method that was used in hypothesis testing. Although this addressed our tests of hypotheses, direct comparison of effect sizes might be statistically challenging as we do not have a statistical significance level to compare two effect sizes. In fact, comparing two effect sizes for significance is not possible because we do not have distributions for effect size values. As a result, we need to use the convention of small, medium, and large effect sizes (0 - .2, .2 - .5, and .5 and larger, respectively) in categorizing and comparing effect sizes for hypothesis testing. The secondary analysis of hypothesis testing is therefore an exploratory investigation for the effect of video characteristics rather than a hard test of specific hypotheses.

A more important limitation might exist regarding the pattern of the results. In most of the results that we see in figures 4, 6, and 7, there are significant differences between participants' rating between the text and video conditions. However, the effect sizes (i.e., Hedges' *g*) for those significant results range from .15 to .35 (and .56 for known organizations). This might not be large-enough improvements for organizations to consider starting the use of videos in their online job descriptions. Although, as we have seen, videos do not have to be made professionally, the introduction of videos for an organization to all or most of its positions can incur costs for which there needs to be a meaningful benefit. Therefore, although the results are statistically significant, organizations need to assess whether the extent of the improvements from videos is worth the effort and costs.

Finally, in comparing the length of videos (i.e., short versus long videos), we saw that longer videos did slightly better than short videos. However, we do not know how long they can go. The mean length of long videos in our data was 6 minutes and 23 seconds. We do not know whether longer videos can further increase the beneficial effects of videos and how.

Future research

Due to the importance of the topic and its relevance to other similar important topics, more research on the topic is needed to further refine our findings and guide the practice of organizations on this topic. To start with, future research can directly address the limitations of this study.

Participants from a variety of backgrounds, interests, and educational levels are needed to verify the effect of video. It is not currently clear whether the videos affect assessments for job seekers who are interested in job categories other than computer and information-related jobs. Also, a better control can be implemented in the creation and use of videos for jobs, and this would inform organizations more accurately on how to create and use videos for particular jobs.

A remaining question is: what if we use still images (or an image gallery) instead of the videos? This is particularly because, as we saw in the results, many participants did not watch the entire videos. If a few images are enough for job seekers to see the job and organization, would images work as good as—or even better than—videos in improving participants' evaluations? That is a question that, to our knowledge, past research did not address and is a remaining question for future research.

Our results indicate the beneficial effects of using videos for online career counseling websites because the largest effects that existed in the results belonged to learning new information about jobs and learning about organizational values, culture, and beliefs. Although the data in this study did not support using videos to affect job seekers' decisions and confidence in applying for jobs, it would be interesting to investigate whether videos can have any effect on job seekers' decision-making when they are actually applying for their positions of interest.

Finally, one question that can exist as the result of this research is: what if the recruiting organization provides the option of having a video-chat for the applicant with a current employee to show a live video stream of the organization and other details that were covered in the videos in this study. In that case, applicants would be able to ask to see where they need to see. This can be a topic of future research. However, this might not be feasible in the early stages of recruitment as organizations cannot spend such resources for any job seeker, and because of this, video is a good solution for early stages of a job seeker's familiarity with a job and organization.

Conclusion

Using videos in online job descriptions can affect job seekers evaluations of the job, message, and the organization. Particularly, it can help applicants to learn something new about a career, can help them learn about the values and culture of an organization, can make the job and organization more attractive and appealing, and can make the message more believable. These benefits are regardless of the characteristics of videos, and whether the organization is a well-known or unknown organization. In short, using videos in online job descriptions can benefit the organization and the job seekers in general. The hope is to see future research that addresses the limitations of this study, and further refine the study variables to better understand the effect of video in online job descriptions.

General conclusion

Based on the methods and results that were observed during this set of research projects, it is obvious that video has various potentials to be used in task- and job-analysis, particularly in application domains such as training-system design and creating online job descriptions for career counseling. The results presented regarding task-analysis showed how videorecording of experts can be used to guide the design of training simulators. The results from the comprehensive research on using video in online job descriptions showed how job seekers and those who seek career counseling can benefit from videos in their job search. In short, the level of realism that the video as a medium can bring is incomparable to other storable media, and this realism was useful regarding the topics of this investigation. I started these lines of research with a belief in video, and I am glad to see the results largely support my belief. My commitment throughout these studies was to take small steps towards bringing practical changes in the design of training systems and online job descriptions. Finally, my hope is to see the future of research in academia to take such a practical turn and bring real changes to the world.

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Appendix A

Examples of Job Descriptions Used in the Survey

Example 1: Video Job Description (corresponding video condition of Example 2)

THIS IS A JOB AD; PLEASE READ CAREFULLY

TSec

Travel Required: No

Security Specialist

TSec is hiring a Security Specialist. We have offices in most major cities across the US; so, you can choose your location of interest, or work from home. Applicants must have Bachelor or Master's degree in a relevant field from an accredited US educational institution.

Requirements

- Graduating from computational or relevant sciences (preferably relevant to computer).
- Physical and mental health (disabilities should be consulted during the interview).
- Knowledge of basic statistical tests in security, risk assessment, and risk analysis.
- Being able to work and live in the United States.
- Being able to obtain clearance.

Responsibilities

- Operate Host Based Security System (HBSS), firewalls, Intrusion Prevention Systems (IPS), Intrusion Detection Systems (IDS), other point of presence security tools, Virtual Private Networks (VPNs), and related security operations.
- Perform other information security duties including operation of Electronic Key Management System (EKMS) and maintenance of Public Key Infrastructure (PKI).
- Develop and execute Government approved security policies, plans, and procedures; implement data network security measures; operate and monitor network intrusion detection and forensic systems; conduct IS security incident handling; support Continuity of Operations Plan/Disaster Recovery (COOP/DR) plans, and perform certification of IS and networks.

(*continued on next page…*)

One of our employees recorded a video of his one day in the job; please watch below.

About TSec

As a cyber-security company, we are a provider of Information Technology (IT) professional services, software solutions and security assessment and training. We have a vision to make our country and the world safer. We value our clients and prioritize their need; as such, we must be flexible. Our core competencies evolved from leveraging IT enablers for knowledge management with an emphasis on Web Based Knowledge Portals and Portal Services, Server/System Services, SharePoint Development and System Administration and SQL Server Services. Our capabilities have expanded to include software development, technical training support and field support services. We implement Equal Opportunity/Affirmative Action to employ people regardless of race, color, religion, sex, sexual orientation, gender identity, national origin, disability, or veteran status, or any other protected class.

Guiding Principles

• Satisfy the customer - "Exceed expectations"

• Set the Example - "Be out front"

• Be Responsive - "Timing is everything"

Press Next to see the questions about this web-page.

Next

Example 2: Text-Based Job Description (corresponding text condition of Example 1)

THIS IS A JOB AD; PLEASE READ CAREFULLY

Company: **DC CyberSec**
Location: Remote
Job Title: Cyber Security Specialist
Travel Required: None

DC CyberSec is looking for a talented individual who is looking to become a Cyber Security Specialist. During the first few weeks, you will be trained on the job, and later, you will work independently. The job location is remote; after the training period, you can work for the company from anywhere.

Desired Qualifications: BA/BS or MA/MS

Responsibilities

- Conducting industry-based risk methodologies and communicates identified cyber risk exposures and potential impact; reviewing existing controls.
- Coordinating with Information Systems Security Officers, Technical Managers, Systems Engineers, Information Owners, and Information System Owners to maintain Authorization Packages (i.e. System Security Plans, IS Plan of Action and Milestones (POA&M), documentation)
- Providing full lifecycle support analysis, documentation, review, validation and continuous monitoring supported systems, networks, and data to achieve and maintain system's Authority-to-Operate (ATO).

A Day of Life in This Job

As a security specialist, most of our employees reported they get up from bed at around 7:30 AM, as they are required to start your daily work from 09:15 AM. There are normally a short, 30-minute SOC meeting every morning, starting at 9:30 AM. Then, you will work on the daily agenda that includes replying to email requests, inspecting logs, redundancy testing, checking high-risk log entries reported by the SOC team, finding vulnerability using Python code injection, and writing a final daily reports that summarizes these activities. A typical security specialist leaves work for home at around 6:30 PM.

(*continued on next page*)

Requirements

- Bachelor's or Master's degree in Computer Science, Computer Engineering, Information Sciences, Mechanical Engineering or other relevant degree
- Working knowledge of risk management frameworks such as NIST and FISMA (can be trained on the job)
- Knowledge of industry information security best practices and Federal, DoD, Navy and USMC information system security policies, regulation, requirements and protocols.

We are **DC CyberSec**; the people supporting some of the most complex government, defense, and intelligence projects across the country. We deliver. Bringing the expertise needed to understand and advance critical missions. We transform. Shifting the ways clients invest in, integrate, and innovate technology solutions. We ensure today is safe and tomorrow is smarter. We are there. On the ground, beside our clients, in the lab, and everywhere in between. Offering the technology transformations, strategy, and mission services needed to get the job done.

DC CyberSec is an Equal Opportunity/Affirmative Action employer. All qualified applicants will receive equal consideration for employment without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, disability, or veteran status, or any other protected class.

Press Next to see the questions about this web-page.

Next

Example 3: Video Job Description (corresponding video condition of Example 4)

Twitter

Software Engineer

Our teams own the core application infrastructure for tweets, users, graph relationships (e.g. follow, block, mute, list subscription, etc.), and links that form the core building blocks of the Twitter product. On top of that, we provide internal interfaces (request/response and push-based) and tools to conveniently and efficiently access Twitter data at scale, respecting users' privacy. Our application infrastructure is critical to the product and has to be incredibly reliable and scale to millions of requests per second.

What you will do:

You will join forces with teammates to deliver cool high scale infrastructure and product features. Our team owns some of the world's largest distributed systems that power a platform relied upon by many people across the world.

Who you are:

• You are curious and open to new ideas

• You have strong opinions but are willing to change your mind

• You love to collaborate, mentor, and learn with a great team

• You care about delivering high-quality software in a team environment

• You like to dig into hard problems and solve them together

Requirements

- BS or MS in computer science, software engineering, information sciences, or relevant fields.
- Preferably having experience with software engineering best practices for iterative development, testing, code reuse, etc.
- Preferably knowing in one of these programming languages: C/C++, Java, PHP, Python, or Hack.
- Preferable experience with Scala or other JVM-based languages preferred (can be trained on the job).

(*continue on next page*)

To see how your life would be as a software engineer in Twitter, one of our employees created a short video of a typical day of his life.

Why Work with Us

- Challenge - Our teams are solving some of the industry's hardest problems with the best teammates. Come to be challenged, learn and thrive as an engineer on our team.
- Collaboration - If you want to go fast, go alone. If you want to go far, go together. We want to go far.
- Variety - We encourage team rotations that allow you to work with and learn from other teams in Core Services.
- Flexibility – your working condition will be very flexible; you can choose to work for us in most major US cities.

Don't worry if you do not have all of the above qualifications and skills; you will be presented with on-the-job training in the first few months of work! We are committed to an inclusive and diverse Twitter. Twitter is an equal opportunity employer. We do not discriminate based on race, ethnicity, color, ancestry, national origin, religion, sex, sexual orientation, gender identity, age, disability, veteran status, genetic information, marital status or any other legally protected status. San Francisco applicants Pursuant to the San Francisco Fair Chance Ordinance, we will consider for employment qualified applicants with arrest and conviction records.

Press Next to see the questions about this web-page.

Example 4: Text-Based Job Description (corresponding text condition of Example 3)

facebook

Job Summary

Facebook is seeking a Software Engineer to join the Software Engineering team. The Software Engineering (Infrastructure) team builds large distributed components that run Facebook. Our code serves millions of requests per second and it does so with sub-second latency and in a fault tolerant manner. We handle everything from Facebook scale data storage, to synchronization and coordination of large server clusters, to providing a runtime environment for front end Facebook code. We are looking for candidates who share a passion for tackling complexity and building platforms that can scale through multiple orders of magnitude.

Our Values

- Facebook's mission is to give people the power to build community and bring the world closer together.
- Through our family of apps and services, we're building a different kind of company that connects billions of people around the world, gives them ways to share what matters most to them, and helps bring people closer together.
- Whether we're creating new products or helping a small business expand its reach, people at Facebook are builders at heart.
- Our global teams are constantly iterating, solving problems, and working together to empower people around the world to build community and connect in meaningful ways.
- Together, we can help people build stronger communities - we're just getting started.

(*continue on next page*)

Preferred Qualifications (you will also have on-the-job training)

- Code using primarily C/C++, Java, PHP, Hack
- Interface with other teams to incorporate their innovations and vice versa
- Conduct design and code reviews
- Analyze and improve efficiency, scalability, and stability of various system resources
- B.S. or M.S. in Computer Science or related field

We have offices in most major US cities, and you can choose to work in any of those offices. In any working office, you will have amenities such as breakfast, lunch, refreshments, game room, and patio for breaks. Most of our employees report having breakfast at the Facebook office at around 9:00 AM, starting work at around 9:15, having lunch at noon at the Facebook buffet, having a meeting sometime between 2 to 3, and leaving work for home at around 4:30 PM. Most of your working time, you will be sitting behind your desk and working with computer; however, there are plenty of spaces (roof deck, game room, etc.) that you can visit during lunch or for break, or you can choose to work in spaces other than your designated office. If you have questions during your work, you can ask help from your co-workers who will be in reaching distance from you.

Facebook is proud to be an Equal Opportunity and Affirmative Action employer. We do not discriminate based upon race, religion, color, national origin, sex (including pregnancy, childbirth, or related medical conditions), sexual orientation, gender, gender identity, gender expression, transgender status, sexual stereotypes, age, status as a protected veteran, status as an individual with a disability, or other applicable legally protected characteristics. We also consider qualified applicants with criminal histories, consistent with applicable federal, state and local law. Facebook is committed to providing reasonable accommodations for candidates with disabilities in our recruiting process.

Press Next to see the questions about this web-page.

Appendix B

Study Questions Seen After Each Job Description (Randomized Order)

The message of the web-page was believable.

Strongly disagree — Strongly agree
1 2 3 4 5 6 7
3

This place is attractive to me for employment.

Strongly disagree — Strongly agree
1 2 3 4 5 6 7
5

The web-page taught me something new about this career that I did not know before.

Strongly disagree — Strongly agree
1 2 3 4 5 6 7
6

A job at this place is very appealing to me.

Strongly disagree — Strongly agree
1 2 3 4 5 6 7
4

How likely are you to apply for this position now or in future?

Not at all — Very likely
1 2 3 4 5 6 7
2

How confident are you in your decision about applying (or not applying) for this position?

Not at all — Very confident
1 2 3 4 5 6 7
6

The web-page told me about the values, beliefs, and culture of the organization and the job.

Strongly disagree — Strongly agree
1 2 3 4 5 6 7
5

How familiar were you with this organization from before?

Never heard the name — Very familiar
1 2 3 4 5 6 7
6

Vita

Pooyan Doozandeh

<<For a more comprehensive vita, visit my personal website at p-doozandeh.com>>
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EDUCATION

2018 – 2022	Ph.D., Human-Centered Design (Information Sciences and Technology) The Pennsylvania State University, University Park, PA
2016 – 2018	M.S. (unfinished), Psychology Lehigh University, Bethlehem, PA
2013 – 2016	M.S., Computer Engineering – Artificial Intelligence and Robotics Iran University of Science and Technology, Tehran, Iran
2011 – 2013	B.S., Computer Software Technological Engineering Jaaber Ibn Hayyan Higher Education Institute, Rasht, Iran

SELECTED PUBLICATIONS

Doozandeh, P., & Hedayati, S. (2022). The effect of fidelity on transfer: A meta-analysis in the domain of troubleshooting. *IISE Transactions on Occupational Ergonomics and Human Factors*. In press.

Doozandeh, P., Wang, Z., Cui, L., & Yu, R. (2022). Street surface condition of wealthy and poor neighborhoods: The case of Los Angeles. *AI & Society*. In press.

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